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Hitachi TagmaStore™ Adaptable Modular Storage and Workgroup Modular Storage

Command Control Interface (CCI) User and Reference Guide

MK-95DF701-12

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Changes in this Revision

- Changed the Software Version section of the Preface
- Added a Note concerning IA-32EL, to the Applicable Platforms section in the Preface
- Changed the number of TrueCopy Volume Pair Numbers in Table 2.1
- Changed Figure 2.9
- Added Note 3 to section 2.3.2
- Added **mode=cc**, **-vl**, and **-vr** values to the **paircreate** command in Table 4.4
- Changed Figure 4.75
- Added section 4.19 Volume Migration
- Changed the following Sense Codes in Table A.5: 9576, 9608, 9609, 961C, 9622, and 9629
- Added Figure 4.80 and Figure 4.81
- Added Table 4.39 Volume Migration command parameters

- Added Table 4.40 Command Issues and Pairing Status Transition

Preface

This document describes and provides instructions for performing Command Control Interface (CCI) software operations on the Hitachi TagmaStore™ Adaptable Modular Storage and Workgroup Modular Storage array subsystem. The CCI software enables the user to issue TrueCopy/TCE™ Synchronous Remote Replication Software (hereafter called TrueCopy/TCE™) and/or Hitachi ShadowImage In-System Replication Software (hereafter called ShadowImage) commands to the Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage array subsystem from the open-systems host (UNIX®-based or PC server).

This user's guide assumes the following:

- The user has a background in data processing and understands RAID storage subsystems and their basic functions.
- The user is familiar with the Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage array subsystem.
- The user is familiar with the functionality of the TrueCopy, TCE, ShadowImage, and SnapShot features.
- The user is familiar with the Windows® 98, Windows NT®, and/or the Windows® 2000 operating system.
- The user has read and understands the *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage ShadowImage In-System Replication Software User's Guide* (MK-95DF709).
- The user has read and understands the *TrueCopy/TCE™ Synchronous Remote Replication Software User's Guide* (MK-95DF710).
- The user has read and understands the *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide* (MK-95DF708).

Notes:

- Throughout this manual, the term **ShadowImage** refers to the ShadowImage In-System Replication Software program.
- Throughout this manual, the term **Navigator** refers to the Storage Navigator Modular program.
- Throughout this manual, the term **TrueCopy/TCE** refers to the TrueCopy/TCE Synchronous Remote Replication Software program.
- Throughout this manual, the term **SnapShot** refers to the Copy-on-Write SnapShot Software program.
- Throughout this manual, the term TCE refers to the TrueCopy Extended Distance Software program.
- Throughout this manual, the term Volume Migration refers to the Modular Volume Migration.

- The term DF700 refers to the Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage array subsystem.
- The term **TagmaStore** refers to the Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage array subsystem, unless otherwise noted. Please refer to the *Hitachi TagmaStore Adaptable Modular Storage 500™ User and Reference Guide* (MK-95DF714), the *Hitachi TagmaStore Adaptable Modular Storage 200™ User and Reference Guide* (MK-95DF713), and/or the *Hitachi TagmaStore™ Workgroup Modular Storage 100™ User and Reference Guide* (MK-95DF738) for further information on your TagmaStore disk array subsystem.
- For further information, please contact your Hitachi Data Systems account team, or visit the Hitachi Data Systems worldwide web site at http://www.hds.com.

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Software Version

This document revision applies to Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Products version 7.2/A and higher and applies to CCI software version 01-19-03/04.

Syntax Conventions

The following table lists the conventions used in syntax explanations:

Example symbol	Convention
|	Only one of the options separated by a vertical bar can be used at one time. Example: A | B | C This indicates A, or B, or C.
{ }	One of the items enclosed in braces and separated by a vertical bar must be specified. Example: {A | B | C} This indicates that one of the items from A, or B, or C must be specified.
[ ]	The item or items enclosed in brackets are optional. Example 1: [A] This indicates the specification of A or nothing. Example 2: [B | C] This indicates the specification of B or C, or nothing.
...	The item or items preceding the ellipsis (...) can be repeated. To specify multiple items, use a comma (,) to delimit them. Example: A, B ... This indicates that B can be specified as many times as necessary after A.
< >	The item or items enclosed in angle brackets are parameters that must be specified. Example: <A> This indicates that A must be specified.

Convention for Storage Capacity Values

This document uses the following convention for storage capacity values for logical units (LUs):

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

Applicable Platforms

This document applies to these platforms:

Vendor	Operating System
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
Sun™	Solaris™ 8
	Solaris™ 9 (SPARC)
	Solaris™ 10 (SPARC)
	Solaris™ 10 (x86)
	Solaris™ 10 (x64)
IBM®	AIX® 5.1
	AIX® 5.2
	AIX® 5.3
Microsoft®	Windows® 2000
	Windows Server™ 2003 (IA32)
	Windows Server™ 2003 (x64)
	Windows Server™ 2003 (IA64)
Red Hat®	Red Hat Linux® AS2.1 (IA32)
	Red Hat Linux® AS/ES 3.0 (IA32)
	Red Hat Linux® AS/ES 4.0 (IA32)
	Red Hat Linux® AS/ES 3.0 (AMD64/EM64T)
	Red Hat Linux® AS/ES 4.0 (AMD64/EM64T)
	Red Hat Linux® AS/ES 3.0 (IA64)
	Red Hat Linux® AS4.0 (IA64) ***Note***

Vendor	Operating System
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 the IA-32EL (Execution Layer). When you install the IA-32EL, install all the 32-bit compatible packages.

VMware® 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

Referenced Documents

- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide*, MK-95DF701
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide*, MK-95DF708
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage TrueCopy, TCE Synchronous Remote Replication Software User's Guide*, MK-95DF710
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage ShadowImage™ In-System Replication Software User's Guide*, MK-95DF709

Comments

Please send us your comments on this document. Make sure to include the document title, number, and revision. Please refer to specific section(s) and paragraph(s) whenever possible.

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

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This chapter includes the following:

- Hitachi Command Control Interface
- TrueCopy/TCE
- ShadowImage
- SnapShot
- Cooperation between the User and Hitachi Personnel

1.1 Hitachi Command Control Interface

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

- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage TrueCopy/TCE Synchronous Remote Replication Software User's Guide (MK-95DF710)*
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage ShadowImage In-System Replication Software User's Guide (MK-95DF709)*
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide (MK-95DF708)*

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 Hitachi replication software operations in a script (or text) file. Using CCI scripting, you can set up and execute a large number of Hitachi replication software commands in a short period of time while integrating host-based high-availability control over remote copy operations.

TrueCopy/TCE operations (see section 1.2) involve the primary (main) subsystems and the secondary (remote) subsystems. The primary subsystems contain the TrueCopy/TCE primary volumes (P-VOLs), which are the original data volumes. The secondary subsystems 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 subsystem as the CCI command device.

ShadowImage operations (see section 1.3) involve primary and secondary volumes within one subsystem. The ShadowImage P-VOLs contain the original data, and the S VOLs are the internal duplicate volumes. ShadowImage allows one S-VOL 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 (see section 1.2) involve primary (P-VOL) and Snapshot image volumes (V-VOLs) within one subsystem. The SnapShot P-VOLs contain the original data, and the V-VOLs are the logical duplicate volumes. SnapShot allows one to fourteen 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.

1.2 TrueCopy/TCE

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

TrueCopy/TCE operations can be performed using the Hitachi CCI software on the Server host. The CCI software on the UNIX®/ MS Windows® 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 TagmaStore subsystem through a dedicated LU called a command device.

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

- When turning on the subsystem where a path has already been set, turn on the remote subsystem first, and turn on the local subsystem after the remote subsystem become READY.
- When turning off the subsystem where a path has already been set, turn off the local subsystem and turn off the remote subsystem.
- A path blockade can occur while using the TrueCopy/TCE function, when the remote subsystem was off. After the remote subsystem is turned back on, it will be automatically recovered the remote subsystem is READY (about 4 minutes).

If a path blockade is not recovered after the subsystem is READY, please contact Hitachi maintenance personnel.

1.3 ShadowImage

The ShadowImage data duplication feature enables you to set up and maintain multiple copies of logical volumes within the same TagmaStore subsystem. ShadowImage operations for Server-based data can be performed using ShadowImage software on the host where the Hitachi CCI software is installed.

The Hitachi CCI software on the Server displays ShadowImage information and allows you to perform ShadowImage operations by issuing commands from the UNIX/MS Windows command line or by executing a script file. The CCI software interfaces with the TagmaStore subsystem through a dedicated LU called a command device.

1.4 SnapShot

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

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

1.5 Cooperation between User and Hitachi Personnel

If a TrueCopy/TCE/ShadowImage 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 Data Systems 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 Data Systems maintenance personnel.

Chapter 2 Overview of CCI Operations

CCI allows you to perform Hitachi replication software operations by issuing commands from the host to the TagmaStore subsystem. Hitachi replication software operations are non-disruptive and allow the primary volume of each volume pair to remain online for both read and write operations (except when a hardware error occurs or an error occurs during reverse—resync in ShadowImage).

This chapter includes:

- Features of Paired Volumes
- Overview of CCI Operations
- Volume Pairs
- Applications of CCI Commands
- CCI Software Structure
- Examples of the Configuration Definition File
- Error Monitoring and Configuration Confirmation
- Recovery Procedures for HA Configurations (TrueCopy only)
- About VMware

2.1 Features of Paired Volumes

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

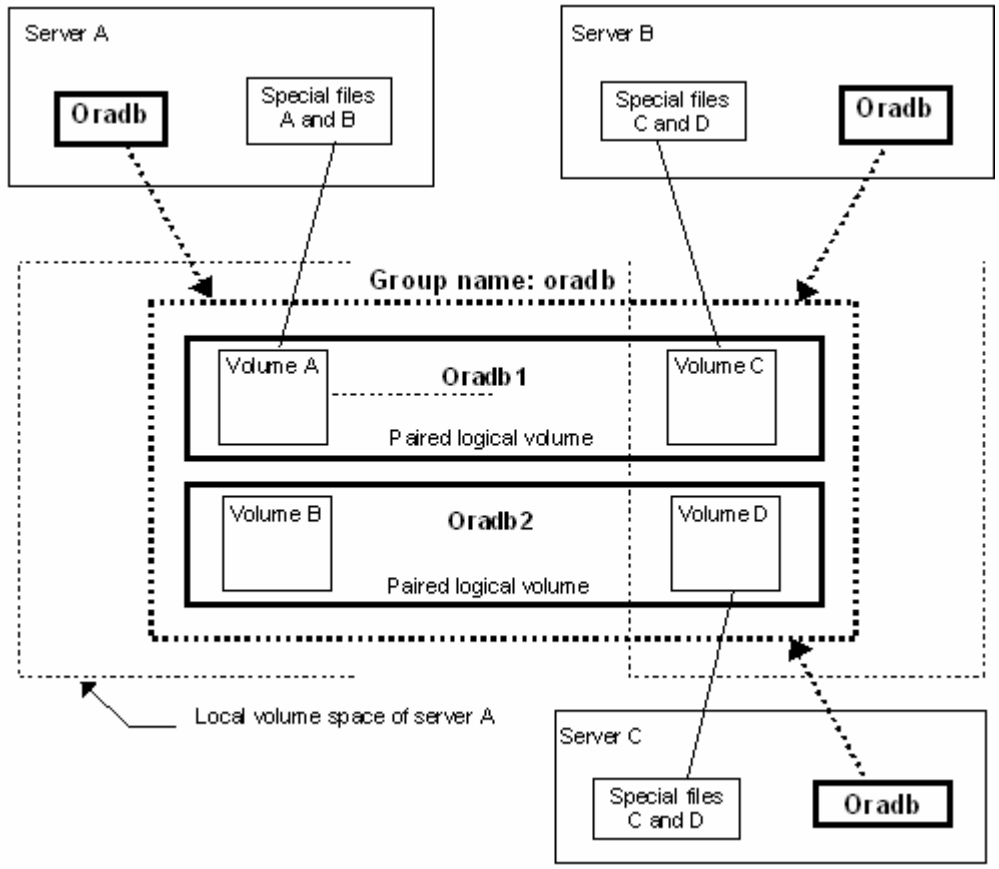


Figure 2.1 Paired Volumes

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 server. Each paired logical volume must belong to a group in the configuration definition file. One group can contain logical volumes for one server, 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.

2.1.1 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#0-2) in the configuration definition file as shown below. However, when one P-VOL configures a pair with the maximum of three S-VOLs, only a set of ShadowImage can be in the PAIR status, the COPY status or the PSUE(R) status.

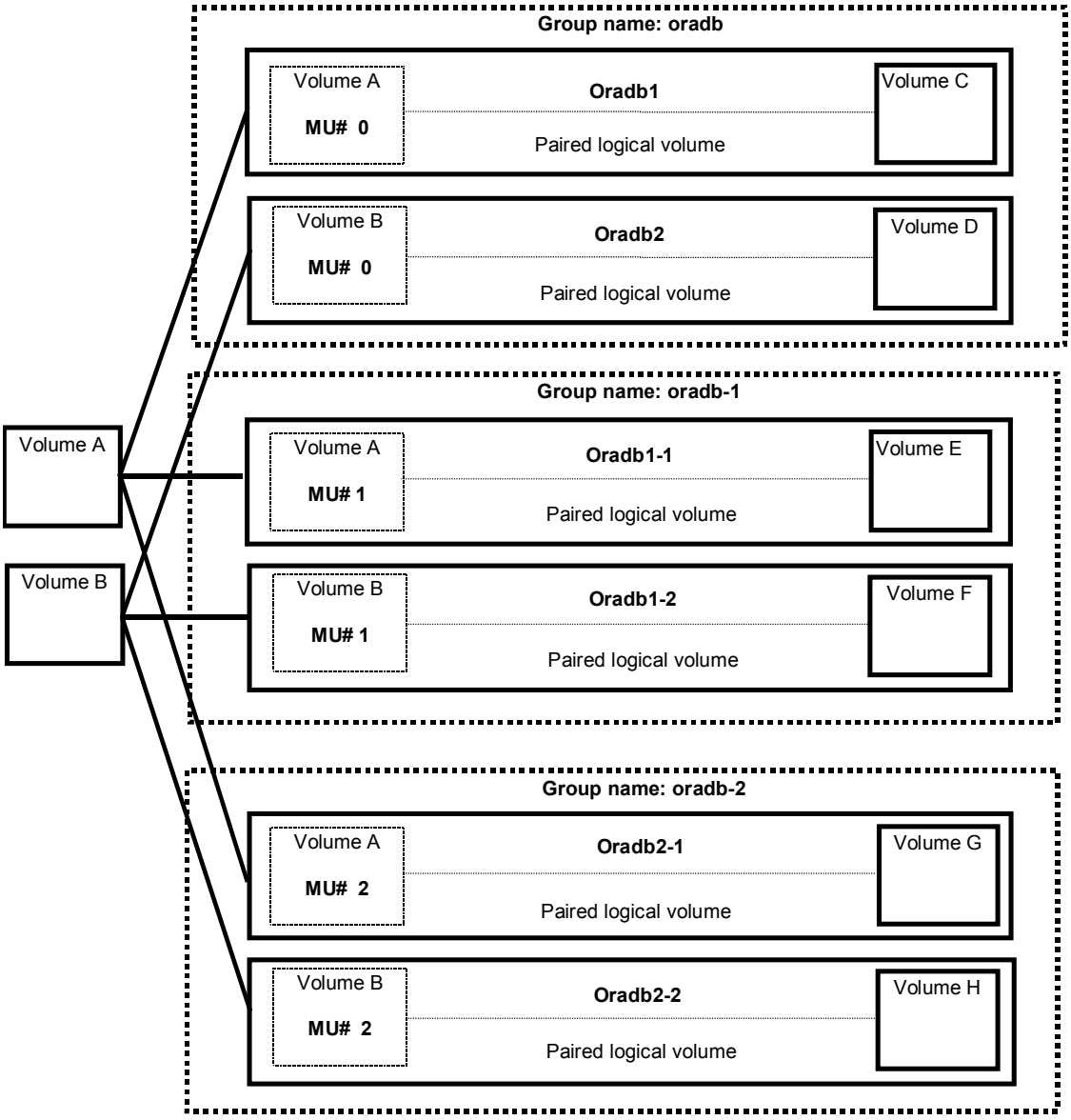


Figure 2.2 ShadowImage Duplicated Mirrors

2.1.2 SnapShot Duplicated Mirroring

Duplicate 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#0-14) in the configuration definition file.

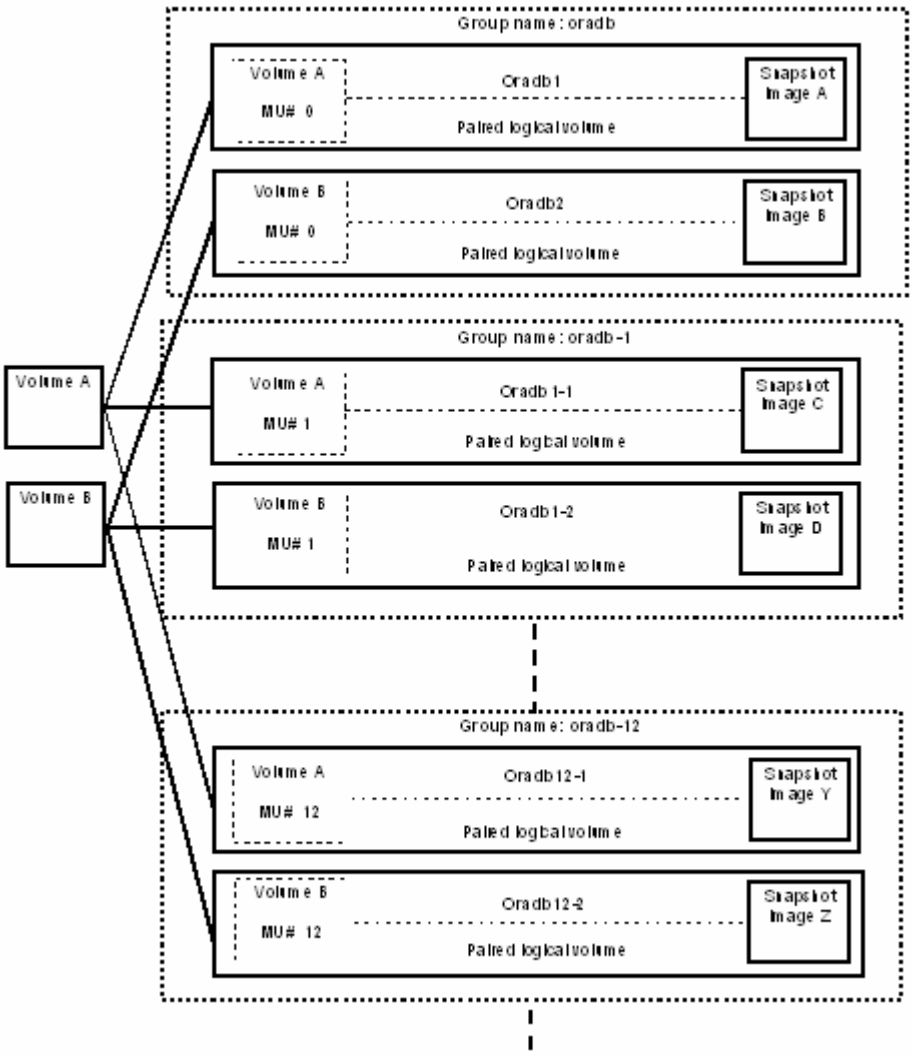


Figure 2.3 SnapShot Duplicated Mirrors

2.2 Overview of CCI Operations

This section includes:

- TrueCopy Takeover Commands
- TrueCopy/TCE Remote Commands
- TrueCopy/TCE Operations
- ShadowImage Operations
- SnapShot Operations

2.2.1 TrueCopy Takeover Commands

CCI TrueCopy operates in conjunction with the software on the servers and the TagmaStore subsystem 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 Server (e.g., MC/ServiceGuard, FirstWatch® , HACMP, or MSCS). 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 section 4.11 for more details about `horctakeover`.

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

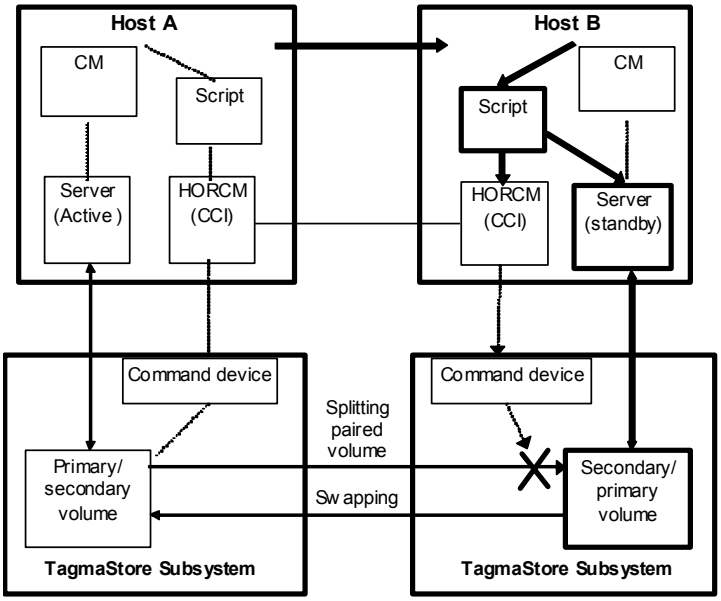


Figure 2.4 Server Failover System Configuration

Note: The swap function, which sends the updated data of the secondary volume to the primary volume by reversing the primary volume and the secondary volume relationship, is not supported of TCE.

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, the package can be transferred to the standby node as an operation executed by the system administrator (see Figure 2.5). However, if the operation is performed in an environment in which TrueCopy is used, the volume is switched from primary to secondary as if an error has occurred, even though data consistency is assured. When returning the package to the current node, it is necessary to copy the secondary volume data into the primary volume, and this operation can take as much time as the initial copy operation for the pair. In actual operation, no package can be transferred when TrueCopy is used. The secondary package is switched to the primary package, and vice versa, when the primary volume is switched to the secondary volume. Therefore, the primary and secondary TrueCopy volumes should be switched depending on the package state.

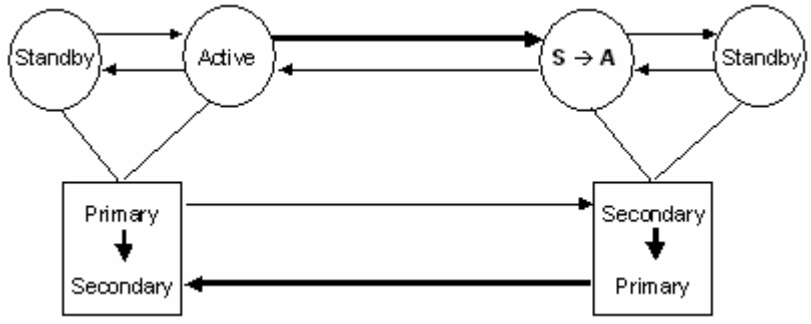


Figure 2.5 Package Transfer on High Availability (HA) Software

2.2.2 TrueCopy/TCE Remote Commands

Figure 2.6 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.

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

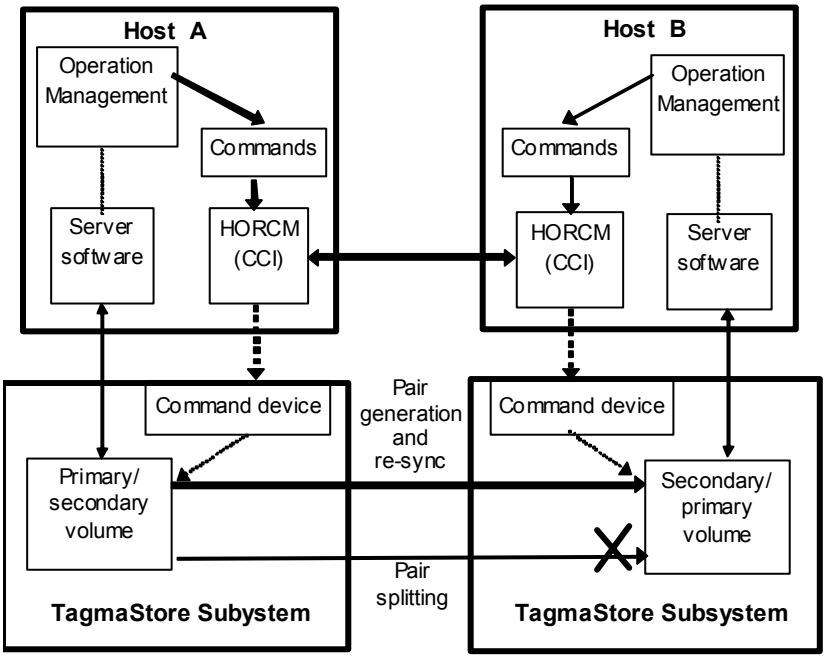


Figure 2.6 TrueCopy/TCE Remote System Configuration

2.2.3 ShadowImage Operations

Figure 2.7 illustrates the ShadowImage configuration. The ShadowImage commands support a function, which links the system operation with the server system operation management to create a volume backup among UNIX® servers.

- **Pair creation command:** Creates a new volume pair. Volume pairs can be created in units of volume or in a group.
- **Pair splitting command:** Splits a volume pair and allows read and write access to the secondary volume.
- **Pair resynchronization command:** Resynchronizes a split volume pair based on the primary volume. The primary volume remains accessible during resynchronization:
  - **Restore option:** Resynchronizes a split pair based on the secondary volume (reverse resync). The primary volume is not accessible during resync with restore option.
- **Event waiting command:** Used to wait for completion of volume pair creation or resynchronization and to check the pair status.
- **Pair status display and configuration confirmation command:** Displays the pair status and configuration of the volume pairs, used for checking the completion of pair creation or pair resynchronization.

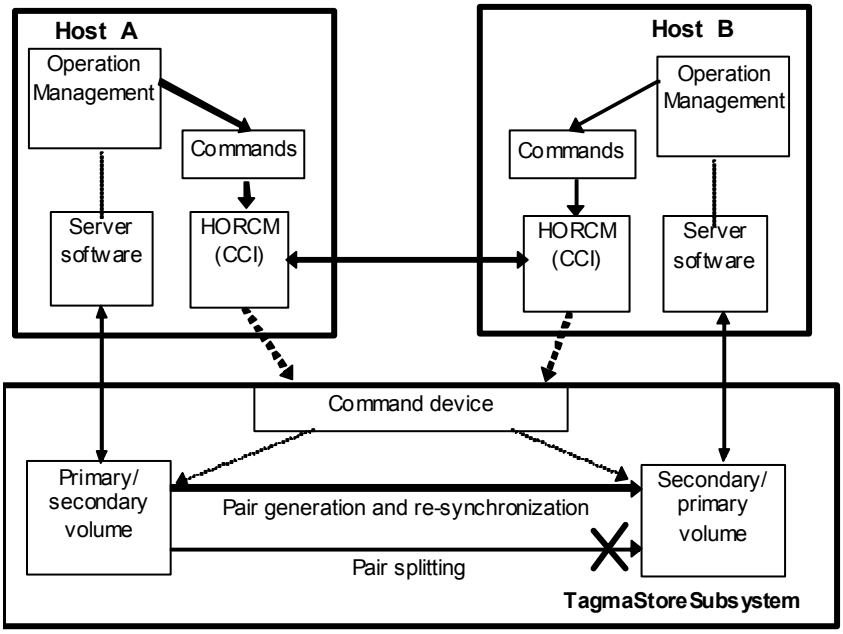


Figure 2.7 ShadowImage System Configuration

2.2.4 SnapShot Operations

Figure 2.8 illustrates the SnapShot configuration. The SnapShot commands support a function, which links the system operation with the server system operation management to create a volume backup among UNIX servers. For detailed information on the operational requirements for SnapShot, refer to the *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide* (MK-95DF708).

- **Pair creation command:** Creates a new volume pair. Volume pairs can be created in units of volume or in a group.
- **Snapshot command:** Creates and splits a volume pair and allows read and write access to the secondary volume.
- **Restore command:** Restores from the secondary volume to primary volume with -restore option.
- **Event waiting command:** Used to wait for completion of volume pair creation or resynchronization and to check the pair status.
- **Pair status display and configuration confirmation command:** Displays the pair status and configuration of the volume pairs, used for checking the completion of pair creation or pair resynchronization.

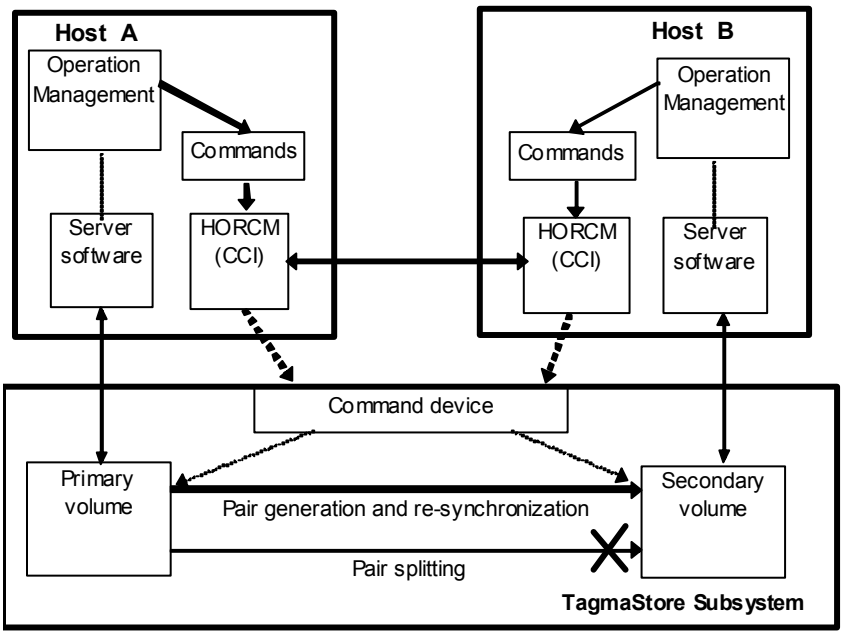


Figure 2.8 SnapShot System Configuration

2.3 Volume Pairs

ShadowImage/SnapShot paired volumes can be created between the same volume sizes. TrueCopy/TCE commands allow you to create a TrueCopy/TCE volume pair consisting of one P-VOL and one S-VOL. ShadowImage commands allow you to create volume pairs consisting of one P-VOL and up to three S-VOLs using the ShadowImage duplicate function. SnapShot commands allow you to create volume pairs consisting of one P-VOL and up to fifteen V-VOLs using the SnapShot duplicate function.
The TrueCopy/TCE P-VOL and S-VOL can be in different subsystems. ShadowImage pairs are contained within the same subsystem and are maintained by re-synchronizing from P-VOL to S-VOL.

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 replication product volumes as individual volumes by specifying logical volume names with Hitachi replication software commands.

Table 2.1 Created Volume Pair Numbers

Equipment Type	TrueCopy	TCE	ShadowImage	SnapShot
WMS100	510	Not Supported	255	254
AMS200	510	Not Supported	255	254
AMS500	2,046	1,022	1,023	1,022
AMS1000	4,094	2,046	2,047	2,046

2.3.1 TrueCopy/TCE Volume Status

Each TrueCopy/TCE pair consists of one P-VOL and one S-VOL. Table 2.2 describes the TrueCopy pair status terms. Table 2.3 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 2.5 shows the relationship between pair status and TrueCopy command acceptance.

Table 2.6 shows the relationship between pair status and TCE command acceptance.

Table 2.2 TrueCopy Pair Status

Status	TrueCopy Pair Status	Primary	Secondary
SMPL	Unpaired volume.	R/W enabled	R/W enabled
PAIR	Paired volume. Initial copy is complete. Updates are processed synchronously.	R/W enabled	R 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.	R/W enabled	R 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 TagmaStore keeps track of P-VOL and S-VOL updates while the pair is split.	R/W enabled	R/W enabled when using write enable pairsplit option.
PSUE (error)	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 TagmaStore copies the entire P-VOL to the S-VOL (same as initial copy).	R/W enabled if no error has occurred and when the fence level is set to **data** in the primary volume.	R enabled (See note 1)

Table 2.3 TCE Pair Status

Status		TCE Pair Status	Primary	Secondary
SMPL		Unpaired volume	R/W enabled	R/W enabled
PAIR		Paired volume. Initial copy is complete. Updates are processed asynchronously	R/W enabled	R enabled (See note 1)
COPY		In paired state, but initial copy, pairsplit, or resync operation is not complete.	R/W enabled	R enabled (See note 1)
PSUS SSUS	PSUS	In paired state, but updates to the S VOL data are suspended due to user-requested pairsplit. The TagmaStore keeps track of P-VOL updates while the pair is split.	R/W enabled	R/W 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.	R/W is impossible	R/W 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.	—	R/W enabled
	PFUS (See note 2)	This is a state in which the available POOL capacity is insufficient (pool-over). The updated data is managed using the differential data of the P-VOL.	R/W enabled	R 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 TagmaStore copies the entire P-VOL to the S-VOL (same as initial copy)	R/W enabled if no error has occurred and when the fence level is set to **data** in the primary volume	R enabled (See note 1)

Note 1: Do not mount in this state. When a mount is performed, the volume is under data copy and the data may be changed (except for PSUE).

Note 2: The state of the pool-over concerning TCE differs depending on the condition. Examples of failures and states are shown in Table 2.4.

Note 3: There may be a case where the status of the S-VOL becomes PSUS, which does not allows no Read/Write operation, because of a failure that occurs in the S-VOL of the pair in the PAIR or SSWS status. When the S-VOL is in this status, it is impossible to perform the SVOL__Takeover operation for it by means of the horctakeover command. The P-VOL status is changed to PSUE and the pair resynchronization is required for the restoration to restore it.

Table 2.4 State of the Pool-Over Concerning TCE

Occasion that causes the PFUS/PSUE status	Status	
	P-VOL	S-VOL
Pool-over of the primary subsystem	PFUS	Keeps as before the occurrence of the pool-over.
Pool-over of the secondary subsystem	PSUE	PFUS
Pool failure for the secondary subsystem 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 2.5 shows the relationship between pair status and TrueCopy command acceptance. Table 2.6 shows the relationship between pair status and TCE command acceptance.

Table 2.5 Pair Status versus TrueCopy Commands

	TrueCopy Command					
	Paircreate		Pairsplit			Pairresync
Pair Status	Copy	Nocopy	Suspend –r, -rw	Suspend –P	Simplex	Resync
SMPL	Accepted	Accepted	Rejected	Rejected	Acceptable	Rejected
② COPY ↓	Acceptable	Acceptable	Accepted ④	Rejected	Accepted ①	Acceptable
PAIR	Acceptable	Acceptable	Accepted	Accepted	Accepted	Acceptable
④ PSUS	Rejected	Rejected	Acceptable	Acceptable	Accepted	Accepted ② (***Note***)
PSUE	Rejected	Rejected	Rejected	Rejected	Accepted	Accepted ② (***Note***)

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 the -swaps(p) option of pairresync. If the pairresync command (from P-VOL to S-VOL) is rejected, use the -fc option of the pairdisplay command to verify this special state.

Table 2.6 Pair Status versus TCE Commands

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

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.

2.3.2 ShadowImage Volume Status

Each ShadowImage pair consists of one P-VOL and one S-VOL. Table 2.7 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 2.7 ShadowImage Pair Status

Status		ShadowImage Pair Status	Primary	Secondary
SMPL		Unpaired volume	R/W enabled	R/W enabled
PAIR		Paired volume. Initial copy is complete. Updates are processed asynchronously.	R/W enabled	R enabled* (***Note***)
COPY		In paired state, but initial copy, pairsplit, or resync operation is not complete. Includes COPY (PD), COPY (SP), and COPY (RS) status.	R/W enabled	R enabled* (***Note***)
RCPY		In paired state, but reverse resync operation is not complete. Includes COPY (RS-R) status.	R/W enabled*	R enabled (***Note***)
PSUS SSUS (split)		In paired state, but updates to the S-VOL data are suspended due to user-requested pairsplit. The TagmaStore keeps track of P-VOL and S-VOL updates while the pair is split.	R/W enabled	R/W enabled when using write enable pairsplit option.
PSUE (error)		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 TagmaStore copies the entire P-VOL to the S-VOL (same as initial copy).	R/W enabled if no error has occurred in the primary volume. (If the status transits from RCPY, all access is disabled.)	R enabled* (***Note***) (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 TagmaStore Adaptable Modular Storage and Workgroup Modular Storage ShadowImage In-System Replication Software User's Guide* (MK-95DF709).	R/W enabled	R/W is impossible

* Read is disabled when the **-m noread** option of `paircreate` 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).

Figure 2.9 shows the relationship between pair status and ShadowImage command acceptance.

	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

Figure 2.9 Pair Status versus ShadowImage Commands

Note 1: 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 a maximum of three 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 ② to ④ is valid only when the pair status is changed to COPY due to 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 )75010061    28.P-VOL PSUS,  100     29  W
oradb   oradev3(R)   (CL2-A , 3,  5-0 )75010061    29.S-VOL COPY,   97     28  -
```

2.3.3 SnapShot Volume Status

Each SnapShot pair consists of one P-VOL and up to 15 S-VOLs (Snapshot image: V-VOL). Table 2.8 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 2.8 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 Read/Write operations.	Read and write	Does not accept 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-term operations occur while this status exists.	Read and write	Does not accept I/O operations (read/write)
COPY (RS-R)	This is a state (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 not accepted for the P-VOL. 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.	Does Not Accept I/O Operations (Read/Write)	Does not accept I/O operations (read/write)
PSUS (SSUS)	This is a state (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 state 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)
PFUS	This is a state (PFUS) when the used rate of POOL reaches the threshold of the 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, can you recognize 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 state (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 disk subsystem. In this state, 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 is invalidated at this point in 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 the 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 accept I/O operations (read/write)

Figure 2.10 shows the relationship between pair status and SnapShot command acceptance.

	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

Figure 2.10 Pair Status versus SnapShot Commands

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

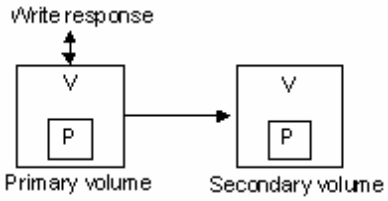
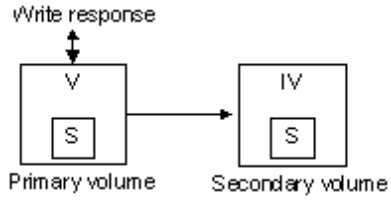
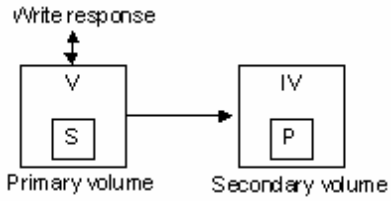
Example:

```
# 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 )75010061    28.P-VOL PSUS,  100     29  W
oradb   oradev3(R)  (CL2-A , 3,  5-0 )75010061    29.S-VOL COPY,   97     28  -
```

2.3.4 TrueCopy/TCE Fence-level Settings

TrueCopy/TCE 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: **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 2.9 shows the relationship between TrueCopy/TCE pair status and fence level.

Table 2.9 Relationship between TrueCopy Pair Status and Fence Level

	Fence Level and Write Response	
Pair Status of Volume	**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

Notes:

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.

- 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.

2.3.4.1 Setting the Fence Level for TrueCopy

Figure 2.11 shows the relationship between redo log files (journal) and data files. If the S-VOL takes over from the P-VOL where two errors have occurred, the secondary host leaves data (V) unprocessed in the rollback 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 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).

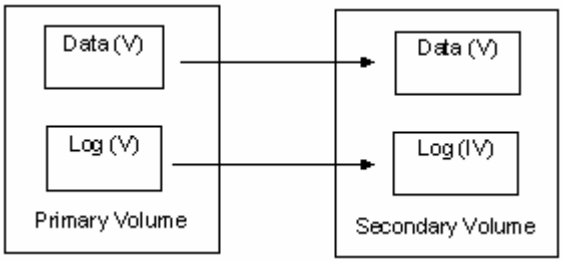


Figure 2.11 Relation between Logs and Data in Paired Status

2.4 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.

2.4.1 Backing Up Secondary Volume in Paired Status

2.4.1.1 TrueCopy/TCE

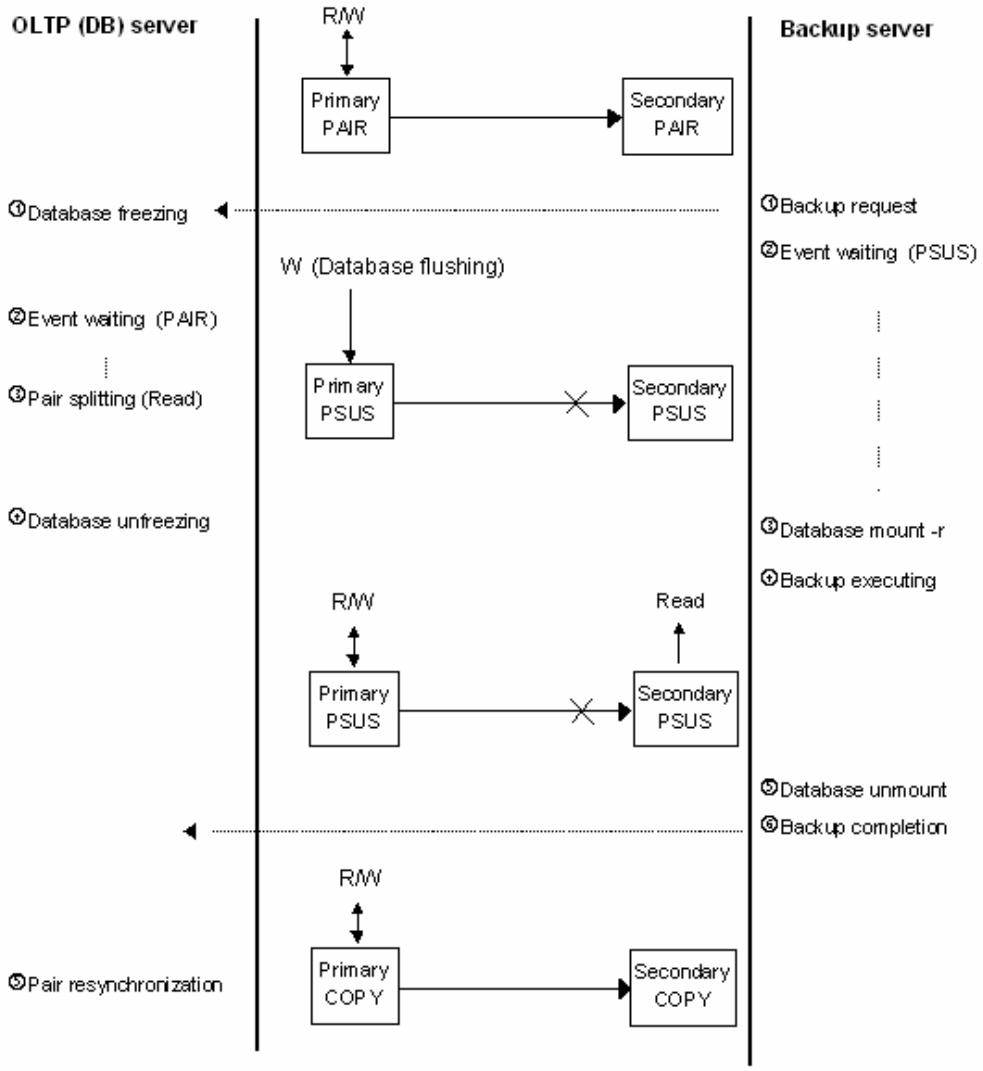


Figure 2.12 Backing Up S-VOL in Paired Status using TrueCopy/TCE

Note: The Secondary status is 'SSUS'.

2.4.1.2 ShadowImage

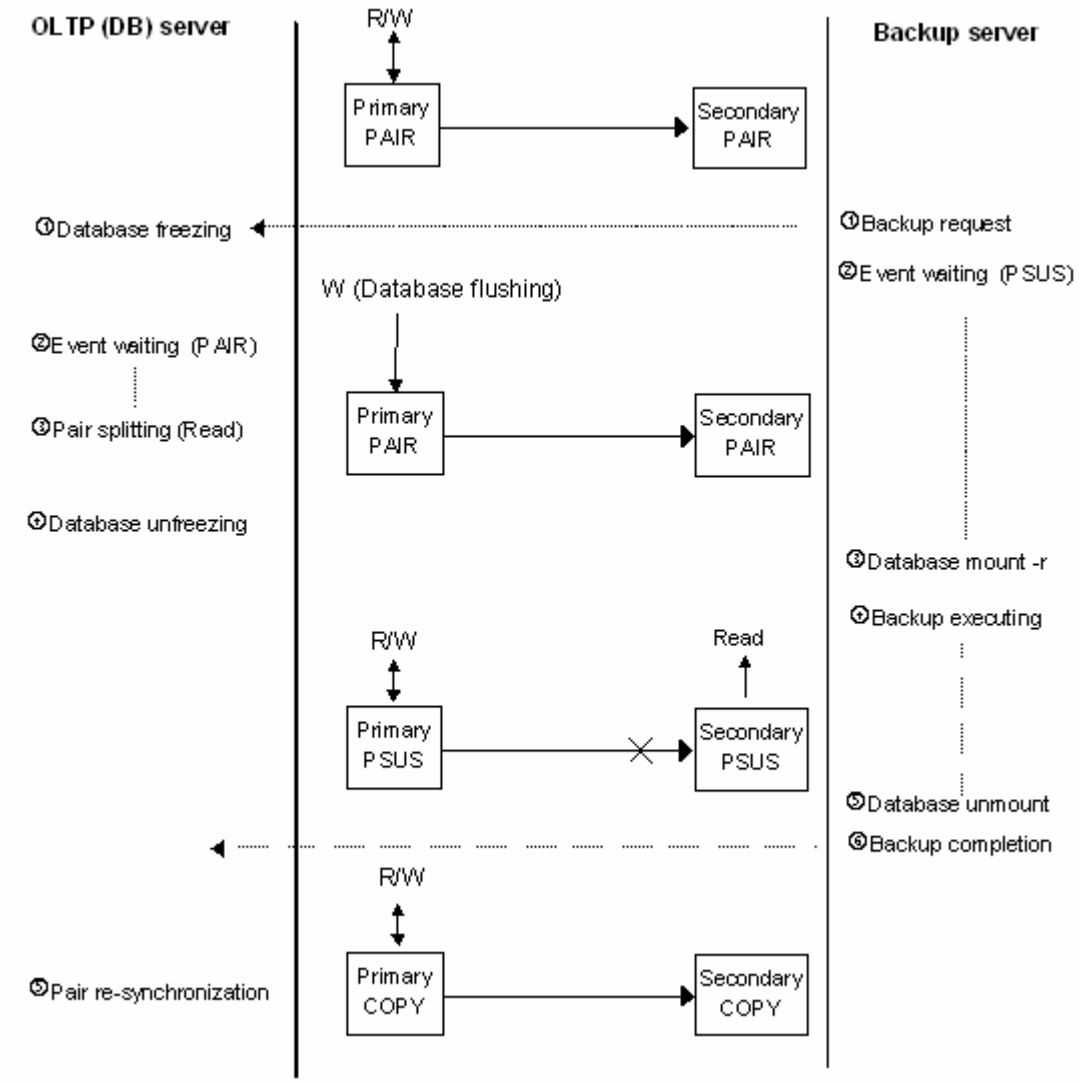


Figure 2.13 Backing Up S-VOL in Paired Status using ShadowImage

Note: The Secondary status is 'SSUS'.

2.4.2 Restoring Secondary Volume to Primary Volume in Split Status

2.4.2.1 TrueCopy/TCE

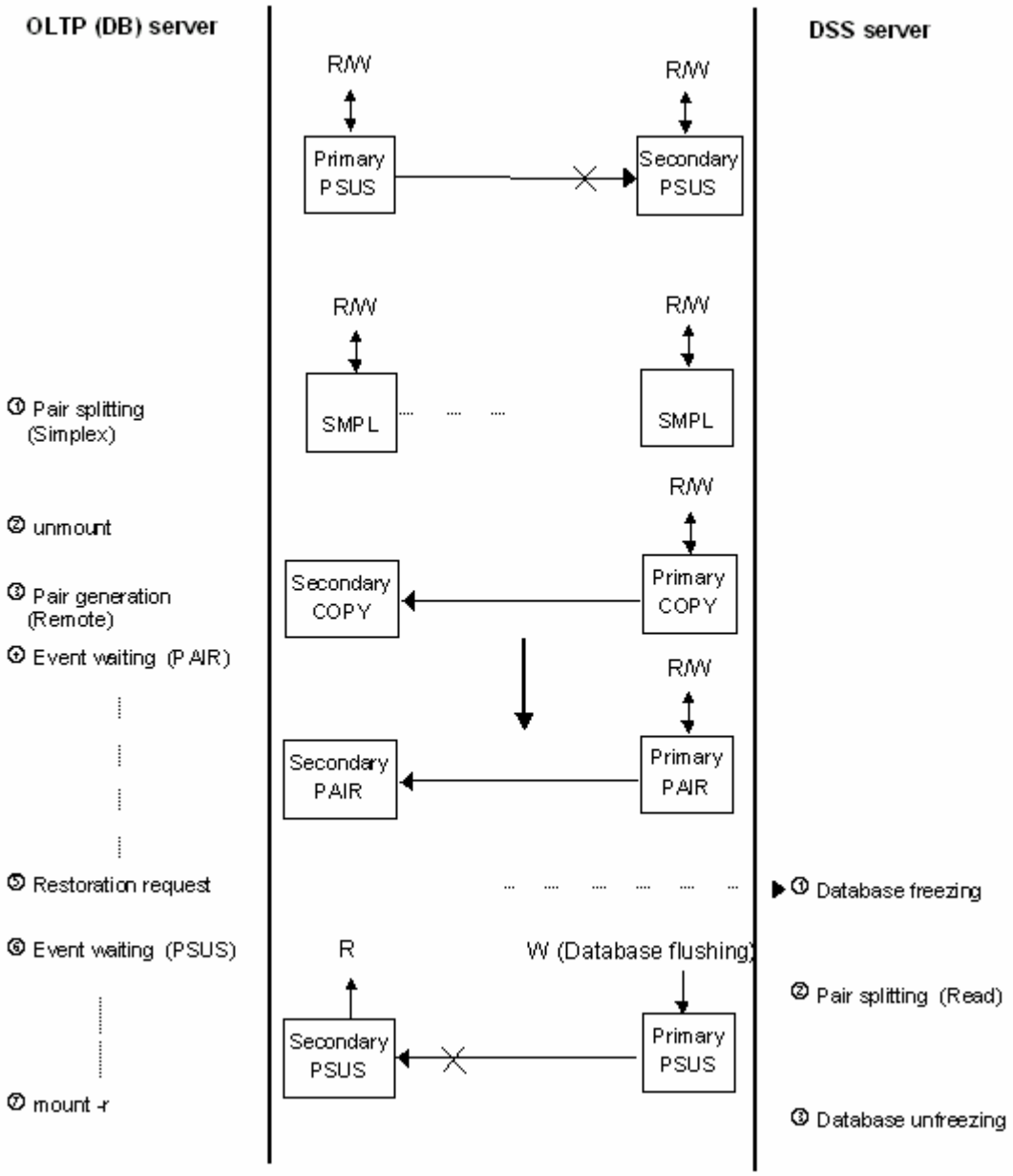


Figure 2.14 Restoring S-VOL to P-VOL in Split Status using TrueCopy/TCE

Note: The Secondary status is 'SSUS'.

2.4.2.2 ShadowImage

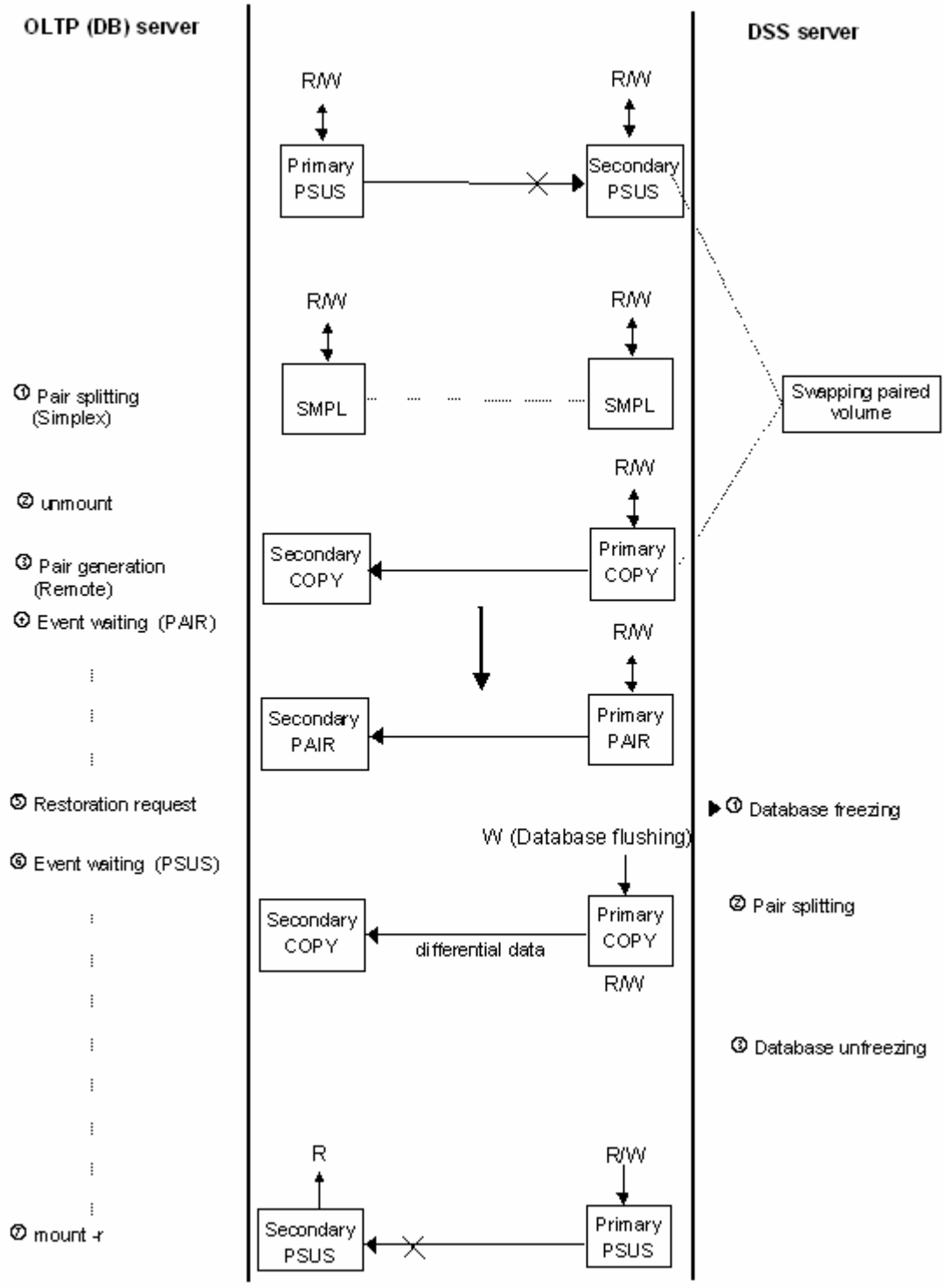


Figure 2.15 Restoring S-VOL to P-VOL in Split Status using ShadowImage

Note: The Secondary status is 'SSUS'.

2.4.3 Swapping Paired Volume for Duplex Operation

The swapping operation cannot be performed because TCE has not the swapping function that reverses the P-VOL and S-VOL.

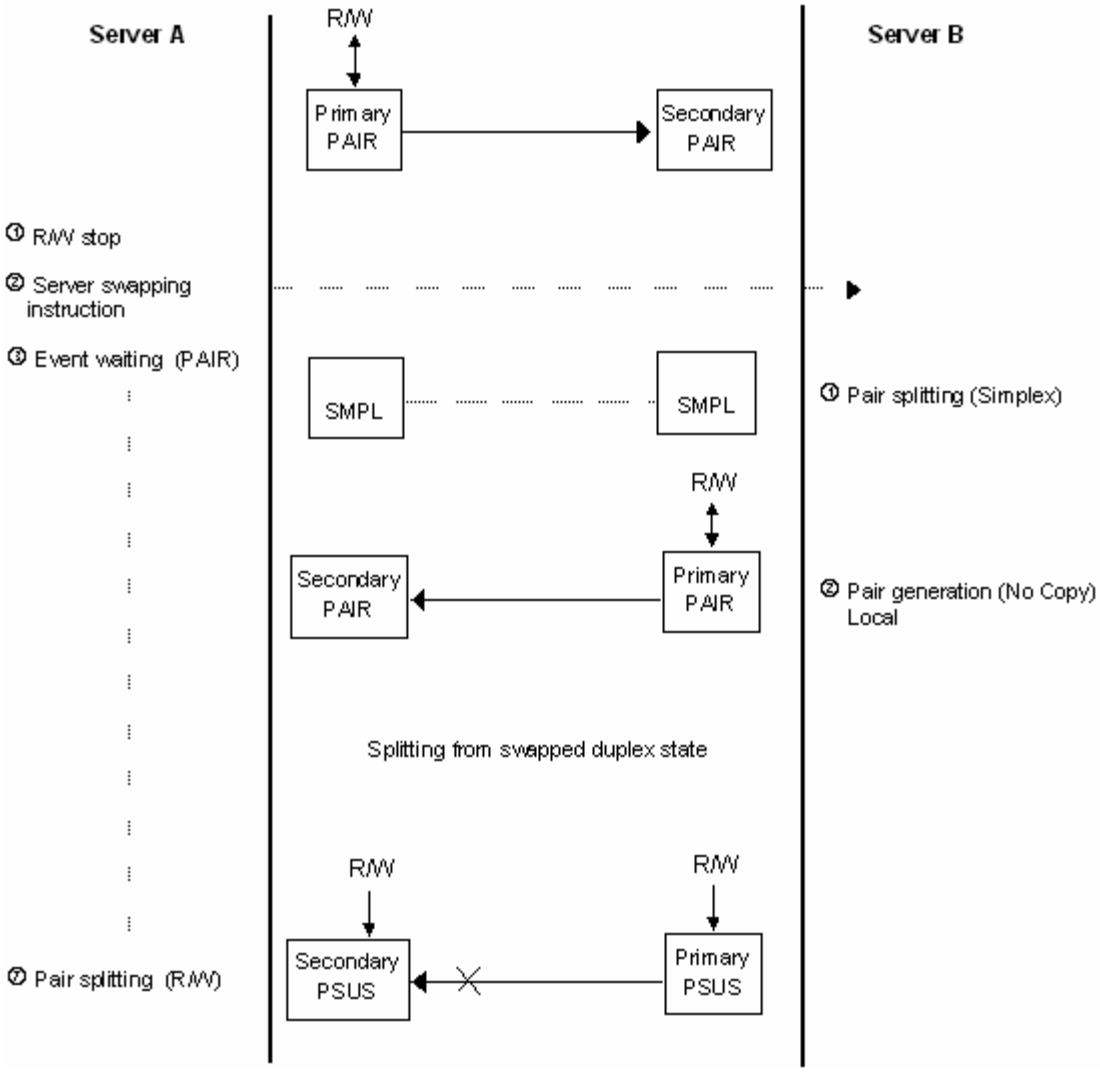


Figure 2.16 Swapping Paired Volume for Duplex Operation using TrueCopy only

Note: The Secondary status is 'SSUS'.

2.4.4 Restoring S-VOL for Duplex Operation

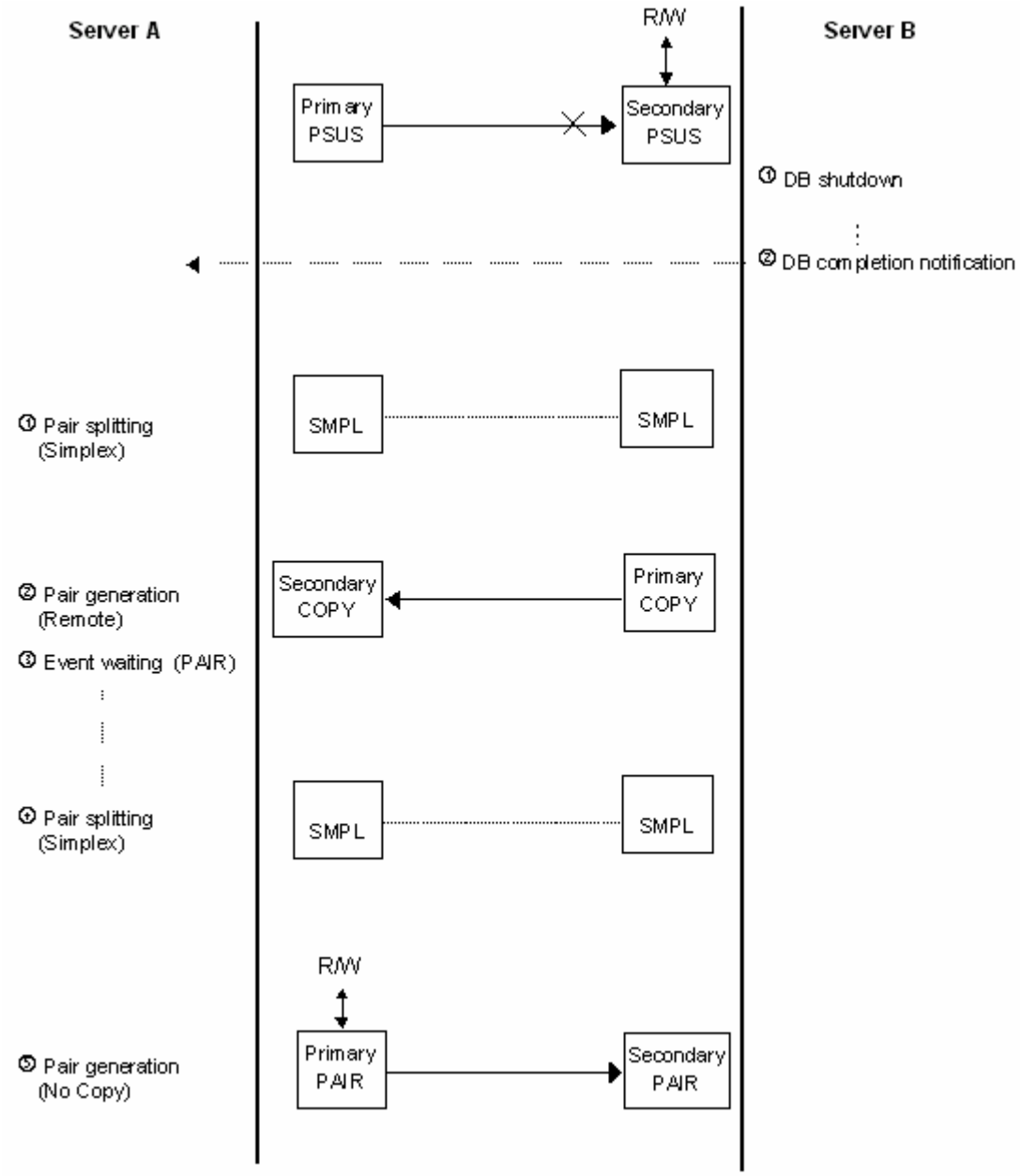


Figure 2.17 Restoring S-VOL for Duplex Operation using TrueCopy/TCE Only

Note: The Secondary status is 'SSUS'.

2.4.5 Backing Up Secondary Volume (V-VOL)

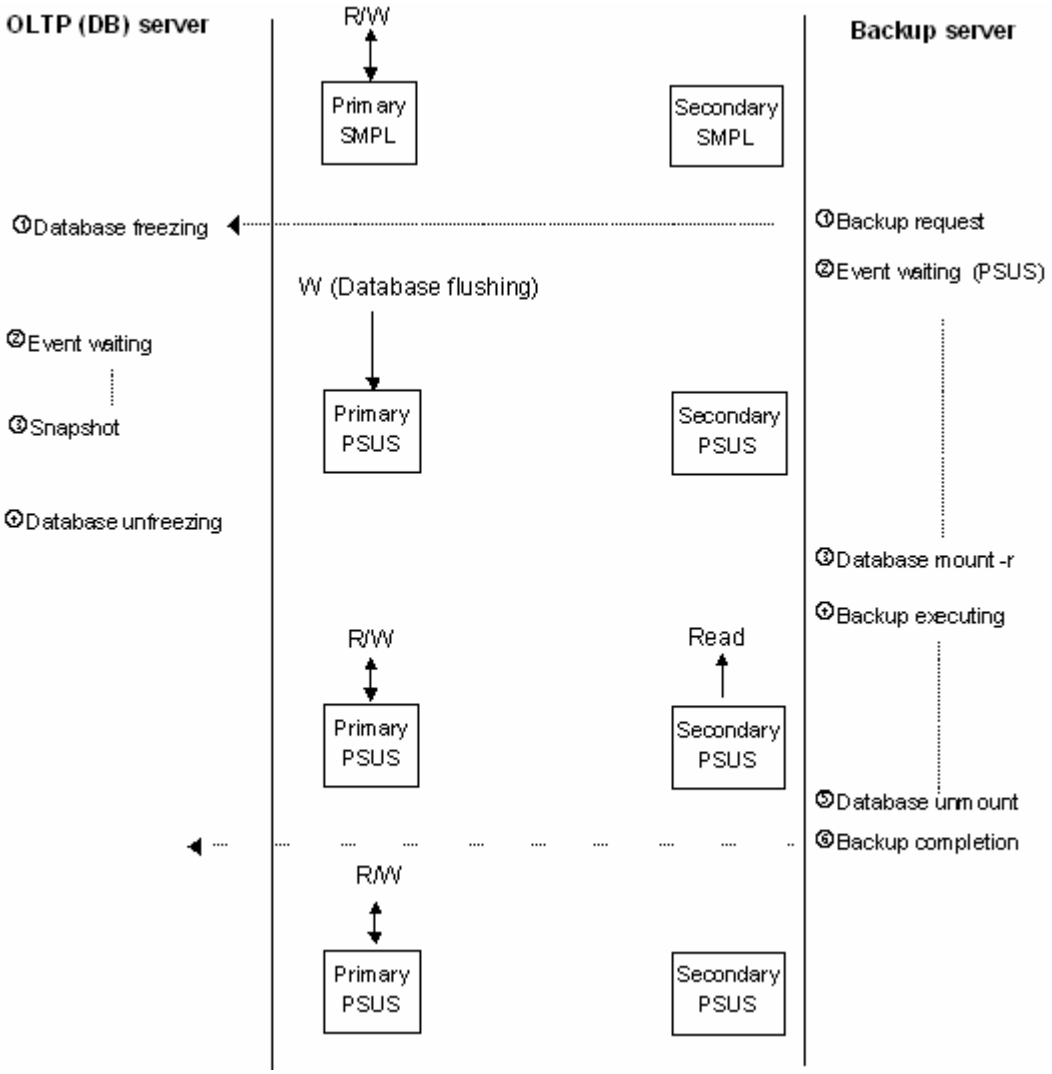


Figure 2.18 Backing up Secondary Volume (V-VOL)

Note: The Secondary status is 'SSUS'.

2.5 CCI Software Structure

Figure 2.19 illustrates the CCI software structure: the CCI components on the TagmaStore subsystem, and the CCI instance on the UNIX/PC server. The CCI components on the TagmaStore subsystem include the command device(s) and the Hitachi replication software volumes. Each CCI instance on a UNIX/PC server includes:

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

2.5.1 HORCM Operational Environment

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

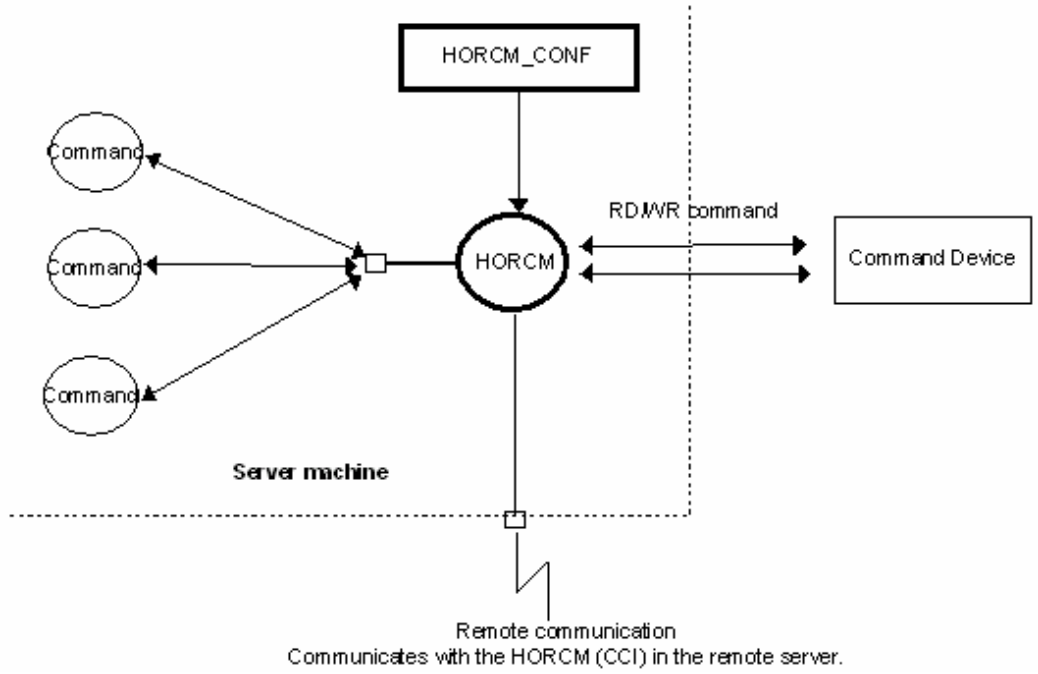


Figure 2.19 HORCM Operational Environment

2.5.2 CCI Instance Configurations

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

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). Besides, 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 2.20 has a remote execution link and a connection to the TagmaStore subsystem. 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 TagmaStore illustrates the connection between the CCI software on the host and the command device. The command device accepts TrueCopy/TCE, ShadowImage, and SnapShot CCI commands and communicates read and write I/Os between the host and the volumes on the TagmaStore. The host does not communicate TrueCopy/TCE, ShadowImage, or SnapShot commands directly to the volumes on the TagmaStore. The CCI commands are always sent through the TagmaStore command device.

Note: The TagmaStore command device must be defined using the Storage Navigator Modular. For details on setting the command device, refer to the *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage TrueCopy Synchronous Remote Replication Software User's Guide* (MK-95DF710), and/or the *TrueCopy Extended Distance User's Guide* (DF700) *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage ShadowImage In-System Replication Software User's Guide* (MK-95DF709), and the *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide* (MK-95DF708).

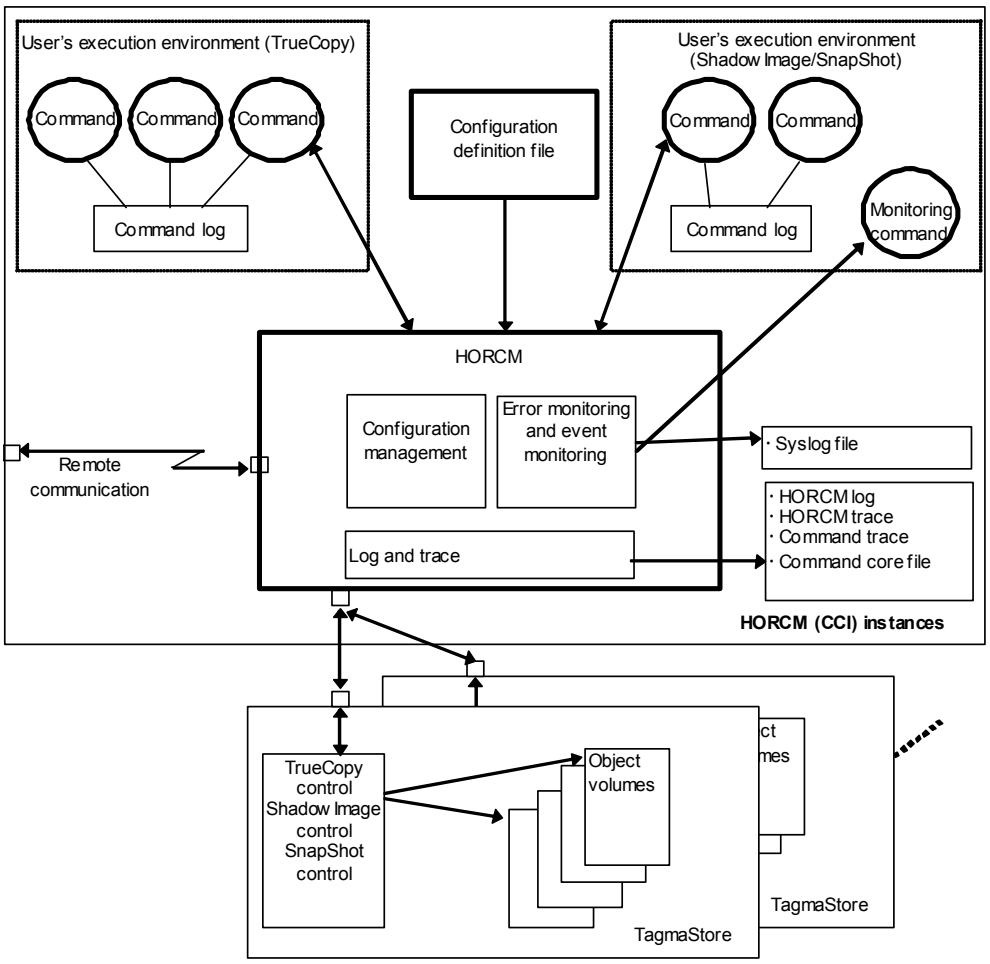


Figure 2.20 CCI Software Structure

2.5.3 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 servers are combined when paired logical volume names and group names are given to them. The configuration definition file describes the correspondence between the physical volumes used by the servers and the paired logical volumes and the names of the remote servers connected to the volumes. See section 2.6 for sample CCI configurations and their configuration definition file(s).

Figure 2.21 illustrates the configuration definition of paired volumes. Figure 2.22 shows a sample configuration file for a UNIX-based operating system. Figure 2.23 shows a sample configuration file for the Windows NT, Windows 2000, or Windows Server 2003 operating system.

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. For details, see the HORCM_CONF described later in this section.

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. For details on the `mkconf` command tool, see section 4.16.2.

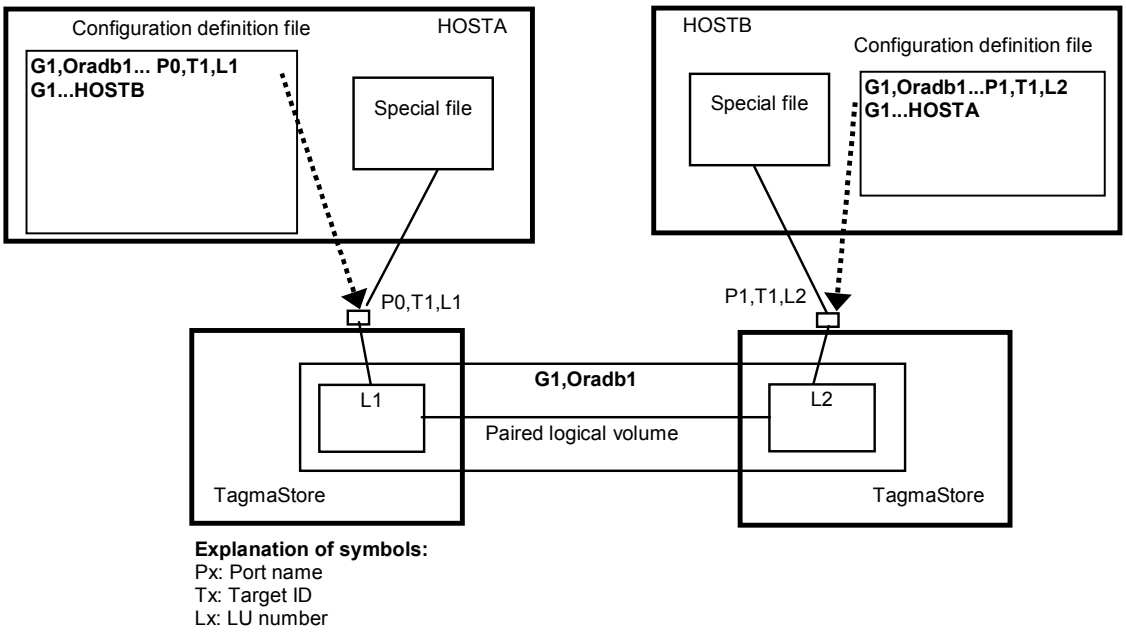


Figure 2.21 Configuration Definition of Paired Volumes

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#75000018)
#dev_name     dev_name       dev_name
/dev/rdsk/c0t2d0

#unitID 1... (seq#75000019)
#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 2.22 Configuration File Example using TrueCopy/TCE — UNIX-based Servers

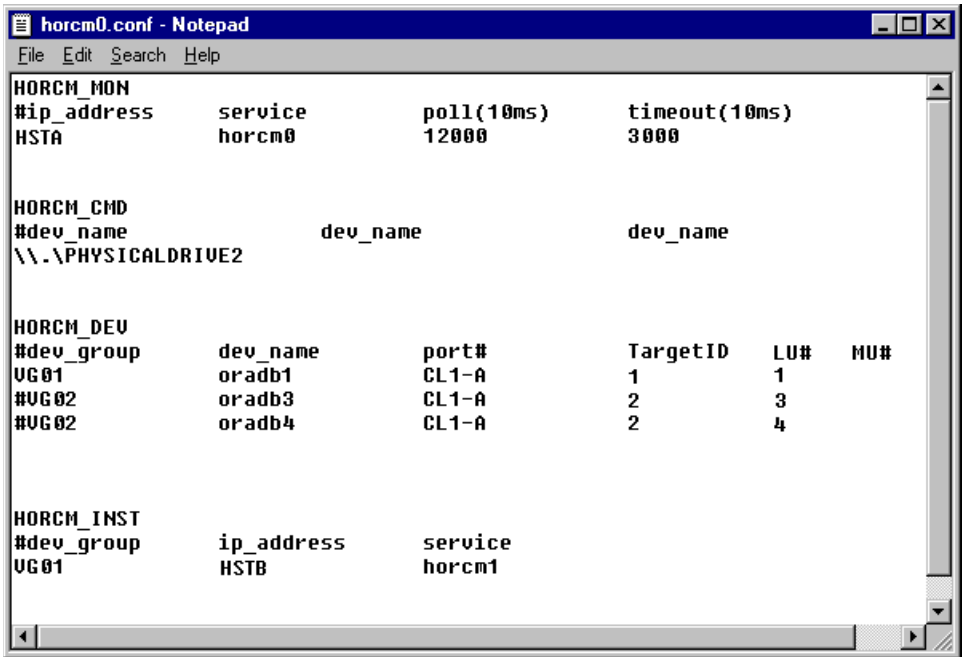


Figure 2.23 Configuration File Example using TrueCopy/TCE — Windows NT/2000 /2003 Servers

The procedure for creating and editing the configuration definition file manually is as follows:

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.

   Note: For details on configuration parameters, see section 3.4.
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 (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:

- **HORCM_MON**. The monitor parameter (`HORCM_MON`) defines the following values:
  - **Ip_address:** The IP address of the local host. When HORCM has two or more network addresses on different subnets for communication, this item must be NONE.
  - **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 greater than or equal to 6000 for Hitachi replication software operations. To calculate the poll(10ms) value, see the following equation and the example below it. Setting the value incorrectly may cause an internal conflict between CCI and the subsystem; the internal processing of the subsystem 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 subsystem, which its host is
connected to the subsystem.
```

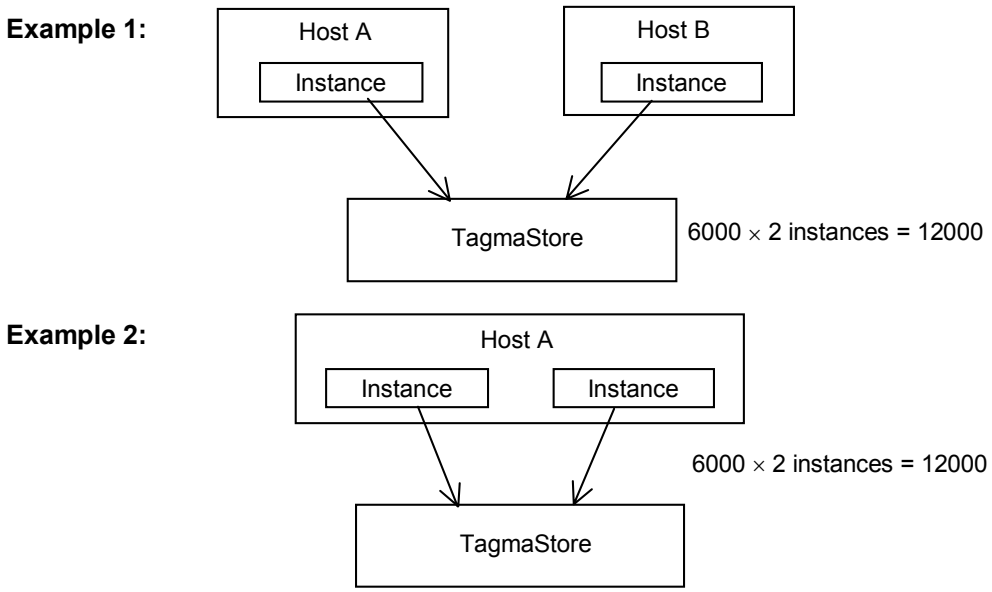


Figure 2.24 Setting Poll (10ms) Value

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

- **HORCM_CMD.** The command parameter (`HORCM_CMD`) defines the UNIX device path or Windows physical device number of the TagmaStore command device. The command device must be mapped to the interface using the Navigator. You can define two command devices to provide failover when the original command device becomes unavailable. For details on command devices, see section 2.5.4. For details on the alternate command device function, see section 2.5.5.

When a server is connected to two or more TagmaStore subsystems, the HORCM identifies each TagmaStore using the unit ID (see Figure 2.25). The unit ID is assigned sequentially in the order described in this section of the configuration definition file. If more than one command device (maximum of two command devices) is specified in a disk subsystem, the second command device has to be described side by side with the already described command device in a line. The server must be able to verify that the unit ID is the same Serial# among servers when the TagmaStore is shared by two or more servers. This can be verified using the **raidqry** command.

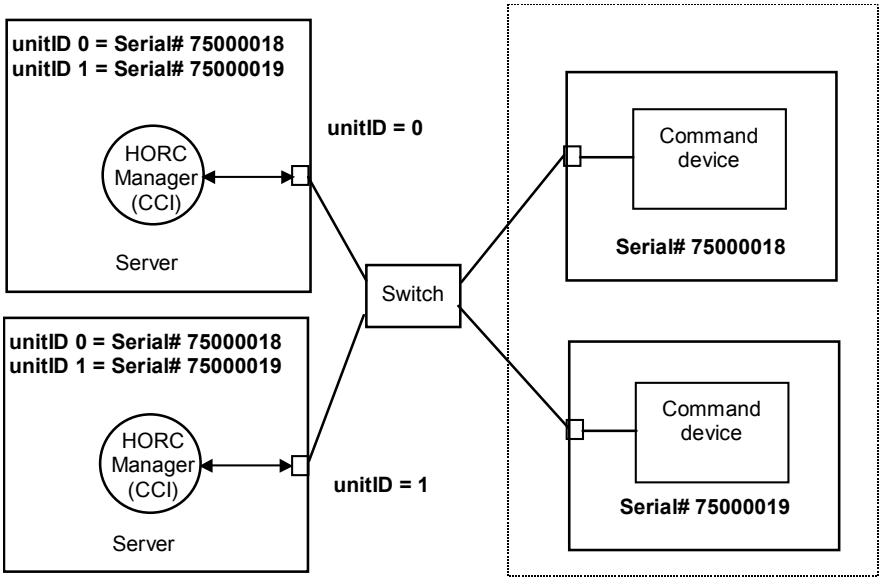


Figure 2.25 Configuration and Unit IDs for Multiple TagmaStore Subsystems

- dev_name (for Windows 2000/ Windows Server 2003):

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

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

  In the following example, the command device is described as the disk array subsystem (serial#75000018), the LU number (#250), the port number (CL1-A), and the host group number (#1).

  ```
  HORCM_CMD
  #dev_namedev_name        dev_name
  \\.\CMD-75000018-250-CL1-A
  ```

  Abbreviated specification: Specify it as shown below when it only has to be a command device of the disk array subsystem (serial#75000018).

  ```
  \\.\CMD-75000018
  ```

  When a command device is used with a multi-path: Specify the disk array subsystem (serial#75000018) and the LU number (#250) as the command device.

  ```
  \\.\CMD-75000018-250
  ```

  Specification of all the parts and the host groups: Specify the disk array subsystem (serial#75000018), the LU number (#250), the port number (CL1-A), and the host group number (#1) as the command device.

  ```
  \\.\CMD-75000018-250-CL1-A-1
  ```

  Other specification: The disk array subsystem (serial#75000018), the LU number (#250), and the port number (CL1-A) can be specified as the command device as shown below.

  ```
  \\.\CMD-75000018-250-CL1-A
  ```

  ```
  \\.\CMD-75000018-250-CL1
  ```

- **HORCM_DEV**. The device parameter (`HORCM_DEV`) defines the TagmaStore device addresses for the paired logical volume names. When the server is connected to two or more TagmaStore subsystems, the TagmaStore unit ID is defined by the port# extension (when the specified value of the combination of the local and remote port number and target ID are duplicated (see Figure 2.22). Each group name is a unique name discriminated by a server that uses the volumes, the attributes of the volumes (such as database data, redo log file, UNIX file), recovery level, etc. The group and paired logical volume names described in this item must reside in the remote server. The hardware fibre bus or iSCSI, target ID, and LUN as hardware components need not be the same.

The following values are defined in the `HORCM_DEV` parameter:

- **dev_group:** Names a group of paired logical volumes. A command is executed for all corresponding volumes according to this group name.
- **dev_name:** Names the paired logical volume within a group (i.e., name of the special file or unique logical volume). The name of a paired logical volume must be different than the dev name on another group. Use the groups, which are specified for the TCE pair, and the CTGs (Consistency Group) giving them a one-to-one correspondence. For the CTG, refer to Appendix G.
- **Port #:** Defines the TagmaStore port number of the volume that corresponds with the dev_name volume (see Table 2.10).

Table 2.10 Port Number of Volume corresponding to dev_name Volume

Displayed by CCI	Port Name used in TagmaStore Subsystem
CL1-A	Controller# 0, Port# A
CL1-B	Controller# 0. Port# B
CL1-C	Controller# 0. Port# C
CL1-D	Controller# 0. Port# D
CL2-A	Controller# 1. Port# A
CL2-B	Controller# 1. Port# B
CL2-C	Controller# 1. Port# C
CL2-D	Controller# 1. Port# D

- **Target ID:** Defines the target ID number of the physical volume on the specified port. See Appendix D for further information on fibre address conversion.

Notes:

- 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.

- The conversion table for Windows NT/2000/ Windows Server 2003 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 NT/2000/ Windows Server 2003 system. In such case, for the configuration definition file, use the target ID that is displayed (obtained) using `raidscan -find` . For conversion table details see Appendix D.
- **LU #:** Defines the logical unit number (LU#) of the physical volume on the specified target ID and port.
- ***Note:*** For Host groups, when using fibre channel, if the target ID and LU# displayed on the system are different than the target ID on the fibre address conversion table, you must use the target ID and LU# indicated by `raidscan` in the CCI configuration file. Specify the TagmaStore LUN designation.
- **MU #:** Defines the mirror unit number (0 - 2) for the identical LU on the HOMRCF. If this number is omitted it is assumed to be zero (0). The cascaded mirroring of the S-VOL is expressed as virtual volumes using the mirror descriptors (MU#1-2) in the configuration definition file. The MU#0 of a mirror descriptor is used for connection of the first S-VOL.
- **HORCM_INST**. The instance parameter (HORCM_INST) defines the network address (IP address) of the remote server (active or standby). It is used to refer to or change the status of the paired volume in the remote server (active or standby). When the primary volume is shared by two or more servers, there are two or more remote servers using the secondary volume. Thus, it is necessary to describe the addresses of all of these servers.

  The following values are defined in the `HORCM_INST` parameter:

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

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

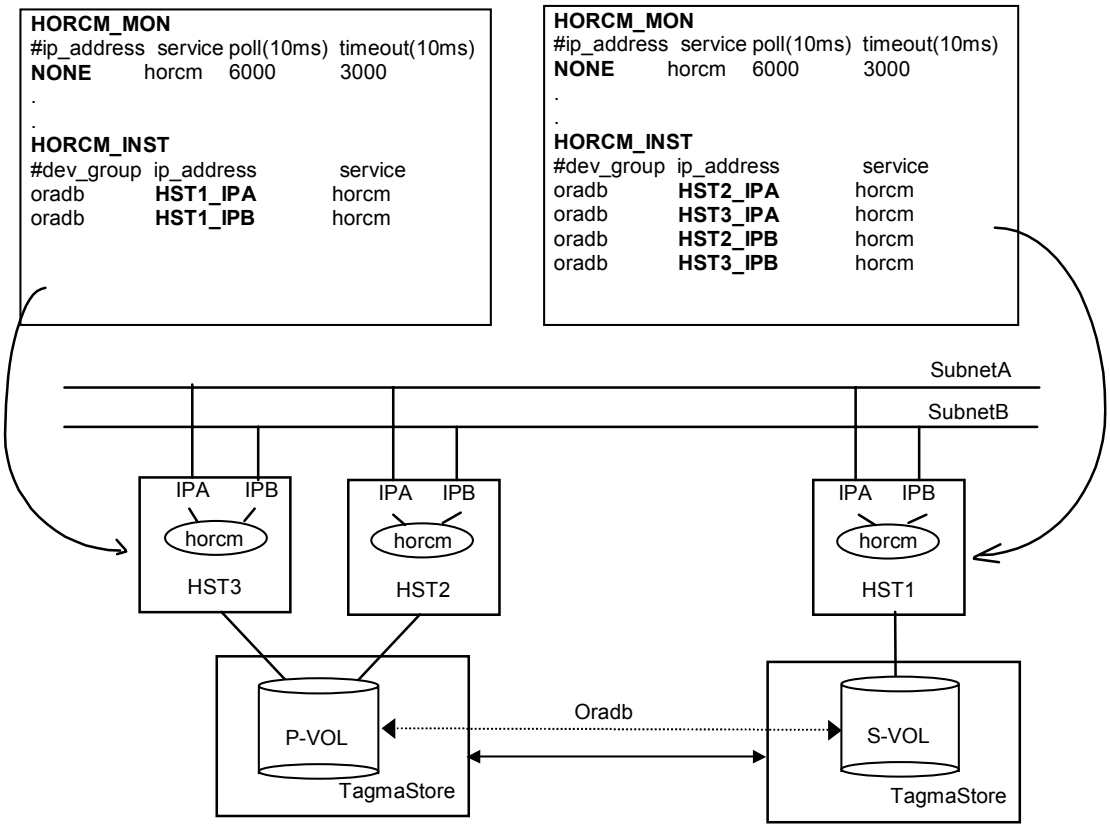


Figure 2.26 Configuration for Multiple Networks

2.5.4 Command Device

The Hitachi replication software commands are issued by the HORC Manager (HORCM) to the TagmaStore command device. The command device is a user-selected, dedicated logical volume on the TagmaStore subsystem which functions as the interface to the CCI software on the UNIX/PC host. The command device is dedicated to CCI communications and cannot be used by any other applications. The command device accepts TrueCopy, TCE, ShadowImage, and SnapShot read and write commands that are executed by CCI.

The volume designated as the command device is used only by the TagmaStore 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 TagmaStore command device. When CCI receives an error notification in reply to a read or write request to the TagmaStore, 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 TrueCopy, TCE, ShadowImage, and SnapShot commands will terminate abnormally, and the host will not be able to issue commands to the subsystem. The user must set two command devices and use the alternate command device facility if a path error occurs or if the command device is blocked (the maximum is two command devices).

When you use the TrueCopy/TCE function, the command devices must be set on both the local and remote disk subsystems.

Each command device must be set using the Navigator. 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 sections 2.5.3 and 2.6 for details.

2.5.5 Alternate Command Device Function

The CCI software issues commands to the TagmaStore command device via the UNIX/PC raw I/O interface. If the command device fails in any way, all TrueCopy, TCE, ShadowImage, and SnapShot 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 2.27).

- **Definition of alternate command devices.** To use an alternate command device, you must define two command devices for the `HORCM_CMD` item in the configuration definition file (see sections 2.5.3 and 2.6). When two command devices are defined, they are recognized as alternate command devices.
- **Timing of alternate command devices.** When the HORCM receives an error notification in reply from the operating system via the raw I/O interface, the command device is alternated. It is possible to alternate the command device forcibly by issuing an alternating command, such as `horcctl -C`.
- **Operation of alternating command.** If the command device will be blocked due to online maintenance, the alternating command should be issued in advance. When the alternating command is issued again after completion of the online maintenance, the previous command device is activated again.
- **Multiple command devices on HORCM startup.** If at least one command device is available when one or more command devices were described in the configuration definition file, HORCM will be able to start with a warning message to the startup log by using an available command device. The user needs to confirm that all command devices can be changed by using `horcctl -C` or HORCM has been started without a warning message to the HORCM start-up log.

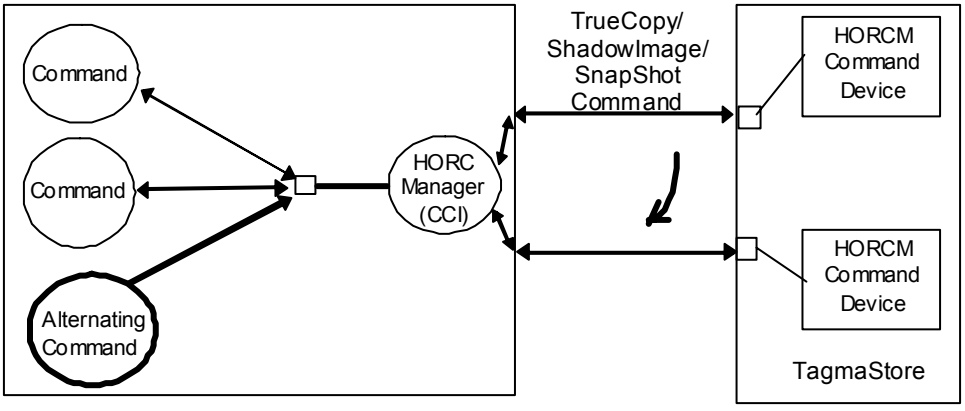


Figure 2.27 Alternate Command Device Function

For an example of setting two command devices, see section 2.6.3.

2.5.6 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 protection function is turned on/off with the Navigator. 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 2.28 shows the definition of the protected volumes.

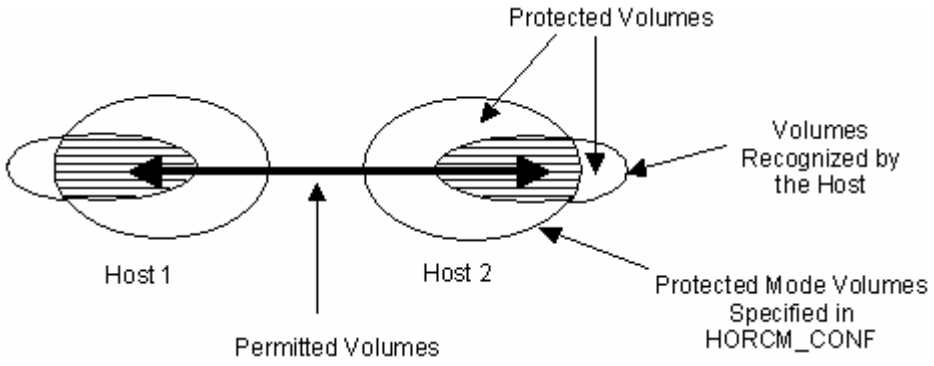


Figure 2.28 Definition of Protected Volumes

- Protection Mode Environment Variable

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. For details on setting the environment variable, see section 4.2. Relations between the settings for a command device and this variable are shown in Table 2.11.

Table 2.11 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.

- Confirming the Protection Mode Command Devices Used by HORCM

To display the protection mode command device used by HORCM, use the `horcctl -D` option. The device file name is displayed with * added.

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

Figure 2.29 Confirming Protection Mode Command Device (HP-UX)

- Protection Mode and Mirror Descriptor

  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 2.12 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								

Permitted Volumes

E = Mirror descriptor volume to be registered in horcm.conf.
Unknown: Volumes that own host cannot recognize, even though volumes were registered in horcm.conf.

Notes:

- For the Fibre Switch environment, volumes that are recognized from the host must be set using the LUN Manager feature.
- Volume matching test is performed when operating pairs. Inhibited volumes are rejected as EX_ENPERM.

- Examples of a Protected Volume Configuration
  - ***Example of one host:*** Group Ora1 and Ora2, in protection mode, cannot differentiate between volume Grp2 and Grp4, and Host 1. The pair operation is inhibited. If the protection mode is OFF, the pair operation is permitted.

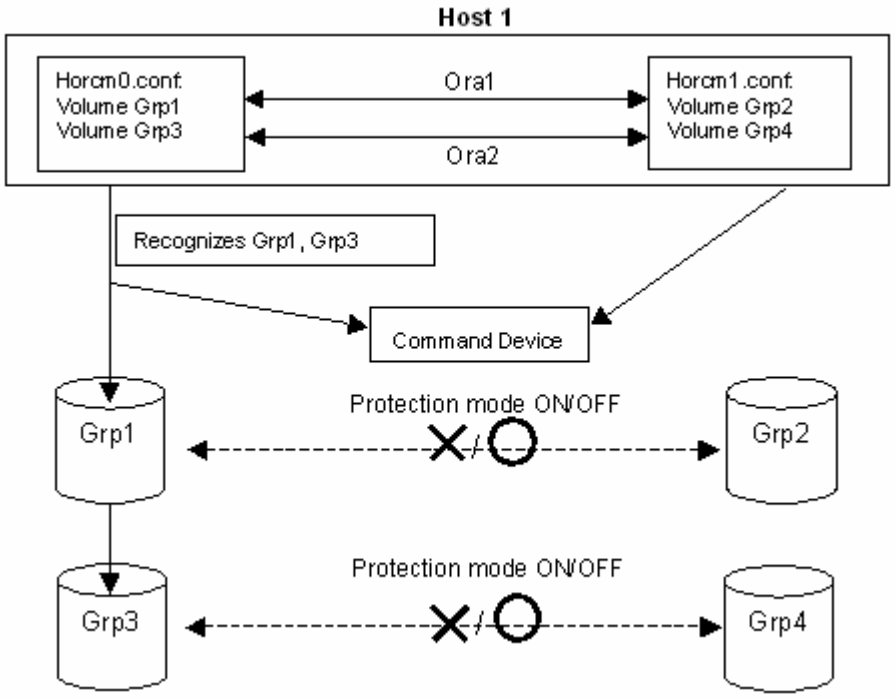


Figure 2.30 Protected Volume Configuration (one CCI host) (1)

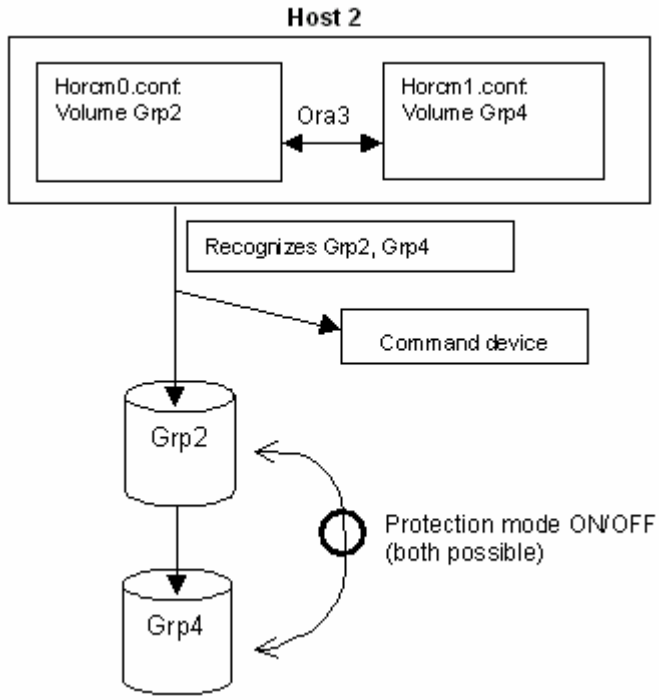


Figure 2.31 Protected Volume Configuration (one CCI host) (2)

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

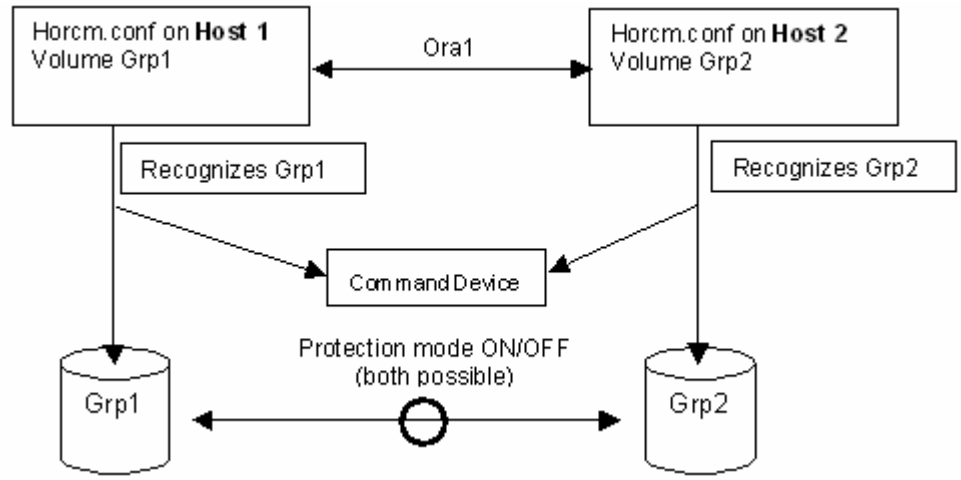


Figure 2.32 Protected Volume Configuration (two CCI hosts) (1)

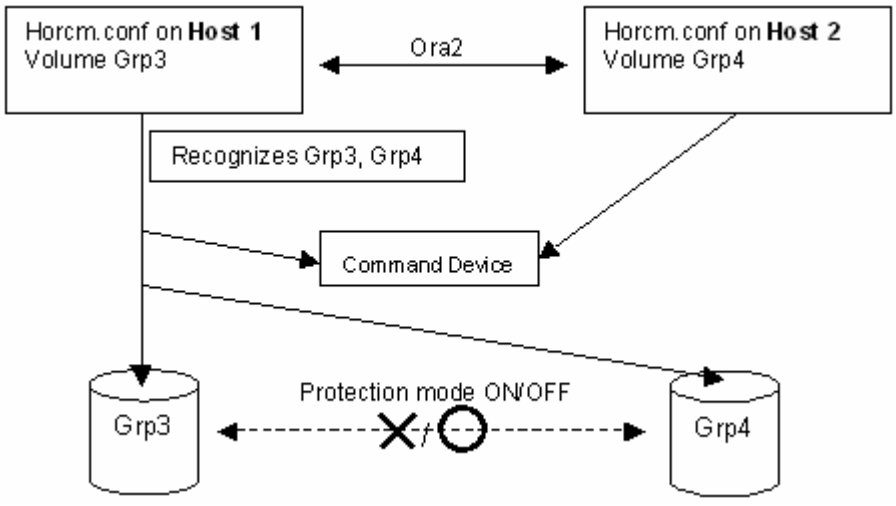


Figure 2.33 Protected Volume Configuration (two CCI hosts) (2)

- Command Usage

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 **horctakeover**, **paircurchk**, **paircreate**, **pairsplit**, **pairresync**, **pairvolchk**, 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 )75010061  ****.----  ----,-----    ----  -
oradb   oradev1(R)   (CL1-A , 3,    1-0 )75010061  ****.----  ----,-----    ----  -
```

- 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** option. 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    F  CL1-A     3     0 75010061    17  DF600F
/dev/rdsk/c0t3d1     0    F  CL1-A     3     1 75010061    18  DF600F
```

- Registering Permitted Volumes

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  75010061    17
/dev/rdsk/c0t3d1        oradb1   oradev2     c0t3d1           1  75010061    18
/dev/rdsk/c0t3d2        oradb    oradev3     c0t3d2           1  75010061    19
/dev/rdsk/c0t3d3        -        -           -                1  75010061    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 NT/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:** 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  75010061    17
Harddisk21              oradb1   oradev2     Harddisk21       1  75010061    18
Harddisk22              oradb    oradev3     Harddisk22       1  75010061    19
Harddisk23              -        -           -                1  75010061    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 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 NT/2000/ Windows Server 2003:

```
'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.

2.5.7 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 server. Table 2.13 lists the CCI files which are provided for UNIX-based systems. Table 2.14 lists the CCI files for Windows.

Table 2.13 CCI Files for UNIX-based Systems

No.	Title	File Name	Command Name	Mode	User*	Group
01	HORCM	/etc/horcmgr	horcmd*	0544	root	sys
02	HORCM_CONF	/HORCM/etc/horcm.conf	–	0444	root	sys
03	Takeover	/usr/bin/horctakeover	horctakeover*	0544	root	sys
04	Accessibility check	/usr/bin/paircurchk	paircurchk*	0544	root	sys
05	Pair generation	/usr/bin/paircreate	paircreate	0544	root	sys
06	Pair splitting	/usr/bin/pairsplit	pairsplit	0544	root	sys
07	Pair resynchronization	/usr/bin/pairresync	pairresync	0544	root	sys
08	Event waiting	/usr/bin/pairevtwait	pairevtwait	0544	root	sys
09	Error notification	/usr/bin/pairmon	pairmon	0544	root	sys
10	Volume check	/usr/bin/pairvolchk	pairvolchk	0544	root	sys
11	Pair configuration confirmation	/usr/bin/pairdisplay	pairdisplay	0544	root	sys
12	RAID scanning	/usr/bin/raidscan	raidscan	0544	root	sys
13	RAID activity reporting	/usr/bin/raidar	raidar	0544	root	sys
14	Connection confirming	/usr/bin/raidqry	raidqry	0544	root	sys
15	Trace control	/usr/bin/horcctl	horcctl	0544	root	sys
16	HORCM activation script	/usr/bin/horcmstart.sh	horcmstart.sh	0544	root	sys
17	HORCM shutdown script	/usr/bin/horcmshutdown.sh	horcmshutdown.sh	0544	root	sys
18	Connection confirming ***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

Note: For information and instructions on changing the UNIX user for the CCI software, please see section 3.3.2.

Note*: Hitachi replication software does not support `horcmd`. TrueCopy/TCE supports `horctakeover` and `paircurchk`. However, for TCE, the operation performed through `horctakeover` is SOL_Takeover only. TCE supports `pairsyncwait` .

***:** Hitachi replication software does not support the `horcmd, horctakeover, paircurchk, pairsyncwait, raidvchkset, raidvchkdsp`, or `raidvchkscan` commands. However, TCE supports `horctakeover`.

Table 2.14 CCI Files for Windows-based Systems

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 generation	\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
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 HP-UX, and Solaris systems.	\HORCM\usr\bin\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	--

No.	Title	File Name	Command Name
27	Accessibility check	\HORCM\usr\bin\paircurchk.exe	paircurchk*
28	Pair generation	\HORCM\usr\bin\paircreate.exe	paircreate
29	Pair splitting	\HORCM\usr\bin\pairsplit.exe	pairsplit
30	Pair resynchronization	\HORCM\usr\bin\pairresync.exe	pairresync
31	Event waiting	\HORCM\usr\bin\pairevtwait.exe	pairevtwait
32	Volume check	\HORCM\usr\bin\pairvolchk.exe	pairvolchk
33	Pair configuration confirmation	\HORCM\usr\bin\pairdisplay.exe	pairdisplay
34	RAID scanning	\HORCM\usr\bin\raidscan.exe	raidscan
35	RAID connection confirmation	\HORCM\usr\bin\raidqry.exe	raidqry
36	Synchronous waiting	\HORCM\usr\bin\pairsyncwait.exe	pairsyncwait*
37	Oracle Validation setting	\HORCM\usr\bin\raidvchkset	raidvchkset*
38	Oracle Validation displaying	\HORCM\usr\bin\raidvchkdsp	raidvchkdsp*
39	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/TrueCopy/TCE/SnapShot does not support the horcmd command. TrueCopy/TCE supports the horctakeover and the paircurchk command. However, concerning TCE, the operation performed through execution of the horctakeover command is SOL_Takeover only. TCE supports the pairsyncwait command.Log and Trace Files

The CCI software (HORCM) and Hitachi replication software 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. Please refer to Appendix B for a complete description of the CCI log and trace files.

2.5.8 Log and Trace Files

The CCI software (HORCM) and TrueCopy/TCE/ShadowImage/SnapShot 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. Please refer to Appendix B for a complete description of the CCI log and trace files.

2.5.9 User-Created Files

Script Files. CCI supports scripting to provide automated and unattended copy operations. A CCI script contains a list of CCI commands, which describes a series of TrueCopy/TCE, ShadowImage, and/or SnapShot 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 TagmaStore command device to execute the Hitachi replication software 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 server error.

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

- UNIX-based systems: **/etc/horcm.conf**or **/etc/horcm*.conf**
- Windows NT/2000 systems: **\WINNT\horcm.conf**or **\WINNT\horcm*.conf**
- Windows Server System: **\WINDOWS\horcm.conf**or **\WINDOWS\horcm*.conf**

2.5.10 Group Version Control for Mixed Subsystem Configurations

CCI checks the facility version of the Hitachi subsystem internally before the execution of each option for a command, so that this method requires a version unified on mixed subsystem configuration. But this method may not be satisfied a requirement on the mixed environment of AMS1000 and AMS500, because AMS500 will hold an enhancement at the current facility version. If the facility versions of the subsystems (e.g., AMS1000 and AMS500) are different, the user is unable to use the facility of AMS1000-specific because CCI does slice to a minimum version to make a unification version as multiple subsystems. To avoid such problems, CCI supports the following “group version control” that manages a version for each group in order to expand the capability for mixed subsystem configurations.

- CCI (HORCM daemon) makes a facility version for each group based on a configuration file at the start-up of HORCM.
- In a mixed subsystem configuration, if the facility version of each subsystem (e.g., AMS1000 and AMS500) is different on a group, then CCI will slice to a minimum version to make a unification version for each group.

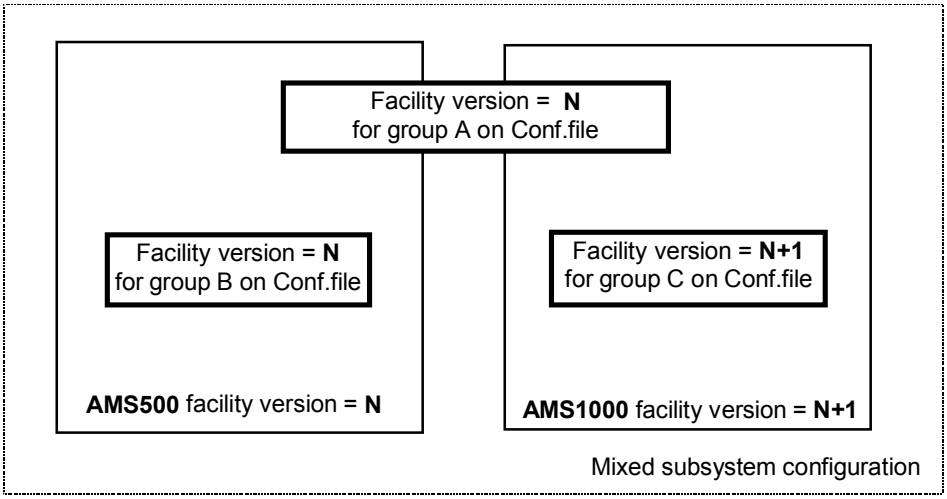


Figure 2.34 Definition of the Group Version

2.6 Examples of Configuration Definition File

Figure 2.35 to Figure 2.44 show examples of CCI configurations, the configuration definition file(s) for each configuration, and examples of CCI command use for each configuration.

2.6.1 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 2.35 and Figure 2.36 would be:

- HP-UX:

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

- Solaris:

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

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

- AIX:

  ```
  HORCM_CMD of HOSTA = /dev/rhdiskX
  HORCM_CMD of HOSTB = /dev/rhdiskX
  ```

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

- Tru64 UNIX:

  ```
  HORCM_CMD of HOSTA = /dev/rdisk/dskXc
  HORCM_CMD of HOSTB = /dev/rdisk/dskXc
  ```

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

- Linux:

  ```
  HORCM_CMD of HOSTA = /dev/sdX
  HORCM_CMD of HOSTB = /dev/sdX
  ```

  Where *X* = device number assigned by Linux.

- IRIX:

  ```
  HORCM_CMD of HOSTA = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD of HOSTA = /dev/rdsk/node_wwn/lunXvol/cXpX
  HORCM_CMD of HOSTB = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD of HOSTB = /dev/rdsk/node_wwn/lunXvol/cXpX
  ```

  Where X = device number assigned by IRIX.

- Windows NT/2000/ Windows Server 2003:

  `HORCM_CMD of HOSTA = \\.\PhysicalDriveX`

  OR

  `HORCM_CMD of HOSTA = \\.\Volume{guid}`

  OR

  `HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

  `HORCM_CMD of HOSTB = \\.\PhysicalDriveX`

  OR

  `HORCM_CMD of HOSTB = \\.\Volume{guid}`

  OR

  `HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

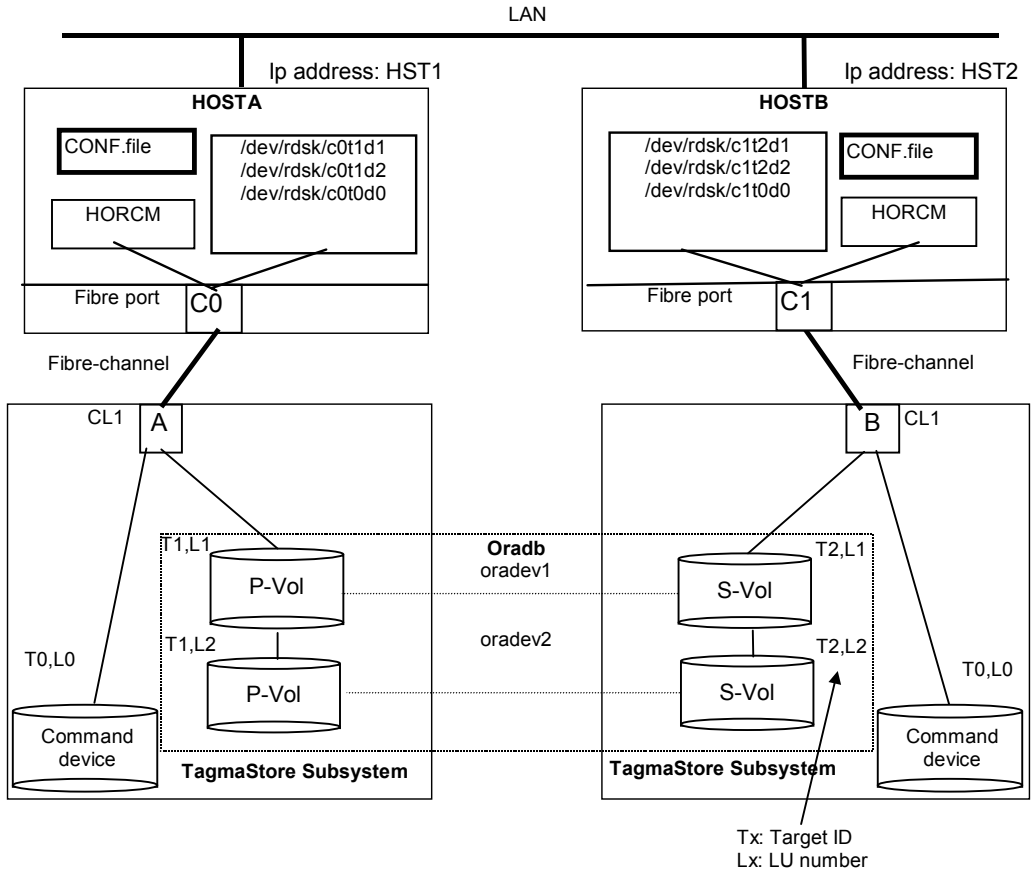
  Where *X* = device number assigned by Windows NT/2000/ Windows Server 2003.

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

Notes:

- Regarding a command device for CCI, do not set two or more paths for a single server. (Windows 2000/ Windows Server 2003 may change the **guid** when a volume with an identical **guid** is found.)
- For Windows 2003, 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 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 the Storage Navigator Modular. 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/TCE

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

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

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

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

```
# paircreate -g Oradb -d oradev1 -f never -vl
```

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

- 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 )75010061    18.P-VOL COPY NEVER ,75010062    20 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )75010062    20.S-VOL COPY NEVER , -----    18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )75010061    19.P-VOL COPY NEVER ,75010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----    19 -
```

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

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

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

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

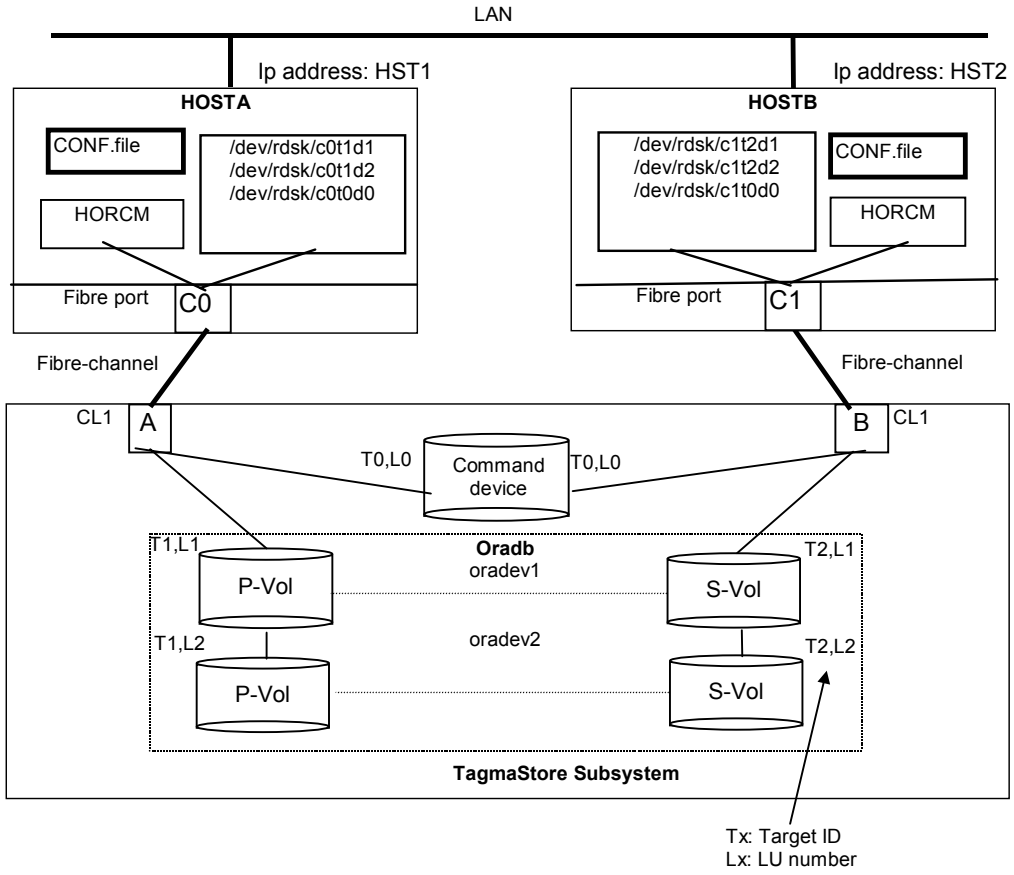
- Designate a volume name (oradev1) and a remote host P-VOL a case.

```
#  paircreate  -g Oradb  -d  oradev1  -f never  -vr
```

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

- 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 )75010062    20.S-VOL COPY NEVER , -----    18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )75010061    18.P-VOL COPY NEVER ,75010062    20 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----    19 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )75010061    19.P-VOL COPY NEVER ,75010062    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 the Storage Navigator Modular. If setting two command devices, add second command device in the HORCM_CMD section.

Figure 2.36 ShadowImage Example with Two Hosts and Two Instances

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

- 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 host P-VOL.

```
#  paircreate  -g Oradb –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 2.36.
- 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 )75010061    18.P-VOL COPY,75010061    20 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )75010061    20.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )75010061    19.P-VOL COPY,75010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )75010061    21.S-VOL COPY,-----       19 -
```

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

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

  For C shell:

```
#  setenv HORCC_MRCF  1
```

  For Windows:

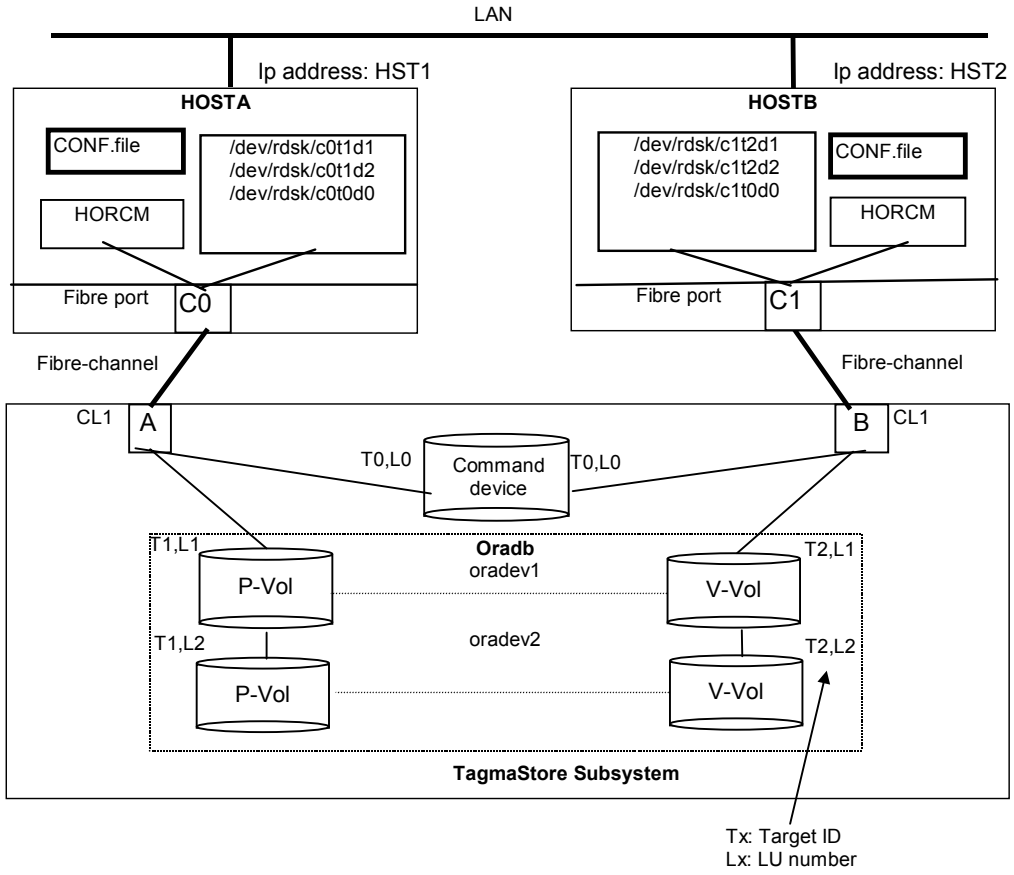
```
set  HORCC_MRCF=1
```

- Designate a group name and a local host P-VOL.

```
#  paircreate  -g Oradb –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 2.36.
- 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 )75010061    18.P-VOL COPY,75010061    20 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )75010061    20.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )75010061    19.P-VOL COPY,75010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )75010061    21.S-VOL COPY,-----       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     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 the Storage Navigator Modular. If setting two command devices, add second command device in the HORCM_CMD section.

Figure 2.37 SnapShot Example with Two Hosts and Two Instances

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

- 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 host P-VOL.

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

- 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 2.37).
- 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 )75010061    18.P-VOL PSUS,75010061    20 -
Oradb   oradev1(R)  (CL1-B , 2,   1-0 )75010061    20.S-VOL COPY,-----       18 -
Oradb   oradev2(L)  (CL1-A , 1,   2-0 )75010061    19.P-VOL PSUS,75010061    21 -
Oradb   oradev2(R)  (CL1-B , 2,   2-0 )75010061    21.S-VOL COPY,-----       19 -
```

2.6.2 One Host and Two Instances

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, then use a different path for each instance. For example, the command devices for Figure 2.38 and Figure 2.39 would be:

- HP-UX:

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

- Solaris:

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

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

- AIX:

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

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

- Tru64 UNIX:

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

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

- Linux:

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

  Where *X* = device number assigned by Linux.

- IRIX:

  ```
  HORCM_CMD for HORCMINST0 = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD for HORCMINST0 = /dev/rdsk/node_wwn/lunXvol/cXpX
  HORCM_CMD for HORCMINST1 = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD for HORCMINST1 = /dev/rdsk/node_wwn/lunXvol/cXpX
  ```

  Where *X* = device number assigned by IRIX.

- Windows NT/2000/ Windows Server 2003:

  ```
  HORCM_CMD of HORCMINST0 = \\.\PhysicalDriveX
  ```

  OR

  ```
  HORCM_CMD of HORCMINST0 = \\.\Volume{guid}
  ```

  OR

  `HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

  ```
  HORCM_CMD of HORCMINST1 = \\.\PhysicalDriveX
  ```

  OR

  ```
  HORCM_CMD of HORCMINST1 = \\.\Volume{guid}
  ```

  OR

  `HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

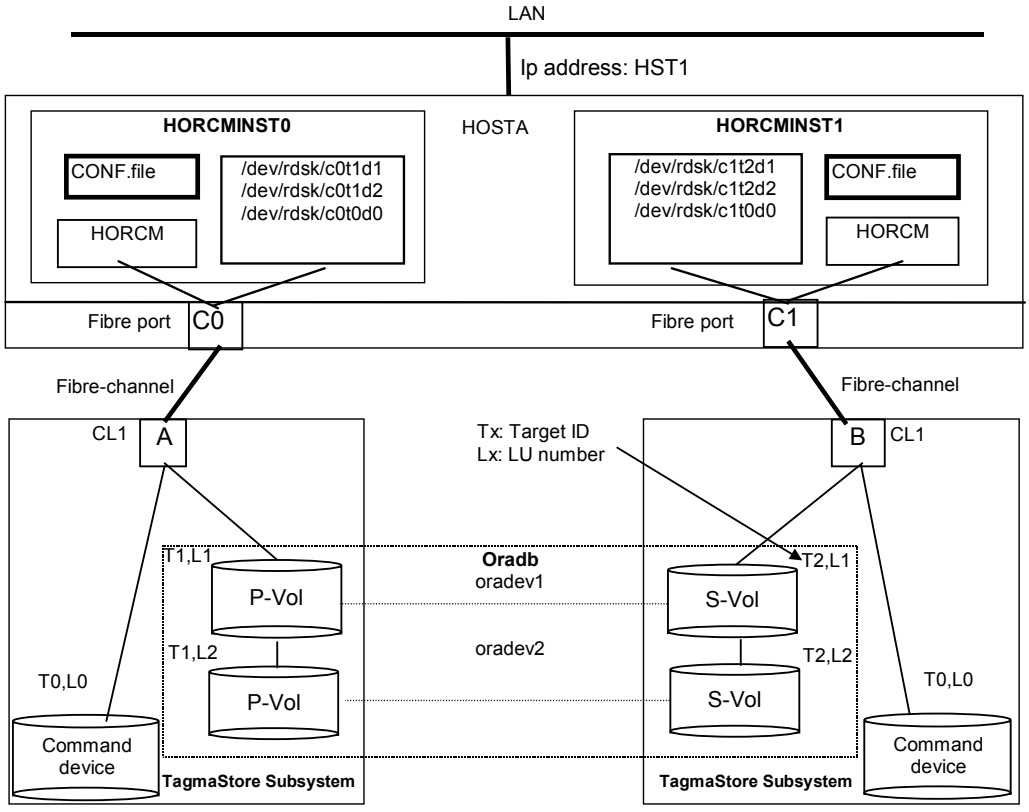
  Where *X* = device number assigned by Windows NT/2000/ Windows Server 2003.

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

Notes:

- Regarding a command device for CCI, do not set two or more paths for a single server. (Windows 2000/ Windows Server 2003 may change the **guide when** a volume with an identical **guid** is found.)
- For Windows 2003, when a path failure, which is caused by a controller failure 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 failure 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
 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 the Storage Navigator Modular. 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/TCE

A fence level of async must be specified for TCE.

- 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 host P-VOL.

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

- This command creates pairs for all LUs designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.38).
- 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 )75010061    18.P-VOL COPY NEVER ,75010062    19 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )75010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )75010061    20.P-VOL COPY NEVER ,75010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----      20 -
```

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

A fence level of async must be specified for TCE.

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

  For C shell:

```
#  setenv  HORCMINST  1
```

  For Windows:

```
set  HORCMINST=1
```

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

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

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.38).

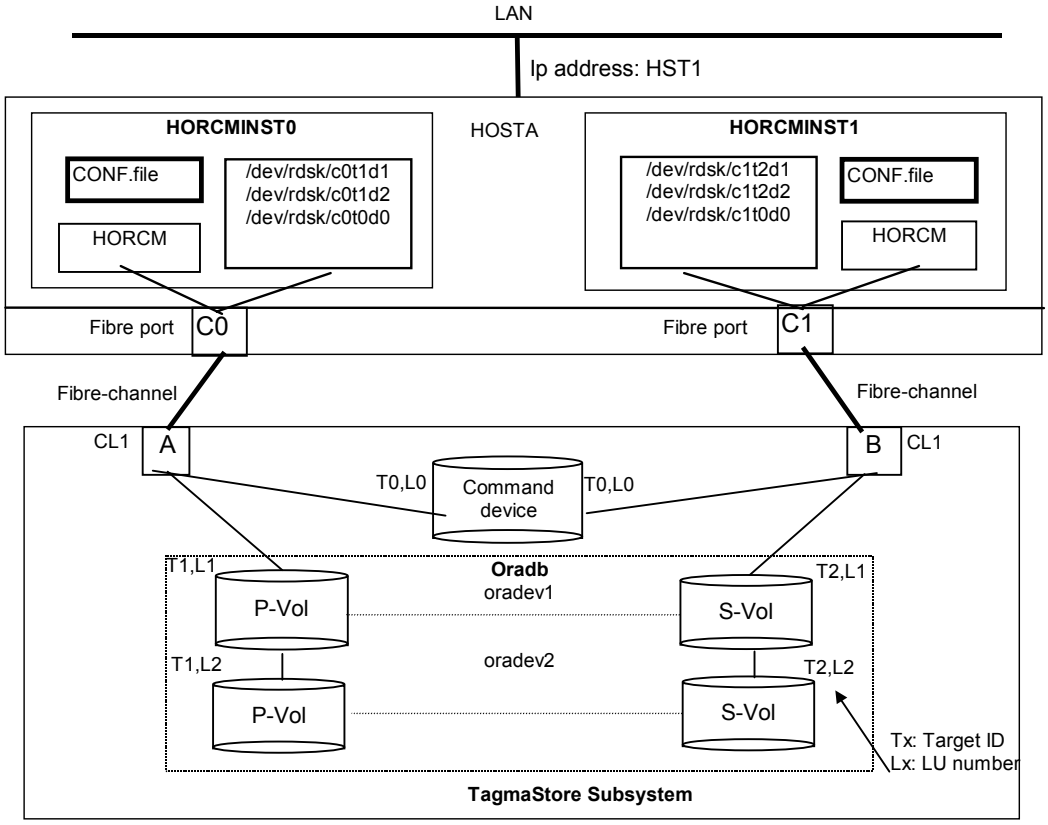
- Designate a volume name (oradev1) and a remote instance P-VOL a case.

```
#  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 2.38).

- 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 )75010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )75010061    18.P-VOL COPY NEVER ,75010062    19 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----      20 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )75010061    20.P-VOL COPY NEVER ,75010062    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 the Storage Navigator Modular. 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 One Host and Two Instances

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 (two pairs for the configuration in Figure 2.39).

- 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 (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.39).

- 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 )75010061    18.P-VOL COPY,75010061    19 -
Oradb   oradev1(R)   (CL1-B , 2,   1-0 )75010061    19.S-VOL COPY,-----       18 -
Oradb   oradev2(L)   (CL1-A , 1,   2-0 )75010061    20.P-VOL COPY,75010061    21 -
Oradb   oradev2(R)   (CL1-B , 2,   2-0 )75010061    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 LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.39).

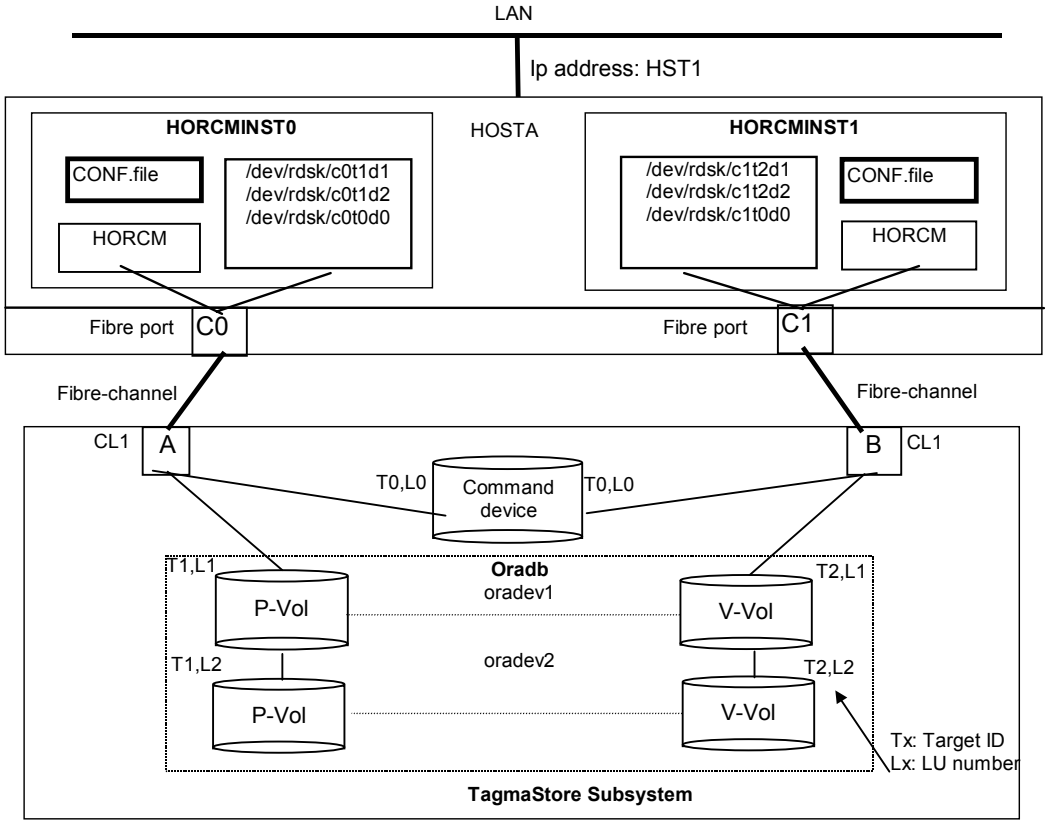
- Designate a volume name (oradev1) and a remote instance P-VOL a case.

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

  This command creates pairs for all LUs designated as **oradev1** in the configuration definition file (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.39).

- 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 )75010061    19.S-VOL COPY,-----       18 -
Oradb   oradev1(R)    (CL1-A , 1,   1-0 )75010061    18.P-VOL COPY,75010061    19 -
Oradb   oradev2(L)    (CL1-B , 2,   2-0 )75010061    21.S-VOL COPY,-----       20 -
Oradb   oradev2(R)    (CL1-A , 1,   2-0 )75010061    20.P-VOL COPY,75010061    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 the Storage Navigator Modular. 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 One Host and Two Instances

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 (two pairs for the configuration in Figure 2.40).

- 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 (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.40).

- 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 )75010061    18.P-VOL PSUS,75010061    19 -
Oradb   oradev1(R)    (CL1-B , 2,   1-0 )75010061    19.S-VOL SSUS,-----       18 -
Oradb   oradev2(L)    (CL1-A , 1,   2-0 )75010061    20.P-VOL PSUS,75010061    21 -
Oradb   oradev2(R)    (CL1-B , 2,   2-0 )75010061    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 local instance P-VOL a case.

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

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

- Designate a volume name (oradev1) and a 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 (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.40).

- 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 )75010061    19.S-VOL SSUS,-----       18 -
Oradb   oradev1(R)   (CL1-A , 1,   1-0 )75010061    18.P-VOL PSUS,75010061    19 -
Oradb   oradev2(L)   (CL1-B , 2,   2-0 )75010061    21.S-VOL SSUS,-----       20 -
Oradb   oradev2(R)   (CL1-A , 1,   2-0 )75010061    20.P-VOL PSUS,75010061    21 -
```

2.6.3 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 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 Figure 2.41 and Figure 2.42 would be:

- HP-UX:

  ```
  HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d0
  HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d1
  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.

- Solaris:

  ```
  HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d0s2
  HORCM_CMD for HORCMINST0 = /dev/rdsk/c0t0d1s2
  HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d0s2
  HORCM_CMD for HORCMINST1 = /dev/rdsk/c1t0d1s2
  ```

- 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.

- Tru64 UNIX:

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

  Where *X* and *Y* = device number assigned by Tru64 UNIX.

- 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.

- IRIX:

```
HORCM_CMD for HORCMINST0 = /dev/rdsk/dksXdXlXvol
```

  OR

```
HORCM_CMD for HORCMINST0 = /dev/rdsk/node_wwn/lunXvol/cXpX
HORCM_CMD for HORCMINST0 = /dev/rdsk/dksYdYlYvol
```

  OR

```
HORCM_CMD for HORCMINST0 = /dev/rdsk/node_wwn/lunYvol/cYpY
HORCM_CMD for HORCMINST1 = /dev/rdsk/dksXdXlXvol
```

  OR

```
HORCM_CMD for HORCMINST1 = /dev/rdsk/node_wwn/lunXvol/cXpX
HORCM_CMD for HORCMINST1 = /dev/rdsk/dksYdYlYvol
```

  OR

```
HORCM_CMD for HORCMINST1 = /dev/rdsk/node_wwn/lunYvol/cYpY
```

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

- Windows NT/2000/ Windows Server 2003:

```
HORCM_CMD of HORCMINST0 = \\.\PhysicalDriveX
```

  OR

```
HORCM_CMD of HORCMINST0 = \\.\Volume{guid}
```

  OR

```
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
```
 (Windows 2000/ Windows Server 2003 only)

```
HORCM_CMD of HORCMINST0 = \\.\PhysicalDriveY
```

  OR

```
HORCM_CMD of HORCMINST0 = \\.\Volume{guid}
```

  OR

```
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
```
 (Windows 2000/ Windows Server 2003 only)

```
HORCM_CMD of HORCMINST1 = \\.\PhysicalDriveX
```

  OR

```
HORCM_CMD of HORCMINST1 = \\.\Volume{guid}
```

OR

`HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

`HORCM_CMD of HORCMINST1 = \\.\PhysicalDriveY`

OR

`HORCM_CMD of HORCMINST1 = \\.\Volume{guid}`

OR

`HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#` (Windows 2000/ Windows Server 2003 only)

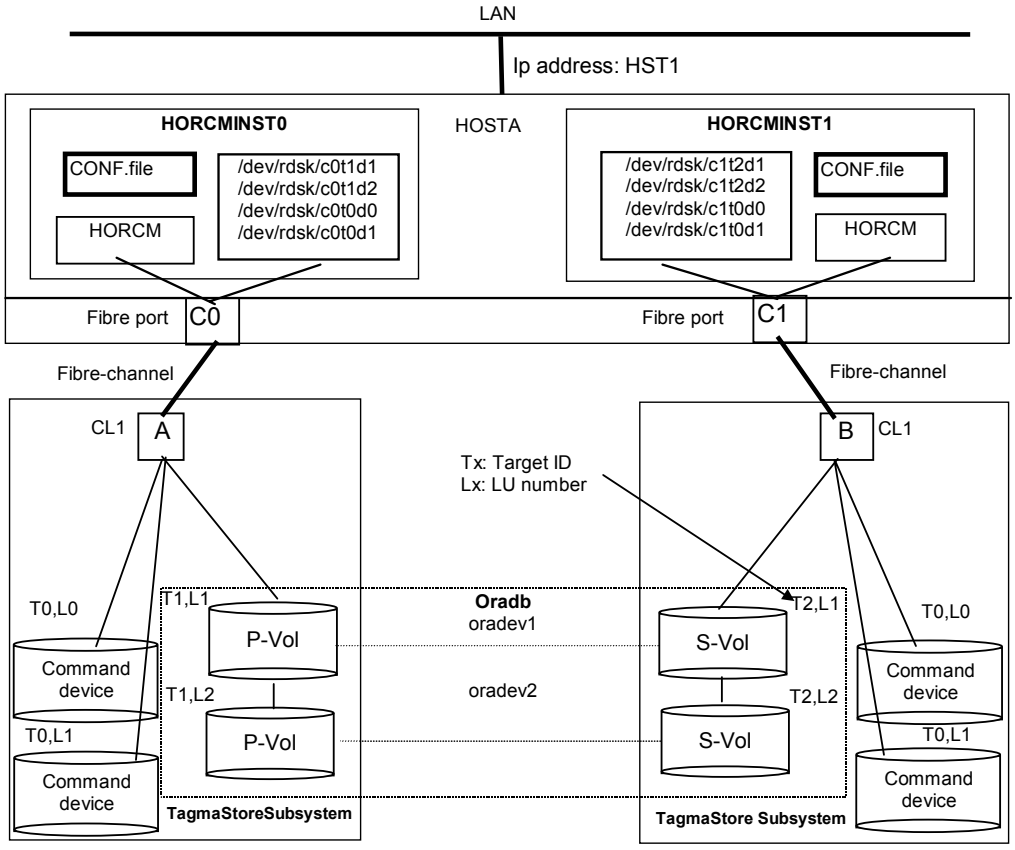
Where *X* and *Y* = device number assigned by Windows NT/2000/ Windows Server 2003.

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 modifies it to `\\.\PhysicalDrive?` to be corresponded. For MSCS, 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 tool. You can find the Volume{guid} by using `inqraid $Volume -CLI -fv` or `raidscan -x findcmddev0.?` commands.

Notes:

- Regarding a command device for CCI, do not set two or more paths for a single server. (Windows 2000/ Windows Server 2003 may change the guid when a volume with an identical guid is found.)
- For Windows 2003, when a path failure, which is caused by a controller failure 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 failure 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
 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 the Storage Navigator Modular. 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/TCE

You must specify the async fence level for TCE.

- 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 )75010061    18.P-VOL COPY NEVER ,75010062    19 -
Oradb  oradev1(R)  (CL1-B  ,  2,  1 )75010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev2(L)  (CL1-A  ,  1,  2 )75010061    20.P-VOL COPY NEVER ,75010062    21 -
Oradb  oradev2(R)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----      20 -
```

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

You must specify the async fence level for TCE.

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

  For C shell:

```
#  setenv  HORCMINST  1
```

  For Windows:

```
set  HORCMINST=1
```

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

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

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.41).

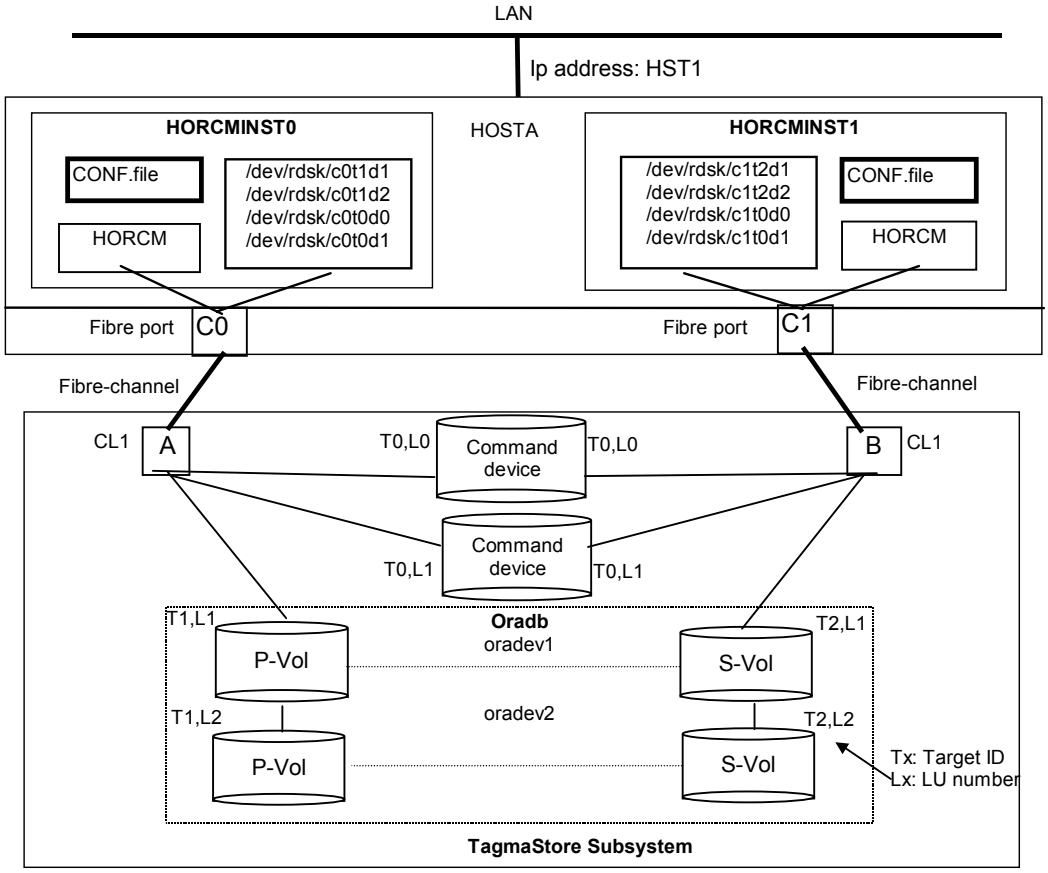
- Designate a volume name (oradev1) and a remote instance P-VOL a case.

```
#  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 )75010062    19.S-VOL COPY NEVER , -----      18 -
Oradb  oradev1(R)  (CL1-A  ,  1,  1 )75010061    18.P-VOL COPY NEVER ,75010062    19 -
Oradb  oradev2(L)  (CL1-B  ,  2,  2 )75010062    21.S-VOL COPY NEVER , -----      20 -
Oradb  oradev2(R)  (CL1-A  ,  1,  2 )75010061    20.P-VOL COPY NEVER ,75010062    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

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 the Storage Navigator Modular. 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 2.42 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 (two pairs for the configuration in Figure 2.42).

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

```
# paircreate -g Oradb -d oradev1 -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 2.42).

- 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 )75010061    18.P-VOL COPY,75010061     19 -
Oradb   oradev1(R)   (CL1-B , 2,   1-0 )75010061    19.S-VOL COPY,-----        18 -
Oradb   oradev2(L)   (CL1-A , 1,   2-0 )75010061    20.P-VOL COPY,75010061     21 -
Oradb   oradev2(R)   (CL1-B , 2,   2-0 )75010061    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 LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.42).

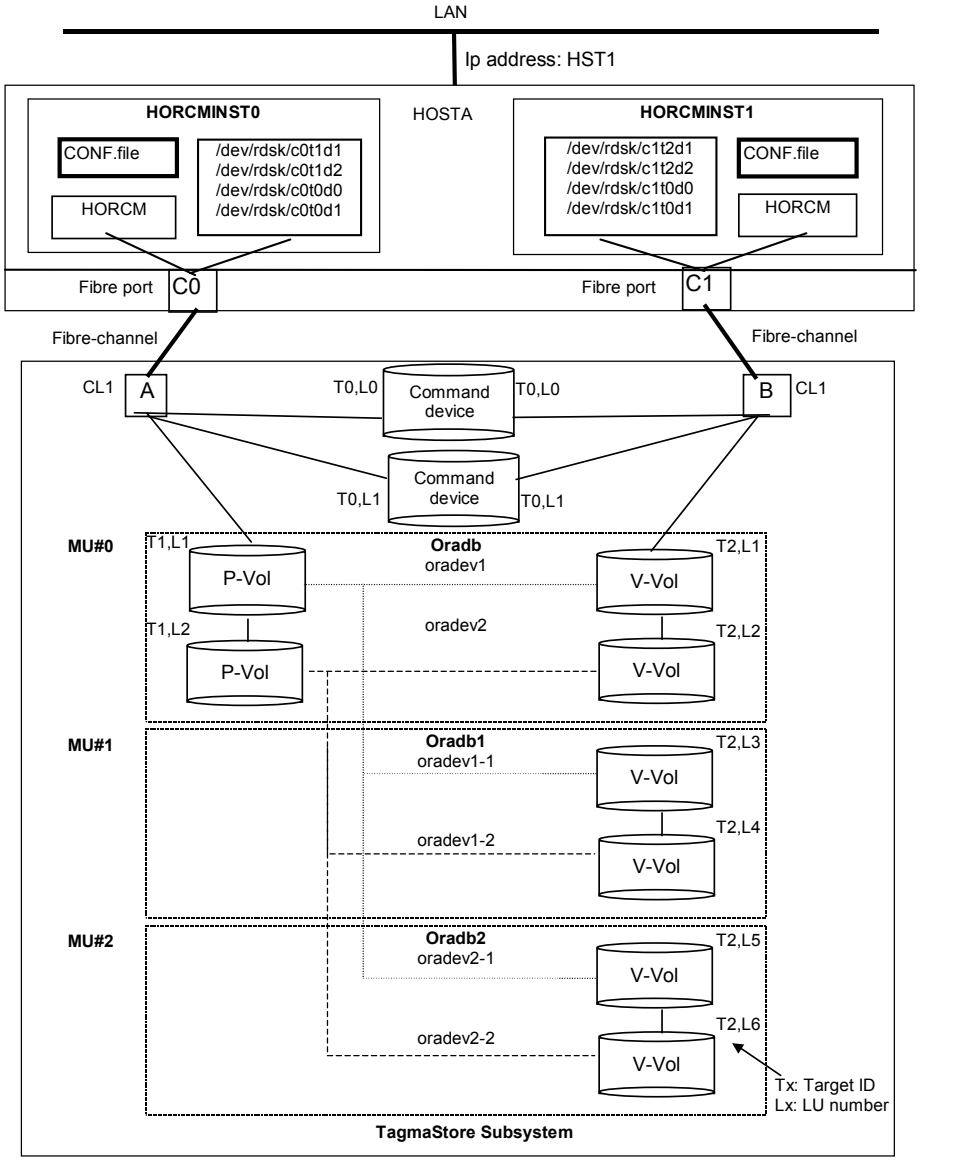
- Designate a volume name (oradev1) and a remote instance P-VOL a case.

```
# paircreate -g Oradb -d oradev1 -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 2.42).

- 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 )75010061    19.S-VOL COPY,-----        18 -
Oradb   oradev1(R)    (CL1-A , 1,   1-0 )75010061    18.P-VOL COPY,75010061     19 -
Oradb   oradev2(L)    (CL1-B , 2,   2-0 )75010061    21.S-VOL COPY,-----        20 -
Oradb   oradev2(R)    (CL1-A , 1,   2-0 )75010061    20.P-VOL COPY,75010061     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 the Storage Navigator Modular. 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 2.43 ShapShot 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 (two pairs for the configuration in Figure 2.43).

- 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 (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
Oradb   oradev1(L)   (CL1-A , 1,   1-0 )75010061    18.P-VOL PSUS,75010061     19 -
Oradb   oradev1(R)   (CL1-B , 2,   1-0 )75010061    19.S-VOL SSUS,-----        18 -
Oradb   oradev2(L)   (CL1-A , 1,   2-0 )75010061    20.P-VOL PSUS,75010061     21 -
Oradb   oradev2(R)   (CL1-B , 2,   2-0 )75010061    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 local instance P-VOL a case.

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

  This command creates pairs for all LU designated as **Oradb** in the configuration definition file (two pairs for the configuration in Figure 2.43).

- 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 (CL1-A, T1, L1 and CL1-B, T2, L1 for the configuration in Figure 2.43).

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   (CL1-B , 2,   1-0 )75010061    19.S-VOL SSUS,-----        18 -
oradb   oradev1(R)   (CL1-A , 1,   1-0 )75010061    18.P-VOL PSUS,75010061     19 -
oradb   oradev2(L)   (CL1-B , 2,   2-0 )75010061    21.S-VOL SSUS,-----        20 -
oradb   oradev2(R)   (CL1-A , 1,   2-0 )75010061    20.P-VOL PSUS,75010061     21 -
```

2.6.4 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 to follow 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
```

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

- AIX:

```
HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdiskX
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdiskX
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdiskX
```

  Where *X* = device number assigned by AIX.

- Tru64 UNIX:

```
HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rhdisk/dskXc
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rhdisk/dskXc
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rhdisk/dskXc
```

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

- Linux:

```
HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/sdX
HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/sdX
HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/sdX
```

  Where *X* = device number assigned by Linux.

- IRIX:

  ```
  HORCM_CMD of HOSTA (/etc/horcm.conf) = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD of HOSTA (/etc/horcm.conf) =
  /dev/rdsk/node_wwn/lunXvol/cXpX
  HORCM_CMD of HOSTB (/etc/horcm.conf) = /dev/rdsk/dksXdXlXvol
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm.conf) =
  /dev/rdsk/node_wwn/lunXvol/cXpX
  HORCM_CMD of HOSTB (/etc/horcm0.conf) = /dev/rdsk/dksXdYlXvol
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm0.conf) =
  /dev/rdsk/node_wwn/lunXvol/cYpX
  ```

  Where X = device number assigned by IRIX.

- Windows NT/2000/ Windows Server 2003:

  ```
  HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\PhysicalDriveX
  ```

  OR

  ```
  HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\Volume{guid}
  ```

  OR

  ```
  HORCM_CMD of HOSTA (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#
  ```
  (Windows 2000/ Windows Server 2003 only)

  ```
  HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\PhysicalDriveX
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\Volume{guid}
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm.conf) = \\.\CMD-Ser#-ldev#-Port#
  ```
  (Windows 2000/ Windows Server 2003 only)

  ```
  HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\PhysicalDriveX
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\Volume{guid}
  ```

  OR

  ```
  HORCM_CMD of HOSTB (/etc/horcm0.conf) = \\.\CMD-Ser#-ldev#-Port#
  ```
  (Windows 2000/ Windows Server 2003 only)

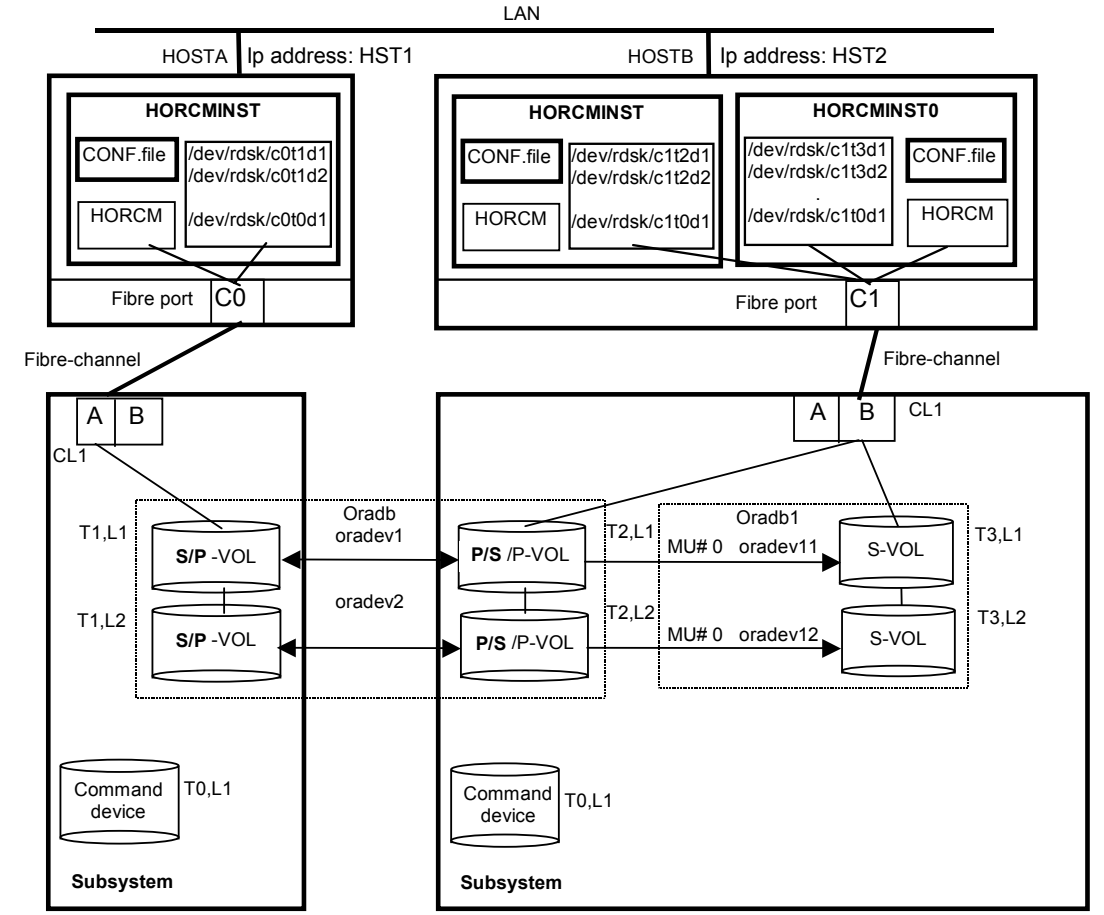
  Where *X* = device number assigned by Windows NT/2000/ Windows Server 2003.

  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 Windows' Disk Management. You can find Volume{guid}by using the inqraid $Volume -CLI -fv or raidscan -x findcmddev0.? commands..

Notes:

- Regarding a command device for CCI do not set two or more paths for a single server. (Windows 2000/ Windows Server 2003 may change the guid when a volume with an identical guid is found.)
- For Windows 2003, when a path failure, which is caused by a controller failure 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 failure 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 the Storage Navigator Modular. 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 2.44 TrueCopy/TCE/ShadowImage Configuration Example with Cascade Pairs

Example of CCI commands with HOSTA and HOSTB:

- Designate a group name (Oradb) on TrueCopy/TCE 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
```

- 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
```

- 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 2.44).

- 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 )75010061    26.SMPL ----,-----  ---- -
Oradb   oradev1(L)    (CL1-A , 1,  1 )75010061    26.P-VOL COPY,75010062    28 -
Oradb1  oradev11(R)   (CL1-B , 2,  1-0 )75010062    28.P-VOL COPY,75010062    30 -
Oradb   oradev1(R)    (CL1-B , 2,  1 )75010062    28.S-VOL COPY,-----      26 -
Oradb   oradev2(L)    (CL1-A , 1,  2-0 )75010061    27.SMPL ----,-----      ---- -
Oradb   oradev2(L)    (CL1-A , 1,  2 )75010061    27.P-VOL COPY,75010062    29 -
Oradb1  oradev12(R)   (CL1-B , 2,  2-0 )75010062    29.P-VOL COPY,75010062    31 -
Oradb   oradev2(R)    (CL1-B , 2,  2 )75010062    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.

See section 4.4 for acceptable conditions about command.

```
#  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) 75003053    30.S-VOL SSUS,-         -
Oradb1   oradev11(R) 75003053    28.P-VOL PSUS,123456ef  123456
```

Example of CCI commands with HOSTB:

- Designate a group name (oradb) on TrueCopy/TCE 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 2.44).

- Designate a group name and display pair status on TrueCopy/TCE 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 )75010062    28.P-VOL PAIR,75010062    30 -
Oradb   oradev1(L)  (CL1-B , 2,  1 )75010062    28.S-VOL PAIR,-----       26 -
Oradb   oradev1(R)  (CL1-A , 1,  1-0 )75010061    26.SMPL ----,-----       ---- -
Oradb   oradev1(R)  (CL1-A , 1,  1 )75010061      26.P-VOL PAIR,75010062    28 -
Oradb1  oradev12(L) (CL1-B , 2,  2-0 )75010062    29.P-VOL PAIR,75010062    31 -
Oradb   oradev2(L)  (CL1-B , 2,  2 )75010062    29.S-VOL PAIR,-----      27 -
Oradb   oradev2(R)  (CL1-A , 1,  2-0 )75010061    27.SMPL ----,-----      ---- -
Oradb   oradev2(R)  (CL1-A , 1,  2 )75010061    27.P-VOL PAIR,75010062    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 )75010062    28.P-VOL PAIR,75010062    30 -
Oradb   oradev1(L)  (CL1-B , 2,  1 )75010062    28.S-VOL PAIR,-----       26 -
Oradb1  oradev11(R) (CL1-B , 3,  1-0 )75010062    30.S-VOL PAIR,-----        28 -
Oradb1  oradev12(L) (CL1-B , 2,  2-0 )75010062    29.P-VOL PAIR,75010062      31 -
Oradb   oradev2(L)  (CL1-B , 2,  2 )75010062    29.S-VOL PAIR,-----       27 -
Oradb1  oradev12(R) (CL1-B , 3,  2-0 )75010062    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 )75010062    30.S-VOL PAIR,-----       28 -
Oradb1  oradev11(R) (CL1-B , 2,  1-0 )75010062    28.P-VOL PAIR,75010062    30 -
Oradb   oradev1(R)  (CL1-B , 2,  1 )75010062    28.S-VOL PAIR,-----       26 -
Oradb1  oradev12(L) (CL1-B , 3,  2-0 )75010062    31.S-VOL PAIR,-----       29 -
Oradb1  oradev12(R) (CL1-B , 2,  2-0 )75010062    29.P-VOL PAIR,75010062    31 -
Oradb   oradev2(R)  (CL1-B , 2,  2 )75010062    29.S-VOL PAIR,-----      27 -
```

2.7 Error Monitoring and Configuration Confirmation

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

2.7.1 Paired Volume Error Monitoring

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

- **Objects and scope of monitoring:** The HORCM operates as a daemon process on the host server and monitors all the paired volumes defined in the configuration definition file, not the volume groups. The HORC Manager's monitoring applies to the primary volumes only (since the primary volumes control the status). The HORC Manager monitors the changes in the pair status of these volumes. Only when the PAIR status changes to the PSUS status and that change is caused by an error (such as 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 TagmaStore 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 server checks Syslog to find system errors in many cases, Hitachi replication software 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 server/client to monitor errors. This command is connected to the HORCM (daemon) to obtain the transition of the pairing status and report it. When an error is detected, this command outputs an error message. This command waits until an error occurs or reports that no error occurs if it finds no errors in pairing status transition queue of the HORCM's pairing monitor. 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.

2.7.2 Pair Status Display and Configuration Confirmation

The configuration definition file combines physical volumes in the TagmaStore used independently by the servers. Therefore, be certain that the server volumes are combined as intended by the server system administrator.

The `pairdisplay` command displays the pairing status to enable you to verify the completion of pair creation or pair resynchronization (see Figure 2.45). This command is also used to confirm the configuration of the paired volume connection path (physical link of paired volumes among the servers). For further information on the `pairdisplay` command, see section 4.9.

```
                              --Link information of ①--  ----Link information of ②---
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
G1      Oradb1(L)    (P1  , T1,   L1 ),Seq#,   1..P-VOL Pair NEVER , Seq#,    2  -
G1      Oradb1(R)    (P2  , T2,   L2 ),Seq#,   2..S-VOL Pair NEVER , Seq#,    1  -
```

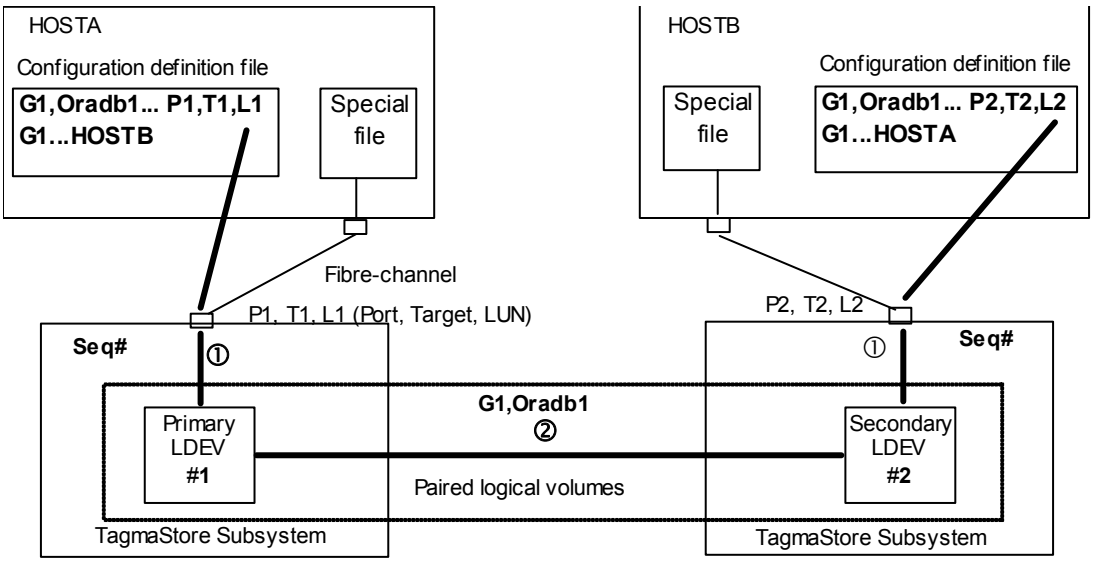


Figure 2.45 Pair Configuration Confirmation (Pairdisplay)

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. For further information on the raidscan command, see section 4.12.1.

2.8 Recovery Procedures for HA Configurations (TrueCopy only)

After configuring and starting TrueCopy operations, the system administrator should conduct operational tests for possible failures in the system. In normal operation, service personnel obtain information for identifying the failure cause on the HITRACK and SNMP Agent or Web. However, a motive for the action above should be given by the TrueCopy operation command.

Figure 2.46 shows the system failover and recovery procedure. Figure 2.47 shows the regression and TrueCopy recovery procedure.

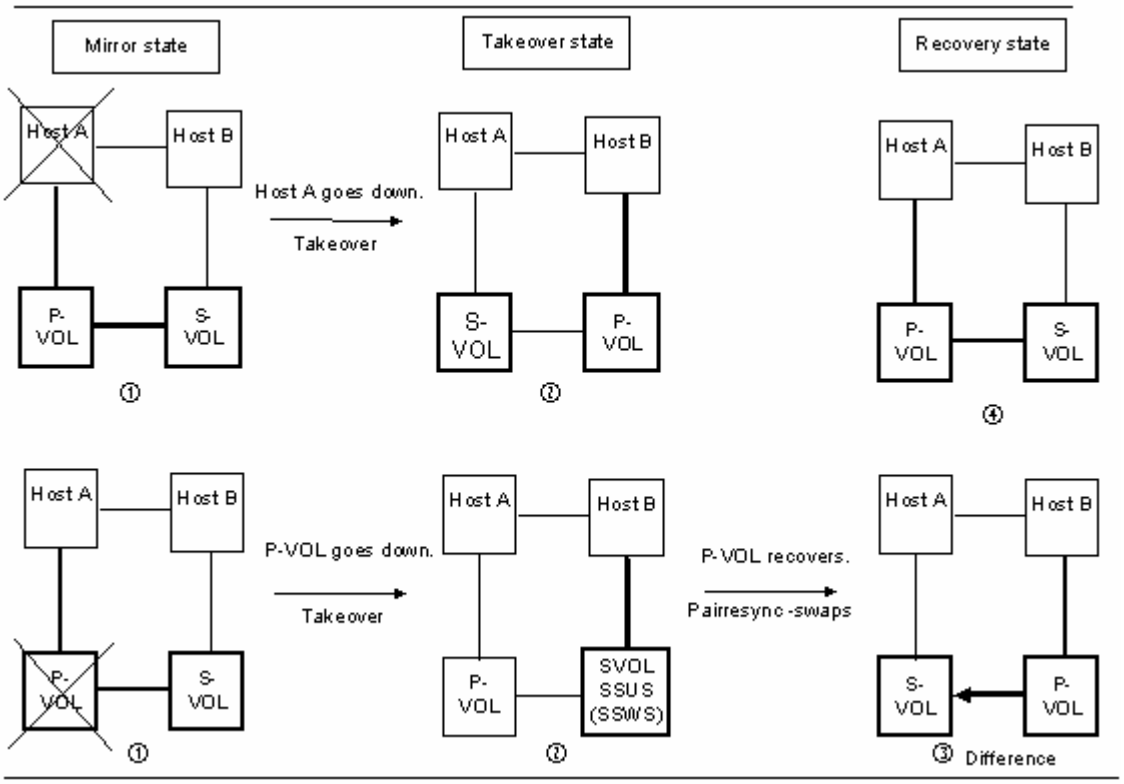


Figure 2.46 System Failover and Recovery

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

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.

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.

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.

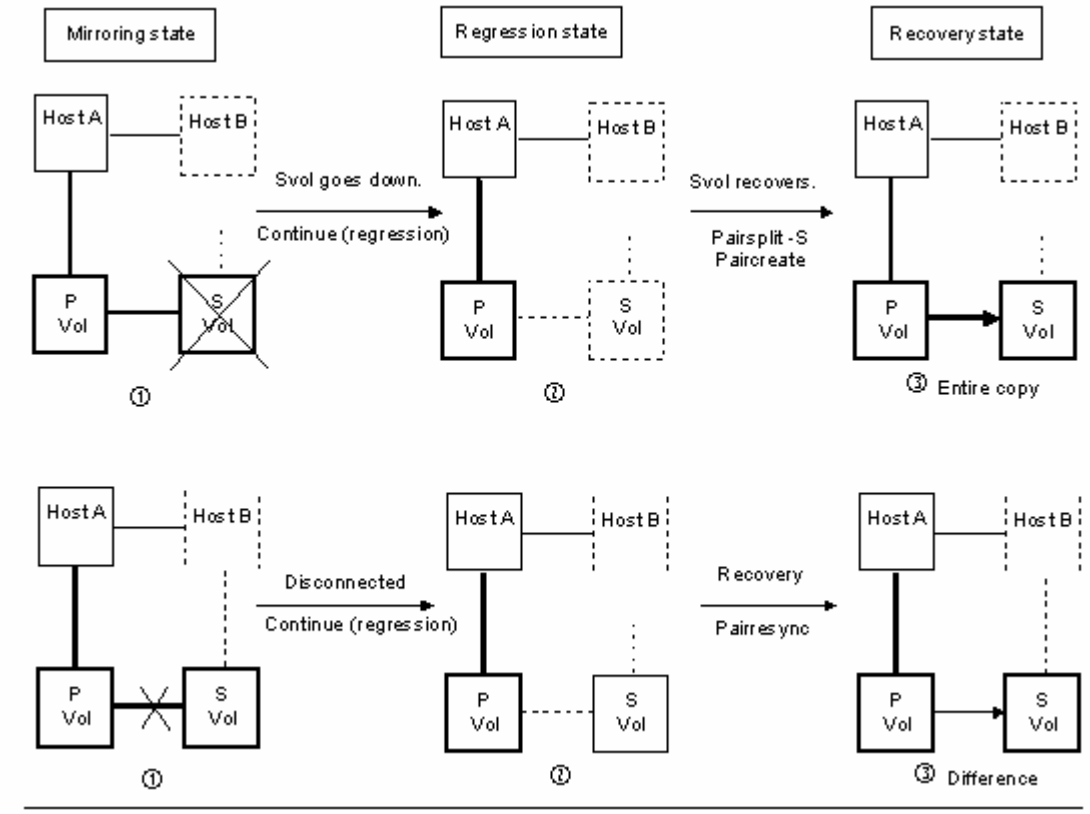


Figure 2.47 Degeneracy and Recovery in Case of System Error

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.)

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.

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.

2.9 About VMware

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

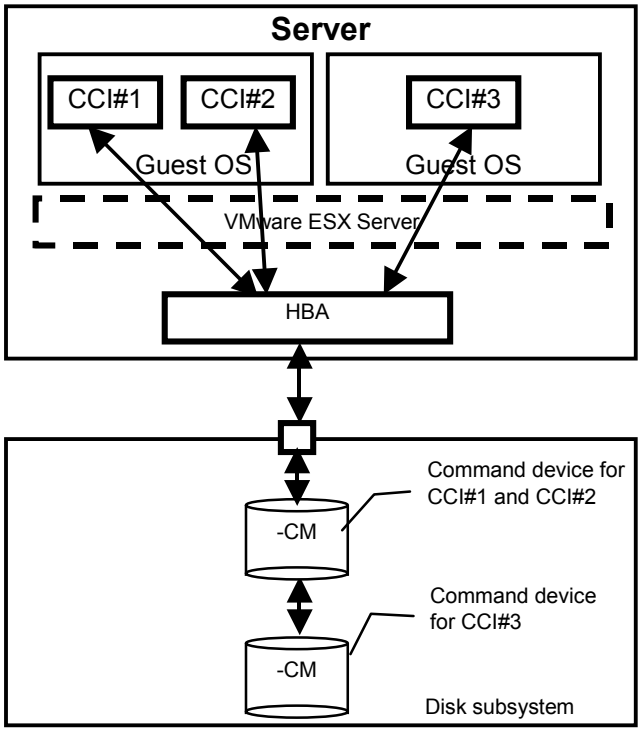


Figure 2.48 CCI Configuration on VMware

2.9.1 Restrictions on VMware

- Notes on 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.

- Notes on 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, each Guest OS requires a command device. Besides, the same instance number cannot be used even if it is between different Guest OS's.

- Restrictions on the LU assigned to the Guest OS

  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.

2.9.2 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 pai

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.
9. Mount the S-VOL.

Chapter 3 Preparing for CCI Operations

3.1 System Requirements

CCI operations involve the CCI software on the UNIX/PC server host and the TagmaStore subsystem(s) containing the command device(s) set using the Navigator, TrueCopy/TCE, ShadowImage, and/or SnapShot primary and secondary volumes. From the Navigator program, specify a local and a remote port (path) of the subsystem.

The system requirements for CCI are:

- **CCI software product.** The CCI software is supplied on CD-ROM. The CCI software files take up 5.5 MB of space. The log files can take up to 3 MB of space.
- **Host platform.** CCI is supported on several UNIX-based and PC server platforms, including Solaris™, HP-UX, AIX®, Linux®, Tru64 UNIX, IRIX®, Windows® 2000, Windows 2003, and Windows NT® systems.
  - Root/administrator access to the host is required to perform CCI operations.
  - Static memory capacity: minimum = 600 KB, maximum = 1,200 KB
    Dynamic memory capacity (depends on the setting in `HORCM_CONF`):

    minimum = (200 × number of unit ID) + (360 bytes × number of LU) + (180 bytes × number of entry)
  - Sometimes the local and remote hosts cannot recognize paired logical volumes; therefore, use hosts with the same operating system architecture. However, a combination of HP-UX, Solaris, AIX, Windows, and Linux hosts can be used for pair operation only.
- **TagmaStore subsystem.** The TagmaStore subsystems support CCI operations.
  - The TagmaStore command device must be defined and accessed as a raw device (no file system, no mount operation).
- **Navigator.** The Navigator is used to define the LUs, path using TrueCopy/TCE, and the CCI command device.

3.2 Hardware Installation

The hardware required for CCI is installed by the user and the Hitachi Data Systems representative. The responsibilities are:

User:

a) Identify the TrueCopy/TCE, ShadowImage, and/or SnapShot primary and secondary volumes, so that the CCI hardware and software components can be installed and configured properly.

b) Verify that the UNIX/PC server hardware and software are properly installed and configured (refer to section 3.1 for system requirements).

Hitachi Data Systems representative:

a) Connect the TagmaStore subsystem(s) to the Server host(s).

b) Install and enable the TrueCopy/TCE, ShadowImage, and/or SnapShot features on the TagmaStore subsystem(s).

3.3 Software Installation

The user, with assistance as needed from the Hitachi Data Systems representative, installs the CCI host server(s) software.

3.3.1 Software Installation for UNIX Systems

If you are installing CCI from CD-ROM, use the following instructions.

Note: The following instructions refer to UNIX commands, which may be different on your platform. Please consult your operating system documentation (e.g., UNIX man pages) for platform-specific command information.

Install this program in a disk other than the root disk.

3.3.1.1 New Installation into Non-root Directory

1. Insert the installation medium (e.g., CD-ROM) into the proper I/O device.
2. Move to the desired directory for CCI. The specified directory must be mounted by a partition of except root disk or an external disk.

```
# cd /Specified Directory
```

3. Copy all files from the installation medium using the **cpio** command:

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

4. Make a symbolic link for /HORCM:

```
# ln -s /Specified Directory/HORCM /HORCM
```

5. Execute the HORCM installation command:

```
# /HORCM/horcminstall.sh
```

6. Verify installation of the proper version using the **raidqry** command:

```
# raidqry -h
Model  : RAID-Manager/HP-UX
Ver&Rev: XX-XX-XX/XX                    XX = product version number
Usage  : raidqry [options] for HORC
 -h     Help/Usage
 :
```

3.3.1.2 New Installation into Root Directory

1. Insert the installation CD into the CD-ROM drive.
2. Move to the current root directory:

```
# cd /
```

3. Copy all files from the installation medium using the **cpio** command:

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

4. Execute the HORCM installation command:

```
# /HORCM/horcminstall.sh
```

5. Verify installation of the proper version using the raidqry command:

```
# raidqry -h
Model  : RAID-Manager/HP-UX
Ver&Rev: XX-XX-XX/XX                    XX = product version number
Usage  : raidqry [options] for HORC
 -h     Help/Usage
 :
```

3.3.2 Changing the CCI User for UNIX Systems

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

To change the CCI user:

1. Change the owner of the following CCI files from the root user to the desired user name:

   `/HORCM/etc/horcmgr`

   All CCI commands in the `/HORCM/usr/bin` directory.

   All CCI log directories in the `/HORCM/log` directories.

2. Change the owner of the raw device file of the HORCM_CMD command device in the configuration definition file from the root user to the desired user name.

Optional: Establishing the HORCM (`/etc/horcmgr`) start environment: If users have designation of the full environment variables (`HORCM_LOG HORCM_LOGS`), they start horcmstart.sh command without an argument. In this case, the `HORCM_LOG` and `HORCM_LOGS` directories must be owned by the CCI administrator. The environment variable (`HORCMINST`, `HORCM_CONF`) is established as necessary.

3. ***Optional:*** Establishing the command execution environment: If users have designation of the environment variables (`HORCC_LOG`), the `HORCC_LOG` directory must be owned by the CCI administrator. The environment variable (`HORCMINST`) is established as necessary.

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

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

3.3.3 Communication Fraction Point File

The following descriptions are valid when the CCI version is 01-16-03/06 or earlier.

HORC manager and CCI command make directory and file (`/var/tmp/.lcm`) to do inter-process communication that used UNIX domain. Do not delete this directory and the file.

If they do not exist when the CCI command is executed, an error occurs.

If directory `/var/tmp/.lcmclxx` has been deleted, this directory should be recreated. (xx: Specifies the HORCM instance number (numerical value).)

3.3.4 Software Installation for Windows NT/2000/ Windows Server 2003 Systems

Install CCI on all servers involved in CCI operations. If the network (TCP/IP) is not established, install a network of the Windows NT/2000/ Windows Server 2003 attachment, and add TCP/IP protocol.

To install the CCI software on a Windows NT/2000/ Windows Server 2003 system:

1. If a previous version of CCI is already installed, uninstall (remove) it as follows:
   a) Confirm that HORCM is not running. If it is running, shut it down:

      One CCI instance:

      ```
      D:\HORCM\etc> horcmshutdown
      ```

      Two CCI instances:

      ```
      D:\HORCM\etc> horcmshutdown 0 1
      ```

   b) If Hitachi replication software commands are running in the interactive mode, terminate the interactive mode and exit these commands using the -q option.
   c) Remove the previous version of CCI using the Add/Remove Programs control panel.
2. Insert the installation medium (e.g., CD-ROM) into the proper I/O device.

3. Run **Setup.exe** and follow the instructions on screen to complete the installation.
4. Verify installation of the proper version using `raidqry`:

```
D:\HORCM\etc> raidqry -h
Model  : RAID-Manager/WindowsNT
Ver&Rev: XX-XX-XX/XX            XX = product version number
Usage  : raidqry [options] for HORC
 -h     Help/Usage
 :
```

3.4 Creating/Editing the Configuration File

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

See section 2.5.3 for a detailed description of editing and creating the configuration definition file(s), and see section 2.6 for sample CCI configurations.

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

Table 3.1 lists the parameters defined in the configuration file and specifies the default value, type, and limit for each parameter.

Table 3.1 Configuration (HORCM_CONF) Parameters

Parameter	Default Value	Type	Limit
ip_address	None	Character string	63 characters
service	None	Character string or numeric value (***Note 1***)	15 characters
Poll (10 ms)	1000*2	Numeric value (***Note 1***)	None (see ***Note 3***)
timeout (10 ms)	3000	Numeric value (***Note 1***)	None
HORCM_DEV dev_name	None	Character string	31 characters Recommended value = 8 or less.
dev_group	None	Character string	31 characters Recommended value = 8 or less.
port #	None	Character string	31 characters
Target ID	None	Numeric value (***Note 1***)	7 characters
LU#	None	Numeric value (***Note 1***)	7 characters
MU#	0	Numeric value (***Note 1***)	7 characters
Serial#	None	Numeric value (***Note 1***)	12 characters
CU: LDEV (LDEV#)	None	Numeric value (***Note 1***)	6 characters
HORCM_CMDdev name	None	Character string	63 characters

Note 1: Use decimal notation for numeric values (not hexadecimal).

Note 2: For Hitachi replication software operations, you must change the default value using the equation described in section 2.5.3. Setting the value incorrectly may cause a conflict in the internal process, which suspends the process temporary and stops the internal process of the subsystem.

Note 3: For details on calculating the value and equation for poll(10ms), refer to section 2.5.3.

3.5 CCI Startup

After you have installed the CCI software (refer to section 3.3) and set the configuration definition file(s) (refer to section 3.4), you can begin using the CCI software (HORCM) to perform TrueCopy/TCE, ShadowImage, and/or SnapShot operations on the attached TagmaStore subsystems.

3.5.1 Startup for UNIX Systems

3.5.1.1 One Instance

To start up one instance of CCI on a UNIX system:

1. Modify **/etc/services** to register the port name/number (service) of the configuration definition file. Make the port name/number the same on all servers.

   horcm xxxxx/udp xxxxx = the port name/number of horcm.conf

2. If you want HORCM to start automatically each time the system starts up, add **/etc/horcmstart.sh** to the system automatic start-up file (e.g., **/sbin/rc**).

3. Execute the **horcmstart.sh** script manually to start the CCI instance:

```
# horcmstart.sh
```

4. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.

5. If you want to perform TrueCopy/TCE operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage /SnapShot operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment.

   For B shell:

```
# HORCC_MRCF=1
# export HORCC_MRCF
```

   For C shell:

```
# setenv HORCC_MRCF 1
```

6. Execute the pairdisplay command to verify the configuration.

```
# pairdisplay -g xxxx            xxxx = group-name
```

3.5.1.2 Two Instances

To start up two instances of CCI on a UNIX system:

1. Make two copies of the sample configuration definition file:

```
# cp /etc/horcm.conf /etc/horcm0.conf
# cp /etc/horcm.conf /etc/horcm1.conf
```

2. Modify **/etc/services** to register the port name/number (service) of each configuration definition file. The port name/number must be different for each CCI instance.

   horcm0 xxxxx/udp xxxxx = the port name/number for horcm0.conf

   horcm1 yyyyy/udp yyyyy = the port name/number for horcm1.conf

3. If you want HORCM to start automatically each time the system starts up, add **/etc/horcmstart.sh 0 1** to the system automatic start-up file (e.g., **/sbin/rc**).

4. Execute the **horcmstart.sh** script manually to start the CCI instances:

```
# horcmstart.sh 0 1
```

5. Set an instance number to the environment which executes a command.

   For borne shell:

```
# HORCMINST=X            X = instance number = 0 or 1
# export HORCMINST
```

   For C shell:

```
# setenv HORCMINST X
```

6. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.

7. If you want to perform TrueCopy/TCE operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage/SnapShot operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment.

   For borne shell:

```
# HORCC_MRCF=1
# export HORCC_MRCF
```

   For C shell:

```
# setenv HORCC_MRCF 1
```

8. Execute `pairdisplay` to verify the configuration:

```
# pairdisplay -g xxxx           xxxx = group-name
```

3.5.2 Startup for Windows Systems

3.5.2.1 One Instance

To start up one instance of CCI on a Windows NT/2000/ Windows Server 2003 system:

1. Copy the sample file (\HORCM\etc\horcm.conf) to the specified directory:

   For Windows NT/2000:

   ```
   D:\HORCM\etc> \HORCM\etc\horcm.conf \WINNT\horcm.conf
   ```

   For Windows Server 2003 system:

   ```
   D:\HORCM\etc> \HORCM\etc\horcm.conf \WINDOWS\horcm.conf
   ```

2. Modify **\WINNT\system32\drivers\etc\services** or **\WINDOWS\system32\drivers\etc\services** to register the port name/number (service) of the configuration definition file. Make the port name/number the same on all servers:

   horcm xxxxx/udp xxxxx = the port name/number of horcm.conf

3. If you want HORCM to start automatically each time the system starts up, add **\HORCM\etc\horcmstart** to the system automatic start-up file (e.g., **\autoexec.bat**).

4. Execute the **horcmstart** script manually to start CCI:

   ```
   D:\HORCM\etc> horcmstart
   ```

5. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.

6. If you want to perform TrueCopy/TCE operations, do not set the **HORCC_MRCF** environment variable. If you want to perform ShadowImage/SnapShot operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment:

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

7. Execute the pairdisplay command to verify the configuration:

   ```
   D:\HORCM\etc> pairdisplay -g xxxx       xxxx = group name
   ```

3.5.2.2 Two Instances

To start up two instances of CCI on a Windows NT/2000/ Windows Server 2003 system:

1. Make two copies of the sample configuration definition file:

   For Windows NT/2000:

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

   For Windows Server 2003 system:

   ```
   D:\HORC\etc> copy \HORCM\etc\horcm.conf \WINDOWS\horcm0.conf
   D:\HORC\etc> copy \HORCM\etc\horcm.conf \WINDOWS\horcm1.conf
   ```

2. Modify **\WINNT\system32\drivers\etc\services** or **\WINDOWS\system32\drivers\etc\services** to register the port name/number (service) of the configuration definition files. Make sure that the port name/number is different for each instance:

horcm0	**xxxxx/udp**	xxxxx = the port name/number of horcm0.conf
horcm1	**yyyyy/udp**	yyyyy = the port name/number of horcm1.conf

3. If you want HORCM to start automatically each time the system starts up, add **\HORCM\etc\horcmstart 0 1** to the system automatic start-up file (e.g., **\autoexec.bat**).

4. Execute the **horcmstart** script manually to start CCI:

   ```
   D:\HORCM\etc> horcmstart 0 1
   ```

5. Set an instance number to the environment which executes a command:

   ```
   D:\HORCM\etc> set HORCMINST=X    X = instance number = 0 or 1
   ```

6. Set the log directory (**HORCC_LOG**) in the command execution environment as needed.

7. If you want to perform TrueCopy/TCE operations, do not set the **HORCC_MRCF** environment variable.

8. If you want to perform ShadowImage/SnapShot operations, set the **HORCC_MRCF** environment variable for the HORCM execution environment:

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

9. Execute the pairdisplay command to verify the configuration:

   ```
   D:\HORCM\etc> pairdisplay -g xxxx       xxxx = group name
   ```

3.5.3 Starting CCI as a Service (Windows Systems)

Usually, CCI (HORCM) is started by executing the start-up script from the Windows services. However, in the VSS environment, there is no interface to automatically start CCI. As a result, CCI provides the following `svcexe.exe` command and a sample script (HORCM0_run.txt) file so that CCI can be started automatically from the services:

C:\HORCM\tool\>svcexe

- Usage for adding [HORCM_START_SVC]: svcexe /A=command_path
  - for deleting [HORCM_START_SVC]: svcexe /D
  - for specifying a service: svcexe /S=service_name
  - for dependent services: svcexe /C=service_name,service_name

This command example uses HORCM0 for the registration of the service name for HORCM instance#0:

- Example for adding [HORCM0]: svcexe /S=HORCM0 "/A=C:\HORCM\Tool\svcexe.exe"
  - for deleting [HORCM0]: svcexe /S=HORCM0 /D
  - for starting [HORCM0] :[1] make a C:\HORCM\Tool\HORCM0_run.txt file.
    - :[2] set a user account to this service.
    - :[3] confirm to start by 'horcmstart 0'.
    - :[4] confirm to stop by 'horcmshutdown 0'.
    - :[5] start from a service by 'net start HORCM0'.

Performing Additional Configuration Tasks

1. Registering the HORCM instance as a service.
   The system administrator must add the HORCM instance by using the following command:

   C:\HORCM\Tool\>svcexe /S=HORCM0 "/A=C:\HORCM\Tool\svcexe.exe"

2. Customizing a sample script file.
   The system administrator must customize the sample script file (HORCM0_run.txt) according to the HORCM instance. For details, please refer to the descriptions in the HORCM0_run.txt file.

3. Setting the user account.
   The system administrator must set the user account for the CCI administrator by using the GUI.

4. Starting the HORCM instance from the service.
   After you have confirmed starting and stopping using “horcmstart 0” and “horcmshutdown 0”, you must verify that HORCM0 starts from the service and that HORCM0 started automatically from REBOOT, using the following command:

   C:\HORCM\Tool\>net start HORCM0

5. Stopping HORCM instance as a service.
   Instead of using the “horcmshutdown 0” command, you must use the following command to stop HORCM0:

C:\HORCM\Tool\>net stop HORCM0

(By using the “horcmshutdown 0” command, the script written into HORCM0_run.txt will automatically restart HORCM0).

Chapter 4 Performing CCI Operations

This chapter includes the following:

- Important Notice
- Environmental Variables
- Creating Pairs (Paircreate)
- Splitting Pairs (Pairsplit)
- Resynchronizing Pairs (Pairresync)
- Confirming Pair Operations (Pairevtwait)
- Monitoring Pair Activity (Pairmon)
- Checking Attribute and Status (Pairvolchk)
- Displaying Pair Status (Pairdisplay)
- Checking TrueCopy/TCE Pair Currency (Paircurchk)
- Performing TrueCopy/TCE Takeover Operations (Horctakeover)
- Displaying Configuration Information
- Data Protection
- Controlling CCI Activity
- Windows NT® and Windows® 2000/ Windows Server 2003 Subcommands
- Command Tools
- Host Group Control
- Synchronous Waiting Command (Pairsyncwait) for TCE
- Volume Migration

4.1 Important Notice

Note the following when performing CCI operations:

- Do not execute Hitachi replication software operations while formatting the volume. Formatting takes priority and Hitachi replication software operations will be suspended.
- Remember to change the default value for the poll(10ms) parameter in the configuration definition file. For details on calculating the poll value, refer to section 2.5.3. For details on configuration parameters, refer to section 3.4.
- When an internal process conflict occurs between the CCI and the subsystem, the processing of the subsystem is temporarily suspended. If the conflict continues, internal processing may not proceed. Therefore, when monitoring (polling) the status of the subsystem (by creating a script using the CCI commands) set the display-information-based commands (e.g. `pairdisplay, raidscan, raidar, and raidqry`) to be issued within interval greater than or equal to a minute.
- Commands that change the status of pairs (`paircreate, pairsplit, pairresync`) cannot be executed while changing the microprogram online.
- Do not change the microprogram online while executing commands that change the status of pairs (`paircreate, pairsplit, pairresync`). The execution time for the copying process varies; changing the microprogram online suspends the copying operation temporarily.
- The processing time for changing the microprogram online is 4 min./CTL (the copying process will be suspended for 4 minutes per CTL). The waiting process in the batch file may end abnormally when executing a copy (using a batch file) by designating a specific time.
- Commands that change the status of pairs (paircreate, pairsplit, pairresync) cannot be executed while the host is being restarted in a TrueCopy/TCE environment. Processing may end abruptly when a command is executed while the host is being restarted.
- It is essential that for Snapshot both P-VOL and V-VOL must be defined in advance from the Navigator (SNM) program. Also, the secondary volume (S-VOL) used and assigned by the CCI is the same as the Snapshot image created by the Navigator program.
- For Windows, do not use the diskpart command to mount and unmount a volume. Use the mount and umount commands of CCI.
- When the host I/O and CCI are used simultaneously, CCI commands may be completed later due to the performance and load of the host.
- All command options displayed in help do not perform.

The options that can perform are limited to the options described in this manual. See Appendix G for more details.

4.2 Environmental Variables

When activating HORCM or initiating a command, users can specify any of the environment variables shown in Table 4.1

Table 4.1 Environment Variables

Variable	Functions
HORCM (/etc/horcmgr) environment variables	**$HORCM_CONF:** Names the HORCM configuration file, default = /etc/horcm.conf **$HORCM_LOG:** Names the HORCM log directory, default = /HORCM/log/curlog **$HORCM_TRCSZ:** Specifies the size of the HORCM trace file in KB, default = 1 MB. The trace file size cannot be changed using the horcctl command. **$HORCM_TRCLVL:** Specifies the HORCM trace level (0–15), default = 4. If a negative value is specified, trace mode is canceled. The trace level can be changed using the **horcctl –c -l** command. **$HORCM_TRCBUF:** Specifies the HORCM trace mode. If this variable is specified, data is written in the trace file in the non-buffer mode. If not, data is written in the buffer mode. The trace mode can be changed using the **horcctl –c -b** command. **$HORCM_TRCUENV:** Specifies whether or not to succeed the trace control parameters (TRCLVL and TRCBUF) as they are when a command is issued. When this variable is specified, the HORCM default trace control parameters are used to the trace control parameters of HORCM as global parameters. If not, the default trace control parameters for HORCM commands are used and tracing level = 4, trace mode = buffer mode. **$HORCMFCTBL:** Changes the fibre address conversion table number, used when the target ID indicated by the raidscan command is different than the TID on the system (see Appendix D). **$HORCMPROMOD:** Sets HORCM forcibly to protection mode. Command devices in non-protection mode can be used as protection mode also. **$HORCMPERM:** Specifies the file name for the protected volumes. When this variable is not specified, the default name is as follows (* as an instance number): **For UNIX® systems:** /etc/horcmperm.conf or /etc/horcmperm*.conf **For Windows NT/2000:** \WINNT\horcmperm.conf or \WINNT\horcmperm*.conf **For Windows Server 2003 systems:** \WINDOWS\horcmperm.conf or \WINDOWS\horcmperm*.conf When the variable is set HORCMPERM = MGFNOINST, the built-in command will not execute. Set this variable when you want to execute any command from the user shell script. For details on protected volumes, refer to section 2.5.6.
CCI command environment variables	**$HORCC_LOG:** Specifies the command log directory name, default = /HORCM/log* (* = instance number). When a magic character STDERROUT is set for this variable, the log output changes to standard error output. Use this character when you want to execute commands from the script file knowing that the error would occur, in order to inhibit log output. **$HORCC_TRCSZ:** Specifies the size of the command trace file in KB, default = HORCM trace file size. The default HORCM trace file size can be changed using **horcctl –d -s**. **$HORCC_TRCLVL:** Specifies the command trace level (0 = 15), default = 4 or the specified HORCM trace level. If a negative value is specified, trace mode is canceled. The default trace level for HORCM commands can be changed using **horcctl –d -l**. **$HORCC_TRCBUF:** Specifies the command trace mode. If specified, data is written in the trace file in the non-buffer mode. If not, the HORCM trace mode is used. The default trace mode for HORCM commands can be changed using **horcctl –d -b**.
CCI instance environment variable	**$HORCMINST:** Specifies the instance number when using two or more CCI instances on the same server. The command execution environment and the HORCM activation environment require an instance number to be specified. Set the configuration definition file (HORCM_CONF) and log directories (HORCM_LOG and HORCC_LOG) for each instance.
ShadowImage/SnapShot /Data Retention command	**$HORCC_MRCF:** Sets the command execution environment of the ShadowImage/SnapShot/Data Retention commands. The selection whether the command

Variable	Functions
environment variables	functions as that of the TrueCopy/TCE or the ShadowImage/SnapShot/Data Retention is made according to this variable. The HORCM is not affected by this variable. When issuing a TrueCopy/TCE command, do not set the HORCC_MRCF variable for the execution environment of the command. When issuing a ShadowImage/SnapShot/Data Retention command, set the environmental variable HORCC_MRCF=1 for the execution environment of the command. Besides, when returning the command execution environment of ShadowImage/SnapShot/Data Retention to that of TrueCopy/TCE, set HORCC_MRCF=.

4.2.1 The Instance Number and the Option for Specifying a Command Execution Environment

Normally, the CCI command executes it using a number set for the environmental variable of $HORCMINST as an instance number. The command operates in the TrueCopy/TCE execution environment when the environmental variable of $HORCC_MRCF is not set or in the ShadowImage/SnapShot/Data Retention execution environment when the valuable is set as 1. When the option for specifying the instance number is used, the instance number can be specified irrespective of the environmental variable of $HORCMINST only in the command execution in which the option is used. Besides, when the option for specifying the execution environment is used, the execution environment can be changed irrespective of the environmental variable of $HORCC_MRCF only in the command execution in which the option is used.

- A way to specify options
  - -I[instance#]

    This option specifies the instance number.

    Example:

    Execute the pairdisplay command setting the instance number as 5.

```
# pairdisplay –g<group> –I5 ...
```

    Execute the pairdisplay command setting the instance number as no instance number.

```
# pairdisplay –g<group> –I ...
```

  - -IH[instance#] or -ITC[instance#]

    This option selects the TrueCopy/TCE execution environment and specifies the instance number.

    Example:

    Execute the pairdisplay command in the TrueCopy/TCE execution environment setting the instance number as no instance number.

```
# pairdisplay –g<group> –IH ...
```

    Execute the pairdisplay command in the TrueCopy/TCE execution environment setting the instance number as 5.

```
# pairdisplay –g<group> –IH5 ...
```

  - -IM[instance#] or -ISI[instance#]

This option selects the ShadowImage/SnapShot/Data Retention execution environment and specifies the instance number.

Example:

Execute the pairdisplay command in the ShadowImage/SnapShot/Data Retention execution environment setting the instance number as no instance number.

```
# pairdisplay –g<group> –IM ...
```

Execute the pairdisplay command in the ShadowImage/SnapShot/Data Retention execution environment setting the instance number as 5.

```
# pairdisplay –g<group> –IM5 ...
```

Note: In the interactive mode (specified with the -z or -zx option), a change of the instance number is rejected because the instance number has been fixed.

- Relation between the environmental variables and the options

  When neither the instance number nor the option for specifying the command execution environment is used, the instance number and the command execution environment depend on the setting of the $HORCMINST and the $HORCC_MRCF. The relation between the instance number and the command execution environment is as shown below.

Table 4.2 The Instance for the Connection

-I[instance#] Option	$HORCMINST	Instance
-I	Don't care	No instance number
-IX		Instance number=X
Not specified	HORCMINST=X	Instance number=X
	Not specified	No instance number

X: Instance number

Table 4.3 Command Environment Variables

-IH, -IM or –ITC, -ISI Option	$HORCMINST	Command Environment
-IH or -ITC	Don't care	TrueCopy/TCE
-IM or -ISI		ShadowImage/SnapShot/Data Retention
Not specified	HORCC_MRCF=1	ShadowImage/SnapShot/Data Retention
	Not specified	TrueCopy/TCE

- A way to verify instance number and command environment

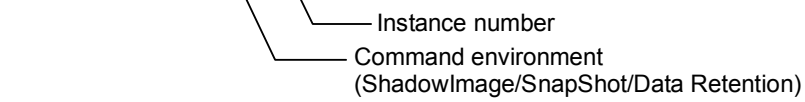
  The instance number and the command execution environment at the time of the command execution are displayed as shown below.

  Example:

```
C:\HORCM\etc>pairdisplay -h
Model  : RAID-Manager/WindowsNT
Ver&Rev: 01-19-03/04
Usage  : pairdisplay [options] for HORC[5]
 -h    Help/Usage
 -I[#]  Set to HORCMINST#
 -IH[#] or -ITC[#] Set to HORC mode [and HORCMINST#]
 -IM[#] or -ISI[#] Set to MRCF mode [and HORCMINST#]
  :
```

  Example with interactive mode:

```
C:\HORCM\etc>pairdisplay -z
pairdisplay[HOMRCF[5]]: -IM
pairdisplay[HOMRCF[5]]: -q
  :
```



4.3 Creating Pairs (Paircreate)

WARNING: Use `paircreate` with caution. It starts the TrueCopy/TCE/ShadowImage initial copy operation, which overwrites all data on the secondary volume. If the primary and secondary volumes are not identified correctly, or if the wrong options are specified (e.g., `vl` instead of `vr`), data will be transferred in the wrong direction.

The `paircreate` command generates a new volume pair from two unpaired volumes. It can create either a paired logical volume or a group of paired volumes. The `paircreate` command allows you to specify the direction (local or remote) of the pair generation. If local (`vl` option) is specified, the server issuing `paircreate` has the primary volume. If remote (`vr` option) is specified, the remote server has the primary volume (TrueCopy/TCE/ShadowImage).

The `-split` option of `paircreate` (ShadowImage/SnapShot) allows you to simultaneously create and split pairs using a single CCI command. When `-split` is used, the pair status changes from COPY to PSUS (instead of PAIR) when the initial copy operation is complete.

Table 4.4 lists the `paircreate` parameters and returned values.

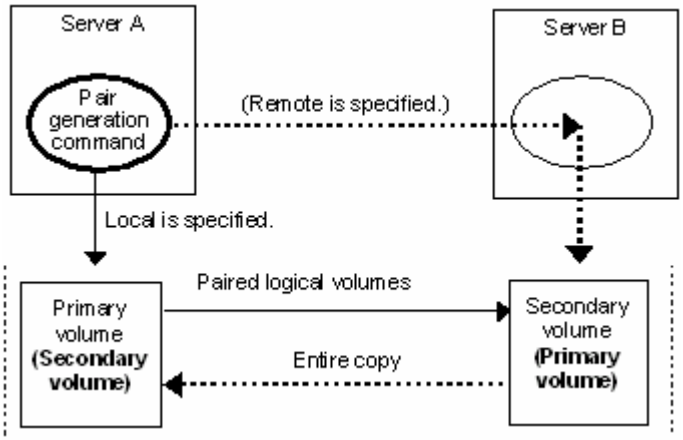


Figure 4.1 Pair Creation

Before issuing `paircreate`, verify that the secondary volume is not mounted on any system. If the secondary volume is mounted after paircreate, delete the pair (pairsplit -S), unmount the secondary volume, and then reissue `paircreate`.

Note: The `paircreate` command terminates before the initial copy operation is complete (except when the **nocopy** option is specified). Use the pair event waiting or pair display command to verify that the initial copy operation completed successfully (status changes from COPY to PAIR, or from COPY to PSUS if the **-split** option was specified). The execution log file also shows completion of the initial copy operation.

The operation of creating a pair is shown below.

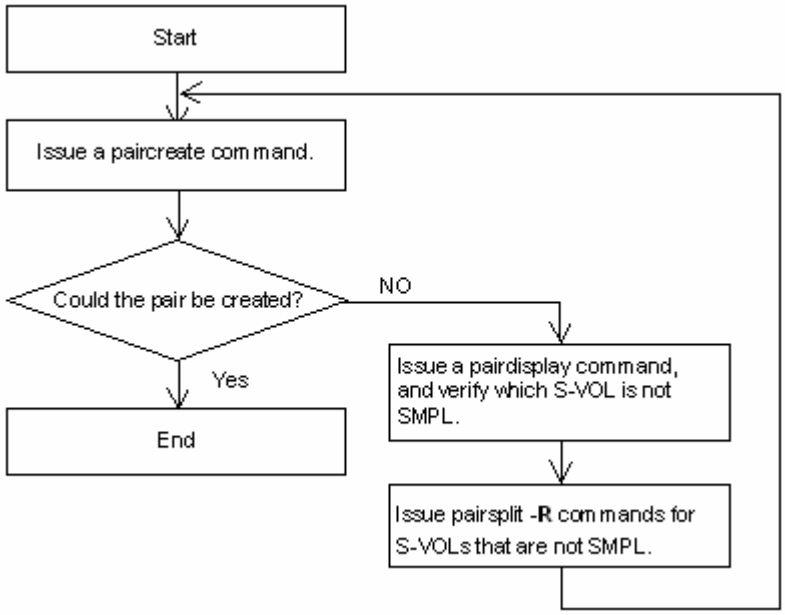


Figure 4.2 Pair Creation Operation

Table 4.4 Paircreate Command Parameters

Parameter	Value
Command Name	paircreate
Format	paircreate { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] -f <fence> [CTGID] | -v | -c <size> | nocopy | -nomsg | -split | [-m <mode>] }
Options	**-h:** Displays Help/Usage and version information. **-q:** Terminates the interactive mode and exits the command. **-z** or **-zx:** Makes the paircreate command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates.
	-I[H | M][instance#] or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. **-g <group>:** Specifies a group name defined in the configuration definition file. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>:** Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. **-d[g] <raw_device> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified raw_device is contained in two or more groups, the command is executed on the first group. **-d[g] <seq#> <LDEV#> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of 0x) or decimal notation. **-f <fence> [CTGID]** (TrueCopy/TCE only): Specifies the level for assuring the consistency of paired volume data. For TrueCopy, a fence level of "never" or "data" must be specified. For TCE, a fence level of "async" must be specified. This option is required for TrueCopy/TCE. If the CTGID (CT group ID) option is not specified, the pair is automatically assigned to a new group. When the CTGID is not specified, the CTG is the group specified in the configuration definition file. Each pair in the same group cannot be assigned to separate CTGs in the configuration definition file. If CTGID is not specified and the maximum number of CT groups (16) exists. The CTGID option is used to make paired volumes of specified group forcibly by given CTGID of another group. The CTGID is validated when the fence level is specified as "async"; it is neglected in other cases. **-vl or –vr:** Specifies the data flow direction and must always be specified. The -vl option specifies local and the host which issues the command possesses the primary volume. The -vr option specifies remote and the remote host possesses the primary volume while the local host possesses the secondary volume. **–c <size>:** You can use this option to specify the copying pace (1–15) to be used for the initial data copy. You can shorten the copy time by specifying a large number. Do not use the default value 3.(1 to 5: slow, 6 to 10: normal, 11 to 15: prior) **-nocopy** (TrueCopy/TCE)**:** Creates paired volumes without copying data in the case in which the data consistency of simplex volumes is assured by the user. **-nomsg:** Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. **-split** (ShadowImage/SnapShot)**:** Splits the paired volume after the initial copy operation is complete. **-m <mode> (ShadowImage only):** For mode, you can specify the following option: **noread:** Specifies the noread mode for hiding the secondary volume. The secondary volume becomes read-disabled when this mode option is specified. The secondary volume is read-enabled when this mode option is omitted.

Parameter	Value
	Note: The primary volume becomes read-disabled only during a reverse resync operation (**restore** option of pairresync command).
	mode=grp [CTGID] (SnapShot/ShadowImage only). Makes a group for splitting all SnapShot/ShadowImage pairs specified in a group. SnapShot/ShadowImage guarantees data consistency among multiple LUNs in a group at a single point in time when doing a split using the pairsplit –g <group> command (except –S or –E option). A CTGID (CT Group ID) is assigned automatically if you do not specify the CTGID option in this command. If CTGID is not specified and 128 CT groups already exist, an EX_ENOCTG error will be returned. Therefore, the CTGID option can forcibly assign a volume group to an existing CTGID (0-127). ***Note:*** This option cannot be specified with -split option in the same command. A plurality of pairs can be created to one P-VOL. But, the number of pair that can be set in one group is one pair per one P-VOL
	mode=cc (Volume Migration only): This option instructs the copying of the volume migration to be made. The **-vl** specifies the local instruction. This is an instruction which copies a local instance LU (P-VOL) to a remote instance LU (S-VOL) It also maps a copying destination volume (a volume of the remote instance) to the local instance LU (P-VOL). The **-vr** specifies remote instruction, and copies data from a remote instance LU (P-VOL) to a local instance LU (S-VOL). It also maps a copy destination volume (a volume of the local instance) to the remote instance LU (P-VOL). ***Note:*** This option cannot be specified with the -split option in the same command.
Returned values	**Normal termination:** 0. When creating groups, 0 = normal termination for all pairs. **Abnormal termination:** Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

Note: During TrueCopy/TCE pair operation, a pair operation can fail when a host has a high volume of I/Os or when pair status is changed frequently on both the local and remote subsystems. If pair operation fails and a state transition is not done, retry the pair operation. (`pairvolchk` can be used to check the state transition). If a pair operation partially fails when doing a pair operation by groups, the operation needs to be done per pair logical volume within that group.

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

C:\HORCM\etc>pairdisplay –g VG01
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01   oradb1(L)    (CL1-A , 1,   1-0 )75000174     1.P-VOL PAIR,75000174       2 -
VG01   oradb1(R)    (CL1-A , 1,   2-0 )75000174     2.S-VOL PAIR,-----       1 -
```

Figure 4.3 Paircreate Command

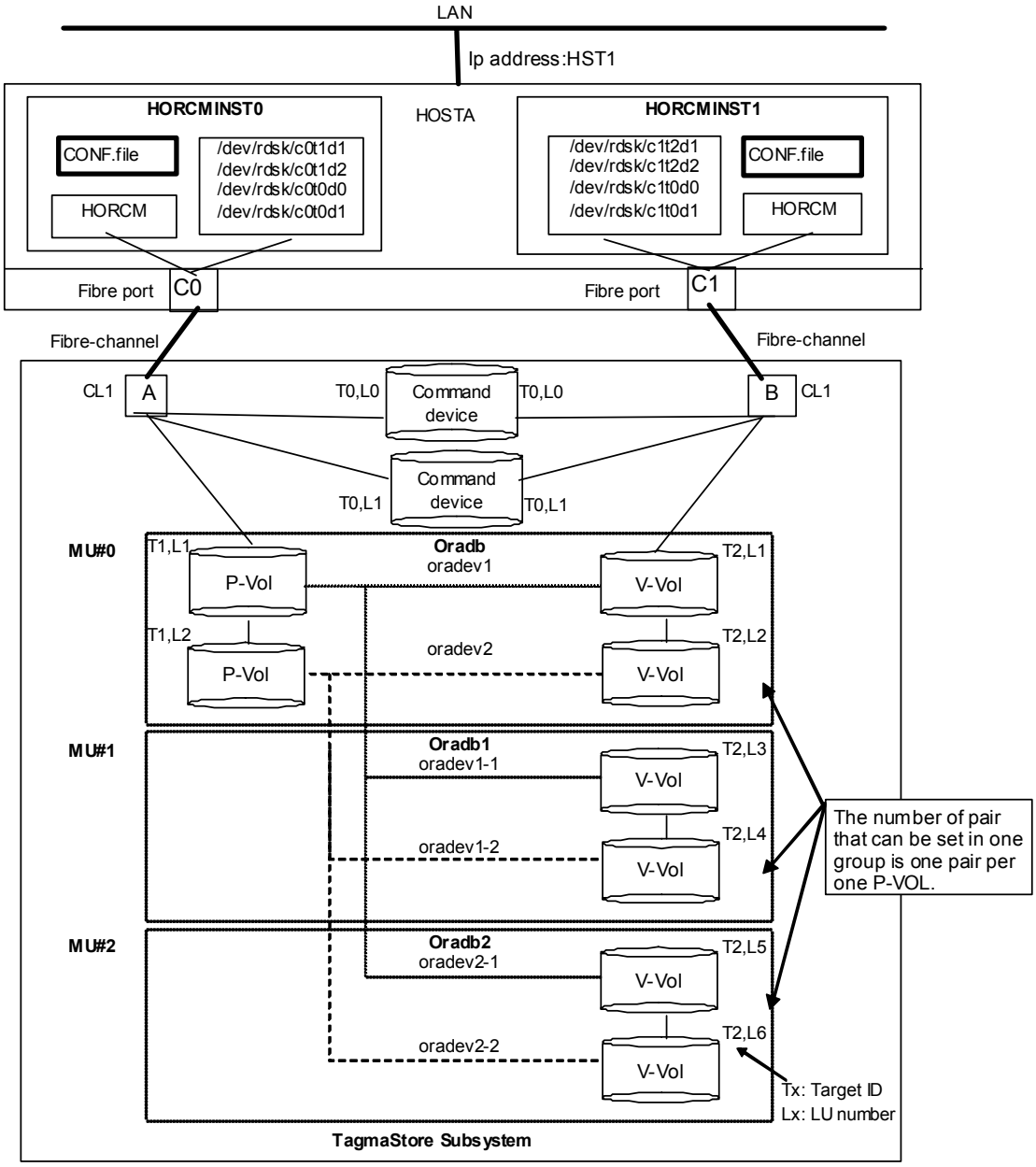


Figure 4.4 Paircreate Command –m Option (appropriate example)

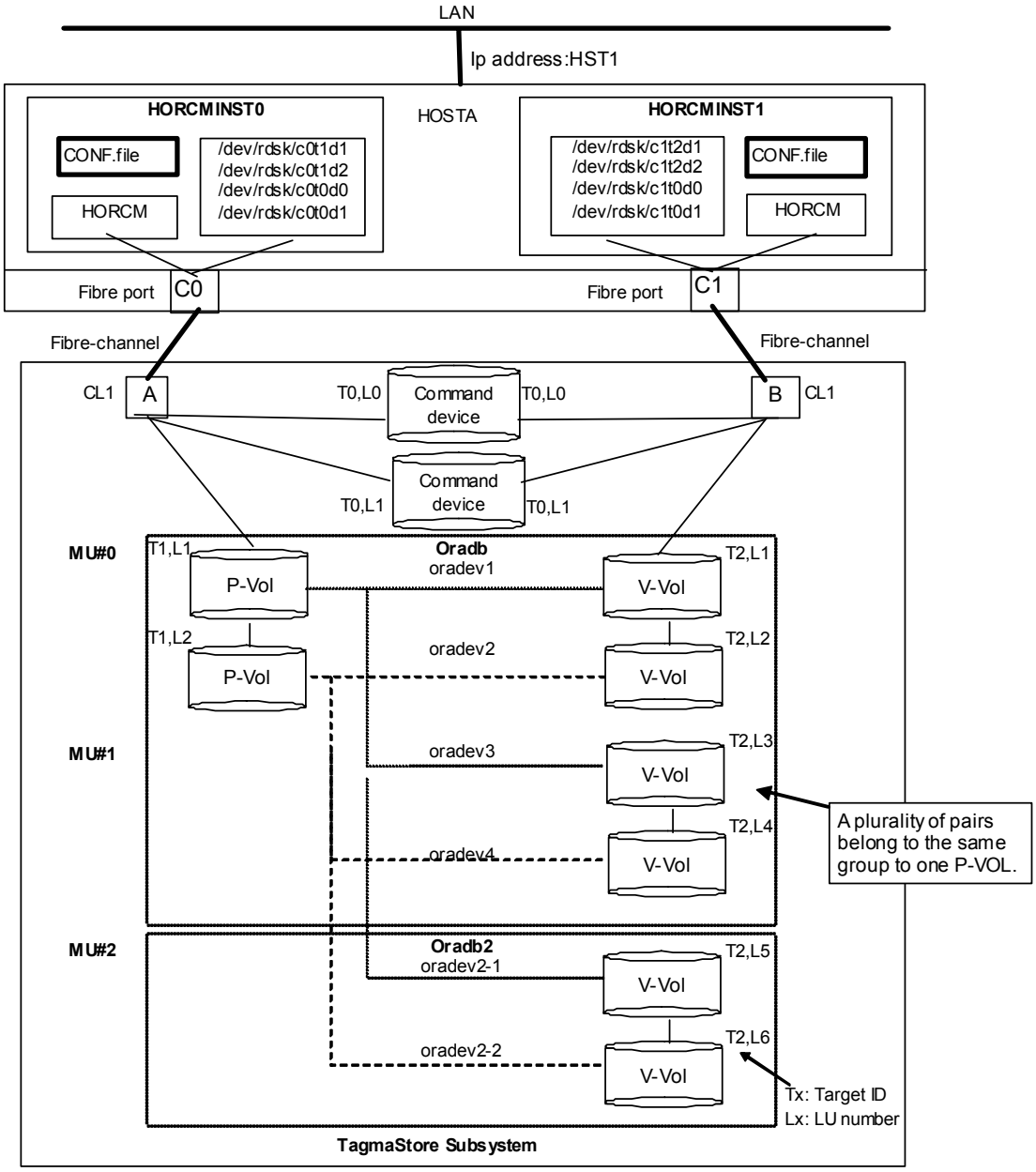


Figure 4.5 Paircreate Command –m Option (inappropriate example)

4.4 Splitting Pairs (Pairsplit)

The `pairsplit` command stops updates to the secondary volume of a pair, `pairsplit` allows read/write access to the secondary volume and can be applied to a paired logical volume or to a group of paired volumes. Table 4.5 lists `pairsplit` parameters and returned values.

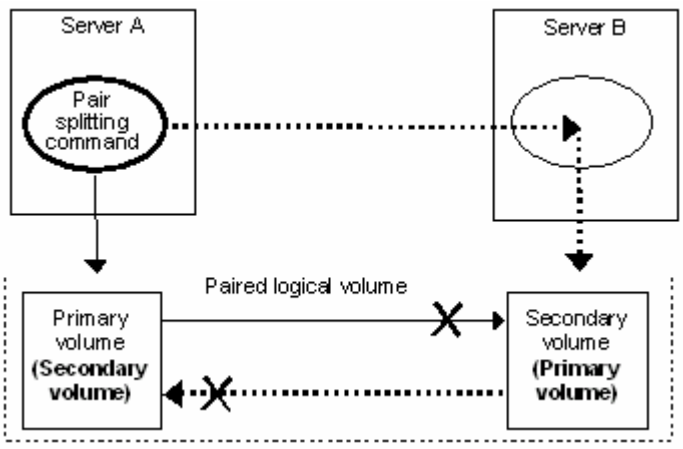


Figure 4.6 Pair Splitting

The `pairsplit` command allows read/write access to the secondary volume, depending on the selected options (`-r, -rw, -S, -R, -P, -E, -mscas`). The primary volume's server is automatically detected by `pairsplit`, so the server does not need to be specified in the command parameters. If the `-S` option (simplex) is used, the volume pair is deleted, the volumes are returned to the simplex state, and the primary and secondary volume status is lost. Paired volumes are split as soon as the pairsplit command is issued. If you want to synchronize the volumes, `pairsplit` must be issued after write I/Os to the paired volume have been completed.

When splitting a pair, whether or not you can change the pair status of S-VOL, changing the pair status of P-VOL to SMPL takes priority. Therefore, if the pair status of S-VOL cannot be changed to SMPL, the pair status of P-VOL might not correspond with that of S-VOL.

When a path failure has occurred or when S-VOL is not used temporarily (for example, while formatting), the pair status of S-VOL cannot be changed to SMPL.

When you want to change the status of P-VOL and S-VOL to SMPL, a `pairdisplay` command is issued and `pairsplit -R` is issued for S-VOL that is not SMPL. (This can be specified for TrueCopy/TCE).

When `pairsplit -R` is issued for an S-VOL in the paired state, `pairsplit -S` is issued for the P-VOL to change its status to SMPL.

When the S-VOL of the TCE pair is placed in the SMPL status through an issue of a command for the pair splitting (pairsplit –R) to the TCE pair, the S-VOL data may become unsettled data that is being copied. Therefore, to use the data as the settled one on which the P-VOL data has been reflected, change the volume status to SSWS by issuing the command for the takeover (horctakeover) beforehand, and then issue the command for the pair splitting (pairsplit –R).

Note: During the period until the response of the command is returned after the pair status change command such as pairsplit is executed, the `pairdisplay` command cannot be executed in the same screen. Therefore, start another screen and execute `pairdisplay` to check the pair status.

Table 4.5 Pairsplit Command Parameters

Parameter	Value
Command Name	pairsplit
Format	pairsplit {-h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] –r | -rw | -S | -R | -P | -I | -nomsg | -C <size> | -E }
Options ***Note:*** Only one pairsplit option (-r, -rw,-S, -P, -C, -E) can be specified. If more than one option is specified, only the last option will be executed.	**-h:** Displays Help/Usage and version information. **-q:** Terminates the interactive mode and exits this command. **-z** or **-zx:** Makes `pairsplit` enter the interactive mode. The `-zx` option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. **-g <group>:** Specifies a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>:** Specifies the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. **-d[g] <raw_device> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-FHORC or -FCA:** Specifies a cascading TrueCopy/TCE volume to be the subject of an operation regardless of a Hitachi replication software environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not). If the -I option is specified, this option splits a cascading TrueCopy/TCE volume on a local host (near site). If no -I option is specified, this option splits a cascading TrueCopy/TCE volume on a remote host (far site). The target TrueCopy/TCE volume must be a P-VOL and the **R** option cannot be specified. Only the SnapShot P-VOLcan be cascaded with TCE. When the SnapShot P-VOL is cascaded with the TCE S-VOL, the split instruction to the SnapShot pair cannot be issued directly when the both pairs are in the PAIR status. **-FMRCF [MU#] or –FBC [MU#]:** Specifies a cascading ShadowImage volume to be the subject of an operation regardless of a TrueCopy/TCE/ShadowImage environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.8). If the -I option is specified, this option splits a cascading ShadowImage volume on a local host (near site). If no -I option is specified, this option splits a cascading ShadowImage volume on a remote host (far site). The target ShadowImage volume must be a P-VOL and the E option cannot be specified. **-d[g] <seq#> <LDEV#> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first

Parameter	Value
	group. The **<seq #> <LDEV #>** values can be specified in hexadecimal (by addition of 0x) or decimal notation. **-r or –rw** (for TrueCopy/TCE): Specifies a mode of access to the S-VOL after paired volumes are split. The -r option (default) allows read-only from the S-VOL. The -rw option enables read and write access for the S-VOL.) **-S:** Selects simplex mode (releases the pair). When the pairing direction is reversed among the hosts (e.g., disaster recovery), this mode is established once, and then the paircreate command is issued. If you want to re-establish a pair which has been released, you must use the paircreate command (not pairresync). CCI changes only the P-VOL status to SMPL when a pass of TrueCopy/TCE is not normal with both passes either. **-R** (for TrueCopy/TCE): Brings the secondary volume into the simplex mode forcibly. It is issued by the secondary host, if the host possessing the primary volume is down or has failed. **-P:** Brings the primary volume into the blocking mode (PSUS) forcibly. It is issued by the secondary host to suppress data updating by the host possessing the primary volume. **-I:** When this command cannot utilize the remote host for host down, this option enables a pairsplit operation by local host only. The target volume of local host can be P-VOL or S-VOL. **-nomsg:** Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. **C <size>:** This option does not affect on operation even if it specified or omitted**.** **-E (ShadowImage only):** Suspends a paired volume forcibly when a failure occurs. Not normally used. **-mscas <Split-Maker> [MU#] (TCE only)** :This option splits the V-VOL of the SnapShot pair cascaded with the S-VOL of the TCE pair by issuing an instruction (only the group can be specified) to TCE. As to the TCE pair targeted, its S-VOL must be cascaded with a SnapShot pair with the same "MU#." All the TCE pairs concerned must be in the PAIR status. All the SnapShot pairs must be in the PSUS or PAIR status. All the TCE pairs (in the PAIR status) in the CTG that includes the specified group are to be processed. The pairs (in the CTG) to be processed must be in the PAIR status only. Besides, an optional character string (with ASCII 31 characters), which is specified by a user, can be added to the V-VOL as a <Split-Marker>. Incidentally, this option cannot be used together with the option of –d.
Returned values	**Normal termination:** 0. When creating groups, 0 = normal termination for all pairs. **Abnormal termination:** Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

Note 1: During TrueCopy/TCE pair operation, a pair operation can fail when a host has a high volume of I/Os or when pair status is changed frequently on both the local and remote subsystems. If pair operation fails and a state transition is not done, retry the pair operation. (`pairvolchk` can be used to check the state transition). If a pair operation partially fails when doing a pair operation by groups, the pair operation needs to be done per each pair logical volume within that group.

Note 2: When two or more groups, which are specified in the configuration definition file, exist in the CTG, an instruction to split the pairs issued to a group specified in the configuration definition file is executed for the entire CTG.

Note 3: When TCE executes the pairsplit command, the response time differs depending on the option(s).

- `pairsplit, pairsplit -S`:

  When the status is PAIR, the response is delayed depending on the amount of the differential data.

- `pairsplit -R, pairsplit -mscas`:

  The response is made immediately after the command is executed.

Note 4: When the –d option is specified for the pairsplit –R command in the case of TCE, only an S-VOL of the target pair is placed in the SMPL status. Besides, at this time, all the other pairs in the same CTG are not kept paired. When a P-VOL was in the PAIR status before the command was accepted, it is placed in the PSUE status because the pair created of it and an S-VOL is split forcibly. On the other hand, statuses of the other S-VOLs in the CTG are not changed and kept as PAIR because the communication from the primary subsystem is cut off.

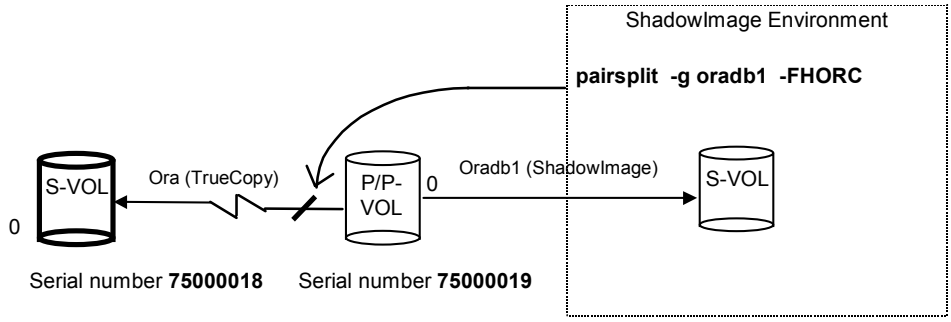


Figure 4.7 Example of -FHORC Option for Pairsplit

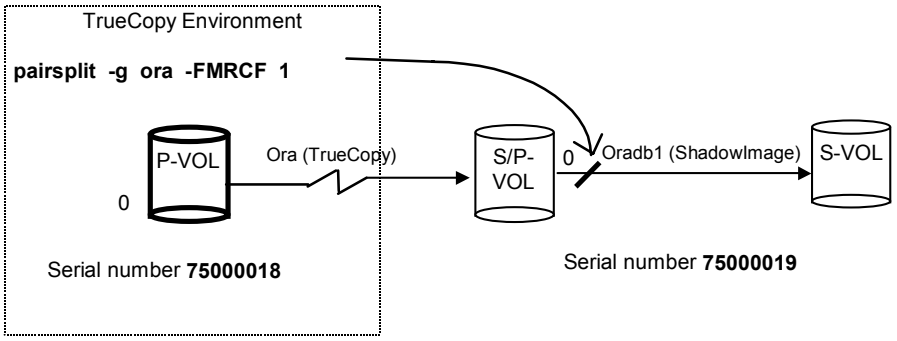


Figure 4.8 Example of -FMRCF Option for Pairsplit

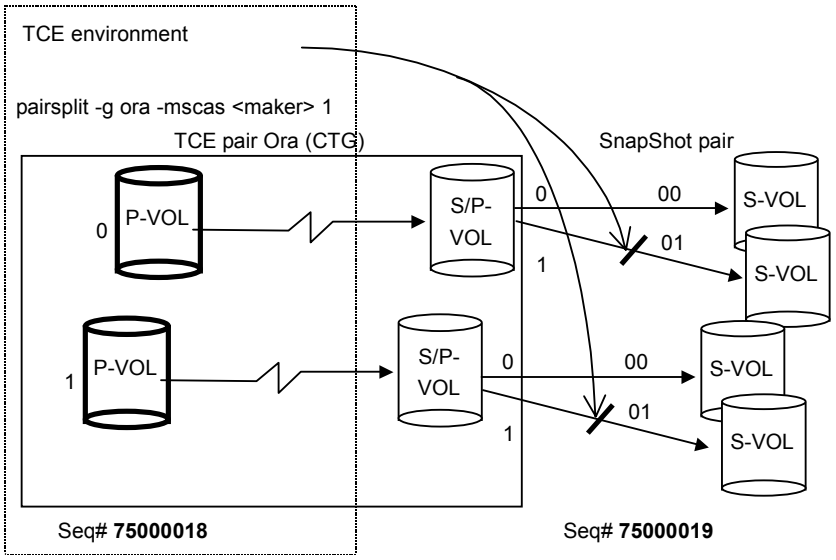


Figure 4.9 Example of –mscas Option for Pairsplit

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

C:\HORCM\etc>pairdisplay -g VG01
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01    oradb1(L)    (CL1-A , 1,   1-0 )75000174     1.P-VOL PSUS,75000174       2 -
VG01    oradb1(R)    (CL1-A , 1,   2-0 )75000174     2.S-VOL SSUS,-----       1 -
```

Figure 4.10 Pair Split Command

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

C:\HORCM\etc>pairdisplay -g VG01
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01    oradb1(L)    (CL1-A , 1,   1-0 )75000174     1.P-VOL PSUE,75000174       2 -
VG01    oradb1(R)    (CL1-A , 1,   2-0 )75000174     2.S-VOL PSUE,-----       1 -
```

Figure 4.11 Pair Split Command –E Option

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

C:\HORCM\etc>pairdisplay -g VG01
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01    oradb1(L)    (CL1-A , 1,   1-0 )75000174     1.SMPL  ----,-----       2 -
VG01    oradb1(R)    (CL1-A , 1,   2-0 )75000174     2.SMPL  ----,-----       1 -
```

Figure 4.12 Pair Split Command -S Option

4.4.1 Timing of Pairsplit Operations

Since a pair is split at the time when the pairsplit command is issued, ensure that there is no IO activity on the P-VOL (all IOs have been completed) before the split operation):

- Instantaneous offline backup of the UNIX file system:
  - Unmount the primary volume, and then split the volume pair.
  - Mount the primary volume (mount).
  - Verify that the pairsplit is complete, and mount the secondary volume (mount -r).
  - Execute the backup.
  - Restore the volumes to their previous state, and resynchronize the volume pair (TrueCopy/ShadowImage).
- Online backup of the UNIX file system:
  - Issue the **sync** command to a mounted primary volume to flush the file system buffer, and then split the volume pair in Read/Write mode.
  - Verify that the pairsplit is complete, and then use the **fsck** command to check the consistency of the secondary volume file system.
  - Mount (**mount**) the secondary volume.
  - Execute the backup.

- Restore the volumes to their previous state and resynchronize the volume pair (TrueCopy/ShadowImage).

- Instantaneous offline backup of the Windows NT/2000/ Windows Server 2003 file system:
  - Execute **-x umount** of the primary volume, then split the volume pair.
  - Execute **x-mount** of the primary volume.
  - Verify that the pairsplit is complete, then execute **-x mount** of the secondary volume.
  - Execute the backup.
  - Restore the volumes to their previous state, and resynchronize the volume pair (TrueCopy/TCE/ShadowImage).
- Online backup of the Windows NT/2000/ Windows Server 2003 file system:
  - Issue the **x-sync** command to a mounted primary volume to flush the file system buffer, and then split the volume pair in Read/Write mode.
  - Verify that the pairsplit is complete, and then use **x-mount** of the secondary volume.
  - Execute the backup.
  - Restore the volumes to their previous state and resynchronize the volume pair (TrueCopy/TCE/ShadowImage).

Note1: If the primary volume is divided by LVM or partition, the control information of LVM or partition on the primary volume is also copied to the secondary volume. When executing the backup from the secondary volume, import this control information and execute pairsplit when activating the secondary volume.

Note 2:TCE takes some time for the pair splitting in order to reflect the P-VOL data on the S-VOL.

Note 3:TCE can split V-VOL of the SnapShot pair cascaded with the secondary volume through the instruction issued from the primary host leaving the pair status as PAIR. From the above, backup data can be collected online more smoothly.

4.5 Resynchronizing Pairs (Pairresync)

The `pairresync` command re-establishes a split pair, and then restarts the update copy operations to the secondary volume (see Figure 4.13). The `pairresync` command can resynchronize either a paired logical volume or a group of paired volumes. The normal direction of resynchronization is from the primary volume to the secondary volume. If the `-restore` option is specified (ShadowImage only), the pair is resynchronized in the reverse direction (i.e., secondary volume to primary volume). Figure 4.14 shows the normal and restore resync operations. The primary volume is read and write accessible during `pairresync`. The secondary volume becomes write-disabled when `pairresync` is issued.

Table 4.6 describes the command parameters and returned values for `pairresync`. The `pairresync` command detects the primary volume's server; the server does not need to be specified in `pairresync` parameters.

The `pairresync` command terminates before resynchronization of the secondary (or primary) volume is complete. Use the pair event waiting or pair display command to verify that the resync operation completed successfully (status changes from COPY to PAIR). The execution log file also shows completion of the resync operation. The status transition of the paired volume is judged by the status of the primary volume.

If no data was written to the secondary volume while the pair was split, the differential data on the primary volume is copied. If data was written to the secondary volume, the differential data on the primary volume and secondary volume is copied to the secondary volume. This process is reversed when the ShadowImage `-restore` option is specified.

Before issuing `pairresync` (normal or reverse direction), make sure that the secondary volume is not mounted on any UNIX system. Before issuing a reverse `pairresync` command, make sure that the primary volume is not mounted on any UNIX system.

Note: Commands that change the status of pairs, `paircreate`, `pairsplit`, and `pairresync`, cannot be executed while the host is being restarted in a TrueCopy/TCE environment. Processing may end abruptly when a command is executed while the host is being restarted.

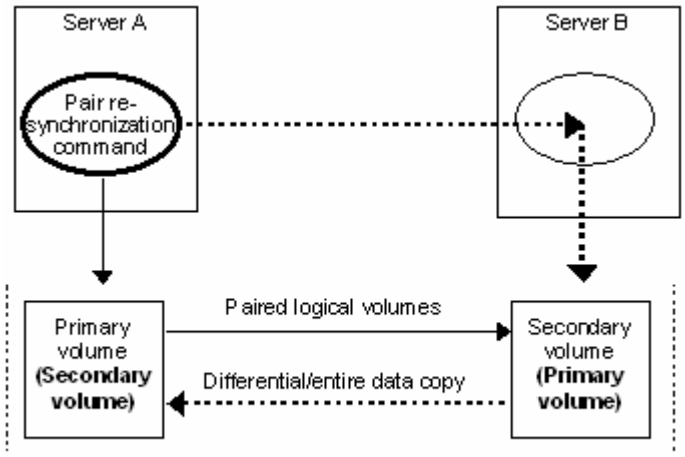


Figure 4.13 Pair Resynchronization

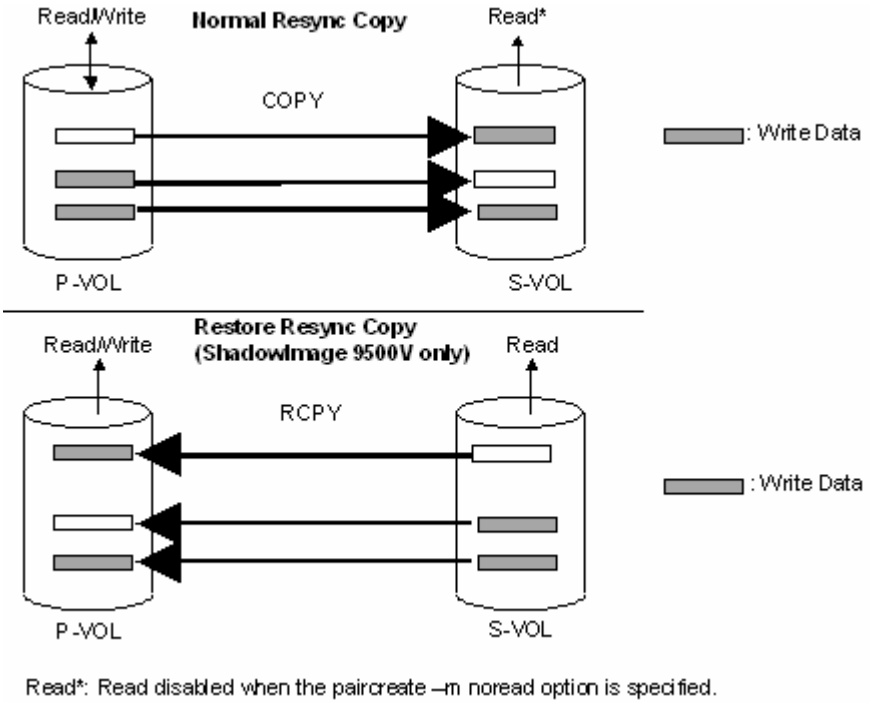


Figure 4.14 Normal Resync and ShadowImage Restore Resync

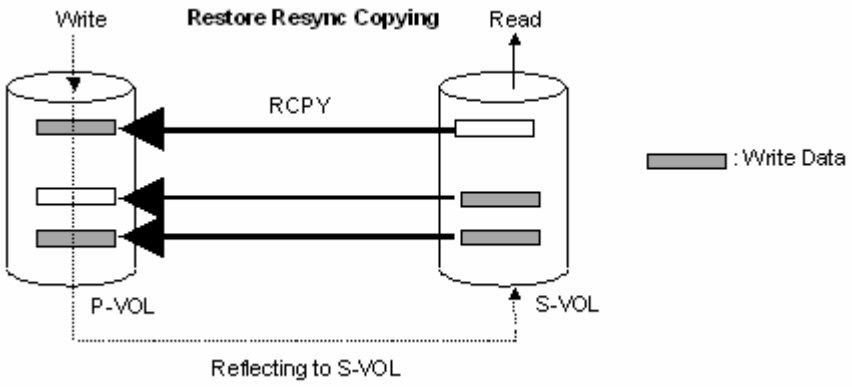


Figure 4.15 Reflecting Write Data to P-VOL during ShadowImage Restore Resync Copy

Table 4.6 Pairresync Command Parameters

Parameter	Value
Command Name	pairresync
Format	pairresync { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -c <size> | -nomsg | -I | -restore | -swaps | -swapp }

Parameter	Value
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits this command. -z or -zx: Makes the pairresync command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section4.2.1. -g <group>: This option is used to specify a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: Specifies a paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -FHORC or -FCA: Specifies a cascading TrueCopy/TCE volume to be the subject of an operation regardless of a ShadowImage/TrueCopy/TCE environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.16). If the -I option is specified, this option resyncs a cascading TrueCopy/TCE volume on a local host (near site). If no -I option is specified, this option resyncs a cascading TrueCopy/TCE volume on a remote host (far site). The target TrueCopy/TCE volume must be a P-VOL. -FMRCF [MU#] or –FBC [MU#]: Specifies a cascading ShadowImage volume to be the subject of an operation regardless of a TrueCopy/TCE/ShadowImage environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.17). If the -I option is specified, this option resyncs a cascading ShadowImage volume on a local host (near site). If no -I option is specified, this option resyncs a cascading ShadowImage volume on a remote host (far site). The target ShadowImage volume must be a P-VOL. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of the -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -c<size>: You can use this option to specify the copying pace for the resync operation (range = 1 to 15). If omitted, the value used for paircreate will be used. (1 to 5: slow, 6 to 10: normal, 11 to 15: prior) -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. -l: When this command cannot utilize the remote host for host down, this option enables a pairresync operation by the local host only. The target volume of the local host can be P-VOL or S-VOL. -restore: Performs reverse resync (from secondary volume to primary volume). -swaps (TrueCopy/TCE only): Executed from the S-VOL side when there is no host on the P-VOL side to help. Typically executed in PSUS state to facilitate fast failback without requiring a full copy. In Figure 4.19, the left side shows T0 for both the P-VOL and S-VOL (before command execution), and the right side shows T1, after the command has executed. For both -swaps and -swapp, the delta data from the original S-VOL becomes dominant and is copied to the original P-VOL, then the S/P-VOL designations are swapped. -swapp (TrueCopy/TCE only): Executes the equivalent of a -swaps from the original P-VOL side. Unlike -swaps, swapp does require the cooperation of hosts at both sides.
Returned Values	Normal termination: 0. When resynchronizing groups, 0 = normal termination for all pairs. Abnormal termination: Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

Note: During TrueCopy/TCE pair operation, a pair operation can fail when a host has a high volume of I/Os or when pair status is changed frequently on both the local and remote subsystems. If pair operation fails and a state transition is not done, retry the pair operation. (pairvolchk command can be used to check the state transition). If a pair operation partially fails when doing a pair operation by groups, the pair operation needs to be done per each pair logical volume within that group.

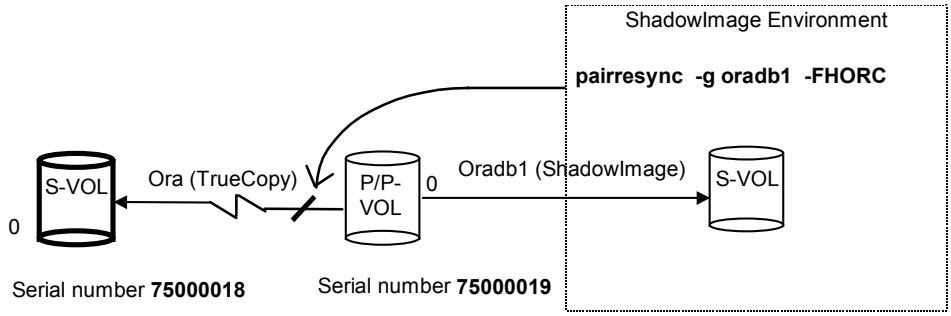


Figure 4.16 Example of -FHORC Option for Pairresync

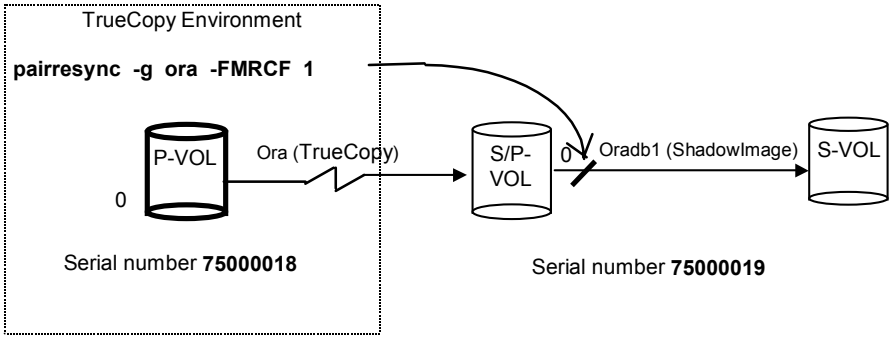


Figure 4.17 Example of -FMRCF Option for Pairresync

```
C:\HORCM\etc>pairresync -g VG01 -c 15

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

C:\HORCM\etc>pairdisplay -g VG01
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
VG01   oradb1(L)    (CL1-A , 1,   1-0 )75000174     1.P-VOL PAIR,75000174       2 -
VG01   oradb1(R)    (CL1-A , 1,   2-0 )75000174     2.S-VOL PAIR,-----       1 -
```

Figure 4.18 Pairresync Command

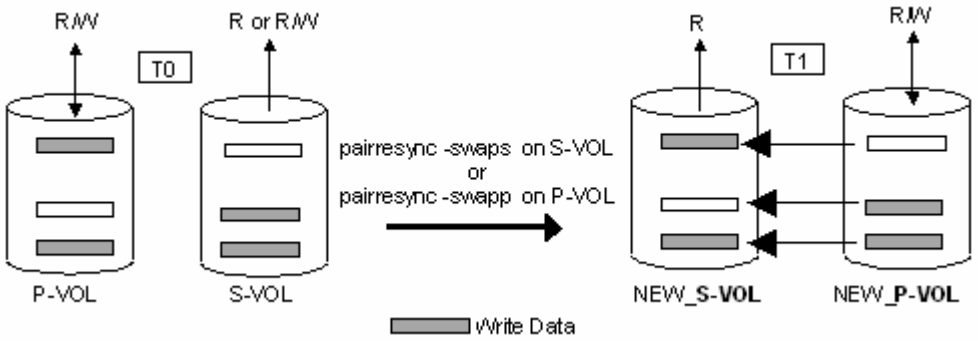


Figure 4.19 Swap Operation

4.6 Confirming Pair Operations (Pairevtwait)

The pair event waiting (`pairevtwait`) command is used to wait for completion of pair creation and pair resynchronization and to check status (see Figure 4.20). It waits (sleeps) until the paired volume status becomes identical to a specified status, then completes. The pairevtwait command can be used for a paired logical volume or a group of paired volumes. The primary volume's server is automatically detected by the pair event waiting command, so the server does not need to be specified in the pair event waiting command parameters.

Table 4.7 lists and describes the pair event waiting command parameters and returned values. The pair event waiting command waits until the specified status is established, and terminates abnormally if an abnormal status is detected. The transition of the paired volume status is judged by the status of the primary volume. If the event waiting command is issued for a group, the command waits until the status of each volume in the group becomes identical to the specified status. When the event waiting command with the `-nowait` option is issued for a group, the status is returned if the status of each volume in the group is identical. This command must be used to confirm a pair status transition.

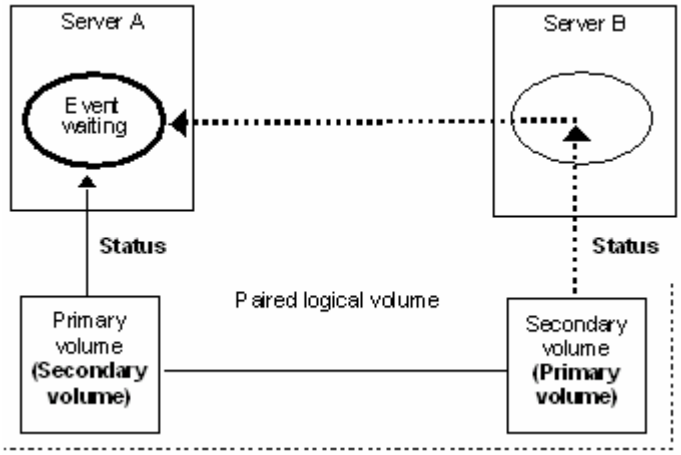


Figure 4.20 Pair Event Waiting

Table 4.7 Pairevtwait Command Parameters

Parameter	Value
Command Name	pairevtwait
Format	pairsplit {-h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] –r | -rw | -S | -R | -P | -I | -nomsg | -C <size> | -E }
Options	**-h**: Displays Help/Usage and version information. **-q**: Terminates the interactive mode and exits this command. **-z or -zx**: Makes the pairevtwait command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section4.2.1. **-g <group>**: Specifies a group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. **-d <pair Vol>**: Specifies a paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. **-d[g] <raw_device> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specifying the **-g <group>** option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. **-FHORC** or -**FCA**: Specifies a cascading TrueCopy/TCE volume to be the subject of an operation regardless of a ShadowImage/SnapShot environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.21). If the -I option is specified, this option tests status of a cascading TrueCopy/TCE volume on a local host (near site). If no -I option is specified, this option tests status of a cascading TrueCopy/TCE volume on a remote host (far site). The target TrueCopy/TCE volume must be P-VOL or SMPL. **-FMRCF [MU#] or –FBC [MU#**]: Specifies a cascading ShadowImage/SnapShot volume to be the subject of an operation regardless of a TrueCopy/TCE/ShadowImage environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.22). If the -I option is specified, this option tests status of a cascading ShadowImage/SnapShot volume on a local host (near site). If no -I option is specified, this option tests status of a cascading ShadowImage/SnapShot volume on a remote host (far site). The target ShadowImage/SnapShot volume must be P-VOL or SMPL. **-d[g] <seq#> <LDEV#> [MU#]:** Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specifying the -g <group> option. If

Parameter	Value
	the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. **-s <status>** Specifies the waiting status, which is smpl, copy/rcpy, pair, psus, or psue/pdub. If two or more statuses are specified following -s, waiting is done according to the logical OR of the specified statuses. This option is valid when the -nowait option is not specified. **-ss <status>** Specifies the waiting status, which is "smpl", "copy/rcpy", "pair", "psus", or "psue" on S-VOL. If two or more statuses are specified following -ss, waiting is done according to the logical OR of the specified statuses. This option is valid when the -nowaits option is not specified. **-t <timeout> [interval]**: Specifies the interval of monitoring a status specified using the -s option and the time-out period in units of 1 sec. Unless [interval] is specified, the default value is used. This option is valid when the -nowait option is not specified. When value, 2,000,000 or more is specified for <timeout>, a warning message is displayed. **-nowait:** When this option is specified, the pair status at that time is reported without waiting. The pair status is set as a returned value for this command. When this option is specified, the t and s options are not needed. **-nowaits**: When this option is specified, the pair status on S-VOL at that time is reported without waiting. The pair status is set as a returned value for this command. When this option is specified, the -t and -ss options are not needed. **-l:** When this command cannot utilize a remote host for host down, this option executes this command by a local host only. The target volume of the local host can be P-VOL or S-VOL. **-nomsg:** Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
Returned values	When the -nowait option is specified: Normal termination: 1: The status is SMPL. 2: The status is COPY or RCPY. 3: The status is PAIR. 4: The status is PSUS. 5: The status is PSUE. When monitoring groups: 1/2/3/4/5 = normal termination for all pairs. Abnormal termination: Returns a common error code and a unique error code for this command. When the -nowaits option is specified: Normal termination: 1: The status is SMPL. 2: The status is COPY or RCPY. 3: The status is PAIR. 4: The status is PSUS. (SVOL_PSUS will be displayed as SSUS) 5: The status is PSUE. When monitoring groups: 1/2/3/4/5 = normal termination for all pairs. Abnormal termination: Returns a common error code and a unique error code for this command. When the -nowait option is not specified: Normal termination: 0. When monitoring groups, 0 = normal termination for all pairs Abnormal termination: Returns a common error code and a unique error code for this command For details on error codes, see Chapter 5.

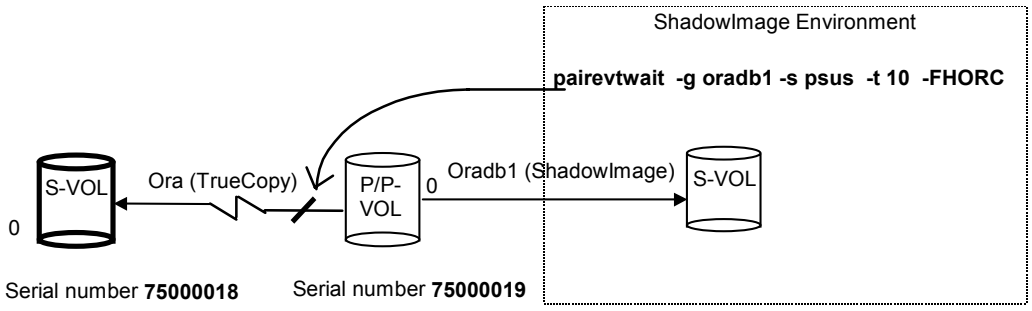


Figure 4.21 Example of -FHORC Option for Pairevtwait

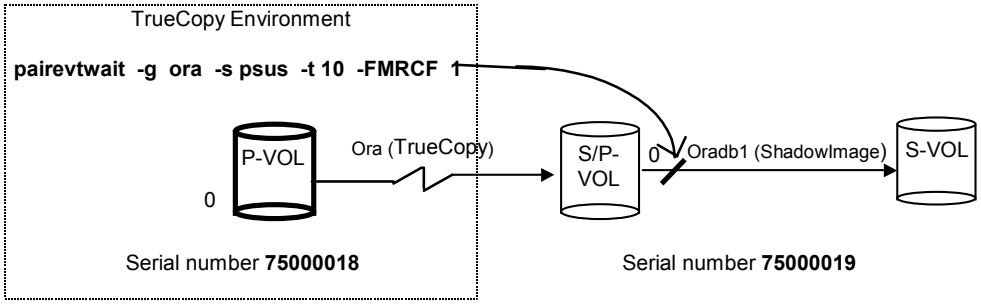


Figure 4.22 Example of -FMRCF Option for Pairevtwait

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

Figure 4.23 Pairevtwait Command

4.7 Monitoring Pair Activity (Pairmon)

The **pairmon** command, connected to the HORCM daemon, obtains the pair status transition of each volume pair and reports it. If the pair status changes (due to an error or a user-specified command), the pairmon command issues a message. Table 4.8 lists and describes the pairmon command parameters. Figure 4.24 shows an example of `pairmon` and its output. Table 4.9 lists the results of the command options.

The pair status transition events exist in the HORCM pair status transition queue. The `-resevt` option (reset event) deletes one/all events from the HORCM pair status transition queue. If reset event is not specified, the pair status transition queue is maintained. If the `-s` option is not specified, `pairmon` displays all events for which it receives information from HORCM. If the `-s` option is specified, only the specified status transitions are displayed.

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

Table 4.8 Pairmon Command Parameters

Parameter	Value
Command Name	pairmon
Format	pairmon { -h | -q | -z | -I[H | M][instance#] | -D | -allsnd | -resevt | -nowait | -s <status> ... }
Options	**-h:** Displays Help/Usage and version information. **-q:** Terminates the interactive mode and exits this command. **-z** or **-zx:** Makes the pairmon command enter the interactive mode. The **-zx** option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. **-D:** Selects the default report mode. In the default mode, if there is pair status transition information to be reported, one event is reported and the event is reset. If there is no pair status transition information to be reported, the command waits. The report mode consists of the three flags: -allsnd, -resevt, and -nowait options. **-allsnd:** Reports all events if there is pair status transition information. **-resevt:** Reports events if there is pair status transition information, then resets all events. **-nowait:** When this option is specified, the command does not wait when there is no pair status transition information. **-s <status> ...:** Specifies the pair status transition to be reported: smpl, copy (includes rcpy), pair, psus, psue. If two or more statuses are specified following -s, masking is done according to the logical OR of the specified statuses. If this option is not specified, pairmon displays all events which received information from HORCM

```
# pairmon  -allsnd   -nowait
Group Pair vol       Port    targ#   lun#    LDEV#…  Oldstat code -> Newstat code
oradb oradb1 CL1-A   1       5       5…      SMPL    0x00 -> COPY    0x01
oradb oradb2 CL1-A   1       6       6…      PAIR    0x02 -> PSUS    0x04
```

Figure 4.24 Pairmon Command

The output of the pairmon command includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair vol:** Shows the paired volume name (dev_name) in the specified group which is described in the configuration definition file.
- **Port targ# lun#:** Shows the port ID, TID, and LUN described in the configuration definition file. For further information on Fibre-to-SCSI address conversion, see Appendix D.
- **LDEV#:** Shows the TagmaStore LDEV ID for the specified device. LDEV indicates LU.
- **Oldstat:** Shows the old pair status when the status of the volume is changed.
- **Newstat:** Shows the new pair status when the status of the volume is changed.
- **Code:** Shows the TagmaStore-internal code for the specified status.

Table 4.9 Results of Pairmon Command Options

-D	-nowait	-resevt	-allsnd	Actions
-D				When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, it reports one event and resets the event which it reported.
Invalid			-allsnd	When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, it reports all events.
Invalid		-resevt		When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, it reports one event and resets all events.
Invalid		-resevt	-allsnd	When HORCM does not have an event, this option waits until an event occurs. If one or more events exist, it reports all events and resets all events.
Invalid	-nowait			When HORCM does not have an event, this option reports event nothing. If one or more events exist, it reports one event and resets the event which it reported.
Invalid	-nowait		-allsnd	When HORCM does not have an event, this option reports event nothing. If one or more events exist, it reports all events.
Invalid	-nowait	-resevt		When HORCM does not have an event, this option reports event nothing. If one or more events exist, it reports one event and resets all events.
Invalid	-nowait	-resevt	-allsnd	When HORCM does not have an event, this option reports event nothing. If one or more events exist, it reports all events and resets all events.

4.8 Checking Attribute and Status (Pairvolchk)

The **pairvolchk** command acquires and reports the attribute of a volume or group connected to the local host (issuing the command) or remote host. The volume attribute is SMPL (simplex), P-VOL (primary volume), or S-VOL (secondary volume). The **-s[s]** option reports the pair status in addition to the attribute. Table 4.10lists and describes the pairvolchk command parameters and returned values. Figure 4.27 shows an example of the pairvolchk command and its output. Table 4.11 shows the truth table for pairvolchk group status display.

Table 4.10 Pairvolchk Command Parameters

Parameter	Value
Command Name	pairvolchk
Format	pairvolchk { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -c | -ss | -nomsg }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the pair volume check command. -z or -zx: Makes the pairvolchk command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol> This option is used to specify the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specifying the -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -FHORC or -FCA: Specifies a cascading TrueCopy/TCE volume to be the subject of an operation regardless of a ShadowImage/TrueCopy/TCE environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not) (see example in Figure 4.25). If no -c option is specified, this option acquires the attributes of a cascading TrueCopy/TCE volume on a local host (near site). If the -c option is specified, this option acquires the attributes of a cascading TrueCopy/TCE volume on a remote host (far site). -FMRCF [MU#] or -FBC [MU#]: Specifies a cascading ShadowImage/SnapShot volume to be the subject of an operation regardless of a TrueCopy/TCE/ environment (i.e. whether ShadowImage/SnapShot HORCC_MRCF environment variable has been set or not) (see example in Figure 4.26). If no -c option is specified, this option acquires the attributes of a cascading ShadowImage/SnapShot volume on a local host (near site). If the -c option is specified, this option acquires the attributes of a cascading ShadowImage/SnapShot volume on a remote host (far site). -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specifying the -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -c: Checks the conformability of the paired volumes of the local and remote hosts and reports the volume attribute of the remote host. If this option is not specified, the volume attribute of the local host is reported. -ss: Used to acquire the pair status of a volume in addition to the volume attribute. If this option is not specified, only the volume attribute is reported. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
Returned values	When the -ss option is not specified: Normal termination: 1: The volume attribute is SMPL 2: The volume attribute is P-VOL 3: The volume attribute is S-VOL Abnormal termination: Returns a common error code and a unique error code for this command For details on error codes, see Chapter 5 When the -ss option is specified: Normal termination:

Parameter	Value
	11: The status is SMPL For TrueCopy 22: The status is PVOL_COPY or PVOL_RCPY 23: The status is PVOL_PAIR 24: The status is PVOL_PSUS25: The status is PVOL_PSUE 28 The status is PVOL_PFUS 32: The status is SVOL_COPY or SVOL_RCPY 33: The status is SVOL_PAIR 34: The status is SVOL_PSUS 35: The status is SVOL_PSUE 38 The status is SVOL_PFUS For TCE: 42: The status is PVOL_COPY 43: The status is PVOL_PAIR 44: The status is PVOL_PSUS 45: The status is PVOL_PSUE48: The status is PVOL_PFUS 52: The status is SVOL_COPY 53: The status is SVOL_PAIR 54: The status is SVOL_PSUS 55: The status is SVOL_PSUE58: The status is SVOL_PFUS Abnormal termination: Returns a common error code and a unique error code for this command For details on error codes, see Chapter 5

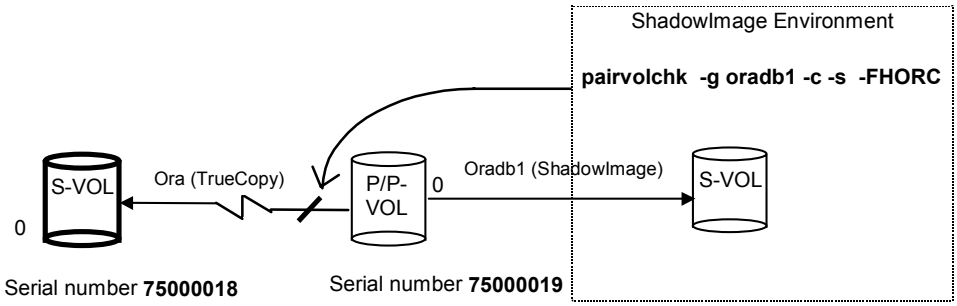


Figure 4.25 Example of -FHORC Option for Pairvolchk

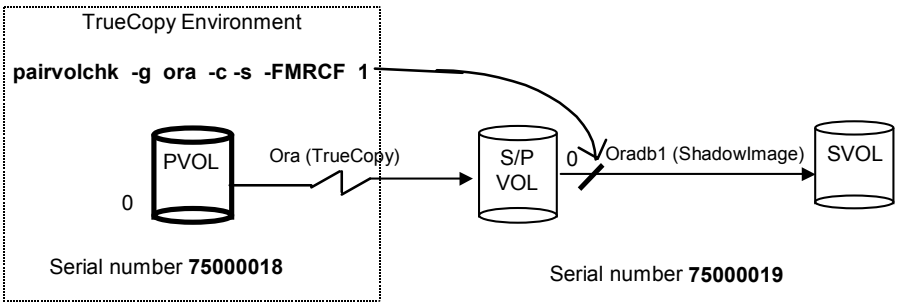


Figure 4.26 Example of -FMRCF Option for Pairvolchk

```
# pairvolchk  -g   ora
Pairvolchk : Volstat is S-VOL.[status = PAIR fence = ASYNC CTGID = 5 MINAP = 2 ]
```

Figure 4.27 Pairvolchk Command

Table 4.11 Truth Table for Pairvolchk Group Status Display

	Status of Each Volume in the Group					
Option	**COPY***	**PSUE**	**PFUS**	**PSUS**	**PAIR**	**Group Status**
Note*	TRUE	x	x	x	x	COPY*
	false	TRUE	x	x	x	PSUE
	false	false	TRUE	x	x	PFUS
	false	false	false	TRUE	x	PSUS
	false	false	false	false	TRUE	PAIR
-ss	TRUE	x	x	x	x	COPY*
	false	TRUE	x	x	x	PSUE
	false	false	x	x	TRUE	PAIR
	false	false	TRUE	false	false	PFUS
	false	false	false	TRUE	false	PSUS

Note:* This option can be executed when the pairvolchk –s command has a USE_OLD_VCHK environment variable.
COPY*: COPY or RCPY
x = true or false (does not matter).

Note:* The pairvolchk -s command is executed with the setting of the environmental variable of USE_OLD_VCHK

4.9 Displaying Pair Status (Pairdisplay)

The `pairdisplay` command displays the pair status; this allows you to verify that pair operations are complete (e.g., paircreate, pairresync). The `pairdisplay` command is also used to confirm the configuration of the pair connection path (the physical link of paired volumes and servers). The `pairdisplay` command can be used for a paired volume or a group of paired volumes. Table 4.12 lists and describes the `pairdisplay` command parameters and returned values. Figure 4.28 shows examples of the `pairdisplay` command and its output.

Note: During the period until the response of the command is returned after the pair status change command such as pairsplit is executed, the `pairdisplay` command cannot be executed in the same screen. Therefore, start another screen and execute `pairdisplay` to check the pair status.

Table 4.12 Pairdisplay Command Parameters

Parameter	Value
Command Name	pairdisplay
Format Options	pairdisplay { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -FHORC | -FMRCF [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -c | -l | -f[xcd] | -CLI -v smk | -m <mode> }- h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the pair volume check command. -z or -zx: Makes the pairdisplay command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: This option is used to specify the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -FHORC or -FCA: Specifies a cascading TrueCopy/TCE volume to be the subject of an operation regardless of a ShadowImage/TrueCopy/TCE environment (i.e. whether ShadowImage HORCC_MRCF environment variable has been set or not. If the -l option is specified, this option displays status of a cascading TrueCopy/TCE volume on a local host (near site). If no -l option is specified, this option displays status of a cascading TrueCopy/TCE volume on a remote host (far site). This option cannot be specified with -m <mode> option on the same command line. -FMRCF [MU#] or –FBC [MU#]: Specifies a cascading ShadowImage volume to be the subject of an operation regardless of a TrueCopy/TCE environment (i.e. whether ShadowImage/Snapshot HORCC_MRCF environment variable has been set or not). If the -l option is specified, this option displays status of a cascading ShadowImage/SnapShot volume on a local host (near site). If no -l option is specified, this option displays status of a cascading ShadowImage/SnapShot volume on a remote host (far site). This option cannot be specified with -m <mode> option on the same command line. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed

Parameter	Value
	as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -c: Checks the configuration of the paired volume connection path (physical link of paired volume among the servers) and displays illegal pair configurations. If this option is not specified, the status of the specified paired volume is displayed without checking the path configuration. -l: Displays the paired volume status of the local host (which issues this command). -fc: Displays the copy operation progress (or the pair consistency rate), and whether the use rate of the data pool has reached its threshold. Used to confirm the SSWS state as indication of SVOL_SSUS-takeover after. This option also shows the PFUS status of the Snapshot pairs. -fx: Displays the LDEV ID as a hexadecimal number. -fd: Displays the group-based device file of the configuration file registered in HORCM and the relation between the groups. If Unknown is displayed in the DEVICE_FILE shown below, the pair operation (except for the local option) is rejected as protection mode because the volume is not registered. *Example:* # pairdisplay –g oradb –fd Group PairVol(L/R) Device_File M,Seq#, LDEV#.P/S, Status, Seq#, P-LDEV# M oradb oradb1(L) c0t3d0 0 75005013 17.P-VOL COPY,75005013 18 - oradb oradb1(R) Unknown 0 75005013 ****.------ -------, ------ ----- - -fe:Displays discrimination between a SnapShot volume and a ShadowImage volume and a number of active link paths, etc. by adding them as the last column. The 80-column format of 80 is neglected. --CLI: Used to specify display for command line interface (CLI). This option displays to the same position that defined number of columns, and displays one header. The delimiters between columns are displayed as spaces or hyphens (-). *Display example:* # pairdisplay –g homrcf1 -CLI Group PairVol L/R Port# TID LU-M Seq# LDEV# P/S Status Seq# P-LDEV# M
Returned Valus	homrcf1 deva0 L CL1-A 3 5 0 75003005 5 P-VOL PAIR 75003005 3 - homrcf1 deva1 L CL1-A 3 5 0 75003005 5 SMPL - - - - homrcf1 deva2 L CL1-A 3 5 0 75003005 5 SMPL - - - - -v smk (for SnapShot):This option displays the time (UTC) when the Split-Marker (a character string with 31 or less characters) is added to the V-VOL and the Split-Marker as an execution result only for the SnapShot pair that has been split by the pairsplit –mscas command. -m <mode>: Used to display a paired status of each mirror descriptors for the specified pair logical volume, and used for paired status indication of the cascading volume. <mode> option can be designated all (see Figure 4.29): all option is used to display a paired status of all mirror descriptors (MU#). 1: The volume attribute is SMPL. 2: The volume attribute is P-VOL. 3: The volume attribute is S-VOL. When displaying groups, 1/2/3 = normal termination for all pairs. Abnormal termination (other than 0 to 127): refer to the execution log files for error details

```
# pairdisplay  -g oradb
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
oradb   oradb1(L)    (CL1-A , 1,   1 )75003005     1.P-VOL COPY Never,75003006      19 -
oradb   oradb1(R)    (CL1-B , 2,   1 )75003006     1.S-VOL COPY Never,-----      18 -
```

Figure 4.28 TrueCopy/TCE Pairdisplay Command

The output of the pairdisplay command includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair Vol(L/R):** Shows the paired volume name (dev_name) described in the configuration definition file. (L) indicates the local host; (R) indicates the remote host.
- **(Port#,TID,LU) (TrueCopy/TCE):** Shows the port number, target ID and LU number as described in the configuration definition file.
- **(Port#,TID,LU-M) (ShadowImage/SnapShot):** Shows the port number, target ID, LU number, and MU number as described in the configuration definition file.
- **Seq#:** Shows the serial number of the TagmaStore subsystem.
- **LDEV#:** Shows the logical device number. LDEV indicates LU.
- **P/S:** Shows the volume attribute.
- **Status:** Shows the status of the paired volume.
- **Fence (for TrueCopy/TCE):** Shows fence level.
- **%:** Shows copy operation completion or percent pair synchronization.

State	TrueCopy			TCE			ShadowImage/SnapShot		
VOL.	COPY	PAIR	OTHER	COPY	PAIR	OTHER	COPY	PAIR	OTHER
P-VOL	CR	BMP	BMP	CR	UnBMP	BMP	CR	CR	CR
S-VOL	-	BMP	BMP	-	UnBMP	BMP	CR	CR	CR

  - **CR:** Shows the copy operation rate (identical rate of a pair).
  - **BMP:** Shows the identical percentage of BITMAP both P-VOL and S-VOL.
  - **UnBMP**: Shows the inconsistent percentage of BITMAP both P-VOL and S-VOL.
  - When `paircreate` or `pairresync` is executed, the pair undergoes the full copy or differential copy in the COPY status, undergoes the cyclic copy once, and then placed in the PAIR status. When a new pair is added to a CTG, which is already placed in the PAIR status, by `paircreate` or `pairresync` , the copy operation halts until the time of the existing cyclic copy after the full copy or differential copy is completed. Further, it is not placed in the PAIR status until the first cyclic copy is completed after it begins to act in time to the cycle. Therefore, the pair synchronization rate displayed by Storage Navigator Modular or CCI may be 100% or not changed when the pair status is COPY.
- **P-LDEV#:** Shows the LDEV number of the partner volume of the pair.
- **M:** Shows the following:
  - **M = W** (PSUS only): For P-VOLs, shows suspension with the S-VOL read/write enabled. For S-VOLs, shows that write I/Os were accepted at the S-VOL.
  - **M = N** (COPY, PAIR, PSUE, PSUS only): Shows that read access is disabled. At this time, make sure of the pair, which is displayed by Storage Navigator Modular, status of which is PSUS (PSUS(N)), and no reading/writing from/to which is allowed.

Figure 4.29 shows examples of the -m option of the `pairdisplay` command.

Display examples for -m all:

```
# pairdisplay -g oradb -m all
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   (CL1-A , 3,   0-0 )75003005     0.SMPL ----, ----   ---- -
oradb   oradev1(L)   (CL1-A , 3,   0-0 )75003005     0.P-VOL PAIR,75003005      26 -
oradb1  oradev11(R) (CL1-A , 3,   2-0 )75003005     2.P-VOL COPY,75003005      27 -
oradb   oradev1(R)   (CL1-A , 3,   2-0 )75003005     2.S-VOL COPY, -----      25 -
# pairdisplay -d /dev/rdsk/c0t3d0 -l -m all
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb   oradev1(L)   (CL1-A , 3,   0-0 )75003005     0.SMPL  ----, ----   ---- -
oradb   oradev1(L)   (CL1-A , 3,   0-0 )75003005     0.P-VOL PAIR,75003005      26 -
```

Figure 4.29 Pairdisplay Command -m Option

Figure 4.30 and Figure 4.31 show examples of the **-fe** option of the `pairdisplay` command.

```
# pairdisplay -g vg01 -fe
Group   PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M CTG CM EM
E-Seq# E-LDEV#
vg01    oradb1()    (CL1-A , 1,   5-0 )75000004     5.P-VOL PSUS,75000004       6 W   -  S
-    -      -
vg01    oradb1(R)    (CL1-A , 1,   6-0 )75000004     6.S-VOL PSUS,-----       5 -   -  S  -
-      -
vg01    oradb2(L)    (CL1-A , 1,   2-0 )75000004     2.P-VOL PSUS,75000004       3 W   -  N
-    -      -
vg01    oradb2(R)    (CL1-A , 1,   3-0 )75000004     3.S-VOL PSUS,-----       2 -   -  N  -
-      -
```

Figure 4.30 Pairdisplay Command –fe Option (ShadowImage/SnapShot)

```
# pairdisplay -g vg01 -fe
Group   PairVol(L/R) .... P-LDEV#  M CTG JID AP EM E-Seq# E-LDEV#
vg01    oradb1(L)    ....   1      -  -   -  2   -  -      -
vg01    oradb1(R)    ....   1      -  -   -  2   -  -      -
```

Figure 4.31 Pairdisplay Command -fe Option (TrueCopy/TCE)

The output of the `pairdisplay` command includes:

- **CTG**:Shows the CTG group ID of SnapShot.
- **JID**:Shows -
- **AP:**Shows the number of active link paths of TrueCopy/TCE on the P-VOL.:
  - **CM:**Shows copy mode
    N: Non-snap shot volume (ShadowImage)
    S: Snap shot volume (SnapShot)
- **EM, E-Seq#, E-LDEV#**:Shows "-"

```
# pairdisplay -g vg01 -v smk
Group   PairVol(L/R)  Serial# LDEV# P/S Status UTC-TIME -----Split-Maker-----
vg01    oradb1(L)      75000004       5 P-VOL PSUS   -         -
vg01    oradb1(R)      75000004       6 S-VOL SSUS   123456ef QS_Check_12345678
```

Figure 4.32 Pairdisplay Command –v smk Option (SnapShot)

The output of the pairdisplay command includes:

- **UTC-TIME**:

  The UTC when the Split-Marker was added to the V-VOL is displayed.

- **Split-Marker:**

  The Split-Marker added to the V-VOL is displayed. When the pair concerned is the SnapShot pair that was split by the pairsplit –mscas command, the Split-Marker is displayed as information on the V-VOL.

4.10 Checking TrueCopy/TCE Pair Currency (Paircurchk)

The TrueCopy/TCE `paircurchk` command checks the currency of the TrueCopy/TCE secondary volume(s) by evaluating the data consistency based on pair status and fence level.

Table 4.13 specifies the data consistency for each possible state of a volume. A paired volume or group can be specified as the `paircurchk` target; the default command target is an S-VOL. If `paircurchk` is specified for a group, the data consistency of each volume in the group is checked, and all inconsistent volumes are found in the execution log file and displayed. `Paircurchk` is also executed as part of the TrueCopy/TCE horctakeover command (see section 4.11).

The TrueCopy/TCE supports the paircurchk command. Paircurchk may be executed in the cases where it is performed by the user specification and the SVOL_Takeover processing by `horctakeover`.

Table 4.13 Data Consistency Displayed by Paircurchk Command

Object Volume		Paircurchk		
Attribute	Status	Fence	User Specification	SVOL_Takeover Processing
SMPL	-	-	To be confirmed	(Not executed)
P-VOL	-	-	To be confirmed	(Not executed)
S-VOL	COPY	Data	Inconsistent	Inconsistent
		Never		
		Async		
	PAIR	Data	OK	OK
		Never	To be analyzed	To be analyzed
		Async	To be analyzed	OK
	PSUS	Data	Suspected	Suspected
		Never		
		Async		
	PSUS(N)	Async	Suspected	Inconsistent
	PFUS	Async	Suspected	OK
	PSUE	Data	OK	OK
		Never	Suspected	Suspected
		Async		OK
	SSWS	Async	Suspected	(Not executed)

Notes:

- **To be confirmed** = It is necessary to check the object volume, since it is not the secondary volume.
- **Not Consistent** = Data in the volume is not consistent because it was being copied. Therefore the SVOL-takeover is not executed.
- **To be analyzed** = Whether S-VOL has a mirror consistency or not cannot be judged by the status of S-VOL. If the status of P-VOL is PAIR, the mirror consistency is OK. If the status of P-VOL is PSUS or PSUE, the mirror consistency is suspected.
- **Suspected** = S-VOL has no mirror consistency.
- **OK** = Mirroring consistency is assured in TrueCopy. Mirroring consistency is not assured in TCE.

Table 4.14 Paircurchk Command Parameters

Parameter	Value
Command Name	paircurchk
Format	paircurchk { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -nomsg }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the pair volume check command. -z or -zx: Makes the pairvolchk command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. For TCE, the horctakeover command is executed for each CTG, however, the paircurchk command is executed for the specified group. -d <pair Vol>: This option is used to specify the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
Returned values	Normal termination: 0 Abnormal termination: Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

```
# paircurchk  -g  oradb
paircurchk : Volume currency error.
Group  Pair vol  Port  targ# lun# LDEV#...P/S  Status  Fence   To be...
oradb  oradb1    CL1-A  1    5       30...SMPL ...     ...     Confirmed
paircurchk: [EX_VOLCUR] S-VOL currency error
```

Figure 4.33 Paircurchk Command

The output of the paircurchk command includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair Vol:** Shows the paired volume name (dev_name) described in the configuration definition file.
- **Port#, targ#, lun#:** Shows the port number, target ID, and LU number as described in the configuration definition file.

- **LDEV#:** Shows the logical device number. LDEV indicates LU.
- **P/S:** Shows the volume attribute.
- **Status:** Shows the status of the paired volume.
- **Fence:** Shows the fence level.
- **To be...:** Evaluating the mirror consistency of S-VOL shows the currency of the volume.

4.11 Performing TrueCopy/TCE Takeover Operations (Horctakeover)

Notes:

- When the horctakeover command is issued from a host (either on the local or remote site) then if an IO is active against the P-VOL at the same time, then the P-VOL is placed in the PSUE status; the S-VOL at the same time is placed in PSUS status(SSWS) and as such can accept IOs.
- When the horctakeover command is issued to a remote disk system, the SWAP-Takeover may fail and terminate in the SVOL-Takeover status due to a load of the other CCI command on the local disk system added to a load of the horctakeover command. However, the S-VOL stays in the PSUS status (SSWS) and reading/writing from/to it can be performed. A swap between a primary and secondary volume can be performed after statuses of the local and remote disk systems are checked and the pairresync -swaps command is executed for the remote disk system.
- When the –d option is specified in the case of TCE, only an S-VOL of the target pair is placed in the SSWS status. Besides, at this time, all the other pairs in the same CTG are not kept paired. When a P-VOL was in the PAIR status before the command was accepted, it is placed in the PSUE status because the pair created of it and an S-VOL is split forcibly. On the other hand, statuses of the other S-VOLs in the CTG are not changed and kept as PAIR because the communication from the primary subsystem is cut off.

The horctakeover command is a scripted command for executing several HORC operations. The horctakeover command checks the specified volume's or group's attributes (paircurchk), decides the takeover function based on the attributes, executes the chosen takeover function, and returns the result. The four TrueCopy takeover functions designed for HA software operation are: takeover-switch, swap-takeover, PVOL-takeover, and SVOL-takeover. TCE takeover function designed for HA software operation is SVOL-takeover only. A paired volume or a group can be specified as the target of the TrueCopy/TCE horctakeover command. If TrueCopy/TCE SVOL-takeover is specified for a group, the data consistency check is executed for all volumes in the group, and all inconsistent volumes are found in the execution log file and displayed (same as paircurchk command).

The horctakeover command allows swapping of the primary and secondary volumes, so that if the primary or secondary volume is switched due to a server error or package transfer, duplex operations can be continued using the reversed volumes. When control is handed over to the current node, swapping the volumes again deletes the need to copy them. The horctakeover command also allows the secondary volume to be separated for disaster recovery operations.

Table 4.15 lists and describes the TrueCopy/TCE horctakeover command parameters and returned values.

Table 4.15 Horctakeover Command Parameters

Parameter	Value
Command Name	horctakeover
Format	horctakeover { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] |-S | -I | -t<timeout> | -nomsg }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the pair volume check command. -z or -zx: Makes the pairvolchk command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies the group name defined in the configuration definition file. This option must always be specified. The command is executed for the specified group unless the -d <pair Vol> option is specified. -d <pair Vol>: This option is used to specify the paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of -g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -S: Selects and executes SVOL-takeover. The target volume of the local host must be an S-VOL. If this option is specified, then the following -I option is invalid. -I: Enables read and write to the primary volume(s) by a local host only without a remote host, and executes PVOL-takeover when the primary volume cannot be used because it is fenced (fence = DATA, state = PSUE, or PSUE volume is contained in the group). If the primary volume can be accessed, nop-takeover is executed. The target volume of the local host must be a P-VOL. **-t<timeout>**: Must be specified for async volumes only (TCE), ignored for sync. Specifies the maximum time to wait (in seconds) for swap-takeover and SVOL-takeover operation to synchronize the P-VOL and S-VOL. If this timeout occurs, the horctakeover command fails with EX_EWSTOT. To avoid timeout, set this value less than or equal to the start-up timeout value of the HA Control Script. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
Returned values	Normal termination: 0: Nop-takeover (no operation) 1: Swap-takeover was successfully executed 2: SVOL-takeover was successfully executed 3: PVOL-SMPL-takeover was successfully executed 4: PVOL-PSUE-takeover was successfully executed 5: SVOL-SSUS-takeover was successfully executed Abnormal termination: Other than 0-5, Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

Note: During TrueCopy/TCE pair operation, a pair operation can fail when a host has a high volume of I/Os or when pair status is changed frequently on both the local and remote subsystems. If pair operation fails and a state transition is not done, retry the pair operation. (pairvolchk command can be used to check the state transition). If a pair operation partially fails when doing a pair operation by groups, the pair operation needs to be done per each pair logical volume within that group.

4.11.1 Horctakeover Command Functions

4.11.1.1 Takeover-Switch Function

The control scripts activated by the HA software are used the same way by all nodes of a cluster; they do not discriminate between primary and secondary volumes. The horctakeover command, when activated by a control script, checks the combination of attributes of the local and remote volumes and determines the proper takeover action.

Table 4.16 lists the volume attributes and specifies the TCE takeover action for each combination of attributes.

TCE does not support the swapping function; the function that is supported by the horctakeover command is the SVOL-Takeover only. ShadowImage and SnapShot do not support the command.

Table 4.16 Volume Attributes and Takeover Actions (TrueCopy)

Local Node (Takeover Node)		Remote Node		
Volume Attribute	**Fence Level and Status**	**Volume Attribute**	**P-VOL Status**	**Takeover Action**
SMPL	--	SMPL	--	NG[1]
		P-VOL	--	Nop-Takeover[2]
		S-VOL	--	Volumes not conform[3]
		Unknown[4]	--	NG
P-VOL (primary)	Fence = Data and Status = PSUE	SMPL	--	NG
		P-VOL	--	Volumes not conform
		S-VOL	--	PVOL-Takeover
		Unknown Status (e.g. LAN down)	--	PVOL-Takeover
	Fence = Never or Status = others	SMPL	--	NG
		P-VOL	--	Volumes not conform
		S-VOL	--	Nop-Takeover
		Unknown Status (e.g. LAN down)	--	Nop-Takeover
S-VOL (secondary)	Status = SSWS[5] After SVOL_SSUS-takeover	Any	--	Nop-Takeover
	Others	SMPL	--	Volumes not conform
		P-VOL	PAIR	Swap-Takeover
			Others	SVOL-Takeover
		S-VOL	--	Volumes not conform
		Unknown	--	SVOL-Takeover

Table 4.17 Volume Attributes and Takeover Actions (TCE)

Local Node (Takeover Node)		Remote Node		
Volume Attribute	**Fence Level and Status**	**Volume Attribute**	**P-VOL Status**	**Takeover Action**
SMPL	-	SMPL	-	NG [1]
		P-VOL	-	Nop-Takeover [2]
		S-VOL	-	Volumes not conform [3]
		Unknown [4]	-	NG
P-VOL (primary)	Fence = Async	SMPL	-	NG
		P-VOL	-	Volumes not conform
		S-VOL	-	Nop-Takeover
		Unknown	-	Nop-Takeover
S-VOL (secondary)	Fence = Async and Status = SSWS	-	-	Nop-Takeover
	Fence = Async and Status = PSUS(N)	-	-	NG
	Fence = Async and Status = COPY	-	-	NG
	Others	SMPL	-	Volumes not conform
		P-VOL	PAIR	SVOL-Takeover
			Others	SVOL-Takeover Notes 2
		S-VOL	-	Volumes not conform
		Unknown	-	SVOL-Takeover Notes 2

Notes:

- **NG:** The takeover command is rejected, and the operation terminates abnormally.
- **Nop-Takeover:** The takeover command is accepted, but no operation is performed.
- **Volumes not conform:** The volumes are not in sync, and the takeover command terminates abnormally.
- **Unknown:** The remote node attribute is unknown and cannot be identified. The remote node system is down or cannot communicate.
- **SSWS:** Suspend for Swapping with S-VOL side only. The SSWS state is displayed as SSUS (SVOL_PSUS) by ALL commands except the -fc option of the pairdisplay command.

Notes 2: When the attribute of the self-node volume is SSUS, the target displays the NG message but the status changes to SSWS.

4.11.1.2 Swap-takeover Function (TrueCopy only)

When the P-VOL status of the remote node is PAIR and the S-VOL data is consistent, it is possible to swap the primary and secondary volumes. Therefore, when the P-VOL status of the remote node is PAIR, the swap-takeover function can be executed. The swap-takeover function is used by the HA control script when a package is manually moved to an alternate data center while all hardware is operational. Swap-takeover can be specified for a paired volume or a group.

The swap-takeover function internally executes the following commands to swap the primary and secondary volumes:

1. Execute **Suspend for Swapping** for the local volume (S-VOL). If this step fails, swap-takeover is disabled and an error is returned.
2. Execute **Resync for Swapping** to switch to the primary volume for which the local volume (S-VOL) is swapped as the NEW_P-VOL. Re-synchronizes the NEW_S-VOL based on the NEW_P-VOL. As for copy pace, if the remote host is known, the command will use the value of P-VOL specified at paircreate time. If the remote host is unknown, the command will use the default number of pace (three). If this step fails, swap-takeover returns at **SVOL-SSUS-takeover**, and the local volume (S-VOL) is maintained in SSUS(PSUS) state which allows and keeps track of write I/Os using a bitmap for the S-VOL This special state is displayed as **SSWS**, using the **-fc** option of the pairdisplay command.

Note: The swap-takeover function does not use **SMPL** or **No Copy** mode for swapping to guarantee mirror consistence. This is included as a function of SVOL-takeover.

4.11.1.3 SVOL-takeover Function (TrueCopy/TCE)

The SVOL-takeover function allows the takeover node to use the secondary volume (except in COPY state) in SSUS(PSUS) state (i.e., reading and writing are enabled), on the assumption that the remote node (possessing the primary volume) cannot be used. The data consistency of the TrueCopy/TCE S-VOL is evaluated by its pair status and fence level (same as paircurchk). If the primary and secondary volumes are not consistent, the SVOL-takeover function fails. If primary and secondary volumes are consistent, the SVOL-takeover function attempts to switch to the primary volume using **Resync** for **Swapping**. If successful, the SVOL-takeover function returns **Swap-takeover** as the return value of the horctakeover command. If not successful, the SVOL-takeover function returns **SVOL-SSUS-takeover** as the return value of the horctakeover command. In case of a host failure, **Swap-takeover** is returned. In case of P-VOL site failure, **SVOL-SSUS-takeover** is returned. Because TCE does not succeed in the Swap-Takeover, **SVOL-SSUS-takeover** is returned as a response and the S-VOL status is changed to SSWS.

SVOL-takeover can be specified for a paired volume or a group. If the SVOL-takeover is specified for a group, a data consistency check is executed for all volumes in the group, and all inconsistent volumes are displayed.

4.11.1.4 PVOL-takeover Function (TrueCopy only)

The PVOL-takeover function releases the pair state as a group, since that maintains the consistency of the secondary volume at having accepted horctakeover command when the primary volume is fenced (data and PSUE state, PSUE volume are contained in the group). This function allows the takeover node to use the primary volume (i.e., reading and writing are enabled), on the assumption that the remote node (possessing the secondary volume) cannot be used. PVOL-takeover can be specified for a paired volume or a group.

The PVOL-takeover function executes the following two commands:

- **PVOL-PSUE-takeover:** Changes the primary volume to the suspend (PSUE, PSUS) state which enables write I/Os to all primary volumes of the group. The action of the PVOL-PSUE-Takeover causes PSUE and/or PSUS to be intermingled in the group. This intermingled pair status is PSUE as the group status; therefore, pairvolchk command returned gives priority to PSUE rather than PSUS as the group status. This special state turns back to the original state when the pairresync command is issued.
- **PVOL-SMPL-takeover:** Changes the primary volume to the simplex (SMPL) state. First, PVOL-takeover executes PVOL-PSUE-takeover further than PVOL-SMPL-takeover. If the PVOL-PSUE-takeover function fails, the PVOL-SMPL-takeover function is executed.

4.11.2 Applications of Horctakeover Command

The basic TrueCopy/TCE commands (takeover, pair creation, pair splitting, pair resynchronization, event waiting) can be combined to enable recovery from a disaster, backup of paired volumes, and many other operations (e.g., restoration of paired volumes based on the secondary volume, swapping of the paired volumes). Figure 4.34 illustrates the flow of starting operations on a UNIX server at the secondary site using the TrueCopy/TCE TagmaStore takeover command. Figure 4.35 illustrates the flow of starting operations on a Windows NT/2000/ Windows Server 2003 server at the secondary site using the TrueCopy/TCE horctakeover command.

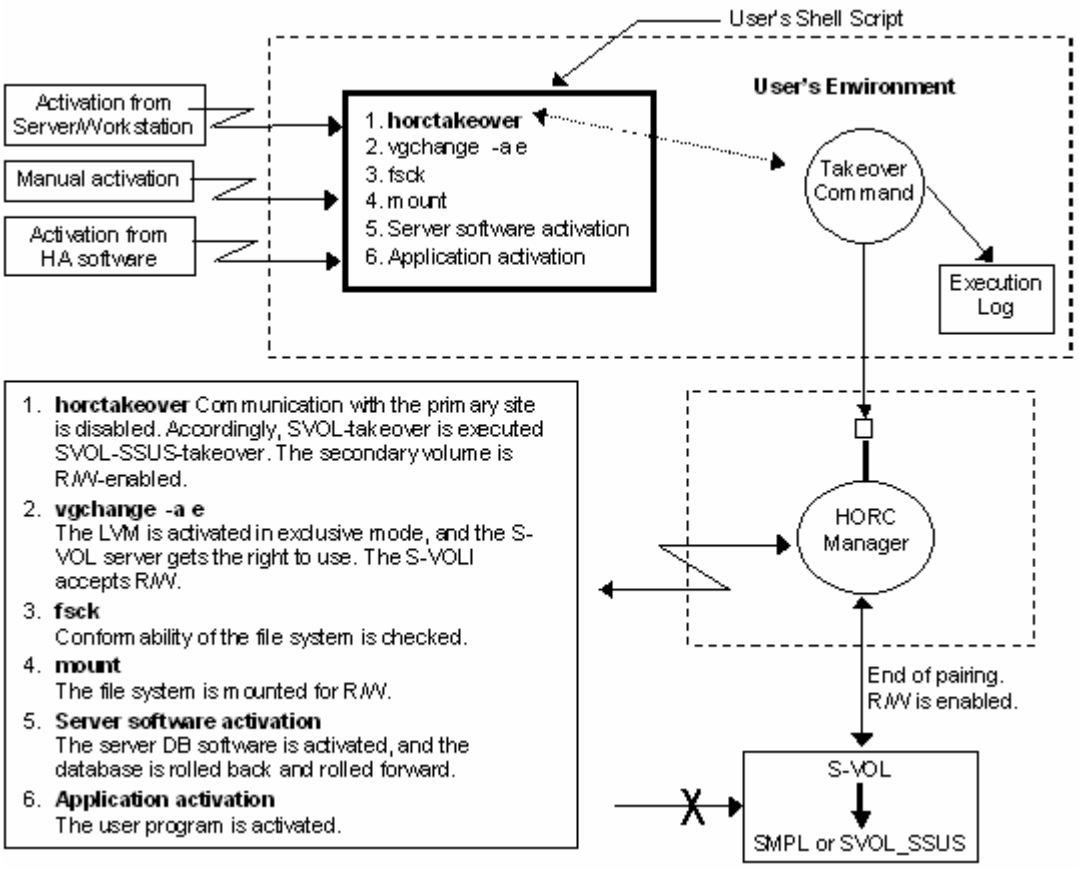


Figure 4.34 Application/Example of TrueCopy/TCE Takeover (UNIX- based system)

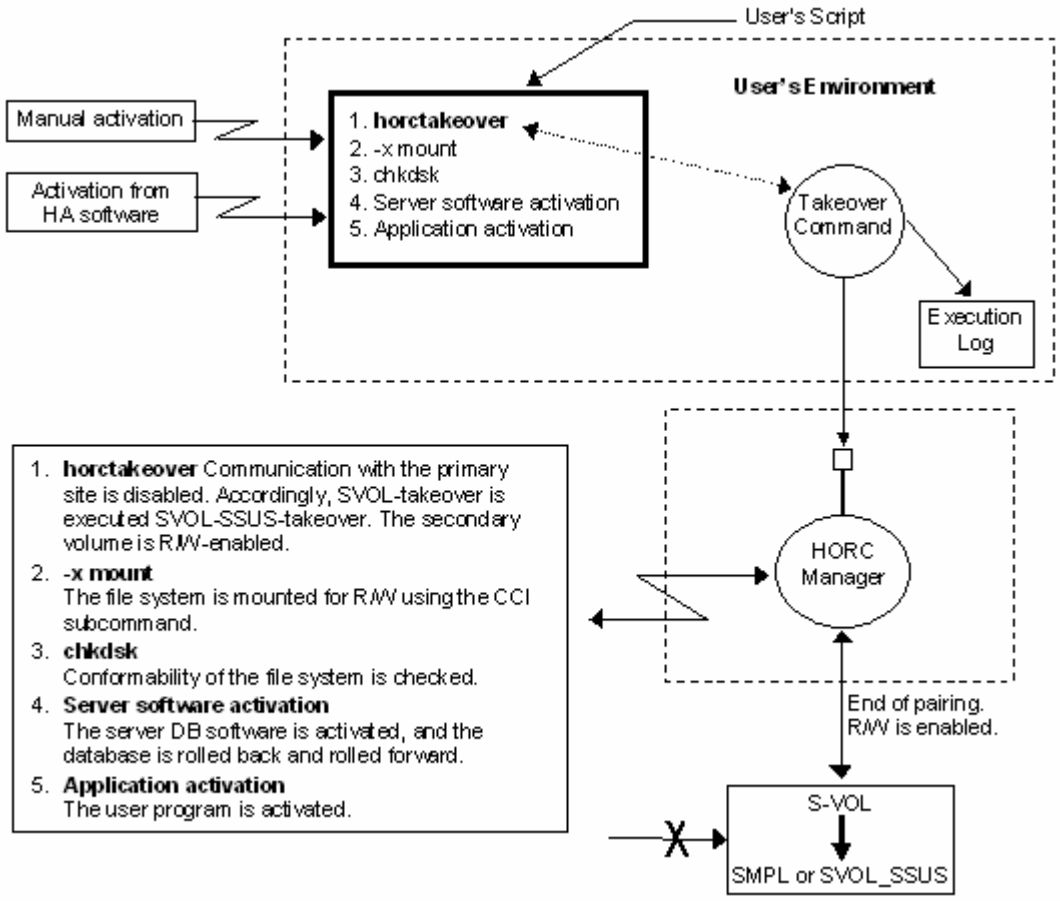


Figure 4.35 Application/Example of TrueCopy/TCE Takeover (Windows-based system)

4.12 Displaying Configuration Information

4.12.1 Raidscan Command

The `raidscan` command displays configuration and status information for the specified TagmaStore port/TID(s)/device(s). The information is acquired directly from the TagmaStore subsystem (not the configuration definition file). Table 4.18 lists and describes the raidscan command parameters. Figure 4.36 to Figure 4.42 list examples of the raidscan command and its output. Note that LDEV indicates LU.

Table 4.18 Raidscan Command Parameters

Parameter	Value
Command Name	raidscan
Format	raidscan { -h | -q | -z | -I[H | M][instance#] | -p <port> [hgrp] | -pd[g] <raw_device> | -s <Seq#> | -t <targ> | -l <lun> | [-f[xfgde]] | -CLI | -find[g] [op] [MU#] [-g group] | -pi <strings> -m<mun> }

Options	-h: Displays Help/Usage and version information.
	-q: Terminates the interactive mode and exits the command.
	-z or -zx: Makes the raidscan command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates.
	-I[H | M][instance#] or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1.
	-p <port> [hgrp]: Specifies the port ID of the TagmaStore port to be scanned. Valid ports are CL1-A to CL1-D. and CL2-A to CL2-D. This option must always be specified. [hgrp] is specified to display only the LDEVs mapped to a host group on a port for TagmaStore.
	-pd[g] <raw_device>: Specifies the raw device name. This option finds Seq# and port_name of the TagmaStore that the specified device can be connected, and scans the port of the TagmaStore which corresponds with the unit ID that searches the unit ID from Seq# . This option must always be specified. The –pdg is specified to find the host storage domain (host group) and display LUN.
	-s <Seq#>: Used to specify the Seq# of the TagmaStore when this option can't specify the unit ID which is contained for -p <port> option. This option scans the port specified by -p <port> option of the TagmaStore which corresponds with the unit ID that searches the unit ID from Seq#. If this option is specified, then the unit ID which is contained in -p <port> option is invalid.
	-t <targ>: Specifies a target ID (0 to 15) of the specified port. If this option is not specified, the command applies to all target IDs.
	-l <lun>: Specifies a LUN (0 to 7) of the specified target ID. If this option is not specified, the command applies to all LUNs. If this option is specified, the TID must also be specified.
	-fx: Displays the LDEV number in hexadecimal notation.
	-f or -ff: Specifies display of volume-type for a display column. If this option is specified, then the following -fg and –fd option are invalid.
	-fg: Specifies display of group_name for a display column. This option searches a group on the configuration definition file (local CCI instance) from the scanned LDEV, and displays a group_name when the scanned LDEV is contained in the group. If this option is specified, the -f[f] option is excluded. If this option is specified, the –fd option is invalid.
	-fd: Displays the device file registered in HORCM. This option is invalid when the –ff or –fg option is specified.
	-fe: This option displays a device serial number and a volume managing number of the other device to which an external LUN is mapped. When no external LUN exists on the specified port, nothing is displayed. *Display example:*
	`Port# /ALPA/C TID# LU# Seq# Num LDEV# P/S Status Fence E-Seq# E-LDEV#`
	`CL1-A ef 0 0 48 75003005 2 256 SMPL - - 75003006 17`
	`CL1-A ef 0 0 49 75003005 2 272 SMPL - - 75003006 23`
	`CL1-A ef 0 0 50 75003005 1 288 SMPL - - 75003006 28`

Parameter	Value

	CLI: Specifies display for command line interface (CLI). This option displays to the same position that defined number of columns, and displays one header. The delimiters between columns are displayed as spaces or hyphens (-). *Display example:*
	
	`Port# TargetID# Lun#  Seq#  Num LDEV#  P/S    Status  P-Seq#  P-LDEV#`
	`CL1-A    1       0    75003005   1    0    SMPL      -      -       -`
	`CL1-A    2       2    75003005   1    2    P-VOL   PAIR    75003005     26`
	`CL1-A    2       3    75003005   1    3    P-VOL   PAIR    75003005     27`
	
	-pi<strings>: Used to change the STDIN of the –find option to argument input. If this option is specified, the STDIN becomes invalid. Specify <strings> in less than or equal to 255 characters.
	
	-find [op] [MU#]: Executes the operation specified in [op] using a special file (raw device file) provided via STDIN. If the –pi <strings> option is specified, the STDIN becomes invalid and changes to <strings>. Restriction: Special files via STDIN are specified in the following ways:
	
	HP-UX® systems: /dev/rdsk/*, /dev/rdisk/disk*
	Solaris™ systems: /dev/rdsk/*s2, c*s2
	AIX® systems: /dev/rhdisk*, /dev/hdisk*,hdisk*
	Linux® systems: /dev/sd*, /dev/rd*, /dev/raw/raw*
	Tru64 UNIX® systems: /dev/rdisk/dsk*c
	IRIX® systems: /dev/rdsk/*vol, /dev/rdsk/node_wwn/*vol/*, /dev/dsk/*vol,
	/dev/dsk/node_wwn/*vol/*
	Windows NT® systems: hd0-10, harddisk0, harddisk1...(numbers indicate the drive number)
	$LETALL, $Phys, D:\DskX\pY, \DskX\pY
	Windows® 2000/Windows Server™ 2003 systems: hd0-10, harddisk0, harddisk1...
	(numbers indicate the drive number)
	$LETALL, $Volume, $Phys, D:\Vol(Dms,Dmt, Dmr)X\DskY,
	\Vol(Dms,Dmt, Dmr)X\DskY
	For Windows® 2000/Windows Server™ 2003 LDM volumes, see Appendix E.
	
	-find[g]: Displays the port, target ID, and LUN (TagmaStore notation) which was mapped for LDEV using a special file (raw device file) provided via STDIN (see Figure 4.37). If target ID and LUN are Unknown for the target device file, the user must start HORCM without a description for HORCM_DEV and HORCM_INST, and should describe the shown Port, target ID, and LUN for HORCM_DEV. This option also uses the -fx option to display the LDEV numbers in hexadecimal. The –findg option is specified to find the host storage domain (host group) and to display LUN.
	
	-find inst: Obtains the Ser# and LDEV# of the volume using a special file (raw device file) provided via STDIN, and then checks the consistency with the volume described in the configuration definition file. Then registers (permits) the special file name to HORCM, and displays the relation between the configuration definition file. This option is not usually used because it is automatically used by /etc/hormgr. This option also uses the -fx option to display the LDEV numbers in hexadecimal (see Figure 4.38).
	
	Note: When activating HORCM, the CCI automatically registers the device file by executing raidscan –find inst command. If this command is executed manually even if the device file has already been registered, a message The registration has been canceled due to enough for HORCM. is displayed and the command will be rejected.
	
	-find verify [MU#]: Displays the relation between the volumes described in the configuration definition file after obtaining the Ser# and LDEV# of the volume using a special file (raw device file). This option also uses the -fx option to display the LDEV numbers in hexadecimal. This option is affected by the command execution environment (HORCC_MRCF).
	
	-find[g] conf [MU#] [-g <group>]: Displays the image of the port, target ID, and LUN (TagmaStore notation) which was mapped for LDEV using a special file (raw device file) provided via STDIN. Before displaying the information, this option edits the information into an image that looks like the configuration definition file. If target ID and LUN are Unknown for the target device file, the user must start HORCM without a description for HORCM_DEV and HORCM_INST, and should describe the shown Port, target ID, and LUN for HORCM_DEV. This option also uses the -fx option to display the LDEV numbers in hexadecimal. The -g group option specifies the group name where the name should be described.
	
	-find sync [MU#] [–g <group>]: This option reads the search conditions ($Physical, $Volume, $LETALL) from the standard input, searches for a logical drive that corresponds to the group (<group>) defined in the configuration definition file, and then sends the unwritten data on the file system buffer to the logical drive (physical disk) to synchronize the pair (see Figure 4.41). The –g <group> option specifies all the group names on the configuration definition file. If omitted, the –find sync [MU#] searches for a logical drive that corresponds to all groups in the CCI local instance, and sends the unwritten data on the file system buffer to the logical

Parameter	Value

	drive (physical disk) to synchronize the pair (see Figure 4.42).
	Notes:
	Windows NT system does not support LDM volumes. Use $LETALL instead of $Volume.
	`raidscan –pi $LETALL –find sync –g ORA`
	`[SYNC] : ORA ORA_000[–] –> F:\Dsk1\p1 : F:`
	The sync option executes the following procedures depending on the execution condition.
	If the logical device that corresponds to the <group> described in the configuration definition file is closed from the application, the sync option flushes the system buffer and changes the logical device to Dismount status.
	If the logical device is opened from the application, the sync option flushes the system buffer only. In this case, [FLUSH] will be displayed.
	[FLUSH] : ORA ORA_000[-1] -> \Vol44\Dsk0 :
	Volume{56e4954a-28d5-4824-a408-3ff9a6521e5d}
	Restriction:
	All logical drives that corresponds to the group defined in the configuration definition file must be closed from the application.
	This option cannot specify the device object name (shown below) for the search conditions:
	D:\Vol(Dms,Dmt, Dmr)X\DskY, \Vol(Dms,Dmt, Dmr)X\DskY
	-m <mun>: Scanning information is displayed only for MU# specified by this option.

Note: When SnapShot is installed, the range searched with raidscan is extended to MU#=13 from MU#=0. Therefore, execution of raidscan takes several minutes. When you want to limit the searched range, please use the option that is displayed only for specified host group **(-p <port> [hgrp]**), or the option that is displayed only for specified MU# (-m <mun>). And when raidscan is executed, because only LU defined in the searched range is displayed, you may seem that the display is frozen during search of LUs that are not defined.

```
# raidscan  -p  cl1-a
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,LDEV#,P-Seq#,P-LDEV#
CL1-A / ef/ 5, 1,  0-0.1(0).............P-VOL ----  ----,  -----  ----
CL1-A / ef/ 5, 1,  1-0.1(1).............SMPL  ----  ----,  -----  ----
```

Figure 4.36 Raidscan Command for Fibre-channel Ports

```
# ioscan –fun | grep rdsk | raidscan –find
DEVICE_FILE     UID  S/F PORT   TARG  LUN    SERIAL    LDEV  PRODUCT_ID
/dev/rdsk/c0t0d4  0   F  CL1-A     0    4     75003116       4  DF600F-CM
/dev/rdsk/c0t0d2  0   F  CL1-A     0    2     75003116       2  DF600F
/dev/rdsk/c1t0d3  -   -  CL1-A     -    -     75003117       -  DF600F
```

Figure 4.37 Raidscan Command -find Option

The output of the raidscan command with the –find option includes:

- **UID:** Shows the unit ID for multiple subsystem configurations. If UID is displayed as '-', the command device for HORCM_CMD is not found.
- **S/F:** Shows whether the PORT is SCSI or fibre.
- **PORT:** Shows the TagmaStore port number.
- **TARG:** Shows the target ID (which was converted by the fibre conversion table).

- **LUN:** Shows the LUN (which was converted by the fibre conversion table).
- **SERIAL:** Shows the production (serial#) number of the TagmaStore subsystem.
- **LDEV:** Shows the LDEV# within the TagmaStore subsystem. LDEV indicates LU.
- **PRODUCT_ID:** Shows the product-id field in the SCSI inquiry page.

```
# iocsan -fun | grep rdsk | raidscan -find
DEVICE_FILE      Group  PairVol   PORT     TARG  LUN M  SERIAL    LDEV
/dev/rdsk/c0t3d0  oradb  oradev1  CL1-A     3      0 -  75003116    17
/dev/rdsk/c0t3d0  oradb  oradev1  CL1-A     3      0 0  75003116    17
```

Figure 4.38 Raidscan Command –find inst Option

Note: If multiple device files were shared (linked) within the same LDEV, the first one founded would be registered as the device file name.

The output of the raidscan command with –find inst option includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file. If - is displayed, the device that corresponds to this group does not exist in the configuration definition file.
- **PairVol:** Shows the dev_name described in the configuration definition file.
- **Port:** Shows the port name described in the configuration definition file.
- **TARG:** Shows the target ID described in the configuration definition file.
- **LUN:** Shows the LU number described in the configuration definition file.
- **M:** Shows the MU# described in the configuration definition file.
- **SERIAL:** Shows the production (serial#) number of the TagmaStore subsystem.
- **LDEV:** Shows the LDEV# within the TagmaStore subsystem. LDEV indicates LU.

```
# iocsan -fun | grep rdsk | raidscan -find verify
DEVICE_FILE      Group  PairVol   PORT     TARG  LUN M  SERIAL     LDEV
/dev/rdsk/c0t3d0  oradb  oradev1  CL1-A     3      0 0  75003501    17
/dev/rdsk/c0t3d1  oradb  oradev2  CL1-A     3      1 0  75003501    18
/dev/rdsk/c0t3d2  -      -        -         -      - 0  75003501    19

# iocsan -fun | grep rdsk | raidscan -find verify 1 -fd
DEVICE_FILE       Group  PairVol   Device_File   M  SERIAL     LDEV
/dev/rdsk/c0t3d0  oradb  oradev1   C0t3d0        1  75003501    17
/dev/rdsk/c0t3d1  oradb  oradev2   Unknown       1  75003501    18
/dev/rdsk/c0t3d2  -      -         -             1  75003501    19
```

Figure 4.39 Raidscan Command –find verify Option

Note: If the contents displayed in DEVICE_FILE and Device_File is different, it indicates that the volumes are shared (linked) within the same LDEV. If Unknown is displayed in Device_File, this volume is not registered, so the pair operation (except for local options) is rejected in the protection mode.

The output of the raidscan command with –find verify option includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file. If - is displayed, the device that corresponds to this group does not exist in the configuration definition file.
- **PairVol:** Shows the dev_name described in the configuration definition file.
- **Device_File:** Shows the device file registered in HORCM.
- **Port:** Shows the port name described in the configuration definition file.
- **TARG:** Shows the target ID described in the configuration definition file.
- **LUN:** Shows the LU number described in the configuration definition file.
- **M:** Shows the MU# described in the configuration definition file.
- **SERIAL:** Shows the production (serial#) number of the TagmaStore subsystem.
- **LDEV:** Shows the LDEV# within the TagmaStore subsystem. LDEV indicates LU.

```
# cat /etc/hormperm.conf | raidscan –find conf 0 –g ORA
HORCM_DEV
#dev_group         dev_name  port#    TargetID      LU#        MU#
#/dev/rdsk/c23t0d0    SER =75006145  LDEV =   2 [FIBRE FCTBL = 4]
ORA                 ORA_000      CL2-A            0     0      0
#/dev/rdsk/c23t0d1    SER =75006145  LDEV =   3 [FIBRE FCTBL = 4]
ORA                 ORA_001      CL2-A            0     1      0
#/dev/rdsk/c23t0d2    SER =75006145  LDEV =   4 [FIBRE FCTBL = 4]
ORA                 ORA_002      CL2-A            0     2      0
#/dev/rdsk/c23t0d3    SER =75006145  LDEV =   5 [FIBRE FCTBL = 4]
ORA                 ORA_003      CL2-A            0     3      0
#ERROR  [CMDDEV]  /dev/rdsk/c23t0d7  SER =75006145  LDEV = 9 [DF600F-CM]
```

Figure 4.40 Raidscan Command –find conf Option

Notes:

- If a command device is included in the STDIN device, a comment is displayed as follows and the target device will not be included.

```
#ERROR  [CMDDEV]  /dev/rdsk/c23t0d7  SER = 75006145  LDV = 9 [DF600F-CM]
```

- If an STDIN device is shared by multiple device files and is displayed as target device, a comment is displayed as follows and the target device will not be included.

```
#ERROR [LDEV LINK] /dev/rdsk/c24t0d3 SER = 75006145 LDV = 5 [FIBRE FCTBL = 4]
```

- If the STDIN device does not have a proper MU#, a comment is displayed as follows and the target device will not be included.

```
#ERROR [INVALID MUN(2<1)] /dev/rdsk/c24t0d3 SER = 75006145 LDV = 5 [DF600F  ]
```

- If the STDIN device is mixed between the subsystems that have different mirroring control, a comment is displayed as follows and the target device will not be included.

```
#ERROR [MIXING RAID TYPE] /dev/rdsk/c24t0d3 SER = 75006145 LDV = 5 [DF600F  ]
```

The following is an example of synchronizing (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 4.41 Raidscan Command –find sync Option Example (1)

The following is an example of synchronizing (flushing) the system buffer that corresponds to all groups in the CCI local instance.

```
[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 4.42 Raidscan Command –find sync Option Example (2)

4.12.2 Raidar Command

The raidar command displays configuration, status, and I/O activity information for the specified TagmaStore port/TID(s)/device(s) at the specified time interval. The configuration information is acquired directly from the TagmaStore subsystem (not from the configuration definition file). Table 4.19 lists and describes the raidar command parameters. Figure 4.43 shows an example of the raidar command and its output.

Notes:

- The I/O activity of a ShadowImage/SnapShot S-VOL in the COPY or PAIR state includes only host-requested I/Os. The I/O activity of a P-VOL or simplex volume includes only host-requested I/Os. If state changed into SMPL in S-VOL (COPY, PAIR) I/O actively, and then I/O activity of the between is reported in the SMPL state.
- The subsystem has I/O activity information to be displayed for each controller. Therefore, if you want to display the I/O information using this command, when creating the configuration definition file, you must set the command device that is specified by the controller that accepts the host I/O.

Table 4.19 Raidar Command Parameters

Parameter	Value
Command Name	raidar
Format	raidar { -h | -q | -z | -I[H | M][instance#] | -p <port> <targ> <lun> <mun> | -pd[g] <raw_device | -s [interval] [count] }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the raidar command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -p <port> <targ> <lun> <mun>....: Monitors one or more (up to 16) devices at a time. <port>: Specifies the port to be reported: CL1-A to CL1-D and CL2-A to CL2-D. This option must be specified. <targ>: Specifies the SCSI/Fibre target ID (0 to 15) of the specified port (see Appendix D for fibre-to-SCSI address conversion information). <lun>: Specifies the LUN (0 to 7) on the specified TID. <mun>: Specifies the MU number of the specified LUN. pd[g] <raw_device>: Allows designation of an LDEV by raw device file name. The –pdg option is specified to find the host storage domain (host group) and to display LUN. -s [interval] or -sm [interval]: Designates the time interval in seconds. -s: Interprets the time interval as seconds. -sm: Interprets the time interval as minutes. [interval]: Designates the time interval value (1 to 60). If the interval is not specified, the default interval (3) is used. [count]: Designates number of repeats. When omitted, this command repeats until CNTL-C.

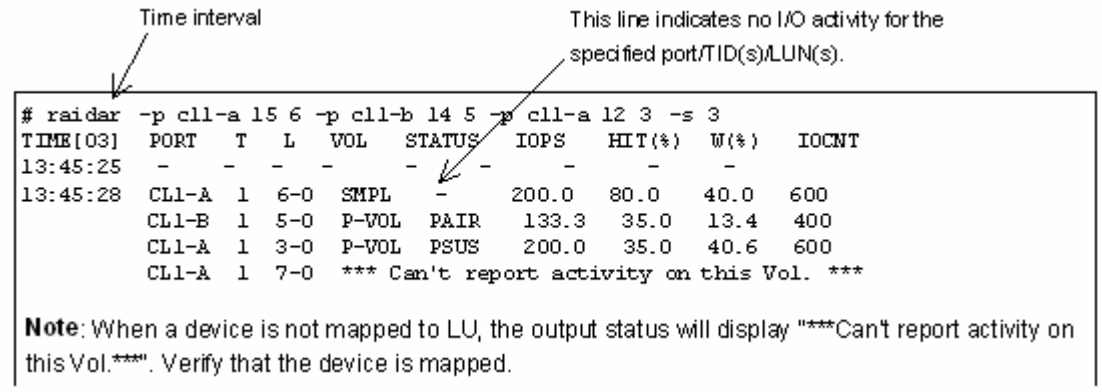


Figure 4.43 Raidar Command Example

The output of the raidar command includes:

- **TIME [ ]:** Shows the interval time.
- **PORT:** Shows the port name of the TagmaStore.
- **T:** Shows the port ID.

- **L:** Shows the LU number in the target ID of the TagmaStore.
- **VOL:** Shows the volume attribute (P-VOL, S-VOL, SMPL).
- **STATUS:** Shows the pair status of the paired volume.
- **IOPS:** Shows the number of I/Os (read/write) per second (total I/O rate).
- **HIT(%):** Shows the hit rate for read I/Os (read hit rate).
- **W(%):** Shows the ratio of write I/Os to total I/Os (percent writes).
- **IOCNT:** Shows the number of times of write and read.

4.12.3 Raidqry Command

The raidqry command (RAID query) displays the configuration of the connected host and TagmaStore subsystem. Table 4.20 lists and describes the raidqry command parameters. Figure 4.44 shows an example of the raidqry command output.

Table 4.20 Raidqry Command Parameters

Parameter	Value
Command Name	raidqry
Format	raidqry { -h | -q | -z | -I[H | M][instance#] | -I | -r <group> | [-f | -g}
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the raidqry command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -I: Displays the configuration information for the local host and the local TagmaStore. -r <group>: Displays the configuration information for the remote host and the remote TagmaStore that contains the specified group. -f: Displays the hostname (ip_address) as specified in the configuration definition file. Use this option if floatable IP address is used for the hostname (ip_address) in the configuration file. **-g** Displays the all group name as specified in the configuration definition file.

```
# raidqry -l
No Group    Hostname            HORCM_ver  Uid  Serial#    Micro_ver Cache(MB)
 1  ---     HOSTA             01-18-03/06    0 75010061  07-35-00/00      1024

# raidqry -r oradb
No Group    Hostname            HORCM_ver  Uid  Serial#    Micro_ver Cache(MB)
 1 oradb    HOSTB             01-18-03/06    0 75010062  07-35-00/00      1024

# raidqry -l  -f
No Group    Floatable Host      HORCM_ver  Uid  Serial#    Micro_ver Cache(MB)
 1  ---    xxx.xxx.xxx.xxx    01-18-03/06    0 75010061  07-35-00/00      1024
# raidqry -g
GNo  Group            RAID_type   IV/H  IV/M  MUN/H  MUN/M
  1  vg01             HTC_DF         8     6      1     14
```

Figure 4.44 Raidqry Command

The output of the raidqry command includes:

- **No:** Shows the order when the group name (dev_group) described in the configuration definition file has multiple remote hosts.
- **Group:** When the **-r** or –g option is used, this column shows the group name (dev_group) described in the configuration definition file.
- **Hostname:** When the **-l** option is used, this column shows the host name of the local host. When the **-r** option is used, this column shows the remote host name for the group (dev_group) which is described in the configuration definition file. The host name with more than or equal to 30 characters cannot be displayed.
- **Floatable Host:** When the **-f** option is used, this column shows the host name (ip_address) described in the configuration definition file. Up to 30 host names can be displayed. The **-f** option interprets the host name as utilizing floatable IP for a host.
- **HORCM_ver:** Shows the version of the HORC Manager on the local or remote host. The **-l** option specifies local host. The **-r** option specifies remote host.
- **Uid Serial# Micro_ver:** Shows the unitID, serial number, and microcode version of the TagmaStore connected to the local or remote host. The **-l** option specifies local host. The **-r** option specifies remote host.
- **Cache(MB):** Shows the logical cache capacity (in MB) of the TagmaStore connected to the local or remote host. The **-l** option specifies local host. The **-r** option specifies remote host.
- **GNo**: When the **-g** option is used, this column shows as order when the group name (dev_group) described in the configuration definition file.
- **RAID_type**: When the **-g** option is used, this column shows the type of RAID configured a group.
- **IV/H**: When the **-g** option is used, this column shows the interface version for TrueCopy/TCE that made the consistence in a group, this is used for the maintenance.
- **IV/M**: When the **-g** option is used, this column shows the interface version for ShadowImage/SnapShot that made the consistence in a group, this is used for the maintenance.
- **MUN/H**: When the **-g** option is used, this column shows the number of maximum MUs for TrueCopy/TCE that made the consistence in a group.
- **MUN/M**: When the **-g** option is used, this column shows the number of maximum MUs for ShadowImage/SnapShot that made the consistence in a group.

Refer to the section 2.5.10 for the details of the Group Version Control for Mixed Subsystem Configurations.

4.13 Data Protection

The TagmaStore supports parameters for the data protection of each LU, and these parameters are set through the command device using CCI. CCI supports the following three commands in order to set and verify these parameters for the data protection of each LU.

- **raidvchkset:** Sets the parameter for data protection to the specified volumes.
- **raidvchkdsp:** Displays the parameter for data protection on the specified volumes based on the CCI configuration definition file.
- **raidvchkscan:** Displays the parameter for data protection on the specified ports based on the raidscan command.

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

```
[HORCM_103] Detected a validation check error on this volume(0000
unit#0,ldev#0) : CfEC=n, MNEC=n, SCEC=n, BNEC=n
```

When the specified volume is set as a protected volume using `raidvchkset`, the following restrictions are present:

- The setting `raidvchkset –vg svd` or `raidvchkset –vg idb` can be performed without using the license key for Data Retention, however, the setting cannot be released by Storage Navigator Modular. In regard to an LU for which the setting has been made using the raidvchkset –vg svd or raidvchkset –vg idb, operations such as deleting and formatting of it are restricted. To release the setting, issue `raidvchkset –vg`.
- When setting data protection for a UNIX file system volume, designate the specified volume as unmounted; to use it, mount it as a read-only volume.
- For a Windows NT/2000/ Windows Server 2003 file system volume, a read-only volume is not correctly recognized.
- When changing the configuration of the LVM, including a protected volume, the specified volume must be temporarily inhibited by the raidvchkset -vg command.
- Place the volume again in the status in which it is checked when the LVM configuration change is completed.
- There may be a case where a volume to which the data protection is applied cannot be used as a resource of the HA cluster software (such as the MSCS). This is because the HA cluster software (such as the MSCS) writes management information in the management area periodically in order to check propriety of the resource.
- When setting a volume used by Windows NT/2000/ Windows Server 2003 as a protected volume, the protection can be applied to a basic disk only. When the protection is applied to a dynamic disk, the volume is not correctly recognized.

Some operating systems cannot recognize LUNs over LUN#1, if LUN#0 is set to the inv as the attribute of the data protection. This is because some HBA drivers do not scan all LUNs on a port, if LUN#0 is invisible.

4.13.1 Raidvchkset Command

`Raidvchkset` sets the parameters for data protection of the specified volumes, and can also be used to turn off all data protection without specifying [type]. The unit of protection for the data is based on the group of the CCI configuration definition file. Table 4.21 lists and describes `raidvchkset` command parameters.

Table 4.21 Raidvchkset Command Parameters

Parameter	Value
Command Name	raidvchkset
Format	raidvchkset { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -nomsg | -vg [type][rtime] }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the raidvchkset command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies a group name written in the configuration definition file. -d <pair Vol>: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute this command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option. -vg [type]: Specifies the following data type that assumes the target volumes as data protection. If [type] is not specified, then this option will disable all of the protection. *Note:* When you specify inv, sz0, rwd, or wtd as the -vg option, specify svd. inv: The object volume is prohibited from reading/writing, the size zero in reply to the Read Capacity command, and is hidden from the Inquiry command. sz0: The object volume is prohibited from reading/writing, and the size zero in reply to the Read Capacity command. rwd: It is prohibited to read/write from/to the object volume. wtd: It is prohibited to write from/to the object volume. svd: It is inhibited to assign the object volume in the SMPL status to an S-VOL. idb: The object volume is hidden from the Inquiry command only. (Specify this option when using VSS. For the details, refer to F.7.2) [rtime]: Specifies the retention time, in units of day. If [rtime] is not specified, the default time defined by the TagmaStore subsystem will be used. The default time is zero. When specifying infinite, specify it as --.

Returned values	Normal termination: 0 Abnormal termination: Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

```
# raidvchkset –g vg01 –d oradb1 –vg wtd svd 365
```

Figure 4.45 Raidvchkset Command Examples with –vg Options

4.13.2 Raidvchkdsp Command

`Raidvchkdsp` displays the parameters for data protection of the specified volumes. The unit of protection for data is based on the group of CCI configuration definition file. Table 4.22 describes `raidvchkdsp` parameters. Figure 4.46 displays command examples.

Table 4.22 Raidvchkdsp Command Parameters

Parameter	Value
Command Name	raidvchkdsp
Format	raidvchkdsp { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] | [-f[xd]] | [-v <op>] | -c }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the raidvchkdsp command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -g <group>: Specifies a group name written in the configuration definition file. -d <pair Vol>: Specifies paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volume. -d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specification of g <group> option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group. -d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specification of -g <group> option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of 0x) or decimal notation. -fx: Displays the LDEV number in hexadecimal. -fd: Displays the relation between the Device_File and the paired Volumes, based on the Group (as defined in the local instance configuration definition file). If Device_File column shows Unknown to HOST (instance) (Figure 4.46), then the volume is not recognized on own HOST, and raidvchkdsp command will be rejected in protection mode. Non-permitted volume is shown without LDEV# information (LDEV# is -).

Parameter	Value
	-v [op]: Specifies the following operation that displays each parameter for data protection: gflag: Displays all flags for protection regarding data block protection for target vols (see Figure 4.46). pool: Displays total capacity and total remaining capacity of data pool the volume is using (see Figure 4.47). -c: When this option is specified, the command checks whether the relation between the connecting path of the volume described in the configuration definition file and the LU was changed or not and displays only the configuration(s) changed illegally.
Returned values	Normal termination: 0 Abnormal termination: Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

```
# raidvchkdsp -g vg01 -fd -v gflag                          ← Example of -v gflag option.
Group    PairVol Device_File      Seq# LDEV# GI-C-R-W-S  PI-C-R-W-S  R-Time
vg01     oradb1  Unknown         75000067     3  D D D D D   E E E D D      365
vg01     oradb2  Unknown         75000067     4  E E E E E   E E E E E       -
```

Figure 4.46 Raidvchkdsp Command Examples with –fd and –v gflag Options

The output of the raidqvchkdsp command with **-v gflag** option includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair Vol:** Shows the paired volume name (dev_name) described in the configuration definition file.
- **Device_File:** Shows the device file registered in HORCM.
- **Seq#:** Shows the serial number of the TagmaStore subsystem.
- **LDEV#:** Shows the logical device number. LDEV indicates LU.
- **GI-C-R-W-S:** This displays the flags for guarding as for the target volume:
  - I=E: The volume is permitted to accept the Inquiry command.
  - I=D: The volume is not permitted to accept the Inquiry command.
  - C=E: The volume returns the formal volume size in reply.
  - C=D: The volume returns the size zero in reply.
  - R=E: It is permitted to read from/to the object volume.
  - R=D: It is prohibited to read from/to the object volume.
  - W=E: It is permitted to write from/to the object volume.
  - W=D: It is prohibited to write from/to the object volume.
  - S=E: The volume can be assigned to an S-VOL.
  - S=D: The volume cannot be assigned to an S-VOL.
- **PI-C-R-W-S:** This displays the permission flags that shows whether each mode flags can be changed to enable or not:
  - I=E: This shows that **I** flag can be changed to enable.
  - I=D: This shows that **I** flag cannot be changed to enable.
  - C=E: This shows that **C** flag can be changed to enable.
  - C=D: This shows that **C** flag cannot be changed to enable.
  - R=E: This shows that **R** flag can be changed to enable.
  - R=D: This shows that **R** flag cannot be changed to enable.
  - W=E: This shows that **W** flag can be changed to enable.
  - W=D: This shows that **W** flag cannot be changed to enable.
  - S=E: This shows that **S** flag can be changed to enable.
  - S=D: This shows that **S** flag cannot be changed to enable.

- **R-Time:** The term of protection set for the LU is displayed with a number of days. When - is displayed, it means that the term is indefinite.

  Expiration Lock status is shown as the retention time plus 1000000.

  R-Time + 1000000 shows the retention time with Expiration Lock status.

```
# raidvchkdsp -g vg01 -d oradb1 -v pool                    ← Example of -v pool option.
Group   PairVol   Port#   TID  LU   Seq#   LDEV#   Bsize    Available    Capacity
vg01    oradb1   CL1-A     1    2     75000015      2     2048         1024        3072
```

Figure 4.47 Raidvchkdsp Command Examples with –v pool Options

The output of the raidvchkdsp command with -v pool option includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair Vol:** Shows the paired volume name (dev_name) described in the configuration definition file.
- **Port#:** Shows the device file registered in HORCM.
- **TID:** Shows the target ID.
- **LU:** Shows the LU number in the target ID of the TagmaStore.
- **Seq#:** Shows the serial number of the TagmaStore subsystem.
- **LDEV#:** Shows the logical device number. LDEV indicates LU.
- **Bsize:** Shows the units for Available and Capacity.
- **Available:** Shows the total remaining pool capacity within controller (in MB).
- **Capacity:** Shows the total pool capacity within controller (in MB).

```
# raidvchkdsp -g vg01 -c
Group   PairVol   Port#   TID  LU   Seq#   LDEV#   LDEV#(conf)  -change->   LDEV#
vg01    oradb1   CL1-A     1    2     75000015     -     2(conf)  -change->   NO LDEV
```

Figure 4.48 Raidvchkdsp Command Examples with –c Option

The output of the raidvchkdsp command with -c option includes:

- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **Pair Vol:** Shows the paired volume name (dev_name) described in the configuration definition file.
- **Port#:** Shows the device file registered in HORCM.
- **TID:** Shows the target ID.
- **LU:** Shows the LU number in the target ID of the TagmaStore.
- **Seq#:** Shows the serial number of the TagmaStore subsystem.
- **LDEV#:** Shows the logical device number. LDEV indicates LU.
- **LDEV#(conf):** Shows the LU number that was described in the configuration definition file at the time of the instance start.

4.13.3 Raidvchkscan Command

The raidvchkscan command displays the fibre or iSCSI port of the TagmaStore, target ID, LDEV mapped for LUN# and the parameters for data protection, regardless of the configuration definition file. Table 4.23 lists and describes the raidvchkscan command parameters.

Table 4.23 Raidvchkscan Command Parameters

Parameter	Value
Command Name	raidvchkscan
Format	raidvchkscan { -h | -q | -z | -I[H | M][instance#] | -p <port> [hgrp] | -pd[g] <raw_device> | -s <seq#> | -t <target> | -l <lun> | [-f[x]] | -v flag }
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the raidscan command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -p <port> [hgrp]: Specifies the port ID of the TagmaStore port to be scanned. Valid ports are CL1-A to CL1-D and CL2-A to CL2-D. This option must always be specified. [hgrp] is specified to display only the LDEVs mapped to a host group on a port for TagmaStore. -pd[g] <raw_device>: Specifies the raw device name. This option finds Seq# and port_name of the TagmaStore that the specified device can be connected, and scans the port of the TagmaStore which corresponds with the unit ID that searches the unit ID from Seq#. This option must always be specified. The -pdg option is specified to find host storage domain (host group) and to display LUN. -s <Seq#>: Used to specify the Seq# of the TagmaStore when this option can't specify the unit ID which is contained for -p <port> option. This option scans the port specified by -p <port> option of the TagmaStore which corresponds with the unit ID that searches the unit ID from Seq#. If this option is specified, then the unit ID which is contained in -p <port> option is invalid. -t <targ>: Specifies a target ID (0 to 15) of the specified port. If this option is not specified, the command applies to all target IDs. -l <lun>: Specifies a LUN (0 to 7) of the specified target ID. If this option is not specified, the command applies to all LUNs. If this option is specified, the TID must also be specified. -fx: Displays the LDEV number in hexadecimal notation. -v gflag: Displays all flags for data regarding data block protection for target vols (see Figure 4.49).
Returned values	Normal termination: 0 Abnormal termination: Returns a common error code and a unique error code for this command. For details on error codes, see Chapter 5.

```
# raidvchkscan -p CL1-A -v gflag
PORT# /ALPA/C TID#  LU#  Seq#   Num LDEV# GI-C-R-W-S  PI-C-R-W-S  R-Time
CL1-A   /ef/ 0   0    2  75002332    1     2  D D D D D   E E E D D      365
CL1-A   /ef/ 0   0    3  75002332    1     3  E E E E E   E E E E E      -
```

Figure 4.49 Raidvchkscan Command Example with –v gflag Option

The output of the raidqvchkscan command with **-v gflag** option includes:

- **Port#:** Shows the port name of the TagmaStore subsystem.
- **ALPA/C:** For the Fibre channel, shows the physical address of the Fibre channel in a port. For iSCSI, displayed ef always.
- **TID#:** Shows the target ID of the TagmaStore subsystem.
- **LU#:** Shows the LU number.
- **Seq#:** Shows the production (serial#) number of the TagmaStore subsystem.
- **Num:** Shows the number of the volumes which constitute LU# (one fixed).
- **LDEV#:** Shows the LDEV# within the TagmaStore subsystem. LDEV indicates LU.
- **GI-C-R-W-S:** This displays the flags for guarding as for the target volume:
  - I=E: The volume is permitted to accept the Inquiry command.
  - I=D: The volume is not permitted to accept the Inquiry command.
  - C=E: The volume returns the formal volume size in reply.
  - C=D: The volume returns the size zero in reply.
  - R=E: It is permitted to read from/to the object volume.
  - R=D: It is prohibited to read from/to the object volume.
  - W=E: It is permitted to write from/to the object volume.
  - W=D: It is prohibited to write from/to the object volume.
  - S=E: The volume can be assigned to an S-VOL.
  - S=D: The volume cannot be assigned to an S-VOL.
- **PI-C-R-W-S:** This displays the permission flags that shows whether each mode flags can be changed to enable or not:
  - I=E: This shows that I flag can be changed to enable.
  - I=D: This shows that I flag cannot be changed to enable.
  - C=E: This shows that C flag can be changed to enable.
  - C=D: This shows that C flag cannot be changed to enable.
  - R=E: This shows that R flag can be changed to enable.
  - R=D: This shows that R flag cannot be changed to enable.
  - W=E: This shows that W flag can be changed to enable.
  - W=D: This shows that W flag cannot be changed to enable.
  - S=E: This shows that S flag can be changed to enable.
  - S=D: This shows that S flag cannot be changed to enable.
- **R-Time:** The term of protection set for the LU is displayed with a number of days. When - is displayed, it means that the term is indefinite.

  Expiration Lock status is shown as the retention time plus 1000000.

  R-Time + 1000000 shows the retention time with Expiration Lock status.

4.14 Controlling CCI Activity

4.14.1 Horcmstart Command

The **horcmstart** command is a shell script that starts the HORCM application (/etc/horcmgr). This shell script also sets the environment variables for HORCM as needed (e.g., HORCM_CONF, HORCM_LOG, HORCM_LOGS). Table 4.24 lists and describes the horcmstart command parameters.

Table 4.24 Horcmstart Command Parameters

Parameter	Value
Command Name	horcmstart
Format	horcmstart.sh { inst ... } horcmstart.exe { inst ... }
Options	Inst: Specifies the HORCM instance number (numerical value). When this option is specified, the horcmstart shell script sets the environment variables (HORCMINST, HORCM_CONF, HORCM_LOG, HORCM_LOGS) that correspond to the instance number, and starts the specified HORCM instance. (Environment variables set by the user become invalid.) When this option is not specified, the horcmstart shell script starts 1 HORCM and uses the environment variables set by the user. If you have designated full environment variables, you should use horcmstart.sh without any arguments. If you did not designate environment variables (HORCM_CONF, HORCM_LOG, HORCM_LOGS), then this shell script sets the environment variables as follows: For UNIX-based platforms: If HORCMINST is specified: HORCM_CONF = /etc/horcm*.conf (* is instance number) HORCM_LOG = /HORCM/log*/curlog HORCM_LOGS = /HORCM/log*/tmplog If no HORCMINST is specified: HORCM_CONF = /etc/horcm.conf HORCM_LOG= /HORCM/log/curlog HORCM_LOGS = /HORCM/log/tmplog For Windows NT/2000 platform: If HORCMINST is specified: HORCM_CONF = \WINNT\horcm*.conf (* is instance number) HORCM_LOG= \HORCM\log*\curlog HORCM_LOGS = \HORCM\log*\tmplog If no HORCMINST is specified: HORCM_CONF = \WINNT\horcm.conf HORCM_LOG= \HORCM\log\curlog HORCM_LOGS = \HORCM\log\tmplog For Windows Server 2003 platform: If HORCMINST is specified: HORCM_CONF = \WINDOWS\horcm*.conf (* is an instance number) HORCM_LOG= \HORCM\log*\curlog HORCM_LOGS = \HORCM\log*\tmplog If no HORCMINST is specified: HORCM_CONF = \WINDOWS\horcm.conf HORCM_LOG= \HORCM\log\curlog HORCM_LOGS = \HORCM\log\tmplog *Note 1:* The HORCM_LOGS environment variable is used to specify the log file directory for automatic storing. When HORCM starts up, the log files created in the operation are stored automatically in the HORCM_LOGS directory. This log directory must give an equality class with HORCM_LOG. *Note 2:* The HORCMSTART_WAIT environment variable waits until HORCM becomes ready for use

Parameter	Value
	setting an appropriate time. However, this time may take longer than it is required depending on an operating system to be used, an HBA driver, or a command device. As a result, a time-out may occur exceeding this waiting time and the start may fail (the process exists in the status where HORCM is starting). In such a case, start HORCM setting the waiting time for the variable. The waiting time must be specified more than 5 seconds and multiple of 5 seconds.

Note: When this command is started in the status where a file under the HORCM_LOG and HORCM_LOGS directory is opened in the case of Windows 2000/ Windows Server 2003, the operation will terminate abnormally. In this case, take actions as shown below since a message, which informs that the file cannot be deleted or moved, is output.

- When a file under the HORCM_LOG and HORCM_LOGS directory is opened, close the file, and then start the command.
- Investigate whether the program, which traces the directories and the files in the drive, is operating in the background as a service (such as CL and DTC service). If it is possible that the program collides with the service, start the program by adjusting the time.

4.14.2 Horcmshutdown Command

The **horcmshutdown** command is a shell script for stopping the HORCM application (/etc/horcmgr). Table 4.25 describes the shutdown command parameters.

Table 4.25 Horcmshutdown Command Parameters

Parameter	Value
Command Name	horcmshutdown
Format	horcmshutdown.sh {inst...} horcmshutdown.exe {inst...}
Option	Inst: Specifies the HORCM (CCI) instance number (numerical value). When this option is specified, the command stops the specified HORCM instance. When this option is not specified, the command refers to the instance (environment variable HORCMINST) of the execution environment of this shell script and stops the following the HORCM instance. When HORCMINST is specified, this command stops the HORCM instance of the execution environment of this shell script. When HORCMINST is not specified, this command stops the HORCM having no instance setting.

4.14.3 Horcctl Command

The HORCM software has logs that identify the cause of software and/or hardware errors as well as a tracing function for investigating such errors. The location of the log files depends on the user's command execution environment and the HORC Manager's execution environment. The command trace file and core file reside together under the directory specified in the HORC Manager's execution environment. See Appendix B for log file and log directory information.

The **horcctl** command can be used for both maintenance and troubleshooting. The horcctl command allows you to change and display the internal trace control parameters (e.g., level, type, buffer size) of the HORC Manager commands. If a new value for a parameter is not specified, the current trace control parameter is displayed. Table 4.26 lists and describes the horcctl command parameters.

Caution: Do not change the trace level unless directed to do so by a Hitachi Data Systems representative. Level 4 is the normal trace level setting. Levels 0-3 are for troubleshooting. Setting a trace level other than 4 may impact problem resolution. If you request a change of the trace level using the horcctl -l <level> command, a warning message is displayed, and this command enters interactive mode.

Table 4.26 Horcctl Command Parameters

Parameter	Value
Command Name	horcctl
Format	horcctl { -h | -q | -z | -I[H | M][instance#] | -d | -c | -l <level> | -d < y/n> | -s <size(KB)> | -t <type> | -S | -D | -C | [-u <-unitid> | ND | -NC | -g <group>}
Options	-h: Displays Help/Usage and version information. -q: Terminates the interactive mode and exits the command. -z or -zx: Makes the horcctl command enter the interactive mode. The -zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1. -d: Interprets the control options following this option (-l <level>, -b <y/n>, -s<size(KB)>, and -t<type>) as the parameters of the CCI commands. -c: Interprets the control options following this option (-l <level>, -b <y/n> and -t <type>) as the parameters of the HORC Manager (HORCM). -l <level>: Sets the trace level (range = 0 to 15). If a negative value is specified, the trace mode is canceled. A negative value n must be specified as --n. *Caution:* Do not change the trace level unless directed to do so by a Hitachi Data Systems representative. Level 4 is the normal trace level setting. Levels 0-3 are for troubleshooting. Setting a trace level other than 4 may impact problem resolution. If you request a change of the trace level using the horcctl -l <level> command, a warning message is displayed, and this command enters interactive mode. -b <y/n>: Sets the trace writing mode: Y = buffer mode, N = synchronous mode. -t <type>: Sets the trace type (range = 0 to 511). When this option is used, only traces of the specified type are output. One or more values can be specified. -s <size(KB)>: Changes the default trace buffer size, which is 1 MB, in units of 1,024 bytes. -S: Shuts down HORCM. -D: Displays the command device name currently used by HORCM. If the command device is blocked due to online maintenance (microcode replacement) of the TagmaStore, you can check the command device name in advance using this option. -C: Changes the command device name being used by HORCM and displays the new command device name. If the command device is blocked due to online maintenance (microcode replacement) of the TagmaStore, you can change the command device in advance using this option. -u <unitid>: Used to specify the unit ID of a command device as the target. This option is effective when the -D or -C option is specified. If this option is not specified, the unit ID is 0. -ND -g <group>: Displays the network address and port name being used by HORCM. The -g <group> option is used to specify the group name defined in the configuration definition file. -NC -g <group>: Changes the network address and port name being used by HORCM and displays the

Parameter	Value
	new network address name. The -g <group> option specifies the group name defined in the configuration definition file.

The following is an example of changing the trace level to 15.

```
C:\HORCM\etc>horcctl -d -l 15
/****************************** WARNING ***********************************/
/*    This is an option for maintenance, and used for troubleshooting.       */
/*    When it is issued, the internal trace control parameters of the HORC  */
/*    manager and HORC commands are changed and displayed.                   */
/*    These trace control parameters should not be changed unless directed  */
/*    by a CS&S service representative.                                      */
/*    For cancel   -> Enter '-q' option                                      */
/*    For continue -> Re-enter '-c ...' or '-d ...'options                   */
/****************************** WARNING ***********************************/
horcctl[HOMRCF]: -q
C:\HORCM\etc>
```

Figure 4.50 Horcctl command –d –l Option

```
C:\HORCM\etc>horcctl -d
logdir = C:\HORCM\log1\curlog
[Client]:
trace = ON
level = 4
mode  = Buffer
size  = 1024 KB
type  =  0, 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,16,17,18,19...Full
```

Figure 4.51 Horcctl command –d Option

```
C:\HORCM\etc>horcctl -c
logdir = C:\HORCM\log1\curlog
[HORCM]:
trace = ON
level = 4
mode  = Buffer
size  = 1024 KB
type  =  0, 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12,13,14,15,16,17,18,19...Full
```

Figure 4.52 Horcctl command –c Option

4.15 Windows NT/2000/ Windows Server 2003 Subcommands

The CCI software provides subcommands for the Windows NT/2000/ Windows Server 2003 platforms which are executed as options (-x <command> <arg>) of another command. When you specify a subcommand as the only option of a command, you do not need to start HORCM. If another option of the command and the subcommand is specified on the same command line, place the other option after the subcommand.

4.15.1 Findcmddev Subcommand

The **findcmddev** subcommand (find command device) searches for command devices within the specified range of disk drive numbers. If it is found, the command device is displayed in the same format as in the configuration definition file. This subcommand is used when the command device name is not known. Table 4.27 lists and describes the findcmddev subcommand parameters.

Caution: The findcmddev subcommand must be used when HORCM is not running.

Note: The findcmddev subcommand searches for the physical and logical devices associated with the command device. If the command device is indicated as a logical device, you must delete the drive letter assigned to the command device to prevent utilization by general users. The physical drive number may change at every reboot. If the number changes, use \\.\CMD-Ser#-ldev#-Port# orVolume{guid} for which the same name is kept. Volume{guid} is created when you make a partition by using Windows Disk Management. Do not format.

Table 4.27 Findcmddev Subcommand Parameters

Parameter	Value
Command Name	findcmddev
Format	x findcmddev drive#(0-N)
Argument	drive#(0-N): Specifies the range of disk drive numbers on the Windows NT/2000/ Windows Server 2003 system.

```
raidscan  -x  findcmddev   hdisk0, 20
cmddev of ser#   3001 = \\.\PhysicalDrive0
cmddev of ser#   3001 = \\.\E:
cmddev of ser#   3001 = \\.\Volume{b9b31c79-240a-11d5-a37f-00c00d003b1e}
```

Figure 4.53 Findcmddev Subcommand

Note: This example searches for command devices in the range of disk drive numbers 0 to 20.

4.15.2 Drivescan Subcommand

The **drivescan** subcommand displays the relationship between the disk numbers assigned by the Windows NT/2000/ Windows Server 2003 system and the LDEVs on the TagmaStore, and also displays attribute and status information for each LDEV. Table 4.28 lists and describes the drivescan subcommand parameters. Figure 4.54 shows an example of the drivescan subcommand used as an option of the raidscan command and its output.

Table 4.28 Drivescan Subcommand Parameters

Parameter	Value
Command Name	drivescan
Format	-x drivescan drive#(0-N)
Argument	drive#(0-N): Specifies the range of disk drive numbers on the Windows NT/2000/ Windows Server 2003 system..

```
raidscan -x drivescan  harddisk0,20
Harddisk 0... Port[ 1] PhId[ 0] TId[  0] Lun[  0] [HITACHI] [DK328H-43WS    ]
Harddisk 1... Port[ 2] PhId[ 4] TId[ 29] Lun[  0] [HITACHI] [DF600F          ]
              Port[CL1-A] Ser#[75003005] LDEV#[   9(0x009)]
              HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
              RAID5[Group  2- 1] SSID = 0x0000
Harddisk 2... Port[ 2] PhId[ 4] TId[ 29] Lun[  1] [HITACHI] [DF600F          ]
              Port[CL1-A] Ser#[75003005] LDEV#[  10(0x00A)]
              HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
              RAID5[Group  2- 1] SSID = 0x0000
Harddisk 3... Port[ 2] PhId[ 4] TId[ 29] Lun[  6] [HITACHI] [DF600F-CM       ]
              Port[CL1-A] Ser#[75003005] LDEV#[  15(0x00F)]
```

Figure 4.54 Drivescan Subcommand Example

***Note*:** This example displays the devices for the range of disk drive numbers from 0 to 20.

The output of the drivescan subcommand includes:

- **Harddisk #:** Shows the hard disk recognized by the Windows NT/2000/ Windows Server 2003 system.
- **Port:** Shows the port number on the device adapter recognized by the NT/2000/ Windows Server 2003 system.
- **PhId:** Shows the bus number on the device adapter port recognized by the Windows NT/2000/ Windows Server 2003 system.
- **TId:** Shows the target ID of the hard disk(s) on the specified port and bus. For further information on Fibre-to-SCSI address conversion, see Appendix D.
- **LUN:** Shows the LU number of the hard disk on the specified port, bus, and TID.
- **Port[CLX-Y]:** Shows the port number on the TagmaStore subsystem.
- **Ser#:** Shows the production number of the TagmaStore subsystem.

- **LDEV#:** Shows the LDEV ID (hexadecimal) of the specified volume on the TagmaStore. LDEV indicates LU.
- **HORC:** Shows the TrueCopy/TCE attribute (P-VOL, S-VOL, and SMPL).
- **HOMRCF:** Shows the ShadowImage/SnapShot attribute (P-VOL, S-VOL, SMPL) and MU number of the specified volume.
- **RAIDX[Group]:** Shows the physical location (frame number-parity group number) of the specified volume and the RAID level of this parity group.
- **SSID:** Shows the SSID of the specified volume.

4.15.3 Portscan Subcommand

The portscan subcommand displays the devices on the specified port(s). Table 4.29 lists and describes the portscan subcommand parameters. Figure 4.55 shows an example of the portscan subcommand used as an option of the raidscan command and its output.

Table 4.29 Portscan Subcommand Parameters

Parameter	Value
Command Name	portscan
Format	-x portscan port#(0-N)
Argument	**port#(0-N):** Specifies the range of port numbers on the Windows NT/2000/ Windows Server 2003 system.

```
raidscan  -x  portscan  port0,20
PORT[ 0] IID [ 7] SCSI Devices
         PhId[ 0] TId[  3] Lun[  0]  [MATSHIT] [CD-ROM CR-508  ] ...Claimed
         PhId[ 0] TId[  4] Lun[  0]  [HP     ] [C1537A         ] ...Claimed
PORT[ 1] IID [ 7] SCSI Devices
         PhId[ 0] TId[  0] Lun[  0]  [HITACHI ] [DK328H-43WS   ] ...Claimed
PORT[ 2] IID [ 7] SCSI Devices
         PhId[ 0] TId[  5] Lun[  0]  [HITACHI ] [DF600F        ] ...Claimed
         PhId[ 0] TId[  5] Lun[  1]  [HITACHI ] [DF600F        ] ...Claimed
         PhId[ 0] TId[  5] Lun[  2]  [HITACHI ] [DF600F        ] ...Claimed
         PhId[ 0] TId[  6] Lun[  0]  [HITACHI ] [DF600F        ] ...Claimed
```

Figure 4.55 Portscan Subcommand

Note: This example displays the devices for the range of ports from 0 to 20.

The output of the portscan subcommand includes:

- **Port:** Shows the port number on the device adapter recognized by the Windows system.
- **IID:** Shows the initiator ID on the specified device adapter port.
- **PhId:** Shows the BUS number on the specified device adapter port.
- **TId:** Shows the target ID of the hard disk(s) on the specified adapter port and bus. For further information on Fibre-to-SCSI address conversion, see Appendix D.
- **LUN:** Shows the LU number of each hard disk on the specified device adapter port/bus. This item shows LDEV# of the partner who becomes a pair in or among the TagmaStore.

4.15.4 Sync Subcommand

The **sync** (synchronization) subcommand sends unwritten data remaining on the Windows NT/2000/ Windows Server 2003 server to the specified device(s) to synchronize the pair(s) before the CCI command is executed.

Table 4.30 lists and describes the sync subcommand parameters.

Table 4.30 Sync Subcommand Parameters

Parameter	Value
Command Name	Sync
Format	x sync A: B: C: ... -x sync all -x sync drive#(0-N) ... -x sync Volume#(0-N) ... (Windows 2000/ Windows Server 2003 systems only) -x sync D:\directory or \directory pattern ... (Windows 2000/ Windows Server 2003 systems only)

Argument	A: B: C:[\directory or \directory pattern] … : Specifies the logical devices that you want to synchronize. The data is flushed to the specified logical device and to the physical device that corresponds to the specified logical device.
	If a directory-mounted volume exists in the specified logical device, the data will be flushed including the directory-mounted volume as follows:
	`pairsplit –x sync D:`
	`[SYNC] D: HarddiskVolume2`
	`[SYNC] D: \hd1 HarddiskVolume8`
	`[SYNC] D: \hd2 HarddiskVolume9`
	[\directory or \directory pattern] (Windows 2000/ Windows Server 2003 systems only)
	Specifies the directory or the directory pattern for searching the directory mount point in the logical device.
	If directory is specified: The applicable directory-mounted volume will be flushed.
	`pairsplit –x sync D:\hd1`
	`[SYNC] D:\hd1 HarddiskVolume8`
	If directory patter is specified: The directory-mounted volume that matches the specified pattern will be flushed.
	`pairsplit –x sync D:\h`
	`[SYNC] D:\hd1 HarddiskVolume8`
	`[SYNC] D:\hd2 HarddiskVolume9`
	all: Synchronizes all logical devices. The logical device on which the CCI software is installed and the logical device containing the Windows NT/2000/ Windows Server 2003 directory are excluded.
	If a directory-mounted volume exists in the specified logical device, the data will be flushed including the directory-mounted volume as follows:
	`pairsplit –x sync all`
	`[SYNC] C: HarddiskVolume1`
	`[SYNC] D: \hd1 HarddiskVolume8`
	`[SYNC] D: \hd2 HarddiskVolume9`
	`[SYNC] G: HarddiskVolume10`
	drive#(0-N) ...: Specifies the range of devices on the Windows NT/2000/ Windows Server 2003 system.
	Volume#(0-N) ...: For Windows 2000/ Windows Server 2003 systems only. Synchronizes the data to the specified LDM (logical device manager) volume.
	The LDM volume specifies the following device objects: \Vol#, \Dms#, \Dmt#, or \Dmr#.
	For Windows 2000/ Windows Server 2003 LDM volumes, see Appendix E.

Note:	The sync command executes the following procedures depending on the execution condition.
	If the logical device is closed from the application, the system buffer is flushed and changes the logical device to Dismount status.
	If the logical device is opened from the application, the sync option flushes the system buffer only. In this case, [WARNING] will be displayed.
	`pairsplit –x sync –C:`
	`WARNING: Only flushed to [\\.\C] drive due to be opening.`
	`[SYNC] C: HarddiskVolume3`

The following examples show the sync subcommand used as an option of the pairsplit command. For the example in Figure 4.56, the data remaining on logical devices C: and D: is written to disk, all pairs in the specified group are split (status = PSUS), and read/write access is enabled for all S-VOLs in the specified group.

```
pairsplit -x sync  C: D:  -g  oradb
```

Figure 4.56 Sync Subcommand Example 1

For the example in Figure 4.57, the data remaining on physical devices harddisk2 and harddisk3 is written to disk, all pairs in the specified group are deleted (status = SMPL), which enables read/write access for all secondary volumes.

```
pairsplit -x sync  hdisk2  hdisk3 -g oradb -S
```

Figure 4.57 Sync Subcommand Example 2

4.15.5 Mount Subcommand

The `mount` subcommand mounts the specified drive to the specified partition on the specified hard disk drive. If `mount` is executed without specifying an argument, all drives that are currently mounted are displayed. Table 4.31 lists the `mount` subcommand parameters. Figure 4.58 and Figure 4.59 show examples of the subcommand used as an option of the `pairsplit` command output.

Cautions:

- The partition on the specified disk drive (hard disk) must be recognized on the Windows NT/2000/ Windows Server 2003 system.
- When you use directory mount, it will be forcibly unmounted by logging off the Windows 2000/ Windows Server 2003 system.

Table 4.31 Mount Subcommand Parameters

Parameter	Value
Command Name	mount
Format	x mount -x mount drive: hdisk# partition# ... (for Windows NT) -x mount drive: Volume#(0-N) ... (for Windows 2000/ Windows Server 2003) -x mount drive: [\[directory]] Volume#(0-N) ... (for Windows 2000/ Windows Server 2003)

Arguments	drive: hdisk# partition#:
	For Windows NT. The drive specifies the logical drive to be mounted. The hdisk# specifies the hard disk drive (number) to be mounted. The partition # specifies the partition number to be mounted. If the partition# is not specified, the drive is mounted as HarddiskVolume# for Windows NT systems. If this command is executed without any argument, the device that is already mounted will be displayed.
	drive: [\[directory]] Volume#:
	For Windows 2000/ Windows Server 2003. The drive specifies the logical device to be mounted. The hdisk# specifies the following device object names of the LDM volume to be mounted: hdisk#, \Vol#, \Dms#, \Dmt#, or \Dmr# or Volume{GUID}.
	[\directory]
	Specifies the directory for specifying the directory mount point in the logical device. The character string of the directory cannot include space letters.
	`pairsplit –x mount D:\hd1 \Vol8`
	`D:\hd1 <.> HarddiskVolume8`
	`pairsplit –x mount D:\hd2 \Vol9`
	`D:\hd2 <.> HarddiskVolume9`
	If this command is executed without any argument, the device that is already mounted will be displayed. For Windows 2000/ Windows Server 2003 LDM volumes, see Appendix E.

Note: When mounting it by using the mountvol command supplied with Windows® 2000 or Windows Server™ 2003, the character string of the specified directory can include space letters (however, do not use the mountvol command when mounting the volumes created in TagmaStore). For more details, see D.1.2 Mountvol Command on Windows® 2000/Windows Server™ 2003. When the character string includes a space (example: aaa bbb), it is indicated by adding "…" to the first character string in the mount command as shown in the following example.

```
pairsplit –x mount
Drive  FS_name  VOL_name   Device     Partition    ... Port PathID Targ Lun
D:     NTFS     Null       HarddiskVolume3         ... Harddisk2
D:\aaa... NTFS     Null       HarddiskVolume4         ... Harddisk3
```

If the command is executed without an argument, a mounted device that contains the directory-mounted volume will be displayed. If the mounted volume is an LDM volume, the physical drive (hard disk) number that configures the LDM volume will also be displayed.

```
pairsplit –x mount F: hdisk2 p1   –x mount G: hdisk1 p1
pairsplit –x mount

Drive   FS_name  VOL_name   Device      Partition   ...  Port  PathID  Targ  Lun
C:      FAT      Null       Harddisk0   Partition1  ...    1      0      0    0
F:      FAT      Null       Harddisk2   Partition1  ...    2      0      5    1
G:      NTFS     Null       Harddisk1   Partition1  ...    2      0      5    0
Z:      CDFS     Null       CdRom0                  ...  Unknown
```

Figure 4.58 Mount Subcommand (Windows NT)

This example mounts the F: drive to partition 1 on disk drive 2, and mounts the G: drive to partition 1 on disk drive 1.

```
pairsplit -x mount  F:\ hdisk2
pairsplit  -x mount
Drive  FS_name  VOL_name   Device          Partition  ...   Port  PathID  Targ  Lun
C:     NTFS     Null       Harddiskvolume1           ...   Harddisk0
F:     NTFS     Null       Harddiskvolume2           ...   Harddisk1
D:     NTFS     Null       Harddiskvolume3           ...   Harddisk2
D:\hd1 NTFS     Null       Harddiskvolume4           ...   Harddisk3
D:\hd2 NTFS     Null       Harddiskvolume5           ...   Harddisk4
G:     NTFS     Null       HarddiskDmVolumes\        ...   \Volume1 ... Harddisk5[3]
```

Figure 4.59 Mount Subcommand (Windows 2000/ Windows Server 2003)

This example executes `mount` from the `pairsplit` command option, mounting the F: drive to the harddiskvolume2, after the mounted devices are displayed.

`mount` subcommand output includes:

- **Drive:** Shows the logical device recognized by the Windows NT/2000/ Windows Server 2003 system.
- **FS_name:** Shows the name of the file system formatted on the specified drive.
- **VOL_name:** Shows the volume label name for the specified drive.
- **Device, Partition:** Shows the device name and partition for the specified drive.
- **Port, PathID, Targ, Lun:** Shows the port number, path ID (bus), target ID, and LUN for the specified drive. For further information on Fibre-to-SCSI address conversion, see Appendix D.

Notes:

- For the Windows 2000/ Windows Server 2003 system, if you specified both hdisk# and partition# arguments for the mount subcommand, the drive characters will not be displayed when the Disk Management is activated in the Control Panel → Administrative Tools → Computer Management → Storage folder. Even if this sub command is executed, a drive letter may not be assigned. In this case, the target volume may be used. Execute the command after making the target volume to unused status. Alternatively, a drive letter can be assigned by activating the Disk Management in the Control Panel-Administrative Tools-Computer Management-Storage folder.
- When using Volume{guid} as an argument to mount a sub-command on Windows 2000/ Windows Server 2003, the Volume{guid} of secondary volumes (S-VOL/V-VOL) of ShadowImage/
  Snapshot/TrueCopy/TCE is set by recognizing the Control Panel → Administrative Tools → Computer Management → Storage folder → Rescan Disks from the OS, while status is PSUS after pair create. Afterwards, the set Volume{guid} can be confirmed by inqraid.exe -CLI $Vol -fv. However, if Volume{guid} is previously set when the partition is created at SMPL status before pair create, then Volume{guid} after pair create may not be recognized even if re-scan disk is done at PSUS status after pair create. When using Volume{guid} with secondary volumes (S-VOL/V-VOL), create a pair when the partition is not created to the secondary volume (S-VOL/V-VOL) before pair create.

- When making a secondary volume (S-VOL or V-VOL) of ShadowImage, SnapShot, or TrueCopy/TCE recognized by a host on Windows 2000/ Windows Server 2003, make it in a state in which the pair is placed in the PSUS status after the pair has been created. If the pair status is changed to PSUS after the pair has been recognized by a host while it has been in the PSUS status, the pair may not operate correctly afterwards because the pair status is changed to that of the primary volume (P-VOL). To be recognized from host by the Control Panel: → Administrative Tools → Computer Management → Storage folder → Rescan Disks, or reboot a host.

4.15.6 Umount Subcommand

The `umount` subcommand unmounts the specified logical drive and deletes the drive letter. Before deleting the drive letter, this subcommand executes sync internally for the specified logical drive and flushes unwritten data. Table 4.32 describes the `umount` subcommand parameters. Figure 4.60 shows an example of the subcommand used as an option of the `pairsplit` command.

Caution: The logical drive to be unmounted and the corresponding physical drive must be closed to all applications.

Table 4.32 Umount Subcommand Parameters

Parameter	Value
Command Name	umount
Format	x umount drive: -x umount drive:[\[directory]] ... (for Windows 2000/ Windows Server 2003)

gument	drive: Specifies the mounted logical device
	drive:[\[directory]]: For Windows 2000/ Windows Server 2003. Specify the mounted logical device for drive. [\directory]: Specifies the directory for specifying the directory mount point in the logical device.
	`pairsplit –x umount D:\hd1`
	`D:\hd1 <-> HarddiskVolume8`
	`pairsplit –x umount D:\hd2`
	`D:\hd2 <-> HarddiskVolume9`

```
pairsplit -x umount F:\  -x umount G:\ -g oradb
pairsplit -x mount

Drive   FS_name   VOL_name   Device       Partition   ...  Port PathID  Targ  Lun
C:      FAT       Null       Harddisk0    Partition1  ...    1    0      0    0
Z:      Unknown   Unknown    CdRom0                   ...  Unknown
```

Figure 4.60 Umount Subcommand

This example unmounts the F: and G: drives, splits all pairs in the specified group (status = PSUS), enables read/write access to all secondary volumes in the specified group, and then displays all mounted drives.

The output of the `umount` subcommand includes:

- **Drive:** Shows the logical drive recognized by the Windows NT/2000/ Windows Server 2003 system.
- **FS_name:** Shows the name of the file system formatted on the specified drive.
- **VOL_name:** Shows the volume label name for the specified drive.
- **Device, Partition:** Shows the device name and partition for the specified drive.
- **Port, PathID, Targ, Lun:** Shows the port number, path ID (bus), target ID, and LUN for the specified drive. For further information on Fibre-to-SCSI address conversion, see Appendix D.

Note:

- For Windows 2000/ Windows Server 2003 system, even if this subcommand is executed, a drive letter may not be deleted. In this case, the target volume may be used. Execute the command after designating an unused status to the target volume. Alternatively, a drive letter can be deleted by activating Disk Management in the Control Panel-Administrative Tools-Computer Management-Storage folder.
- If you use the mount command with directory mount option on the Windows 2000/ Windows Server 2003 server, the umount command must be used with directory mount option.

Correct Example 1:

```
pairsplit  -x mount  F:\ hdisk2
pairsplit  -x umount  F:\
```

Correct Example 2:

```
pairsplit  -x mount  F: hdisk2
pairsplit  -x umount  F:
```

Incorrect Example:

```
pairsplit  -x mount  F:\ hdisk2
pairsplit  -x umount  F:
```

4.15.7 Environment Variable Subcommands

If no environment variables are set in the execution environment, the environment variable subcommand sets or cancels an environment variable within the CCI command. The setenv subcommand sets the specified environment variable(s). The usetenv subcommand deletes the specified environment variable(s). The env subcommand command displays the environment variable(s). The sleep subcommand causes CCI to wait for the specified time. Table 4.33 lists and describes the environment variable subcommands and their parameters.

Caution: The environment variables must be set before connecting to HORCM, and must be specified during interactive mode (-z option). Changing an environment variable after a CCI command execution error is invalid.

Table 4.33 Environment Variable Subcommand Parameters

Parameter	Value
Command Name	setenv usetenv env sleep
Format	x setenv vaname value -x usetenv vaname -x env -x sleep time
Argument	Vaname: Specifies the environment variable to be set or canceled. Value: Specifies the value or character string of the environment variable to be set. Time: Specifies the sleep time in seconds.

Figure 4.61 shows an example of the setenv subcommand used as an option of the raidscan command. This example changes from TrueCopy/TCE to ShadowImage/Snapshot/Data Retention an execution environment of the raidscan command which makes a dialog mode, because of establishing HORCC_MRCF as an environment variable.

Important: Always set HORCC_MRCF 1 for the ShadowImage/SnapShot/Data Retention operation.

```
raidscan[HORC]:  -x setenv  HORCC_MRCF 1
raidscan[MRCF]:

raidscan[MRCF]:  -x usetenv  HORCC_MRCF
raidscan[HORC]:
```

Figure 4.61 Example of the setenv subcommand

4.16 Command Tools

4.16.1 Inqraid Command Tool

The **inqraid** command tool confirms the drive connection between the TagmaStore and the host system. The inqraid command displays the relation between special file(s) on the HP-UX system and actual physical drive of the TagmaStore. Table 4.34 lists and describes the inqraid command and parameters. Figure 4.62 to Figure 4.69 show examples of using inqraid and system commands to display the connection between the STDIN special file and the actual physical drive of TagmaStore.

Table 4.34 Inqraid Command Parameters

Parameter	Value
Command Name	inqraid
Format	/HORCM/usr/bin/inqraid [-h | quit | -inqdump | -fx[l][g][w] | -find[c] | <special file> | –CLI | -CLIWP | -CLIWN | sort | -CM]

Parameter	Value
	\HORCM\etc\inqraid [-h | quit | -inqdump | -fx[l][g][w] | -find[c] | <special file> | –CLI | -CLIWP | -CLIWN | sort | -CM | -gvinf | -svinf]
Options	-h: This option displays Help/Usage. quit: This option terminates from waiting STDIN and exits this command. -inqdump: This option displays information for standard inquiry with Dump Image of hexadecimal. -fx: This option displays the LDEV number with hexadecimal. -find [c]: This option searches a group on the configuration definition file (local instance) from <special file> of STDIN by using pairdisplay command, and uses the following options of the pairdisplay command to display its state. The –find option executes the following command (see Figure 4.70 also). pairdisplay –d <Seq#><LDEV> 0 1 2 -l [-fx] [-CLI] 2>/dev/null The –find[c] option executes the following command and then displays the result edited to CLI format (see Figure 4.71 also). pairdisplay –d <Seq#><LDEV><MU#> -fd –CLI 2>/dev/null <special file>: This option is used to specify the special file name as argument of command. If no argument, this command makes mode that wait for STDIN without argument. -CLI: Displays the CLI. This option displays the CLI using one header and divides the column with space or with - (see Figure 4.72 also). -CLIWP and -CLIWN: For fibre channel, these options display the WWN of the host adaptor in CLI format. PWWN or NWWN will be displayed for WWN (see Figure 4.73 also). For iSCSI, 0000000000000000 will be always displayed for WWN. -sort [-CM]: Sorts and displays the order of the TagmaStore subsystem product number and the volume management number. The [-CM] option searches for command device from the specified special file (raw device file) provided via STDIN or argument input, and then displays only the command device in the image of the configuration definition file (see Figure 4.74 also). -gvinf: For Windows NT/2000/ Windows Server 2003 systems only. -gvinfex: For Windows 2003 GPT disk only. This option obtains the signature and the volume layout information from the device that is given by a standard input or by an argument, and saves (shelters) the information under the system device in the following format). File format: \WindowsDirectory\VOLssss_llll.ini (ssss indicates the serial number of the subsystem, and llll indicates the LDEV number). Usually, you do not need to be aware of this file, since the file is used by Windows Disk Management at the beginning when setting the S-VOL signature and the volume information. -svinf: For Windows NT/2000/ Windows Server 2003 systems only. -svinfex: For Windows 2003 GPT disk only. This option sets the saved (sheltered) signature and the system volume layout information of the system device into the device that is given by a standard input or by an argument. When setting the signature and the volume layout information to the device, the host issues the SCSI inquiry command, obtains the serial number of the subsystem and the LDEV number, and then reads the applicable VOLssss_llll.ini file. Therefore, even if the hard disk number is changed due to changing the configuration, the signature and the volume layout information will be set correctly since it is managed by the subsystem serial number and the LDEV number. For [=PTN], after –svinf option, specify a pattern for selecting the character string that is given as a device by a standard input or by an argument). -fv: For Windows 2000/ Windows Server 2003 systems only. This option is used with $Volume specification. Volume{guid} of the appropriate volume is displayed in the wide format. *Example:* # inqraid -CLI $Vol –fv DEVICE_FILE PORT SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID Volume{cec25efe-d3b8-11d4-aead-00c00d003b1e}\\Vol3\Dsk0 CL1-B 2496 56 - - - - DF600F-CM -fl: Shows a data protection volume with -CLI option by appending an asterisk (**) to the device file name. -fg: This option is specified to find the host storage domain (host group) and to display LUN.

Parameter	Value
	-fw: This option extends the contents of display, and indicates the V-VOL information to the maximum of MU#. This option is used by combining with the option of -CLI.
Returned values	The –svinf option returns the following values to distinguish the execution result from the user program: Normal termination: 0. Abnormal termination: 1 (when the execution to the specified device did not end normally).
Restriction	The special file of STDIN or Argument must be specified following name: HP-UX: /dev/rdsk/*, /dev/rdisk/disk* Solaris: /dev/rdsk/*s2, c*s2 AIX: /dev/rhdisk*, /dev/hdisk*, hdisk* Linux: /dev/sd*, /dev/rd*, /dev/raw/raw* Tru64 UNIX: /dev/rdisk/dsk*c IRIX: /dev/rdsk/*vol, /dev/rdsk/node_wwn/*vol/*, /dev/dsk/*vol, /dev/dsk/node_wwn/*vol/* Windows NT systems: hd0-10, harddisk0, harddisk1...(numbers indicate the drive number) $LETALL, $Phys, D:\DskX\pY, \DskX\pY Windows 2000/ Windows Server 2003 systems: hd0-10, harddisk0, harddisk1...(numbers indicate the drive number) $LETALL, $Volume, $Phys, D:\Vol(Dms,Dmt, Dmr)X\DskY, \Vol(Dms,Dmt, Dmr)X\DskY *Example:* ls /dev/sd* | ./inqraid echo /dev/sda /dev/sdb /dev/sdc | ./inqraid For Windows 2000/ Windows Server 2003 LDM volumes, see Appendix E.

```
ioscan -fun | grep rdsk | ./inqraid
/dev/rdsk/c0t2d1 -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
                    HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                    RAID5[Group  2- 0] SSID = 0x0000
/dev/rdsk/c0t4d0 -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.62 Inqraid Command Example (HP-UX)

```
ls /dev/rdsk/* | ./inqraid
/dev/rdsk/c0t2d1s2 -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
                      HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                      RAID5[Group  2- 0] SSID = 0x0000
/dev/rdsk/c0t4d0s2 -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.63 Inqraid Command (Solaris)

```
lsdev -C -c disk | ./inqraid
hdisk10 -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
           HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
           RAID5[Group  2- 0] SSID = 0x0000
hdisk11 -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.64 Inqraid Command (AIX)

```
ls /dev/sd* | inqraid
/dev/sdh -> CHNO =   0 TID =   1 LUN =   7
             [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
             HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
             RAID5[Group  2- 0] SSID = 0x0000
/dev/sdi -> CHNO =   0 TID =   4 LUN =   0
             [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.65 Inqraid Command (Linux)

```
ls /dev/rdisk/dsk* | ./inqraid
/dev/rdisk/dsk10c -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
             HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
             RAID5[Group  2- 0] SSID = 0x0000
/dev/rdisk/dsk11c -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.66 Inqraid Command (Tru64 UNIX)

```
echo hd10-11 | .\inqraid
Harddisk10 -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F          ]
              HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
              RAID5[Group  2- 0] SSID = 0x0000
Harddisk11 -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM       ]
```

Figure 4.67 Inqraid Command (Windows NT/2000/ Windows Server 2003)

```
ls /dev/rdsk/*vol | ./inqraid
/dev/rdsk/dks1d6vol -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ] [DF600F        ]
                           HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                           RAID5[Group  2- 0] SSID = 0x0000
/dev/rdsk/dks1d7vol -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ] [DF600F-CM     ]
```

Figure 4.68 Inqraid Command (IRIX FC_AL)

```
ls /dev/rdsk/*/*vol/* | ./inqraid
/dev/rdsk/50060e8000100262/lun3vol/c8p0 -> [ST] CL2-A Ser =75003005 LDEV =   9 [HITACHI ]
[DF600F          ]
                            HORC = SMPL  HOMRCF[MU#0 = SMPL MU#1 = NONE MU#2 = NONE]
                            RAID5[Group  2- 0] SSID = 0x0000
/dev/rdsk/50060e8000100262/lun4vol/c8p0 -> [ST] CL2-A Ser =75003005 LDEV =  14 [HITACHI ]
[DF600F-CM       ]
```

Figure 4.69 Inqraid Command (IRIX Fabric Fibre)

The output of the inqraid command includes:

- **CLX-Y:** Shows the port number.
- **Ser:** Shows the serial number.
- **LDEV:** Shows the LDEV ID. LDEV indicates LU.
- **HORC:** Shows TrueCopy/TCE attributes (P-VOL/S-VOL/SMPL) of the volume.
- **HOMRCF:** Shows ShadowImage/SnapShot attributes (PVOL/SVOL/SMPL) of the volume for MU#. ***(Note)***

- **Group:** Shows the array (parity) group ID (physical position of the volume in the TagmaStore). LDEV indicates LU. ***(Note)***
- **SSID:** Shows the subsystem ID of the volume. LDEV indicates LU. ***(Note)***
- **CHNO:** Channel number on the device adapter that recognizes the volume. Displayed only for Linux systems.
- **TID:** Target ID of the volume. Displayed only for Linux systems. For further information on Fibre-to-SCSI address conversion, see Appendix D.
- **LUN:** Logical unit number of the volume. Displayed only for Linux systems.

Note: The display of HOMRCF, Group, and SSID depends on the TagmaStore microcode level.

```
# echo /dev/rdsk/c23t0d0  /dev/rdsk/c23t2d3 | ./inqraid –find
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,LDEV#, P/S, Status, Seq#, P-LDEV#  M
horcl   dev00(L)    (CL2-A , 0, 0-0)75006145     0  S-VOL  SSUS, -----       9   -
->/dev/rdsk/c23t0d0
Group   PairVol(L/R) (Port#,TID,LU-M), Seq#,LDEV#, P/S, Status, Seq#, P-LDEV#  M
horcl   dev10(L)    (CL2-A,  2, 3-0)75006145     3  S-VOL  SSUS, -----       6   -
->/dev/rdsk/c23t2d3
```

Figure 4.70 Inqraid Command –find Option (HP-UX)

```
# echo /dev/rdsk/c23t0d0  /dev/rdsk/c23t2d3 | ./inqraid –findc
DEVICE_FILE    M Group    PairVol  P/S   Stat  R_DEVICE  M  P/S   Stat  LK
C23t0d0  0 horcl    dev00    S-VOL SSUS  c23t0d1   0  P-VOL PSUS  OK
/dev/rdsl/c23t0d0[1]   -> No such on the group
/dev/rdsl/c23t0d0[2]   -> No such on the group
DEVICE_FILE    M Group    PairVol  P/S   Stat  R_DEVICE  M  P/S   Stat  LK
C23t2d3  0 horcl    dev10    S-VOL SSUS  c23t2d2   0  P-VOL PSUS  OK
/dev/rdsl/c23t2d3[1]   -> No such on the group
/dev/rdsl/c23t2d3[2]   -> No such on the group

# echo /dev/rdsk/c23t0d0  /dev/rdsk/c23t2d3 | ./inqraid –findc –CLI
DEVICE_FILE    M Group    PairVol  P/S   Stat  R_DEVICE  M  P/S   Stat  LK
C23t0d0  0 horcl    dev00    S-VOL SSUS  c23t0d1   0  P-VOL PSUS  OK
C23t2d3  0 horcl    dev10    S-VOL SSUS  c23t2d2   0  P-VOL PSUS  OK
```

Figure 4.71 Inqraid Command –findc Option (HP-UX)

The output of the inqraid command with –find (and -findc) includes:

- **DEVICE_FILE:** Shows only the device file name.
- **M:** Shows the MU#.
- **Group:** Shows the group name (dev_group) described in the configuration definition file.
- **PairVol:** Shows the paired volume name (dev_name) of the group described in the configuration definition file.
- **P/S:** Shows the volume attribute (P-VOL, S-VOL, SMPL).
- **Stat:** Shows the status of the paired volume.
- **R_DEVICE:** Shows the device file name of the remote site.

- **LK:** Shows the configuration check result for the paired volume connection path (physical link of the paired volumes between the servers).

```
# ls /dev/sd* | ./inqraid -CLI
DEVICE_FILE     PORT    SERIAL  LDEV  H/M/12  SSID R:Group PRODUCT_ID
sdh             CL2-B   75003005    23   -/P/--  0004 5:02-00  DF600F
sdi             CL2-B   75003005    14     -      -      -     DF600F-CM
sdj             -       -        -      -      -      -    -
```

Figure 4.72 Inqraid Command -CLI Option (Linux)

The output of the inqraid command with -CLI includes:

- **DEVICE_FILE:** Shows only the device file name.
- **PORT:** Shows the port name of the TagmaStore.
- **SERIAL:** Shows the product number of the TagmaStore.
- **LDEV:** Shows the volume management number in the TagmaStore. LDEV indicates LU.
- **H/M/12:** Shows the volume attribute (P-VOL is indicated as P, S-VOL is indicated as S, and SMPL is indicated as s).
- **SSID:** Shows the subsystem ID where LDEV is allocated. LDEV indicates LU.
- **R:Group:** Shows the position of the physical CCI group mapped in LDEV. LDEV indicates LU.
- **PRODUCT_ID:** Shows the product ID in the standard inquiry page.

```
# echo  /dev/rdsk/c23t0d0  /dev/rdsk/c23t0d1  |  ./inqraid -CLIWP
DEVICE_FILE    PWWN              AL PORT  LUN    SERIAL   LDEV  PRODUCT_ID
c23t0d0        500060e802f01018  -  CL2-A   -    75006145    12   DF600F
c23t0d1        500060e802f01018  -  CL2-A   -    75006145    12   DF600F
```

Figure 4.73 Inqraid Command –CLIWP Option Example (HP-UX)

The output of the inquaid command with –CLIWP includes:

- **DEVICE_FILE:** Shows only the device file name.
- **WWN (PWWN** or **NWWN):** For fibre channel, if –CLIWP option is specified, this option shows the Port_WWN of the host adaptor for the specified device. If –CLIWN option is specified, this option shows the Node_WWN of the host adaptor. For iSCSI, 0000000000000000 will be always displayed.
- **AL and LUN:** Shows a hyphen (-) all the time.
- **PORT:** Shows the port name of the TagmaStore.
- **SERIAL:** Shows the product number of the TagmaStore.
- **LDEV:** Shows the volume management number in the TagmaStore. LDEV indicates LU.
- **PRODUCT_ID:** Shows the product ID in the standard inquiry page.

```
# ioscan -fun | grep rdsk | ./inqraid -sort -CM -CLI
HORCM_CMD
# dev_name            dev_name              dev_name
#UnitID 0  (Serial# 75003001)
/dev/rdsk/c0t3d0        /dev/rdsk/c1t2d1
#UnitID 1  (Serial# 75003002)
/dev/rdsk/c2t3d0
```

Figure 4.74 Inqraid Command –sort[-CM] Option (HP-UX)

Note: The unit ID is added in the order of the TagmaStore subsystem's product number. If multiple command devices exist within the subsystem, the device file that is used to share between the subsystem port would be chosen in prior, and is used as alternate command device.

The following is an example of using the **-gvinf** option of the inqraid command. The information in all physical drives will be saved (sheltered) by giving **$Phy**.

```
D:\HORCM\etc>inqraid $Phys -gvinf –CLI
\\.\PhysicalDrive0:
\ Harddisk0      -> [VOL75006145_448_DA7C0D91] [DF600F      ]
\\.\PhysicalDrive1:
\ Harddisk1      -> [VOL75006145_449_DA7C0D92] [DF600F      ]
\\.\PhysicalDrive2:
\ Harddisk2      -> [VOL75006145_450_DA7C0D93] [DF600F      ]
```

Signature

LDEV number

TagmaStore serial number

Figure 4.75 Inqraid Command –gvinf Option Example

The following is an example of using the –svinf option of the inqraid command. The information is set to the hard disk number indicated by the pairdisplay command that is issued from S-VOL instance.

```
D:\HORCM\etc>pairdisplay -l -fd -g URA
Group   PairVol(L/R) Device_File   M ,Seq#,LDEV#.P/S, Status, Seq#,P-LDEV# M
URA     URA_000(L)    Harddisk3     0 75006145  51.S-VOL SSUS,-----     48 -
URA     URA_001(L)    Harddisk4     0 75006145  52.S-VOL SSUS,-----     49 -
URA     URA_002(L)    Harddisk5     0 75006145  53.S-VOL SSUS,-----     50 -

D:\HORCM\etc>pairdisplay -l -fd -g URA | inqraid -svinf=Harddisk
[VOL75006145_51_5296A763] -> Harddisk3        [DF600F          ]
[VOL75006145_52_5296A760] -> Harddisk4        [DF600F          ]
[VOL75006145_53_5296A761] -> Harddisk5        [DF600F          ]
```

Figure 4.76 Inqraid Command –svinf Option Example

Important: If you have created a pair using a noread option, the device object (\Device\HarddiskVolume#) and the Volume{guid} of the S-VOL will not be generated at the time when Windows is booted in Noread status. However, executing the pairsplit command, and then executing the inqraid –svinf command results in generation of the device object (\Device\HarddiskVolume#) and the Volume{guid}.

The hard disk volume number of the device object is generated in the order of the command that Windows issued. Therefore, the same number will be maintained unless the configuration is changed. However, if you want the hard disk volume number to be absolute, add the –sort option, as shown below, so that the serial number of the subsystem and the LDEV number will be sorted in numbers.

Example:

```
D:\HORCM\etc>echo hd5 hd4 hd3 | inqraid -svinf -sort
[VOL75006145_51_5296A763] -> Harddisk3        [DF600F          ]
[VOL75006145_52_5296A760] -> Harddisk4        [DF600F          ]
[VOL75006145_53_5296A761] -> Harddisk5        [DF600F          ]
```

The following is an example of using the –fw option of the inqraid command.

```
C:\horcm\etc>inqraid $Phy -CLI -fw
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H../M/..           SSID R:Group PRODUCT_ID
Harddisk0        -          -     -   -  -                     -       - FIREBALL CR6
Harddisk1        -          -     -   -  -                     -       - PSEUDO LUN
Harddisk2       CL1-A  75000008     1   -  -                      -       - DF600F-CM
Harddisk3       CL1-A  75000008     2   -  s/P/PPsssssssssP   0000 5:00-00 DF600F
```

Figure 4.77 Inqraid Command -fw Option Example (Windows 2000/ Windows Server 2003)

4.16.2 Mkconf Command Tool

The **mkconf** command executes the following operation and creates a configuration definition file automatically from the special file via STDIN. The user must edit the created configuration definition file as needed.

1. The mkconf command executes **inqraid -sort -CM -CLI** and then creates a configuration definition file only for HORCM_CMD.
2. The mkconf command starts the HORCM instance using the created definition file.
3. The mkconf command executes **raidscan -find conf** by using the special file via STDIN, and then creates the definition file that contains HORCM_DEV and HORCM_INST.

4. The mkconf command starts the HORCM instance again to verify the created definition file.
5. The mkconf command executes **raidscan -find verify** and displays the correspondence between the special files via STDIN with the definition file.

Table 4.35 Mkconf Command Parameters

Parameter	Value
Command Name	mkconf
Format	/HORCM/usr/bin/mkconf.sh[-g][g] <group> [-m <mu#>] [-i <inst#>] [-s <service>] [-a]] \HORCM\etc\ mkconf.exe[-g[g] <group> [-m <mu#>] [-i <inst#>] [-s <service>] [-a] [-c <drive>]]
Options	If no argument, this command creates a mode that waits for STDIN without argument. -g[g] <group>: This option specifies the group described in the configuration definition file. If omitted, VG is used for the group name. This option is specified to find the host storage domain (host group) and to display LUN. -m <MU#>: This option specifies the mirror descriptor MU#. -i <inst>: This option shows the instance number. -s <service>: This option specifies the service name (port number) described in the configuration definition file. If omitted, 52323 is used for the port number. -a: This option adds a group to an already created configuration definition file. -c <drive>: (for Windows NT/2000/ Windows Server 2003 only) This option specifies the range of the command device to be searched. If omitted, $PhysicalDrive is used for <drive>.

WARNING: If you have created the configuration definition file using the mkconf command tool, remember to change the value of the poll(10ms) manually. For details on calculating the poll(10ms) value, refer to section 2.5.3. Setting the value incorrectly may cause a conflict between CCI and the subsystem; the internal processing of the subsystem may suspend temporarily. Processing may not proceed.

Note: The configuration definition file and the log file are created in the current directory as horcm*.conf or log*
(* as an instance number).

The user must edit the created configuration definition file as necessary (such as ip_addresses, and services).

```
# cd /tmp/test
# cat /etc/horcm.conf | /HORCM/usr/bin/mkconf.sh -g ORA -i 9 -m 0
starting HORCM inst 9
HORCM inst 9 starts successfully.
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
starting HORCM inst 9
HORCM inst 9 starts successfully.
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
/dev/rdsk/c23t0d0       ORA      ORA_000     CL2-A     0    0 0   75006145     0
/dev/rdsk/c23t0d1       ORA      ORA_001     CL2-A     0    1 0   75006145     1
/dev/rdsk/c23t0d2       ORA      ORA_002     CL2-A     0    2 0   75006145     2
/dev/rdsk/c23t0d3       ORA      ORA_003     CL2-A     0    3 0   75006145     3
/dev/rdsk/c23t0d4       ORA      ORA_004     CL2-A     0    4 0   75006145     4
/dev/rdsk/c23t0d5       ORA      ORA_005     CL2-A     0    5 0   75006145     5
/dev/rdsk/c23t0d6       ORA      ORA_006     CL2-A     0    6 0   75006145     6
/dev/rdsk/c23t0d7       -         -           -       -    - 0   75006145     -
HORCM Shutdown inst 9 !!!
Please check '/tmp/test/horcm9.conf','/tmp/test/log9/curlog/horcm_*.log', and modify
ip_address & service'.

# ls
horcm9.conf  log9
# vi horcm9.conf

# Created by mkconf.sh on Mon Jan 22 17:59:11 JST 2001

HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
localhost          52323           1000 [Note]      3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 75006145)
/dev/rdsk/c23t3d0

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/rdsk/c23t0d0    SER =75006145  LDEV =    0  [ FIBRE FCTBL = 4 ]
ORA                ORA_000          CL2-A            0        0       0
# /dev/rdsk/c23t0d1    SER =75006145  LDEV =    1 [ FIBRE FCTBL = 4 ]
ORA                ORA_001          CL2-A            0        1       0
# /dev/rdsk/c23t0d2    SER =75006145  LDEV =    2 [ FIBRE FCTBL = 4 ]
ORA                ORA_002          CL2-A            0        2       0
# /dev/rdsk/c23t0d3    SER =75006145  LDEV =    3 [ FIBRE FCTBL = 4 ]
ORA                ORA_003          CL2-A            0        3       0
# /dev/rdsk/c23t0d4    SER =75006145  LDEV =    4 [ FIBRE FCTBL = 4 ]
ORA                ORA_004          CL2-A            0        4       0
# /dev/rdsk/c23t0d5    SER =75006145  LDEV =    5 [ FIBRE FCTBL = 4 ]
ORA                ORA_005          CL2-A            0        5       0
# /dev/rdsk/c23t0d6    SER =75006145  LDEV =    6 [ FIBRE FCTBL = 4 ]
ORA                ORA_006          CL2-A            0        6       0
# ERROR [CMDDEV] /dev/rdsk/c23t0d7    SER =75006145  LDEV =    7 [DF600F-CM       ]

HORCM_INST
#dev_group        ip_address      service
ORA                localhost       52323
```

Figure 4.78 Mkconf Command Example (HP-UX)

Note: Remember to change the value of poll(10ms) parameter using the equation described in section 2.5.3.

Notes:

- Unit IDs are added in the order of the subsystem product number. If multiple command devices exist in the subsystem, the device file that was shared between the ports of the subsystem will be selected, and will be handled as an alternative command device.
- If the standard input device includes a command device, the target device will be displayed as the comment shown below and will be omitted.

  Example:

```
# ERROR [CMDDEV] /dev/rdsk/c23t0d7  SER =75006145  LDEV = 7 [DF600F-CM      ]
```

- If the standard input device is shared between several command devices and is already displayed as a target device, the target device will be displayed as the comment shown below and will be omitted.

  Example:

```
# ERROR [LDEV LINK] /dev/rdsk/c24t0d3 SER =75006145  LDEV = 3 [FIBRE FCTBL = 4]
```

- If the standard input device does not have an appropriate mirror descriptor (MU#), the target device will be displayed as the comment shown below and will be omitted.

  Example:

```
# ERROR [LDEV MUN (2<1)] /dev/rdsk/c24t0d3  SER =75006145  LDEV = 3 [DF600F  ]
```

- If the device from the standard input co-reside between subsystems with different mirror control, the target device will be displayed as the comment shown below and will be omitted.

  Example:

```
# ERROR [MIXING RAID TYPE] /dev/rdsk/c24t0d3 SER =75006145 LDEV = 3 [DF600F  ]
```

4.17 Host Group Control

The TagmaStore has the defined host group in the port and are able to allocate Host LU every this host group. CCI does not use this host LU, and specifies by using absolute LUN in the port. Therefore, a user can become confused because LUN of the CCI notation does not correspond to LUN on the host view. Thus, CCI supports a way of specifying a host group and LUN on the host view.

4.17.1 Specifying a Host Group

- Defining the formats

The way what CCI has addition of argument for the host group to the raidscan command and the configuration file will not be able to maintain the compatibility with conventional CLI. Therefore, CCI adopts a way that supports in the form which specifies a host group in the port strings as follows.

- CL1-A-**GRP#** (GRP# are up to 127)

Specifying the host group for the raidscan command:

```
raidscan -p CL1-A-5
```

Specifying the host group for the configuration file:

```
#dev_group    dev_name     port#       TargetID     LU#   MU#
ORA           ORA_000      CL1-A-1          4        1     0
ORA           ORA_001      CL1-A-1          4        2     0
```

If the port including a host group is specified to the port name, then maximum of specifiable LUNs are up to 255.

- Specifiable port strings

As the result, CCI supports four kinds of forms in the port name.

- Specifying the Port name without a host group:

  CL1-A

  CL1-A**n** where **n**: unit ID for multiple RAID

- Specifying the Port name with a host group:

  CL1-A-**g** where **g**: host group

  CL1-A**n**-**g** where **n**-**g**: host group=**g** on CL1-A in unit ID=**n**

4.17.2 Commands and Options including a Host Group

- **Specifiable command for host group**

The following commands are able to specify a host group with the port strings:

– **raidscan -p <port>, raidar -p <port>, raidvchkscan -p <port>**

```
# raidscan -p CL2-D-1
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-A-1 /da/ 0,  4,  0.1(256).....SMPL  ----  ------ ----, -----  ----
CL1-A-1 /da/ 0,  4,  1.1(257).....SMPL  ----  ------ ----, -----  ----
CL1-A-1 /da/ 0,  4,  2.1(258).....SMPL  ----  ------ ----, -----  ----
```

- **New option including a host group**

CCI supports new option for the following commands in order to show a LUN on the host view by finding a host group via the specified device.

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

```
# raidscan -pdg /dev/rdsk/c57t4d1
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....)...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-A-1 /da/ 0,  4,  0.1(256).....SMPL  ----  ------ ----, -----  ----
CL1-A-1 /da/ 0,  4,  1.1(257).....SMPL  ----  ------ ----, -----  ----
CL1-A-1 /da/ 0,  4,  2.1(258).....SMPL  ----  ------ ----, -----  ----
Specified device(hgrp=1) is LDEV# 0257
```

– **raidscan** -find**g**

```
# ls /dev/rdsk/c57* | raidscan -findg
DEVICE_FILE         UID  S/F PORT   TARG  LUN    SERIAL  LDEV  PRODUCT_ID
/dev/rdsk/c57t4d0    0    F  CL1-A-1   4    0    75001000   256  DF600F-CM
/dev/rdsk/c57t4d1    0    F  CL1-A-1   4    1    75001000   257  DF600F
/dev/rdsk/c57t4d2    0    F  CL1-A-1   4    2    75001000   258  DF600F
```

– **raidscan -findg conf, mkconf** -**gg**

```
# ls /dev/rdsk/c57* | raidscan -findg conf 0 -g ORA
HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/rdsk/c57t4d1    SER = 75001000  LDEV =  257 [ FIBRE FCTBL = 4 ]
ORA                ORA_000         CL1-A-1          4       1       0
# /dev/rdsk/c57t4d2    SER = 75001000  LDEV =  258 [ FIBRE FCTBL = 4 ]
ORA                ORA_001         CL1-A-1          4       2       0
```

– **inqraid** -**fg**

```
# ls /dev/rdsk/c57* | ./inqraid -CLI -fg
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
c57t4d0         CL1-A-1 75001000   256   -       -     -       - DF600F-CM
c57t4d1         CL1-A-1 75001000   257   -  s/P/ss  0000 1:01-02 DF600F
c57t4d2         CL1-A-1 75001000   258   -  s/P/ss  0000 1:01-02 DF600F
```

4.18 Synchronous Waiting Command (Pairsyncwait) for TCE

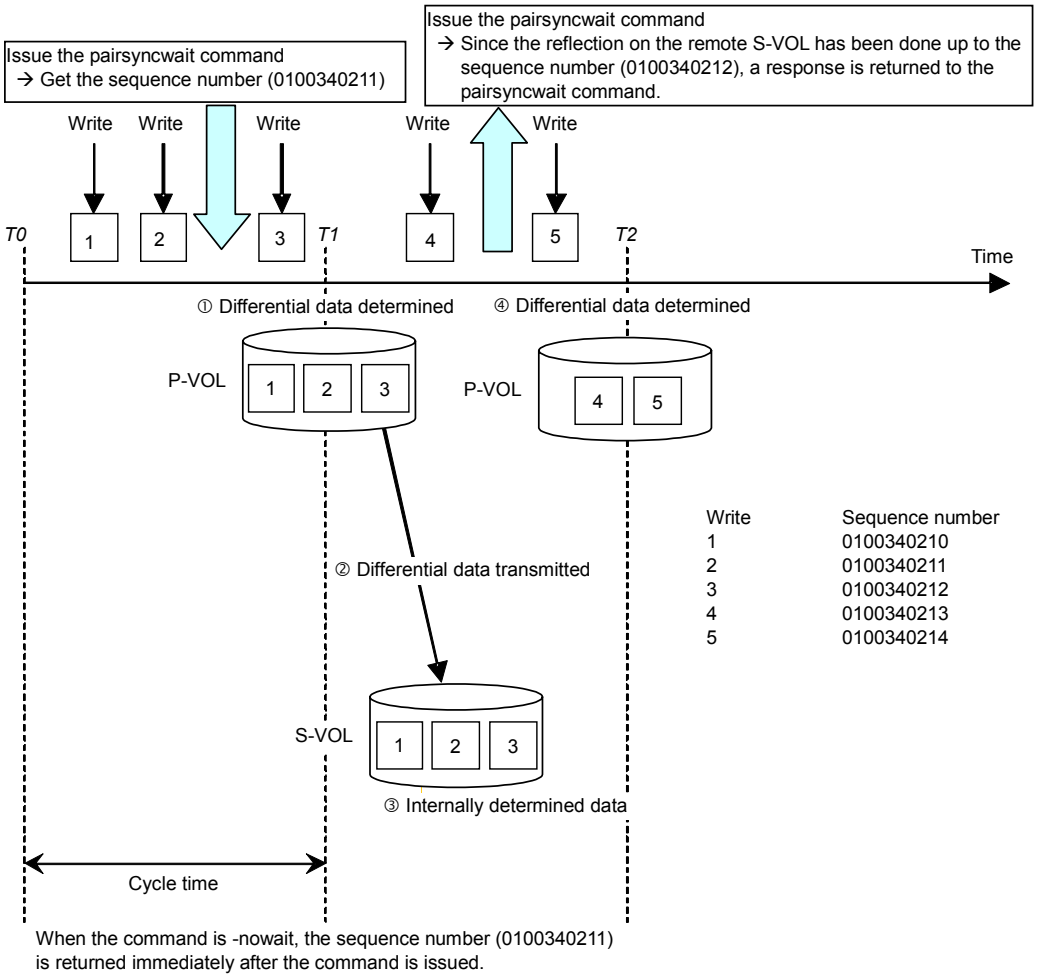
Table 4.36 describes the pair synchronization waiting command parameters and returned values. The pairsyncwait is a command exclusive for TCE. It is a command to check whether or not the data written immediately after the issue of the command is reflected on the S-VOL of the remote site. This command gets the latest sequence # of local TagmaStore (P-VOL latest sequence # within the CT group) and the sequence # of remote TagmaStore within the CT group which correspond to the <group> or <raw_device> that is specified by pairsyncwait, and compares local TagmaStore with remote TagmaStore sequence # at that time and at regular interval. Because the sequence number is updated for each group, you can check whether the S-VOL data has been updated or not by executing the command specifying a group when all the pairs in the target group are in the PAIR status.

If remote TagmaStore sequence # is over the value of local TagmaStore sequence # within the term that was specified by pairsysncwait, this command reports the return code 0 with the meaning of completion of synchronization. The –nowait option shows the latest sequence # (Q-marker) of local TagmaStore P-VOL and CTGID. The marker is shown in hexadecimal of ten characters.

Table 4.36 Pairsyncwait Command Parameters

Parameter	Value
Command Name	pairevtwait
Format	pairevtwait { -h | -q | -z | -I[H | M][instance#] | -g <group> | -d <pair Vol> | -d[g] <raw_device> [MU#] | -d[g] <seq#> <LDEV#> [MU#] | -m <marker> | -t <timeout> | -nowait | -nomsg }
Options	-h: Displays Help/Usage and version information.
	-q: Terminates the interactive mode and exits this command.
	-z or –zx: Makes the pairsyncwait command enter the interactive mode. The –zx option guards performing of the HORCM in the interactive mode. When this option detects a HORCM shut down, interactive mode terminates. **-I[H | M][instance#]** or **-I[TC | SI][instance#]:** Specifies the instance number and the command execution environment. Refer to section 4.2.1.
	-g <group>: Specifies a group name defined in the configuration definition file. The command is executed for each CTG unless the –d <pair Vol> option is specified. The execution result of the pairsyncwait command for each option, see Table 4.37 and Table 4.38.
	-d <pair Vol>: Specifies a paired logical volume name defined in the configuration definition file. When this option is specified, the command is executed for the specified paired logical volumes.
	-d[g] <raw_device> [MU#]: Searches a group on the configuration definition file (local instance) for the specified raw_device, and if the specified raw_device is contained in the group, the target volume is executed as the paired logical volume (-d) or group (dg). This option is effective without specifying the
	"-g <group>" option. If the specified the raw_device is contained in two or more groups, the command is executed on the first group.
	-d[g] <seq#> <LDEV#> [MU#]: Searches a group on the configuration definition file (local instance) for the specified LDEV, and if the specified LDEV is contained in the group, the target volume is executed as the paired logical volume (-d) or group (-dg). This option is effective without specifying the "-g <group>" option. If the specified LDEV is contained in two or more groups, the command is executed on the first group. The <seq #> <LDEV #> values can be specified in hexadecimal (by addition of "0x") or decimal notation.
	-t <timeout>: Specifies the timeout value to wait for the completion. The unit is 100 ms. Local TagmaStore gets the latest sequence # from remote TagmaStore at regular interval.
	-nowait: Gets the latest sequence # of local TagmaStore P-VOL and CTGID without waiting. When this option is specified, the latest sequence # of local TagmaStore P-VOL is reported immediately, and –t <timeout>option is ignored.
	nomsg: Suppresses messages to be displayed when this command is executed. It is used to execute a command from a user program. This option must be specified at the beginning of a command argument. The command execution log is not affected by this option.
	-m <marker>: Specifies the sequence # of local TagmaStore P-VOL, called the Q-marker. If the application gets Q-marker as the result of execution of pairsyncwait because of timeout or "-nowait", the application can reconfirm the completion of asynchronous transfer by using pairsyncwait with Q-marker. If the application does not specify Q-marker, CCI uses the latest sequence # when CCI receives pairsyncwait. It is also possible to wait for the completion from S-VOL side with this option.
	Q-Marker format: = iisssssss, where ii = incarnation # of pair volume, and sssssss = P-VOL serial #.
Returned values	When the –nowait option is specified: Normal termination: 0: The status is NOWAIT. Abnormal termination: other than 0 to 127, refer to the execution logs for error details

Parameter	Value
	When the –nowait option is not specified: Normal termination: 0: The status is DONE (completion of synchronization). 1: The status is TIMEOUT (timeout). 2: The status is BROKEN (Q-marker synchronized process is rejected). 3: The status is CHANGED (Q-marker is invalid due to resynchronize). Abnormal termination: other than 0 to 127, refer to the execution logs for error details.



```
# pairsyncwait -g oradb  -nowait    ← -nowait is specified.
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  NOWAIT        2
# pairsyncwait -g oradb  -t 100     ← -nowait is not specified.
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  DONE          2
# pairsyncwait -g oradb  -t 1
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  TIMEOUT       3
# pairsyncwait -g oradb  -t 100 -m 01003408ef
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  DONE          0
# pairsyncwait -g oradb  -t 100
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  BROKEN        0
# pairsyncwait -g oradb  -t 100     -m  01003408ef
UnitID  CTGID     Q-Marker  Status    Q-Num
     0      3   01003408ef  CHANGED       0
                                          ↖ Q Marker(01003408ef) is invalid  when P-VOL
                                          was resynchronized while this command is
                                          executed.
```

Figure 4.79 Pairsyncwait Command Examples

The output of the pairsyncwait command is:

- **UnitID**: Unit ID in case of multiple subsystem connection
- **CTGID**: CTGID within Unit ID
- **Q-Marker**: The latest sequence # of local TagmaStore P-VOL (Marker) when the command is received.
- **Status**: The status after the execution of command.
- **Q-Num**: The number of process queue to wait for synchronization within the CTGID.

Execute `pairsyncwait` only when the target pair statuses are all PAIR. It can also be executed when the target pair status is other than PAIR, but the output result becomes as it is shown in the table below.

Table 4.37 Command is Issued to the Primary Subsystem in which a TCE Pair has been created

Options	Result
-g or –g –nowait	The command can be executed when a status of a pair, which is defined as the lead pair of the specified group in the configuration definition file, is PAIR.
-d or –d –nowait	The command can be executed when the status of the specified pair is PAIR.
-g, -m, or –d –m	The command can be executed even when a single pair in the PAIR status exists in the specified group.

Table 4.38 Command is Issued to the Secondary Subsystem in which a TCE Pair has been created

Options	Result
-g, -d, –g –nowait, or –d –nowait	Cannot executed
-g –m, or –d –m	The command can be executed even when a single pair in the PAIR status exists in the specified group.

4.19 Volume Migration

4.19.1 Overview of Volume Migration

Volume Migration is a function which migrates a logical volume to the other RAID group in the disk subsystem. CCI operates with the software on the server and the Volume Migration of the disk subsystem. It also provides a function to control Volume Migration by CLI commands.

4.19.2 Specifications for Volume Migration

To execute CCI migration by operating Volume Migration, map the migration destination volume to a port or a host group that is not connected to a host beforehand.

Figure 4.80 is the execution example of the volume migration executed for LDEV#18.

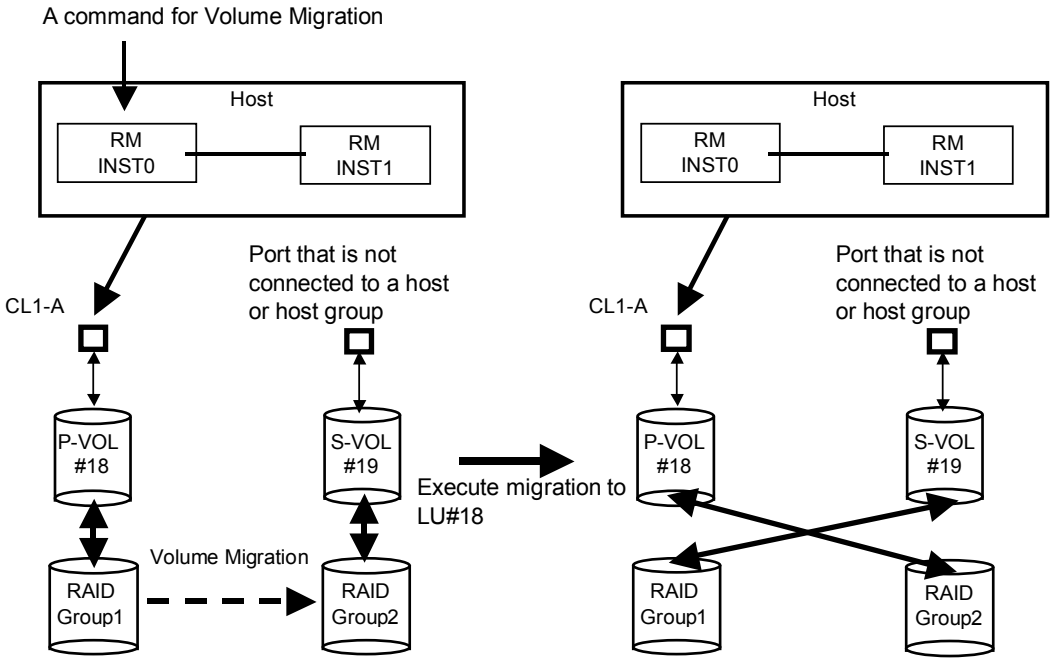


Figure 4.80 Volume Migration Configurations

- Command specification

  To operate Volume Migration using CCI, define the mapping of the migration source volume and the migration destination volume. The volumes are registered in the horcm*.conf file of CCI in the same way as ShadowImage, etc., to define mapping. When the remote instance is instructed to execute the migration by Volume Migration, the volume of the remote instance is interpreted as the migration source volume and a volume of the local instance is made to be the migration destination volume.

- Group operation

It is possible to perform an operation of Volume Migration for a group through a description in the horcm*.conf file of CCI, but the data consistency of a group for which the command has been executed is not maintained. When a host crashes while the command is executed for the group, the command execution is interrupted halfway and LUs in statuses different from each other may exist.

- HORCM instance

  It is possible to describe a volume to be operated by Volume Migration in the horcm*.conf file, in which a volume to be operated by the other function such as ShadowImage is described, as the other group in duplicate. It is also possible to define a volume to be operated by Volume Migration in the other horcm*.conf file than that for a volume to be operated by the other function such as ShadowImage and to operate it from the independent HORCM instance.

4.19.3 Commands to Control the Volume Migration

Table 4.39 lists and describes the Volume Migration command parameters.

- Command for volume migration

  CCI supports the volume migration by adding an option (**-m cc**) to the paircreate command.

Table 4.39 Command for Volume Migration

Parameter	Value
Command Name	paircreate
Format	paircreate -g <group> -d <pair Vol> -m cc -vl[r] -c <size>
Options	**-m cc**: This option instructs the copying of the volume migration to be made. ***Note:*** This option cannot be specified with -split option in the same command. **-vl** or **–vr**: Specifies the data flow direction and must always be specified. The **-vl** specifies the local instruction. This is an instruction which copies a local instance LU (P-VOL) to a remote instance LU (S-VOL). It also maps a copying destination volume (a volume of the remote instance) to the local instance LU (P-VOL). The **-vr** specifies the remote instruction, and copies data from a remote instance LU (P-VOL) to a local instance LU (S-VOL) and maps a copy destination volume (a volume of the local instance) to the remote instance LU (P-VOL). **-c <size>**: You can use this option to specify the copying pace (1 – 15) to be used for the initial data copy. You can shorten the copy time by specifying a large number. Do not use the default value 3. (1 to 5: slow, 6 to 10: normal, 11 to 15: prior) If copying is performed at the normal pace when the host I/O load is heavy, the host I/O performance may significantly deteriorate. When you want to prevent deterioration of host I/O performance, select the slow pace. Select the prior pace only when you want to give high priority to the time for the completion of the copy rather than the host I/O performance in a period of time when the P-VOL is rarely accessed.

- Confirming the migration pair status

  You can check that the RAID group to which the LU that executed the migration belongs has been changed by referring to the RAID group to which the LU concerned belongs using the inqraid command.

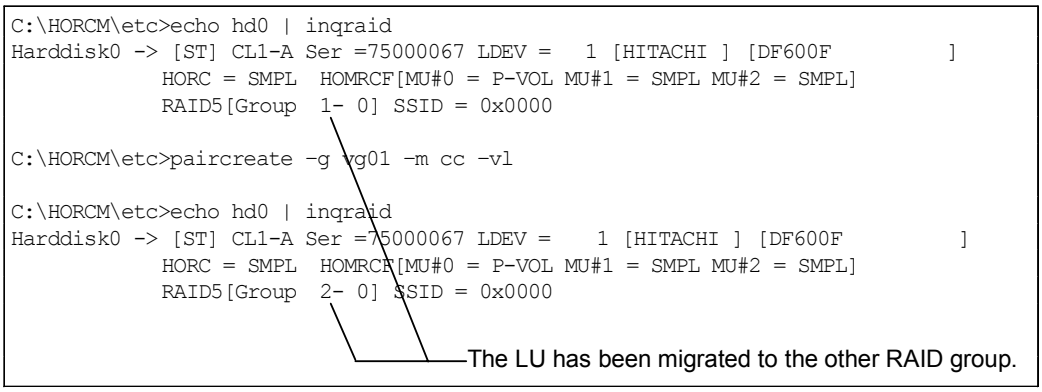


Figure 4.81 Inqraid Command Example

4.19.4 Relations between "cc" Command Issues and Status

The migration volumes can be handled by issuing CCI commands (pair creation and pair splitting commands). The validity of the specified operation is checked according to the status of the paired volume (primary volume). Table 4.40 shows the relations between the migration volume statuses and command acceptances.

Table 4.40 Command Issues and Pairing Status Transition

Command / Command option / Pair Status	paircreate -m cc	paircreate -S
① SMPL	Accepted ②→③ ②→④	Acceptable
② COPY	Acceptable	Accepted ①
③ PSUS		Accepted ①
④ PSUE		Accepted ①

- **Accepted**: A command is accepted and executed. When the command execution succeeds, the status changes to that of the shown number.
- **Acceptable**: No operation is executed, though a command is accepted.
- **Shaded portions**: Command execution is rejected and the operation terminates abnormally.

Note 1: Other commands and option (e.g., pairresync…) for operating a paired-volume are rejected.

Note 2: The "-m cc" option cannot be specified with "-split" option in the same command.

Chapter 5 Troubleshooting

This chapter includes the following troubleshooting information:

- ShadowImage Troubleshooting
- SnapShot Troubleshooting
- TrueCopy/TCE Troubleshooting
- General Troubleshooting
- Error Reporting
- Data Recovery Procedure for Suspended (PSUE) Status Using ShadowImage
- Data Recovery Procedure for Suspended (PSUE) Status Using TrueCopy/TCE
- Data Recovery Procedure for Suspended (PSUE) Status Using SnapShot

5.1 ShadowImage Troubleshooting

If a hardware error occurs while you are operating ShadowImage, both of the following are necessary:

- A CCI user intervention
- Assistance from a Hitachi Data Systems Customer Service representative.

For example, when formatting is needed to resolve an LU error and that LU is used for ShadowImage, the pair must be released by the user (CCI operation by the user) before the LU can be formatted. Therefore, please contact Hitachi personnel because maintenance requires the user to issue CCI commands. Note that the Hitachi personnel can only remove errors which result from hardware. An operation such as recovering a ShadowImage pair status (e.g. resynchronizing) must be done by the user. Figure 5.1 shows the flow of action when the PSUE error occurs. Table 5.1 shows the share of action to be taken by the user.

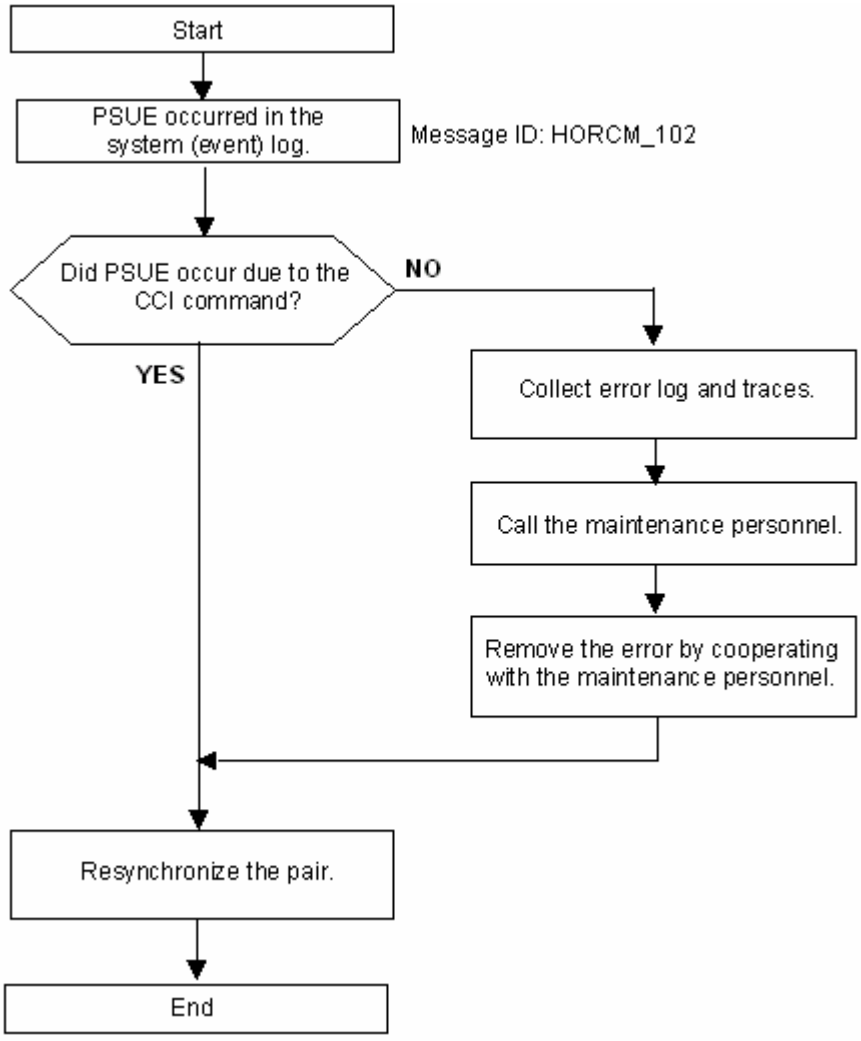


Figure 5.1 Pair Status Information Example using ShadowImage

Table 5.1 Operational Notes for ShadowImage Operations

Action	Action Taken By
Confirm the message (syslog).	User
Verify that PSUE is caused by the user operation.	User
Verify the status of the subsystem.	User
Call maintenance personnel when the subsystem malfunctions.	User
For other reasons, call the Hitachi support center.	User (only for users that are registered in order to receive a support).
Hardware maintenance	Hitachi Customer Service
Reconfigure and recover the pair.	User

5.2 SnapShot Troubleshooting

If a hardware error occurs while you are operating SnapShot, both of the following are necessary:

- A CCI user intervention
- Assistance from a Hitachi Customer Service representative.

There are two cases of suspend failure (PSUE failure) of SnapShot. 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 Data Systems maintenance personnel.

Figure 5.2 shows the flow of action when the PSUE error occurs. Table 5.2 shows the action to be taken by the user.

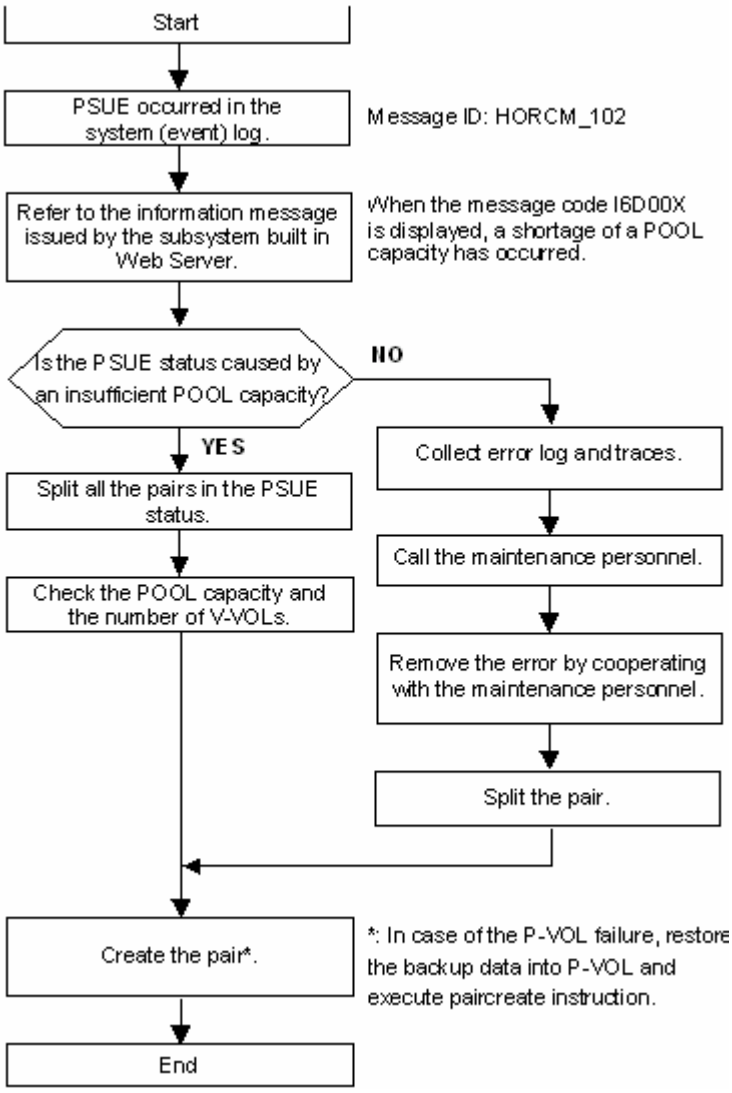


Figure 5.2 Pair Status Information Example using SnapShot

Table 5.2 Operational Notes for SnapShot Operations

Action	Action Taken By
Confirm the message (syslog).	User
Refer to the information message issued by the subsystem built in Web Server (a shortage of a POOL capacity).	User
Verify the status of the subsystem.	User
Call maintenance personnel when the subsystem malfunctions.	User
For other reasons, call the Hitachi support center.	User (only for users that are registered in order to receive a support)
Split the pair.	User
Hardware maintenance.	Hitachi Customer Service
Reconfigure and recover the pair.	User

5.3 TrueCopy Troubleshooting

If a hardware or Fibre path error occurs while you are operating the TrueCopy, both of the following are necessary:

- A CCI user intervention
- Assistance from a Hitachi Data Systems Customer Service representative.

For example, when formatting is needed to resolve an LU error and that LU is used for TrueCopy, the pair must be released by the user (CCI operation by the user) before the LU can be formatted. Therefore, please contact Hitachi personnel because maintenance requires the user to issue CCI commands. The Hitachi personnel can only correct hardware errors. An operation such as recovering the TrueCopy pair status (e.g. resynchronizing) must be done by the user. Figure 5.3 shows the flow of action when the PSUE error occurs. Table 5.3 shows the share of action to be taken by the user.

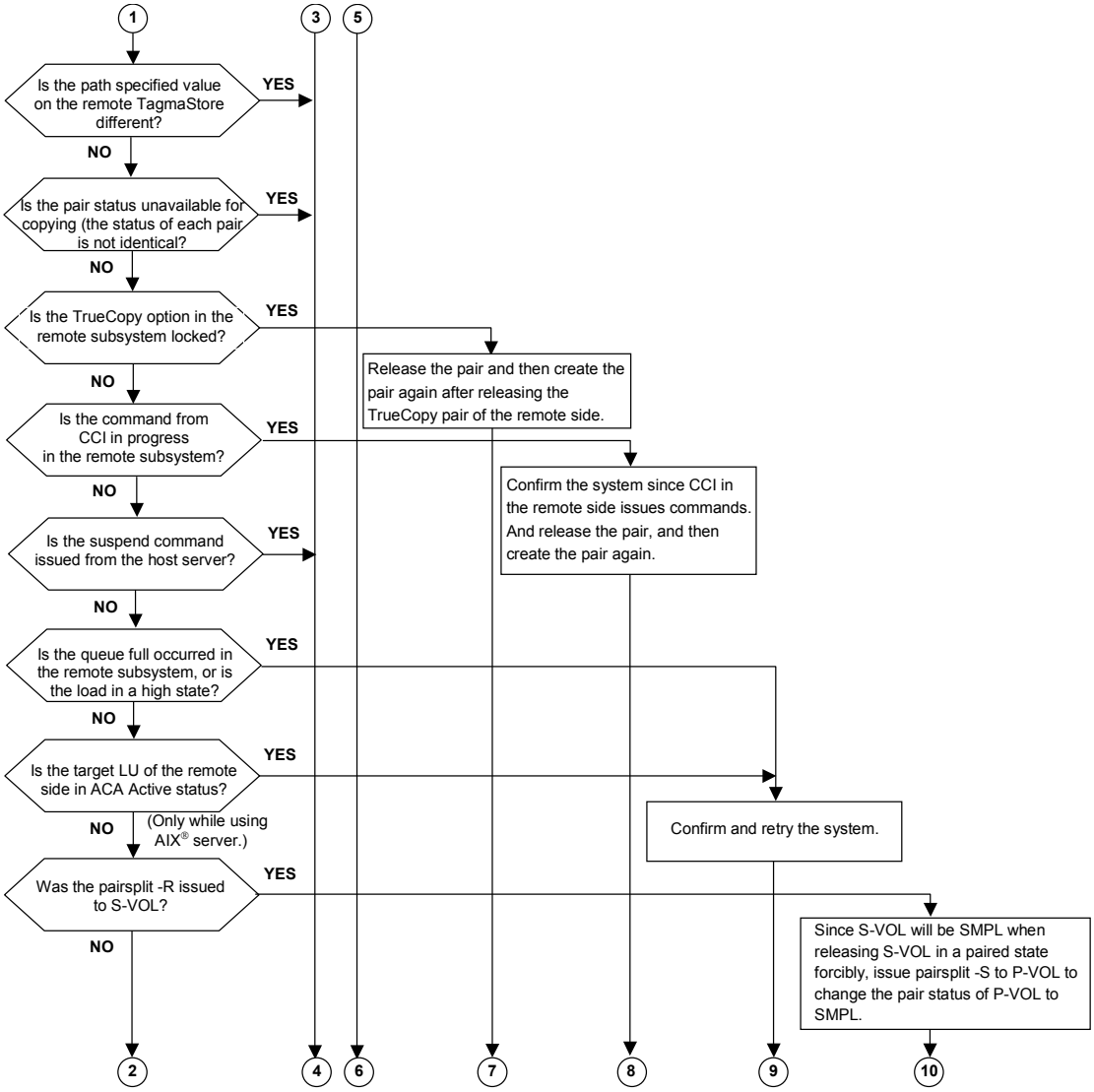


Figure 5.3 Pair Status Information Example using TrueCopy, Panel 1

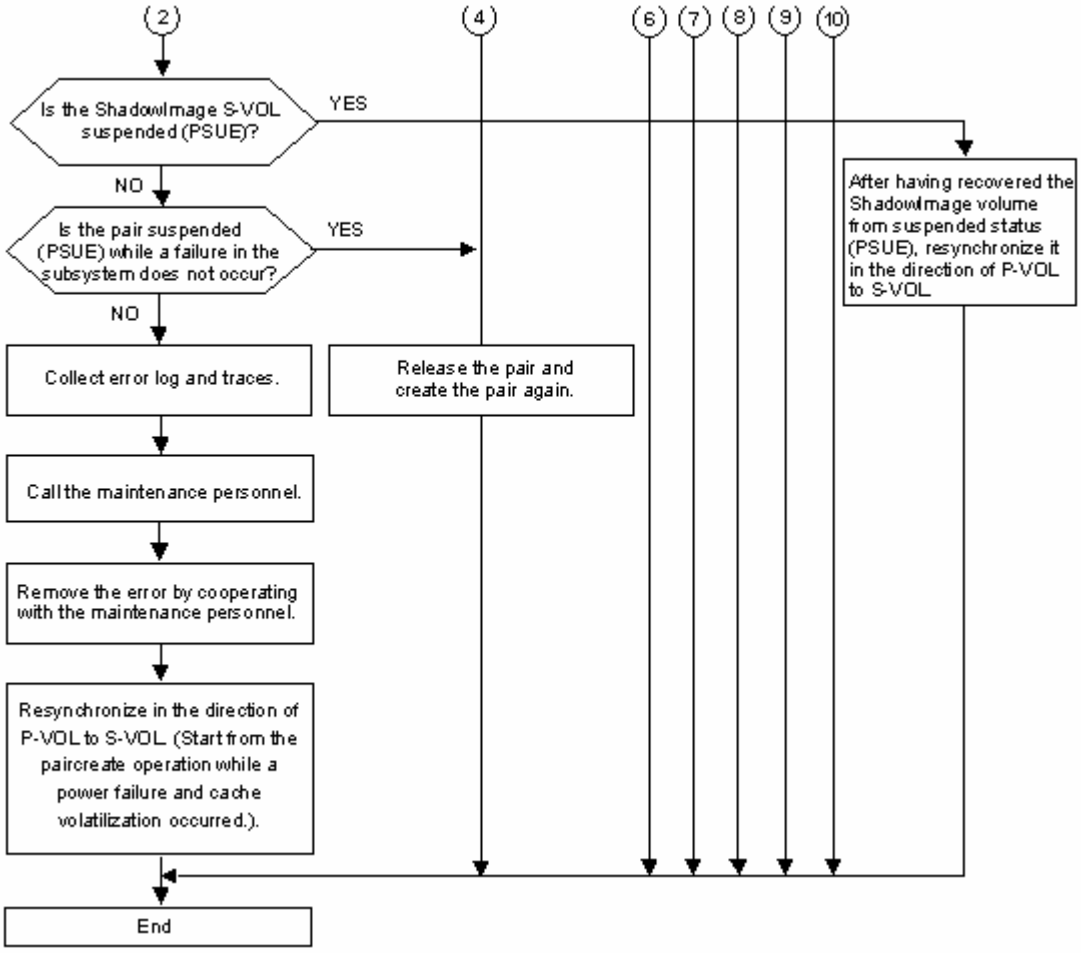


Figure 5.4 Pair Status Information Example using TrueCopy Panel 2

When an error occurs in the Fibre route between subsystems while operating TrueCopy, the path is blocked. The system maintenance by the Hitachi personnel is necessary. Figure 5.5 shows the flow of the failure isolation while the path blockage occurred.

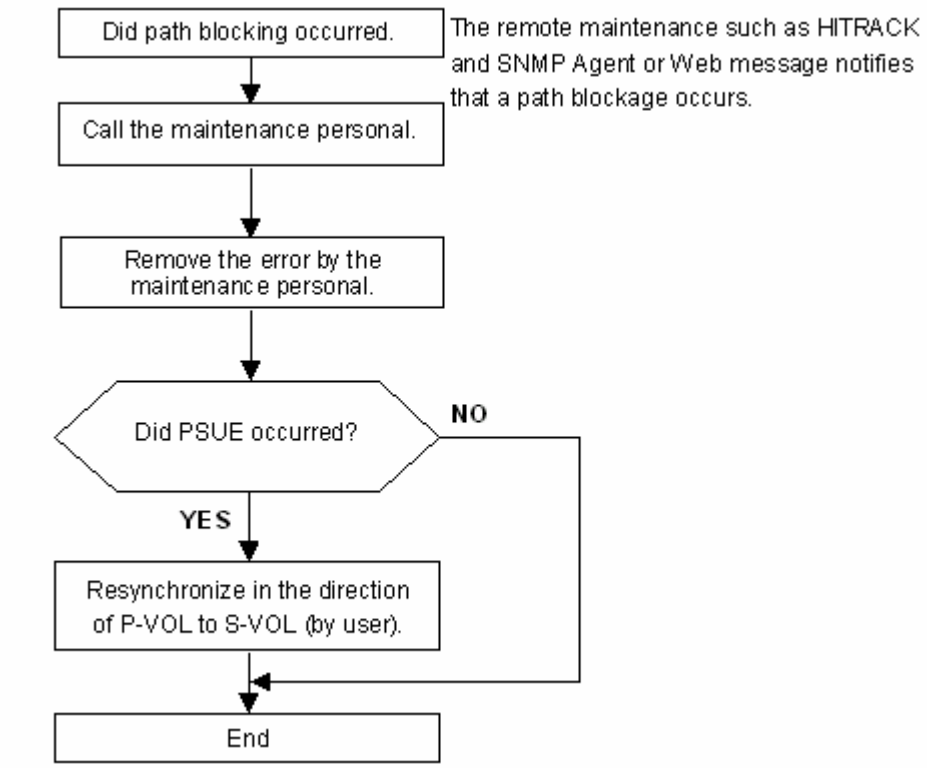


Figure 5.5 Path Status Information Example using TrueCopy

Table 5.3 Operational Notes for TrueCopy Operations

Action	Action Taken By
Confirm the message (syslog).	User
Confirm whether PSUE is caused by the user operation.	User
Confirm the status of the subsystem.	User
Call the maintenance personnel when the subsystem malfunctions.	User
For other reasons, call the Hitachi support center.	User (only for users that are registered in order to receive a support).
Hardware maintenance (including path blockage).	Hitachi maintenance personnel
Reconfigure and recover the pair.	User

5.4 TCE Troubleshooting

If a hardware or Fibre path error occurs while you are operating the TCE, both of the following are necessary:

- A CCI user intervention
- Assistance from a Hitachi Customer Service representative

There are two causes of the status change to PSUE that occurs during the operation of TCE: One is an excessive use of the POOL and the other is occurrence of a logical error caused by a hardware failure. When the amount of the data in the POOL exceeds the capacity allowed to be used, can be recover by resynchronizing all the pairs whose P-VOLs are placed in the PSUE or PFUS status. After that, check if the configuration including the POOL capacity and number of V-VOLs (when concurrent use of SnapShot) is appropriate because it is judged that the system configuration has a problem. After the check is finished, carry out an operation of TCE for recovering a pair status (such as `paircreate`). All those operations are to be done by a user.

For example, when formatting is needed to resolve an LU error and that LU is used for TCE, the pair must be released by the user (CCI operation by the user) before the LU can be formatted. Therefore, please contact Hitachi personnel because maintenance requires the user to issue CCI commands. Note that the Hitachi personnel can only remove errors which result from hardware. An operation such as recovering the TCE pair status (e.g. resynchronizing) must be done by the user. Figure 5.5 shows the flow of action when the PSUE error occurs. Table 5.4 shows the share of action to be taken by the user.

Notes: In the case of TCE, even when one of the pairs belonging to the same CTG is placed in the PSUE status, all the pairs in the CTG are placed in the PSUE status because the change to the PSUE status is made in units of CTG. However, concerning the pair in the PSUS status, the status is not changed to PSUE but left as it is.

– In the case where the pool-over occurs in the secondary POOL, it is reported to the P-VOL after the S-VOL status is changed to PFUS and the P-VOL status is changed to PSUE. On the other hand, when the pool-over occurs in the primary POOL, only the P-VOL status is changed to PFUS and the change of the S-VOL status does not occur.

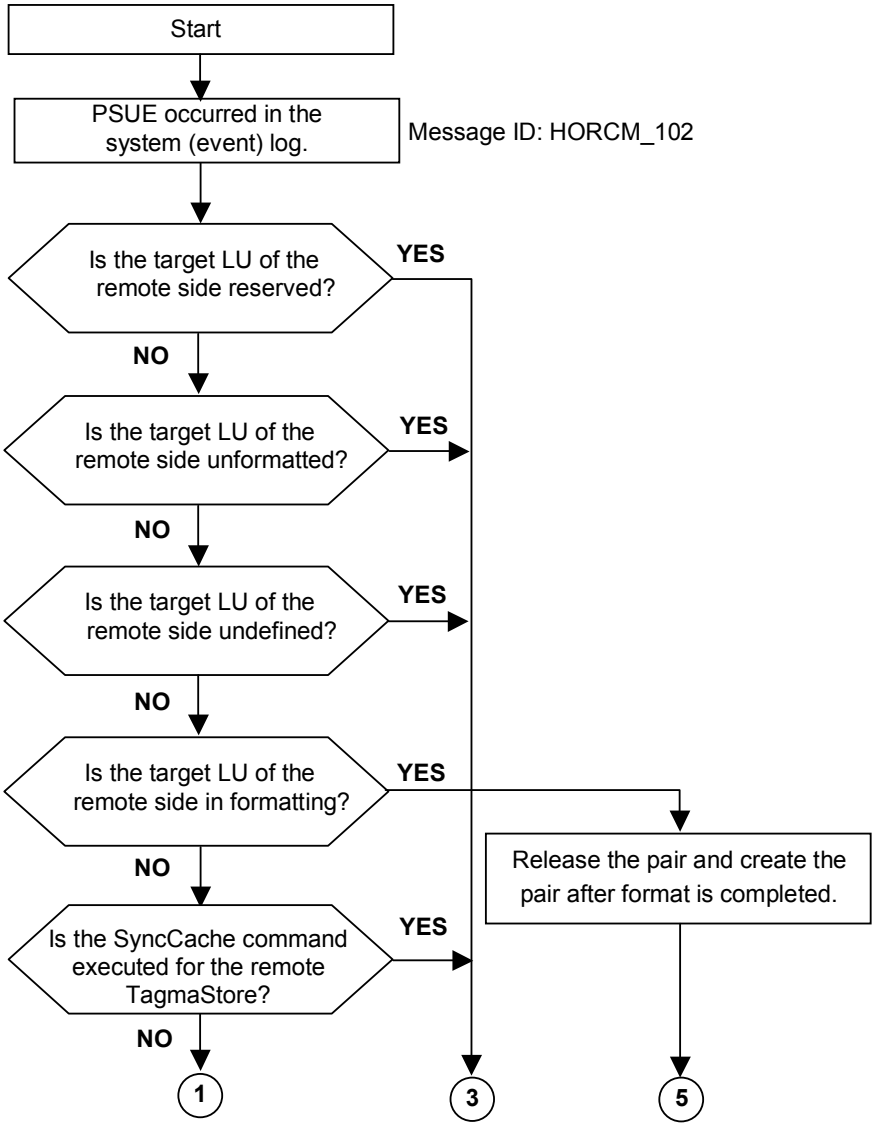


Figure 5.6 TCE Pair Status Information Example

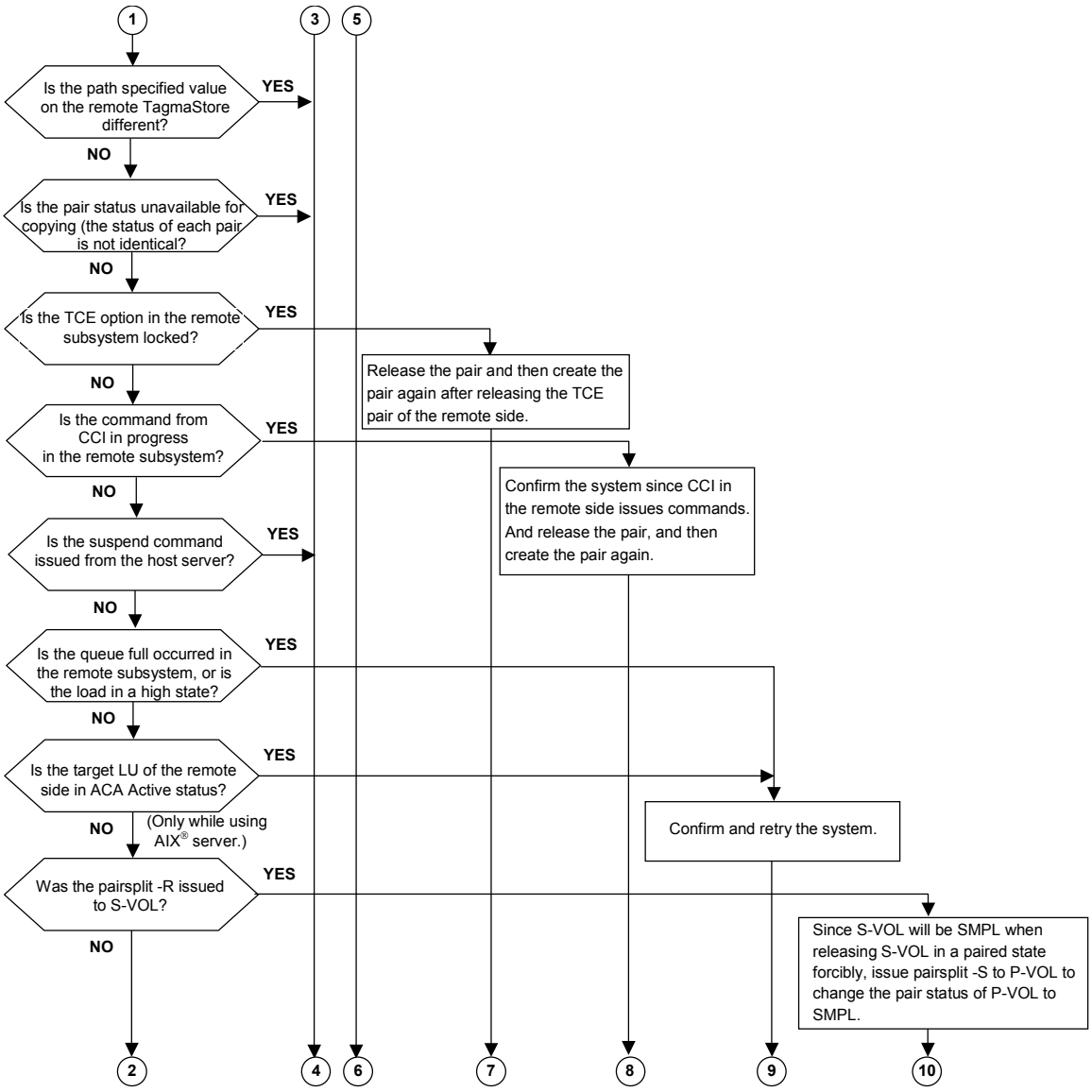


Figure 5.6 Pair Status Information Example Using TCE (continued)

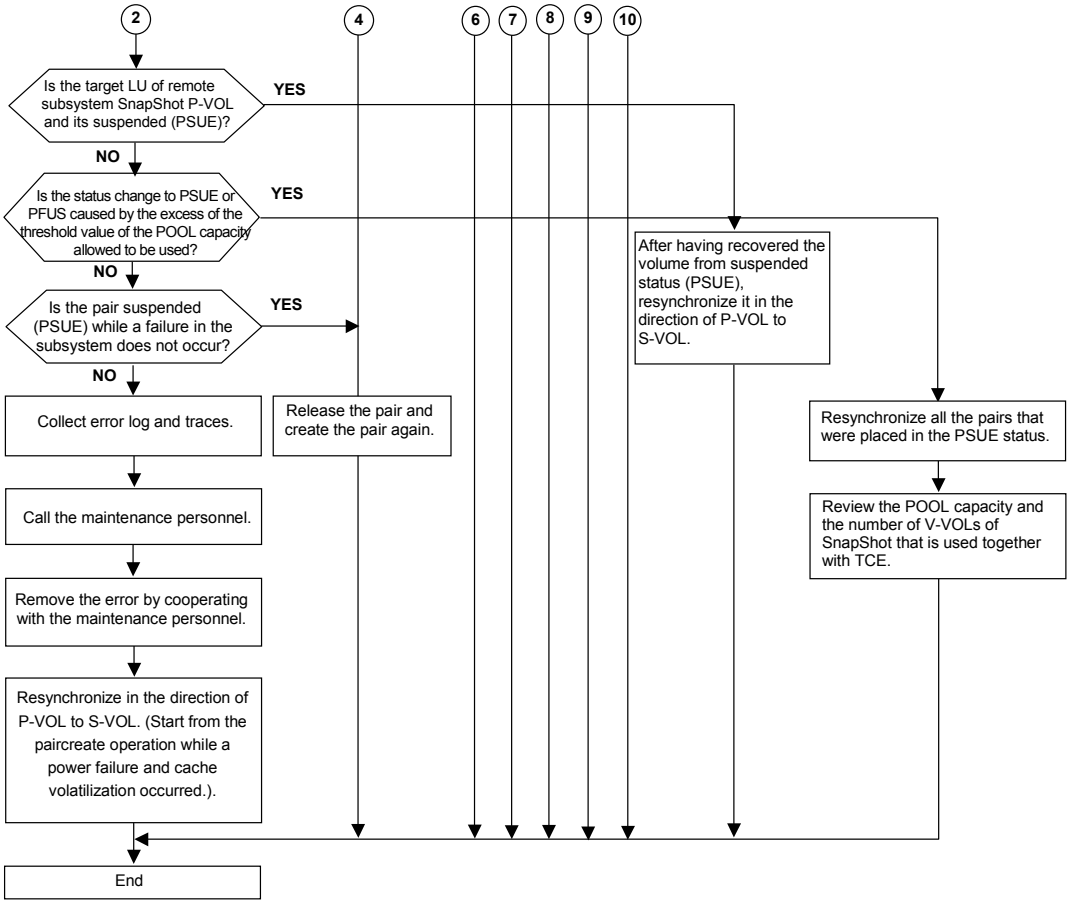


Figure 5.7 Pair Status Information Example Using TCE (continued)

When an error occurs in the Fibre route between subsystems while operating TCE, the path is blocked. The system maintenance by the Hitachi personnel is necessary. Figure 5.8 shows the flow of the failure isolation while the path blockage occurred.

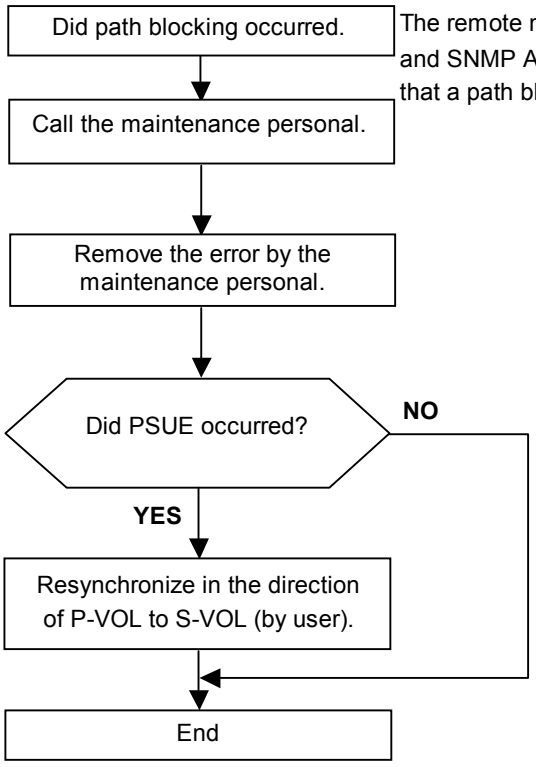


Figure 5.8 Path Status Information Example Using TCE

Table 5.4 Operational Notes for TCE Operations

Action	Action taken by whom
Confirm the message (syslog).	User
Checking the Information message sent from the Web built-in disk array subsystem (making sure of insufficiency of the POOL capacity)	User
Confirm whether PSUE is caused by the user operation.	User
Confirm the status of the subsystem.	User
Call the maintenance personnel when the subsystem malfunctions.	User
For other reasons, call the Hitachi support center.	User (only for users that are registered in order to receive a support)
Hardware maintenance (including path blockage).	Hitachi maintenance personnel
Reconfigure and recover the pair.	User

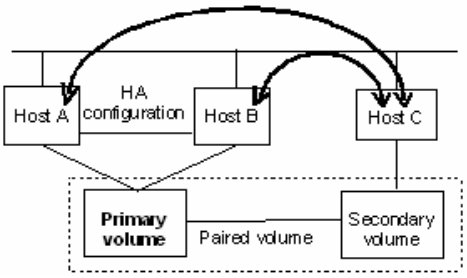
5.5 General Troubleshooting

If you have a problem with the CCI software, first verify that the problem is not being caused by the Server hardware or software, and try restarting the server. Table 5.5 provides operational notes and restrictions for CCI operations.

For maintenance of Hitachi replication software volumes, if a failure occurs, it is important to find the failure in the paired volumes, recover the volumes, and continue operation in the original system.

Table 5.5 Operational Notes for CCI Operations

Condition	Recommended Action
Startup/shutdown restrictions	When the server starts, the primary volume server may update the secondary volume. The secondary volume must not be mounted automatically in the startup sequence. If the secondary volume is used by the LVM, the volume group of the LVM must be deactivated. The secondary volume must be mounted in the split state or in the simplex mode. When the server starts, the secondary volume can be activated without confirmation, once it can be guaranteed that the secondary volume has been PSUS (R/W enable) or it is in the SMPL state during the server shutdown sequence.
Hot standby operations	CCI commands cannot execute hot standby operations between the primary and secondary volumes. Use the takeover command intended for the HA configuration to execute the hot standby operation. In hot standby operation, two servers are used, and the active (primary) and standby (secondary) server programs are run alternately in each server in case one server fails. Follow these precautions: Operation across volumes. Since each CCI command causes the server software to handle the volume by volume, a single volume should not be partitioned to prevent it from being used by selected servers. Using LVM and paired volume together. When constructing the LVM on the paired volume in the mutual hot standby configuration, the LVM logical volumes must be constructed in units of volume to prevent the volumes from being mounted by the LVM.
Coexistence of LVM mirror and TrueCopy/TCE	When the LVM mirror and TrueCopy/TCE volumes are used together, the LVM mirror handles write errors and changes the volumes. Thus, the fence level of the volumes used by the LVM mirror must be set to data.
Using paired volume in a single host	When constructing a paired volume in a single host, it is necessary to activate two or more CCI instances. To activate two or more CCI instances, instance numbers must be assigned using the environmental variable HORCMINST. The HORCM and CCI commands must possess this environmental variable. A configuration definition file and a log directory must be set for each instance. The command device described in the configuration definition file must be established to follow every instance. If using a command device between different instances on the same port, the maximum number of instances per command device is 16. If this number is exceeded, use a different path for each instance.

Condition	Recommended Action
Sharing volumes in a hot standby configuration	When a paired volume is used for the disk shared by the hosts in a hot standby configuration using HA software, use the primary volume as the shared disk and describe the corresponding hosts using the paired volume in the configuration definition file as shown below. In the HA configuration, if a CCI command issued by host C fails in host B (because host B has gone down and/or there is a command device IO_ERROR), host A is connected and command execution is retried. 
Linkage with HA software	The HORCM must not be an object of the process monitored by the HA software (cluster manager), because HORCM should run at the same level as the cluster manager. ***Note:*** Do not use the pair volume for the cluster lock disk that HA software uses for election.
Maintenance	A HORCM restart is required if the TagmaStore configuration is changed (e.g., microcode exchange, cache memory install/uninstall).
Command device	Each CCI command is executed by issuing a command to the command device. This command is read or written from/into the specific block area of the command device. Therefore, the user cannot use the command device. In addition, this device must not belong to an LVM volume group. For Windows® systems, do not assign a drive letter to the command device to prevent utilization by general users.
Alternate path restrictions	If the P-VOL and S-VOL are on the same server, an alternate path from P-VOL to S-VOL cannot be used. Use of alternate path to a volume pair is limited to primary (secondary) volumes.
HORCM failure to activate	After a new system has been constructed, failure to activate HORCM may occur due to an improper environmental setting and/or configuration definition by the user. Refer to the HORCM activation log, and correct the setting(s).
Abnormal termination of command	Refer to the command log file and HORCM log file to identify the cause of the error. If a command terminates abnormally because of a remote server failure, recover the server from the failure, then re-execute the command. If HORCM has shut down, restart HORCM. If an unrecoverable error occurs, obtain the log files and contact the Hitachi Data Systems Support Center.
Restriction for formatting the volumes	Do not execute Hitachi replication software operations while formatting the volume. Formatting takes priority and Hitachi replication software operations will be suspended.
The poll(10ms) parameter in the configuration definition file	Always set the poll(10ms) parameter with a value more than or equal to 6,000. For details on calculating the poll(10ms) parameter, see section 2.5.3. If you have created the configuration definition file using the mkconf command tool, set this value manually. If the value is set incorrectly, it may cause a conflict between CCI and the subsystem; the internal processing of the subsystem suspends temporarily. The process may not proceed.
Internal process conflict between the CCI and the subsystem	When an internal process conflict occurs between the CCI and the subsystem, the process of the subsystem suspends temporarily. If the conflict continues, the internal process may not proceed. Therefore, when monitoring (polling) the status of the subsystem (by creating a script using the CCI commands), set the information-display-based commands (e.g. pairdisplay, raidscan, raidar, and raidqry) to be

Condition	Recommended Action
	issued to more than or equal to a minute.
Maximum supported capacity value of ShadowImage	The maximum supported capacity value is changed with the equipment type and the mounted cache memory capacity. Please refer to each user's guide for details.
Maximum supported capacity value of TrueCopy/TCE	
Maximum supported capacity value of SnapShot	
Restriction for TrueCopy/TCE	Since the S-VOL is reserved while it is in used by TrueCopy it must not be used as the resource of MSCS. Commands that change the status of pairs (paircreate, pairsplit, pairresync) of TrueCopy/TCE cannot be executed while the host re-starting in TrueCopy/TCE environment. The command may end abnormally when executing a command while the host re-starting.

5.6 Error Reporting

For detailed information on CCI error reporting, see Chapter 4 of Hitachi TagmaStore Adaptable Modular Storage (AMS) and Workgroup Modular Storage (WMS) Storage Navigator Modular Error Codes (MK-96DF788).

Table 5.6 describes the HORCM system log messages and provides guidelines for resolving the error conditions.

Table 5.7 describes the command error messages and their return values and also provides guidelines for resolving the error conditions. Table 5.8 and Table 5.9 list and describe common error messages for each command. Table 5.10 lists unique error messages.

Table 5.6 System Log Messages

Message ID	Condition	Cause	Recommended Action
HORCM_001	The HORCM log file cannot be opened.	The file cannot be created in the HORCM directory.	Create space on the disk where the root directory resides.
HORCM_002	The HORCM trace file cannot be opened.	The file cannot be created in the HORCM directory.	Create space on the disk where the root directory resides.
HORCM_003	The HORCM daemon process cannot create a child process due to an error.	HORCM daemon attempted to create more processes than the maximum allowable number.	Terminate unnecessary programs or daemon processes running simultaneously.
HORCM_004	HORCM assertion failed, resulting in a fatal internal error in the HORCM.	An internal error occurred which could not be identified by the HORCM.	Restart the system, collect all HORCM log and trace information, and call the Hitachi Data Systems support center.
HORCM_005	The CCI software failed to create the end point for remote communication.	HORCM failed to create a socket, or an error exists in the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error and reset the parameters.
HORCM_006	HORCM memory allocation	HORCM memory could not be	Increase the system virtual memory, or close any

Message ID	Condition	Cause	Recommended Action
	failed.	secured.	unnecessary programs.
HORCM_007	An error exists in the HORCM setup file.	An error exists in the HORCM setup file.	Refer to the startup log and reset the parameters.
HORCM_008	HORCM configuration file parameters could not be read.	An error exists in the format or parameters of the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error.
HORCM_009	ShadowImage connection to the CCI software failed.	System devices are improperly connected, or an error exists in the HORCM configuration file.	Refer to the HORCM startup log to identify the cause of the error.
HORCM_101	ShadowImage and the CCI software communication fails.	A system I/O error occurred or an error exists in the HORCM configuration file ($HORCM_CONF).	Refer to the HORCM startup log to identify the cause of the error.
HORCM_102	The volume is suspended in code 0006.	The pair status was suspended due to code 0006.	(For ShadowImage) Determine how the pair was suspended. If the pair was forcibly suspended, resynchronize the pair. If the pair was not suspended forcibly, the pair was suspended due to an error in the subsystem. Collect all HORCM log and trace information, and call the Hitachi Data Systems support center. After maintenance personnel have recovered the subsystem, refer to section 5.7 to recover the data. (For TrueCopy/TCE) Refer to section 5.8 to recover the data. (For SnapShot, refer to section 5.9.)

Table 5.7 Command Error Messages

Message ID	Error Message	Condition	Recommended Action	Return Value
EX_COMERR	Can't be communicated with HORC Manager	This command failed to communicate with the CCI software.	Verify that HORCM is running by using UNIX® commands [ps-ef | grep horcm].	255
EX_REQARG	Required Arg list	An option or arguments of an option are not sufficient.	Choose the correct option using the h option.	254
EX_INVARG	Invalid argument	An option or arguments of an option are incorrect.	Choose the correct option using the h option.	253
EX_UNWOPT	Unknown option	Designated an unknown option.	Choose the correct option using the h option.	252
EX_ATTHOR	Can't be attached to HORC Manager	Could not connect with HORCM.	Verify that HORCM is running and/or that HORCMINST is set correctly. Note 1: For Windows Server™ 2003, when a path detachment, which	251

Message ID	Error Message	Condition	Recommended Action	Return Value
			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 HORCM becomes able to recognize the command device, restart HORCM. Note 2: If Communication Fraction Point File (see section 3.3.3) is deleted, this error occurs.	
EX_ATTDBG	Can't be attached to a Debug layer	Failed to communicate with HORCM, or cannot make a log directory file.	Verify that HORCM is running by using UNIX® commands [ps-ef | grep horcm].	250
EX_INVNAM	Invalid name of option	The name specified in an argument of an option is not appropriate.	Choose the correct option using the h option.	249
EX_OPTINV	A specified option is invalid	Detected contradiction in information that RAID reported.	Call the Hitachi Data Systems Support Center.	248
EX_ENOENT	No such device or group	The designated device or group name does not exist in the configuration file.	Verify the device or group name and add it to the configuration file of the remote and local hosts.	247
EX_ENODEV	No such device	The designated device name does not exist in the configuration file.	Verify the device name and add it to the configuration file of the remote and local hosts.	246
EX_ENOUNT	No such RAID unit	The designated RAID unit ID does not exist in the configuration file.	Verify the RAID unit ID and add it to the configuration file of the remote and local hosts.	219
EX_ENQSER	Unmatched Serial# vs RAID unitID	The group designated by ShadowImage/SnapShot paircreate does not have the same RAID unit, or the unitID is not identical to the unit ID in the same RAID serial#.	Verify the serial# using the pairdisplay command, or confirm serial# of the RAID using the raidqry -r command	218
EX_ENOMEM	Not enough core	Insufficient memory exists.	Increase the virtual memory capacity of the system, or close any	245

Message ID	Error Message	Condition	Recommended Action	Return Value
			unnecessary programs and/or daemon processes.	
EX_ERANGE	Result too large	Tried to use arguments for an option beyond the maximum allowed, or a result beyond the maximum was created.	Refer to the error message, and designate an appropriate value.	244
EX_ENAMLG	File name too long	Undefined error.	--	243
EX_ENORMT	No remote host alive for remote commands or Remote Raid Manager might be blocked(sleeping) on an existing I/O	A timeout occurred on remote communication, and HORC Manager failed to re-execute.	Confirm that the HORC Manager in the remote host is running, and then increase the value of the timeout in the configuration file. If you want to execute within the local server, execute the command that supports the local option (-l).	242
EX_INVMOD	Invalid RAID command mode	Detected a contradiction for a command.	Collect all HORCM log information, and call the Hitachi Data Systems Support Center.	241
EX_INVCMD	Invalid RAID command	Detected a command error.	Collect all HORCM log information, and call the Hitachi Data Systems Support Center.	240
EX_ENOGRP	No such group	The designated device or group name does not exist in the configuration file, or the network address for remote communication does not exist.	Verify the device or group name and add it to the configuration file of the remote and local hosts	239
EX_UNWCOD	Unknown function code	Detected a command error.	Collect all HORCM log information, and call the Hitachi Data Systems Support Center.	238
EX_CMDIOE	Control command I/O error	A read/write to the command device failed with an I/O error.	Refer to the host syslog file, and investigate the cause of the error. If the problem persists, collect all HORCM log information, and call the Hitachi Data Systems Support Center.	237
EX_CMDRJE	An order to the control/command device was rejected	The request to the command device failed or was rejected. Note: This error code is sometimes caused by the operating system and reported as EX_CMDIOE instead of EX_CMDRJE	Investigate the detailed factor of the error referring to the information on the syslog of the server or the HORCM log (refer to section B.4). Confirm the following items, and if the	221

Message ID	Error Message	Condition	Recommended Action	Return Value
		(see next row).	problem persists, collect all HORCM log information, and call the Hitachi Data Systems Support Center. Verify Hitachi replication software functions are installed. Verify that the target volume is available.	
EX_CMDIOE	Control command I/O error, or rejected	A read/write to the command device failed with an I/O error or was rejected.	Investigate the detailed factor of the error referring to the information on the syslog of the server or the HORCM log (refer to section B.4). If the cause is “Illegal Request (0x05)” Sense Key, please confirm the following items. If the problem persists, collect all HORCM log information, and call the Hitachi Data Systems Support Center. Verify TrueCopy/TCE ShadowImage/SnapShot functions are installed. Verify that the target volume is available.	237
EX_ENQVOL	Unmatched volume status within the group	The volume attribute or the fence level within a group is not identical.	Verify status using the pairdisplay command. Make sure all volumes in the group have the same fence level and volume attributes.	236
EX_EVOLCE	Pair Volume combination error	Combination of a volume is unsuitable between the remote and local host.	Verify volume status using the pairdisplay command, and change the combination of volumes properly.	235
EX_EWSUSE	Pair suspended at WAIT state	Detected a suspended status (PSUE) for the paired volume, before it achieves the designated status.	Determine how the pair was suspended. If the pair was forcibly suspended, resynchronize the pair. If the pair was not suspended forcibly, the pair was suspended due to an error in the subsystem. Collect all HORCM log and trace information, and call the Hitachi Data Systems support center. After maintenance personnel has recovered the subsystem, refer to section 5.7 to recover the	234

Message ID	Error Message	Condition	Recommended Action	Return Value
			data.	
EX_EWSTOT	Timeout waiting for specified status	Detected a timeout before it achieved the designated status.	Increase the value of the timeout using the -t option.	233
EX_EWSLTO	Timeout waiting for specified status on the local host	Timeout error because the remote did not note expected status.	Verify that HORC Manager on the remote host is running.	232
EX_ESTMON	HORCM Monitor stopped	HORC Manager monitoring was refused.	Verify the value of “poll” in the configuration file.	231
EX_UNWCMD	Unknown command	An unknown command was attempted.	Verify the command name.	230
EX_INCSTG	Inconsistent status in group	The pair status of a volume within a group is not identical to the status of the other volumes in the group.	Verify the pair status using the pairdisplay command.	229
EX_INVSTP	Invalid pair status	The pair status of the target volume is not appropriate.	Verify the pair status using the pairdisplay command.	228
EX_INVVOL	Invalid volume status	The volume status of the target volume is not appropriate.	Verify the pair status using the pairdisplay -l command.	222
EX_INVMUN	Invalid mu# with HORC or HOMRCF	The MU# of the volume to be operated is not appropriate.	Verify the MU# for the specified group using the pairdisplay command. Also verify whether the command execution environment is set as HORCC_MRCF 1.	220
EX_ENLDEV	No such LDEV within the RAID	A device defined in the configuration file does not have a mapping to a real LUN and Target ID within the RAID.	Please confirm that the Port, Target ID, LUN is defined correctly under HORCM_DEV in the configuration file.	227
EX_INVRCD	Invalid return code	Wrong return code.	Collect all HORCM log information, and call the Hitachi Data Systems Support Center.	226
EX_VOLCUR	S-VOL currency error	Currency check error for S-VOL. Cannot guarantee identical data on S-VOL.	Check the volume list to see if an operation was directed to the wrong S-VOL.	225
EX_VOLCUE	Local Volumecurrency error	The volume specified with the SVOL-takeover command is not the same as the P-VOL.	Verify the pair status of the local volume.	224
EX_VOLCRE	Local and Remote Volumecurrency error	The combination of the volumes specified with Swap-takeover is unsuitable.	Verify the pair status of remote and local volumes using the pairdisplay command.	223
EX_UNWERR	Unknown Error code	Wrong error code.	Collect all HORCM log	--

Message ID	Error Message	Condition	Recommended Action	Return Value
			information, and call the Hitachi Data Systems Support Center.	
EX_ENOCTG	Not enough CTgroups in RAID	CTGID could not be registered due to being beyond the max number of CT groups (0-127) for a volume.	Choose an existing CTGID (use pairvolchk to display CTGIDs). Use the '-f <CTGID>' option of the paircreate command to force the pair into a pre-existing CTGID.	217
EX_EXTCTG	Extended CTgroup across RAIDs	A volume is defined in the configuration file (HORCM_CONF) as a group that extends across subsystems.	Please confirm the serial # of the volumes by using the pairdisplay command to verify that the CT group is contained completely within one RAID subsystem.	216
EX_ENXCTG	No CTgroups left for OPEN Vol use	An available CT group for volume does not exist.	—	215
EX_ENQCTG	Unmatched CTGID within the group	The CT group references within a group do not have an identical CTGID.	Please confirm the CTGID using the pairvolchk command and/or confirm that group references within the configuration file (HORCM_CONF) refer to the same CT group.	214
EX_ERPERM	Permission denied with the LDEV	The device described in the configuration definition file is not permitted for pair operation.	Execute the pairdisplay command or the raidscan – use the verify command to verify that the device is permitted for the pair operation.	213
EX_ENQSIZ	Unmatched volume size for pairing	1. The number or the size of the volume between the local and remote volume is not appropriate. 2. The product ID on the local subsystem does not correspond with the product ID on the remote subsystem.	1. Check the volume size of the target pair using raidscan –f option, and then set the same size for local and remote volumes for the target pair. 2. Set the identical product ID in the local and remote subsystem.	212
EX_ERPERM	Permission denied with the RAID	The volume on the configuration file is a volume that is not permitted to operate a pair in the subsystem.	Set HITACHI for the vendor ID.	211
EX_ESVOLD	SVOL denied due to be disabling	It is inhibited to assign the specified volume to be paired to an S-VOL.	Check whether the volume to be paired is not inhibited to be assigned to an S-VOL using the inquired -fl or raidvchkdsp -v gflag command.	209

Message ID	Error Message	Condition	Recommended Action	Return Value
EX_ENOSUP	Microcode not supported	The specified command option is not supported by the microcode of the disk array subsystem.	Make sure of a version of the microcode of the disk array subsystem using the raidgry -l command.	210
EX_EPRORT	Mode changes denied due to retention time	It is inhibited to change a mode of the specified volume during the term of protection.	Make sure of the term of protection for the object volume using the raidvchkdsp -v gflag command.	208

The following list includes common error messages for horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairevtwait, pairvolchk, pairsyncwait, and pairdisplay.

Table 5.8 Common Error Messages (1)

Type	Message ID	Error Message	Return Value
Syntax for Argument Unrecoverable	EX_REQAR	Required Arg list	254
	EX_INVARG	Invalid argument	253
	EX_INVNAM	Invalid name of option	249
	EX_UNWOPT	Unknown option	252
	EX_UNWCOD	Unknown function code	238
	EX_UNWCMD	Unknown command	230
	EX_ERANGE	Result too large	244
	EX_ENAMLG	File name too long	243
	EX_INVRCD	Invalid return code	226
Configuration Unrecoverable	EX_ENOGRP	No such group	239
	EX_ENOENT	No such device or group	247
	EX_ENODEV	No such device	246
	EX_ENLDEV	No such LDEV within the RAID	227
	EX_ENOUNT	No such RAID unit	219
	EX_INVMUN	Invalid mu# with HORC or HOMRCF	220
	EX_ENQSER	Unmatched Serial# vs RAID unitID	218
	EX_EXTCTG	Extended CTgroup across RAIDS	216
	EX_ENQCTG	Unmatched CTGID within the group	214
	EX_ENPERM	Permission denied with the LDEV	213
	EX_ERPERM	Permission denied with the RAID	211
Command I/O to RAID Recoverable	EX_CMDRJE	An order to the control/command device was rejected	221
	EX_CMDIOE	Control command I/O error	237

Type	Message ID	Error Message	Return Value
		Control command I/O error, or rejected	
	EX_OPTINV	A specified option is invalid	248
	EX_INVMOD	Invalid RAID command mode	241
	EX_INVCMD	Invalid RAID command	240
Communication for HORCM Recoverable	EX_ATTHOR	Can't be attached to HORC Manager	251
	EX_ATTDBG	Can't be attached to a Debug layer	250
	EX_COMERR	Can't be communicated with HORC Manager	255
	EX_ENORMT	No remote host alive for remote commands or Remote Raid Manager might be blocked (sleeping) on an existing I/O.	242
Resource Unrecoverable	EX_ENOMEM	Not enough core	245
Syntax for Argument Unrecoverable	EX_REQARG	Required Arg list	254
	EX_INVARG	Invalid argument	253
	EX_INVNAM	Invalid name of option	249
	EX_UNWOPT	Unknown option	252
	EX_UNWCOD	Unknown function code	238
	EX_UNWCMD	Unknown command	230
	EX_ERANGE	Result too large	244
	EX_ENAMLG	File name too long	243
	EX_INVRCD	Invalid return code	226
Configuration Unrecoverable	EX_ENLDEV	No such LDEV within the RAID	227
	EX_ENOUNT	No such RAID unit	219
	EX_INVMUN	Invalid mu# with HORC or HOMRCF	220
	EX_ERPERM	Permission denied with the RAID	211
	EX_ENOSUP	Micro code not supported	210
Command I/O to RAID Recoverable	EX_CMDIOE	Control command I/O error Control command I/O error, or rejected	237
	EX_OPTINV	A specified option is invalid	248
	EX_INVMOD	Invalid RAID command mode	241
	EX_INVCMD	Invalid RAID command	240
Communication for HORCM Recoverable	EX_ATTHOR	Can't be attached to HORC Manager	251
	EX_ATTDBG	Can't be attached to a Debug layer	250
	EX_COMERR	Can't be communicated with HORC Manager	255
Resource Unrecoverable	EX_ENOMEM	Not enough core	245

The following list includes unique error messages for the horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairevtwait, pairsyncwait, and pairvolchk commands.

Table 5.9 Unique Error Messages

Command	Type	Message ID	Error Message	Return Value
paircreate, pairsplit, pairresync, pairevtwait, pairvolchk, horctakeover	Volume status Unrecoverable	EX_ENQVOL	Unmatched volume status within the group	236
paircreate, pairsplit, pairresync, pairevtwait, horctakeover		EX_INCSTG	Inconsistent status in group	229
paircreate, pairsplit, pairresync, pairevtwait, pairsyncwait		EX_INVVOL	Invalid volume status	222
pairsplit, pairevtwait, pairvolchk, horctakeover		EX_EVOLCE	Pair Volume combination error	235
paircreate, pairsplit, pairresync		EX_INVSTP	Invalid pair status	228
paircurchk, horctakeover		EX_VOLCUR	S-VOL currency error	225
horctakeover		EX_VOLCUE	Local Volume currency error	224
horctakeover		EX_VOLCRE	Local and Remote Volume currency error	223
pairsplit, pairevtwait		EX_EWSUSE	Pair suspended at WAIT state	234
paircreate		EX_ENQSIZ	Unmatched volume size for pairing	212
		EX_EWSTOT	SVOL denied; disabled	209
raidvchkset		EX_EWSLTO	Mode changes denied due to retention time	208
pairevtwait, horctakeover	Timer Recoverable	EX_EWSTOT	Timeout waiting for specified status	233
pairevtwait		EX_EWSLTO	Timeout waiting for specified status on the local host	232
paircreate	Resource Unrecoverable	EX_ENOCTG	Not enough CTgroups in RAID	217
paircreate		EX_ENXCTG	No CTgroups left for OPEN Vol use	215

Note: When the EX_EWSTOT of the horctakeover command completes with an error, the error is recorded in the CCI command log ($HORCC_LOG) (see Appendix A).

5.7 Data Recovery Procedure for Suspended (PSUE) Status using ShadowImage

When a pair was suspended (PSUE) due to a failure in the subsystem, collect the CCI system log files and call the Hitachi Data Systems Customer Support (see section 5.7.3).

Maintenance personnel will remove the source of error in the subsystem. After the source of the error has been removed, the system administrator must recover the pair using the CCI commands.

5.7.1 Recovering the Pair

Verify that the system administrator has determined that the PSUE occurred while restoring from S-VOL to P-VOL (pairresync –restore). Table 5.10 shows data assurance and the method for recovering the pair.

Table 5.10 Data Assurance and Method for Recovering the Pair

State before PSUE	Data Assurance	Action Taken after PSUE
Other than RCPY	P-VOL: Assured S-VOL: Not assured	Resynchronize (pairresync) in the direction of P-VOL to S-VOL. Note that the pair may have been split due to the drive's double-malfunction in either or both volumes. In such case, confirm that the data exists in the P-VOL, and then recreate the pair (paircreate).
RCPY	P-VOL: Not assured S-VOL: Not assured	Split the pair (pairsplit –S), restore the backup data to P-VOL, and then create a pair (paircreate). Note that the pair may have been split due to the drive's double-malfunction in either or both volumes. In such case, confirm that the backup data restoration has been completed to the P-VOL, and then recreate the pair.

5.7.2 Correspondence of Internal LU in Subsystem and Device Recognized by Server

To verify the correspondence of the internal LU number in the subsystem and the device name recognized by the server, use the inqraid command tool or the raidscan command. The following example illustrates using the inqraid command tool in the HP-UX system.

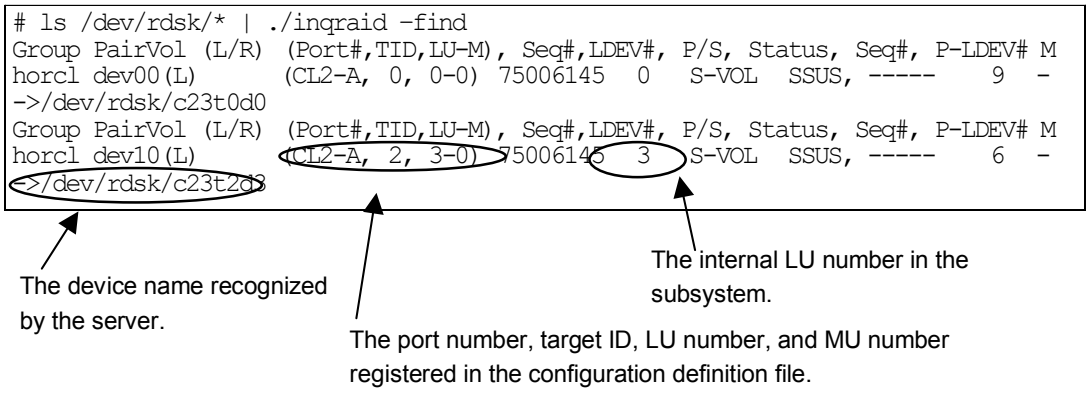


Figure 5.9 Correspondence Between Internal LU and Device Recognized by Server

For details on the inqraid command tool, refer to section 4.16.1. For details on raidscan command, refer to section 4.12.1.

5.7.3 Splitting Pair before LU Format or during Reverse Pairresync Status

When the host cannot recognize an LU while the protection function is ON, the message in Figure 5.10 is displayed and operations to the pair of the unrecognized LU cannot be performed.

```
[EX_ENPERM] Permission denied with the LDEV
```

Figure 5.10 Host Cannot Recognize an LU Message

Issue the pairdisplay command and verify the pair status. An example is shown in Figure 5.11.

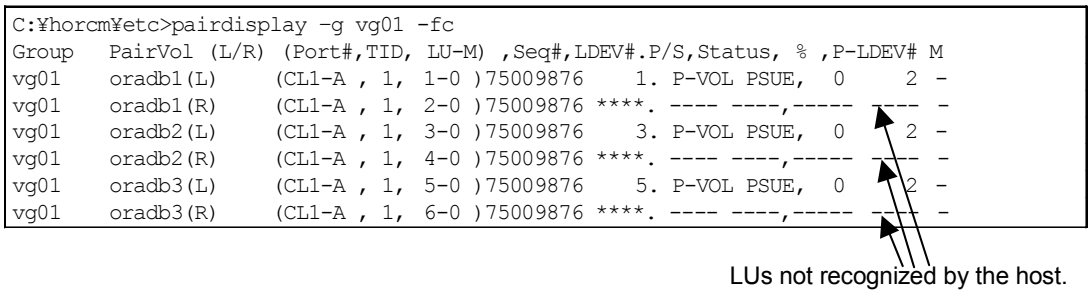


Figure 5.11 Pair Status Verification

After the pair status is verified, turn the protection function OFF, restart HORCM, and then split the pair (to turn the protection function OFF, delete the environment variable $HORCMPROMOD). For details on the environment variable, refer to section 4.2.

After splitting the pair and when the drive maintenance is done by the maintenance personnel, restore the backup data, make the host recognize the LU, and create the pair. And then turn the protection function ON and start HORCM.

5.8 Data Recovery Procedure for Suspended (PSUE) Status using TrueCopy/TCE

When a pair was suspended (PSUE) due to a failure in the subsystem, collect the CCI system log files and then call the Hitachi maintenance personnel The maintenance personnel will remove the error cause of the subsystem. After the error cause has been removed, the system administrator must recover the pair using the CCI commands.

5.8.1 Recovering the Pair

Resynchronization in the direction of P-VOL to S-VOL enables the recovery of a TrueCopy/TCE pair. (The resynchronization cannot be performed in the direction of S-VOL to P-VOL.) However, when a pair was suspended (status = PSUE) without a failure in the system, to recover, release the pair and then recreate it again. Please refer to the recovery procedure in the flow of Figure 5.3, or Figure 5.7.

Note: In the case of TCE, the resynchronization of the S-VOL with the P-VOL is required when the P-VOL status is changed to PFUS because the amount of the data in the primary POOL exceeds the capacity allowed to be used or the S-VOL status is changed to PSUS(N) as well as the P-VOL status is changed to PSUE. The PSUS(N) means the PSUS status that the Read/Write operation cannot be performed; and it is a status in which the S-VOL data is not restored even when the SVOL-Takeover operation is performed.

5.9 Data Recovery Procedure for Suspended (PSUE) Status using SnapShot

When a pair was suspended (PSUE) due to a failure in the subsystem, collect the CCI system log files and then call the Hitachi maintenance personnel The maintenance personnel will remove the error cause of the subsystem. After the error cause has been removed, the system administrator must recover the pair using the CCI commands.

5.9.1 Recovering the Pair

The concrete pair recovery using SnapShot occurs when the pair is split (with pairsplit-S) once and then created again (with paircreate). Recover the pair following the detailed recovery procedure shown in Figure 5.2.

Verify that the system administrator has determined that the PSUE occurred while restoring from V-VOL to P-VOL (pairresync –restore). Table 5.11 shows data assurance and the method for recovering the pair.

Table 5.11 Data Assurance and Method for Recovering Pair

State before PSUE	Data Assurance	Action Taken after PSUE
Other than COPY(RS-R)	P-VOL: Assured V-VOL: Not assured	Split the pair (pairsplit –S), and then recreate the pair (paircreate) again. Note that the pair may have been split due to the drive's double-malfunction in either or both volumes. In such case, confirm that the data exists in the P-VOL, and then create a pair (paircreate). The V-VOL data generated is not the one invalidated previously but the P-VOL data at the time when the pair was newly formed.
COPY(RS-R)	P-VOL: Not assured V-VOL: Not assured	Split the pair (pairsplit –S), restore the backup data to P-VOL, and then recreate the pair (paircreate). Note that the pair may have been split due to the drive's double-malfunction in either or both volumes. Confirm that the backup data restoration has been completed to the P-VOL, and create a pair. The V-VOL data generated is not the one invalidated previously but the P-VOL data at the time when the pair was newly formed.

Appendix A Maintenance Logs and Tracing Functions

A.1 Log Files

The CCI software (HORCM) and Hitachi replication software commands maintain internal logs and traces which can be used to identify the source of errors and keep records of the status transition history of paired volumes. Figure A.1 displays the CCI logs and traces.

HORCM logs are classified into start-up logs and execution logs. The start-up logs contain data on errors that occur before the HORCM is ready to provide services. Thus, if the HORCM fails to start up due to improper environment settings, refer to the start-up logs to resolve the problem. The HORCM execution logs (error log, trace, and core files) contain data on errors that are caused by software or hardware problems. These logs contain internal error data, which does not apply to any user settings; therefore, users do not need to refer to the HORCM execution logs. When an error occurs during the execution of a command, data on the error is collected in the command log file. Users may refer to the command log file if a command execution error occurs.

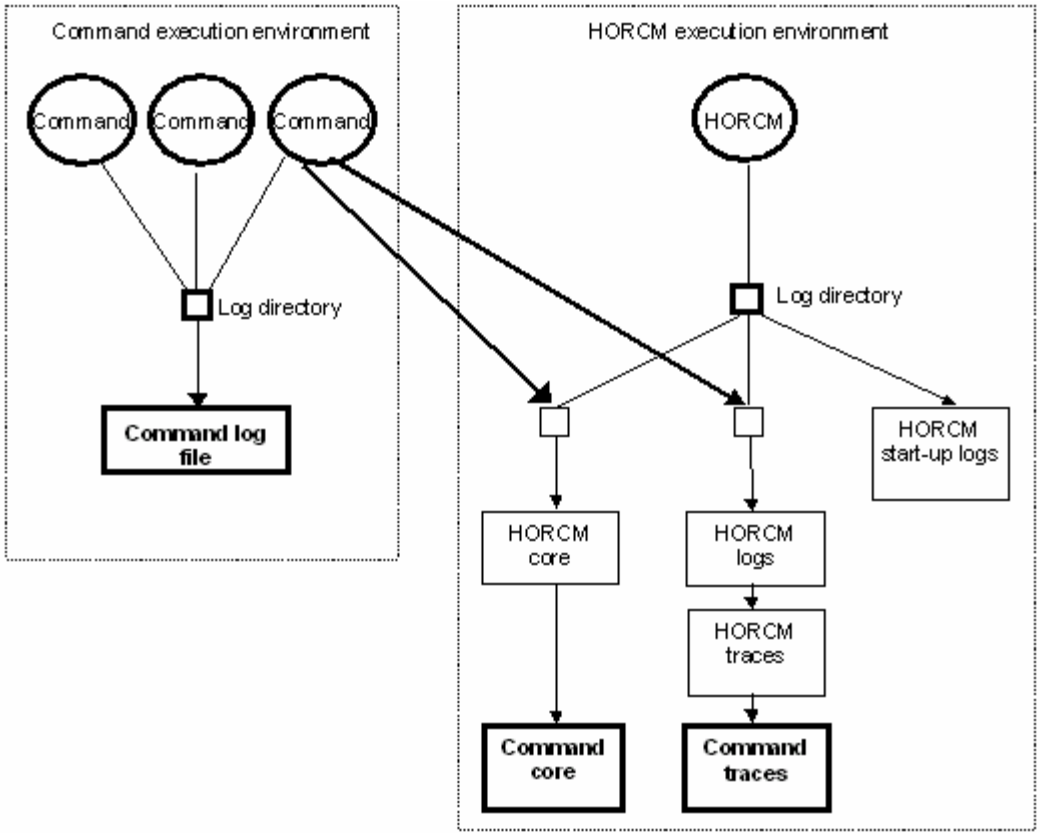


Figure A.1 Logs and Traces

The start-up log, error log, trace, and core files are stored as shown in Table A.1. Specify the directories for the HORCM and command log files using the HORCM_LOG and HORCC_LOG environmental variables as shown in Table A.2. If it is not possible to create the log files, or if an error occurs before the log files are created, the error logs are output in the system log file. If the HORCM activation fails, the system administrator should check the system log file, identify the error cause, and take the proper action. For details on message output to the system log file and the recommended actions for resolving the error conditions, refer to Chapter 5. The system log file for UNIX®-based systems is the syslog file. The system log file for Windows®-based systems is the event log file.

Table A.1 Log Files

File	UNIX-based Systems	Windows-based Systems
Start-up log	HORCM start-up log: $HORCM_LOG/horcm_HOST.log Command log: $HORCC_LOG/horcc_HOST.log	HORCM start-up log: $HORCM_LOG\horcm_HOST_log.txt Command log: $HORCC_LOG\horcc_HOST_log.txt
Error log	HORCM error log: $HORCM_LOG/horcmlog_HOST/horcm.log	HORCM error log: $HORCM_LOG\horcmlog_HOST\horcm_log.txt
Trace	HORCM trace: $HORCM_LOG/horcmlog_HOST/horcm_PID.trc Command trace: $HORCM_LOG/horcmlog_HOST/horcc_PID.trc	HORCM trace: $HORCM_LOG\horcmlog_HOST\horcm_PID_trc.txt Command trace: $HORCM_LOG\horcmlog_HOST\horcc_PID_trc.txt
Core	HORCM core: $HORCM_LOG/core_HOST_PID/core Command core: $HORCM_LOG/core_HOST_PID/core	HORCM core: $HORCM_LOG\core_HOST_PID\core Command core: $HORCM_LOG\core_HOST_PID\core

Note: HOST denotes the host name of the corresponding machine. PID denotes the process ID of that machine.

The location of the directory that contains the log file depends on the user's command execution environment and the HORCM execution environment. The command trace file and core file reside together under the directory specified in the HORCM execution environment. A directory specified using the environmental variable HORCM_LOG is used as the log directory in the HORCM execution environment. If no directory is specified, directory /tmp is used. A directory specified using the environmental variable HORCC_LOG is used as the log directory in the command execution environment. If no directory is specified, the directory **/HORCM/log*** is used (* = instance number). A nonexistent directory may be specified as a log directory using the environmental variable.

Table A.2 Log Directories

Directory Name	Definition
$HORCM LOG	A directory specified using the environmental variable **HORCM_LOG**. The HORCM log file, trace file, and core file as well as the command trace file and core file are stored in this directory. If no environmental variable is specified, **/HORCM/log/curlog** is used.
$HORCC LOG	A directory specified using the environmental variable **HORCC_LOG**. The command log file is stored in this directory. If no environmental variable is specified, the directory **/HORCM/log*** is used (* is the instance number). While the HORCM is running, the log files are stored in the **$HORCM_LOG** directory shown in (a). When the HORCM starts up, the log files created in the operation are stored automatically in the **$HORCM_LOGS** directory shown in (b). a. HORCM log file directory in operation $HORCM_LOG = /HORCM/log*/curlog (* is instance number) b. HORCM log file directory for automatic storing $HORCM_LOGS = /HORCM/log*/tmplog (* is instance number)

A.2 Trace Files

The command trace file is used for maintenance troubleshooting maintenance. It is not created normally. If the source of an error cannot be identified by means of the log file, the environmental variables or trace control commands with trace control parameters are issued to start tracing and the trace file is created. The trace control parameters consist of the trace level, file size, mode, etc. Increasing the trace level enables more detailed tracing. Tracing is made in wraparound within the range of the file size. The HORCM creates the trace file according to the trace level specified in the HORCM start-up shell script set to activate the HORCM.

A.3 Trace Control Command

The trace control command (one of the HORCM control commands) sets or changes the trace control parameters. This command is used for troubleshooting and maintenance. If no trace control parameters can be specified using the environmental variables in the user's command execution environment, it is possible to change the trace control parameters into the global parameters using this command. Table A.3 lists and describes the parameters of the trace control command.

Table A.3 Trace Command Parameters

Parameter	Function
Trace level parameter	Specifies the trace level, range = 0 to 15.
Trace size parameter	Specifies the trace file size in KB.
Trace mode parameter	Specifies the buffer mode or non-buffer mode for writing data in the trace file.
Trace type parameter	Specifies the trace type defined internally.
Trace change instruction	Specifies either the command or the HORCM (CCI instance) for which the trace control parameters are changed.

A.4 How to Read Detailed Error Log Codes

You can access detailed information on an error from the error message (EX_CMDIOE and/or EX_CMDRJE) collected in the command log by referring to a detailed code in the error log.

A command log is output to the side of an instance that has executed a command. An error log is output to an instance on the primary volume side or the secondary volume side depending on the type of the command irrespective of whether the instance that has executed the command is on the primary volume side or the secondary volume side. When an error occurs during the execution of the command, examine the error cause by looking at the error logs of both local instance (an instance that has executed the command) and the remote instance. Examples of the decisions, to which of the local instance and the remote instance the error log corresponding to the command log is output, are shown in Table A.4.

Table A.4 Command Log and Error Log Destination

Command	Command Log	Error Log
paircreate -vr	Local instance	Remote instance
pairresync (Issuing the command from an instance on the primary volume side)	Local instance	Local instance
pairresync (Issuing the command from an instance on the secondary volume side)	Local instance	Remote instance

The error log corresponding to the command log can be found by using the time when the error occurred as a key. The detailed code is stored in the error log location shown in Figure A.3 and Figure. For an explanation of the detailed codes, refer to

Table A.5.

A.4.1 Solaris™

The command log is stored in the command log file located in the start log directory (refer to Figure A.1, Log File List). The error log is stored in the HORCM error log file located in the error log directory (refer to Figure A.1, Log File List). Figure A.2 and Figure A.3 display locations for storing the command log and error log when the directories are not specified using the environmental variable, HORCC_LOG.

Command log: /HORCM/logINS/horcc_HOST.log

Error log: /HORCM/logINS/curlog/horcmlog_HOST/horcm.log

INS is the instance number. HOST is the host name of the computer.

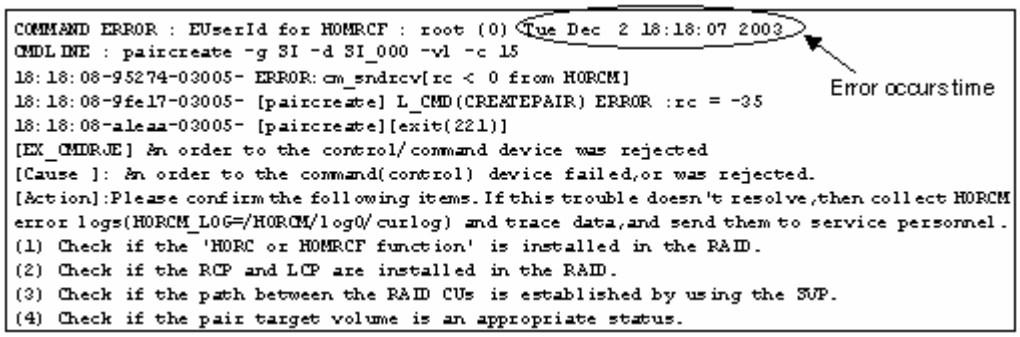


Figure A.2 Command Log Output Example (Solaris)

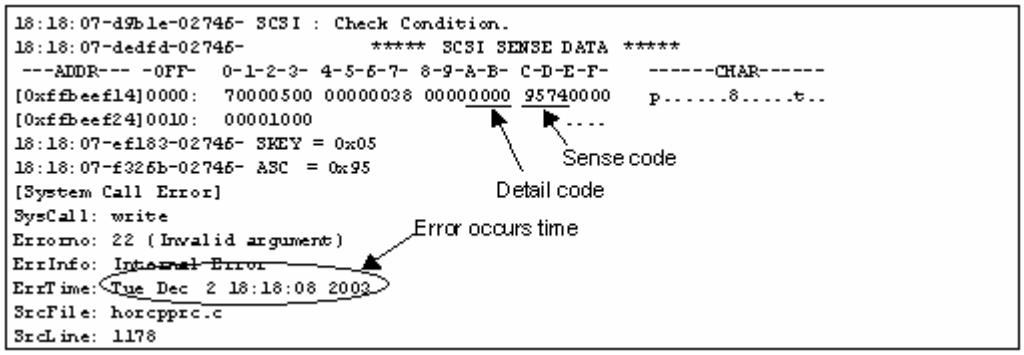


Figure A.3 Error Log Output Example (Solaris)

A.4.2 Linux®

The command log is stored in the command log file located in the start log directory (refer to Figure A.1, Log File List). The error log is stored in the HORCM error log file located in the error log directory (refer to Figure A.1, Log File List). Figure A.2 and Figure A.3 display locations for storing the command log and error log when the directories are not specified using the environmental variable, HORCC_LOG.

Command log: /HORCM/logINS/horcc_HOST.log

Error log: /HORCM/logINS/curlog/horcmlog_HOST/horcm.log

INS is the instance number. HOST is the host name of the computer.

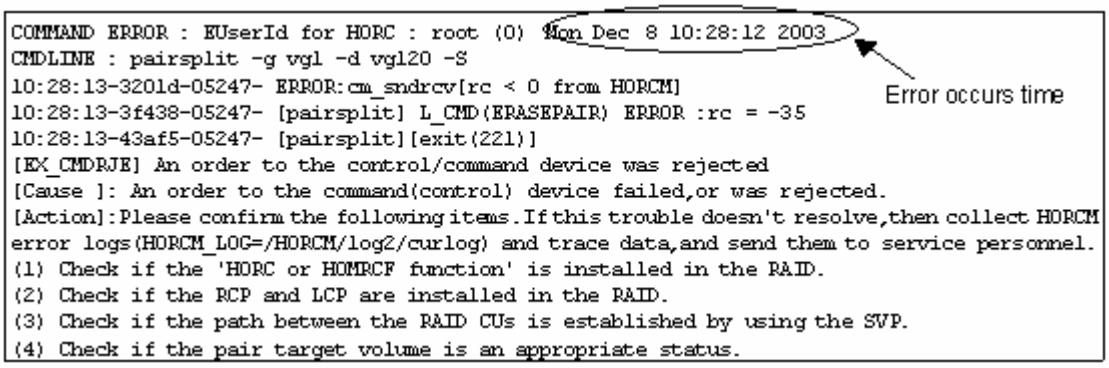


Figure A.4 Command Log Output Example (Linux)

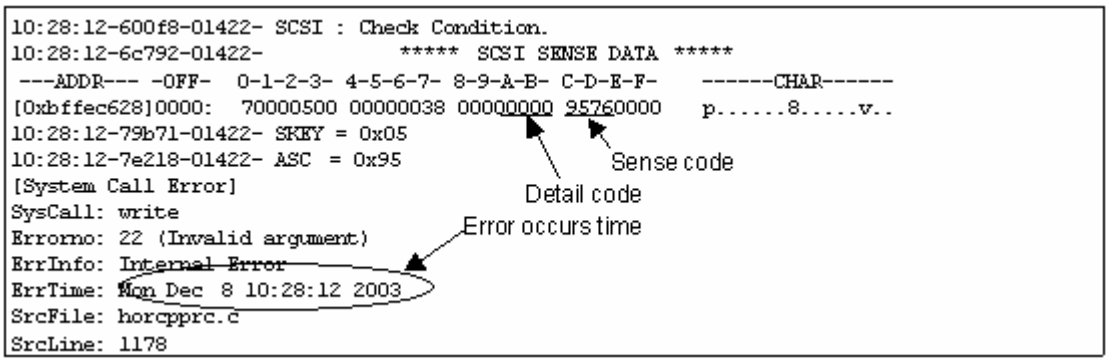


Figure A.5 Error Log Output Example (Linux)

A.4.3 Windows

The command log is stored in the command log file located in the start log directory (refer to Figure A.1, Log File List). The error log is stored in the HORCM error log file located in the error log directory (refer to Figure A.1, Log File List). Figure A.2 and Figure A.3 display locations for storing the command log and error log when the directories are not specified using the environmental variable, HORCC_LOG.

Command log: /HORCM/logINS/horcc_HOST.log

Error log: /HORCM/logINS/curlog/horcmlog_HOST/horcm.log

INS is the instance number. HOST is the host name of the computer.

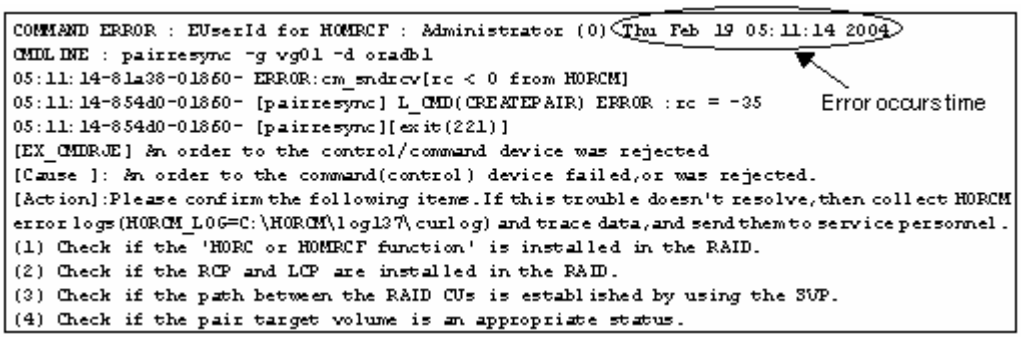


Figure A.6 Command Log Output Example (Windows)

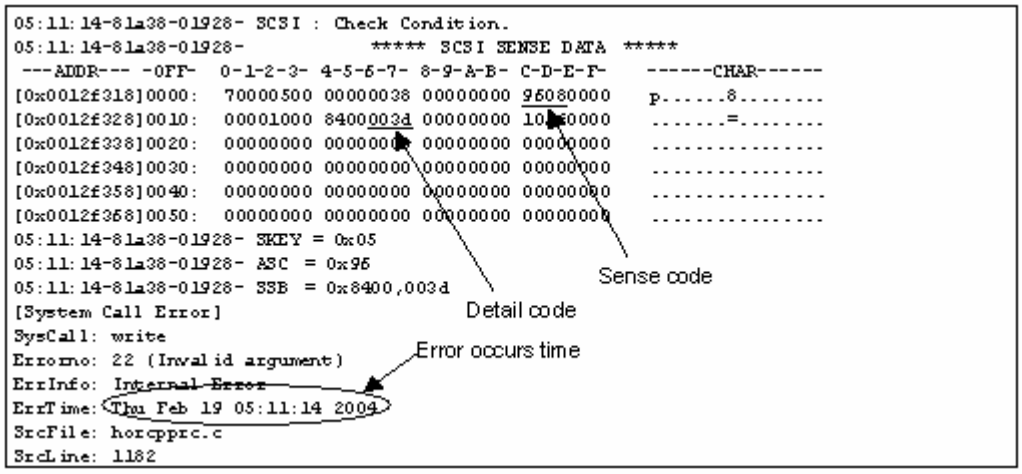


Figure A.7 Error Log Output Example (Windows)

A.4.4 Sense Code and Detail Code

For detailed information on sense codes and detail codes, refer to section 4.1 of Hitachi TagmaStore Adaptable Modular Storage (AMS) and Workgroup Modular Storage (WMS) Storage Navigator Modular Error Codes (MK-96DF788). The table below displays sense codes and detailed codes. 0~9 will be set in the x of detailed codes.

Table A.5 Sense Codes and Detailed Codes

Sense Code	Detailed Code	Error Contents	Recommended Action
2602		The primary sequence number is beyond the limits of support.	Check the serial number.
2602		The secondary sequence number is beyond the limits of support.	Check the serial number.
2602		The LUN of the P-VOL is beyond the limits of support.	Check the specified LUN.
2602		The LUN of the S-VOL is beyond the limits of support.	Check the specified LUN.
2602		The primary port number is beyond the limits of support.	Check the specified port number.
2602		The secondary port number is beyond the limits of support.	Check the specified port number.
2602		The object LU is beyond the limits of support.	Check the status of the LU.
2602		The object LU is undefined.	Check the status of the LU.
2602		The environment has a problem.	Check the environment of CCI.
2602		The Retention Term is beyond the limits of validity.	Check that the specified value that has been set is 0 to 21900.
3180		The object LU is unformatted.	Check the status of the LU.
9501		A command was received during execution of the pseudo deliberate shutdown.	Retry after the pseudo deliberate shutdown is completed.
9510		A command was received during a performance of hot replacement of the microprogram.	Retry after waiting for a while.
9531		The password protection is being logged in.	Retry after waiting for a while.
9536		The optional feature is invalid.	Install the optional feature.
9552		The object LU is defined as a command device.	Check the attribute of the LU.
9557		LU capacities of the P-VOL and S-VOL are not the same.	Check the capacity of the LU.
956B		The capacity is beyond the limits of support.	Split the unnecessary pairs.
9574		The specified LU as ShadowImage S-VOL is already comprised in a TrueCopy pair.	Before creating the TrueCopy pair for cascading, delete the TrueCopy pair, create the ShadowImage pair, then create the TrueCopy pair for cascading.
9574		The pair status of the TrueCopy for the ShadowImage P-VOL is other than PSUS.	Check the pair status of the TrueCopy.
9574		The pair status of the TrueCopy for the ShadowImage P-VOL is PSUS and writing to the P-VOL is prohibited.	Check the status of the LU.
9574		The pair status of the TrueCopy for the ShadowImage S-VOL is other than PSUS and is other than PSUE.	Check the pair status of the TrueCopy.
9576	0000	The pair status of the P-VOL is other than SMPL.	Check the pair status of the LU.
9576	0001	The status of the P-VOL is other than normal and regressive.	Check the status of the LU.
9576	0002	The P-VOL is a Cache Residency LU.	Check the status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	0003	The P-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
9576	0004	The P-VOL is a command device.	Check the status of the LU.
9576	0005	The primary sequence number is different from the own serial number.	Check the serial number.
9576	0006	Both of the two paths are abnormal.	Check the status of the path.
9576	0007	The P-VOL has been defined as a SubLU of a unified LU.	Check the status of the LU.
9576	000D	The P-VOL is in a status other than PSUS and PSUE.	Check the pair status of the LU.
9576	000E	The status of the P-VOL is other than normal and regressive.	Check the pair attribute of the LU.
9576	000F	The number of the LU to be paired is different.	Check the specified LUN.
9576	0010	The primary sequence number is different from the own serial number.	Check the serial number.
9576	0011	Both of the two paths are abnormal.	Check the status of the path.
9576	0012	The specified P-VOL is in a status other than COPY and PAIR.	Check the pair status of the LU.
9576	0016	The number of the LU to be paired is different.	Check the specified LUN.
9576	0017	The primary sequence number is different from the own serial number.	Check the serial number.
9576	0018	The pairsplit -R command to a P-VOL or the pairsplit -S command to an S-VOL was received.	Check the pair status of the LU.
9576	0020	The Asynchronous mode is turned on.	The Asynchronous mode is not supported.
9576	0021	The fence level is STATUS.	Make sure of the specified fence level.
9576	0023	The P-VOL is a volume of ShadowImage™. It is in the PSUE status and cannot accept Read/Write instructions.	Check the pair status of the LU.
9576	0024	The P-VOL is undergoing a reverse resynchronization with ShadowImage	Check the pair status of the LU.
9576	0025	The P-VOL received an instruction to undergo a resynchronizing swap.	Check the pair status of the LU.
9576	0026	It is not in the SSWS status when it is undergoing a resynchronizing swap.	Check the pair status of the LU.
9576	0027	The S-VOL received an instruction to undergo a resynchronization.	Check the pair status of the LU.
9576	0028	The volume is a P-VOL of ShadowImage. It is in the PSUE status and cannot accept Read/Write instructions.	Place the P-VOL concerned in the SMPL status and create the pair again.
9576	0028	The remote subsystem is receiving a command.	Retry after waiting for a while.
9576	0029	The volume is a P-VOL of ShadowImage and undergoing a reverse copy.	Check the pair status of the LU.
9576	002A	The P-VOL received an instruction to be taken over.	Check the pair status of the LU.
9576	002B	It is in the SMPL or COPY status.	Check the pair status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	002C	The secondary sequence number is different from the serial number.	Check the serial number.
9576	002D	The S-VOL received an instruction to be taken over.	Check the pair status of the LU.
9576	002E	The pair status of the P-VOL is SMPL or COPY.	Check the pair status of the LU.
9576	002F	The primary sequence number is different from the serial number.	Check the serial number.
9576	0030	The S-VOL received the pairsplit -E (pair suspend) command.	Check the pair status of the LU.
9576	0031	The capacity is beyond the limits of support.	Split the unnecessary pairs.
9576	0032	The P-VOL is configured as RAID 0.	Check the RAID level of the specified LU.
9576	0033	The specified LU is an S-VOL of ShadowImage and it is in a pair status other than PSUS.	Check the pair status of the LU.
9576	0034	The specified LU is comprised in a ShadowImage pair and it has already been cascaded with a TrueCopy pair.	Check the pair status of the LU.
9576	0035	The volume is an S-VOL of ShadowImage and it is in a pair status other than PSUS.	Check the pair status of the LU.
9576	0036	The volume is a P-VOL of SnapShot and being restored.	Check the pair status of the LU.
9576	0037	The volume is a P-VOL of SnapShot It is in the PSUE status and cannot accept Read/Write instructions.	Change the statuses of all V-VOLs of the P-VOL concerned to SMPL, and create the pair again.
9576	0038	The volume is a P-VOL of SnapShot and the mate to it has already been paired by TrueCopy.	Check the pair status of the LU.
9576	0039	The volume is a V-VOL of SnapShot and it is in a status other than PSUS of SnapShot.	Check the pair status of the LU.
9576	003A	The volume is a V-VOL of SnapShot. The related P-VOL of SnapShot is being restored or has been placed in the PSUE status during a restoration.	Check the pair status of the LU.
9576	003B	The specified LU is comprised in a SnapShot pair and it has already been cascaded with a TrueCopy pair.	Check the pair status of the LU.
9576	003C	The specified LU is comprised in a SnapShot pair and it has already been cascaded with a TrueCopy pair.	Check the pair status of the LU.
9576	003D	The volume is a P-VOL of SnapShot and being restored.	Check the pair status of the LU.
9576	003E	The volume is a P-VOL of SnapShot. It is in the PSUE status and cannot accept Read/Write instructions.	Change the statuses of all V-VOLs of the P-VOL related to SMPL and create the pair again.
9576	003F	The volume is a V-VOL of SnapShot and it is in a status other than PSUS of SnapShot.	Check the pair status of the LU.
9576	0040	The volume is a P-VOL of SnapShot. It is being restored or in the PSUE status and cannot accept Read/Write instructions.	Check the pair status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	0041	The number of unified LUs is 17 or more.	Check the number of unified LUs of the volume corresponding to the specified LU.
9576	0042	The RAID level differs between the MainLU and SubLU.	Check that the RAID level of the specified LU is the same as that expected.
9576	0043	The number of data disks differs between the MainLU and SubLU.	Check that the number of data disks of the specified LU is the same as that expected.
9576	0044	The specified LU is a V-VOL of SnapShot. The P-VOL of the related SnapShot pair is a unified LU and the number of unified LUs is 17 or more.	Check the number of unified LUs of the SnapShot P-VOL corresponding to the specified LU.
9576	0045	The specified LU is a V-VOL of SnapShot. The P-VOL of the related SnapShot pair is a unified LU, whose MainLU and SubLU are different in RAID level.	Check that the RAID level of the SnapShot P-VOL corresponding to the specified LU is the same as that expected.
9576	0046	The specified LU is a V-VOL of SnapShot. The P-VOL of the related SnapShot pair is a unified LU, whose MainLU and SubLU are different in number of data disks.	Check that the number of data disks of the SnapShot P-VOL corresponding to the specified LU is the same as that expected.
9576	0047	Data of the TrueCopy P-VOL is partially destroyed.	Issue the Snapshot instruction (to change the status from PAIR to PSUS) to the SnapShot pair again, and then create the pair again.
9576	0048	Data of the TrueCopy P-VOL is partially destroyed.	Format the specified LU after getting backup data of it. Then restore the backup data.
9576	0049	A problem occurred in the pair.	After splitting the pair, create a pair again.
9576	004A	A problem occurred in the pair.	After splitting the pair, create a pair again.
9576	004B	The specified P-VOL is in the PSUE (S-VOL Switch) status of ShadowImage™.	Request service personnel to replace drives that compose the P-VOL. Format them after the replacement, then resynchronize them.
9576	004D	The DM-LU is not set.	Retry after setting the DM-LU.
9576	004E	The DM-LU was specified as P-VOL.	Check the status of the LU.
9576	004F	Validity of the license expired.	Purchase the license.
9576	0050	The specified P-VOL is the system LU for the NAS.	Check the status of the LU.
9576	0051	The specified P-VOL is the user LU for the NAS.	Check the status of the LU.
9576	0052	The pairsplit -mscas was issued in the TrueCopy environment.	The pairsplit -mscas is not supported in the TrueCopy environment.
9576	0053	The specified P-VOL is the reserved LU.	Check the status of the LU.
9576	0054	The specified P-VOL is undergoing the migration.	Check the pair status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	0055	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
9576	0056	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
9576	201E	The status of the pair of the object LU is illegal.	Check the pair status of the LU.
9576	5047	The specified LU is an S-VOL of ShadowImage	Specify an LU other than a ShadowImage S-VOL that comprises the LU of the remote subsystem (at the time of a swap).
9576	504B	The P-VOL is in the S-VOL Disable mode.	Cancel the S-VOL Disable specified for the LU of the remote subsystem (at the time of a swap).
9576	5056	The object LU of the remote subsystem is a V-VOL of SnapShot (at the time of a resynchronizing swap).	Specify the LU of the remote subsystem to a volume other than a V-VOL of SnapShot.
9576	901E	There is a TCE pair which is in the pair status other than PAIR and whose S-VOL is one of the S-VOLs with the specified CTG numbers.	Check the pair status of the LU.
9576	6040	The specified S-VOL has been organized into a TrueCopy pair.	Check the pair status of the LU.
9576	7040	The specified S-VOL has been organized into a TrueCopy pair.	Check the pair status of the LU.
9576	903D	The statuses of the pairs in the specified CTG are illegal.	Check the pair status of the LU and specified LUN.
9576	905E	There is a SnapShot pair, which has an MU number specified for a SnapShot P-VOL, has not been placed in the PAIR or PSUS status, and whose S-VOL is one of the S-VOLs with the specified CTG numbers.	Check the pair status of the SnapShot.
9576	905F	There is no pair, which is in the PAIR status, in the target CTG.	Check the pair status of the LU.
9576	x005	The LU of the remote subsystem is being formatted.	Retry after waiting for a while.
9576	x006	The remote subsystem is undergoing the pseudo deliberate shutdown.	Retry after the pseudo deliberate shutdown is completed.
9576	x007	The remote subsystem has undergone the pseudo deliberate shutdown.	Retry after waiting for a while.
9576	x008	The S-VOL is undefined.	Check the status of the LU.
9576	x009	The WWN of the remote subsystem is illegal.	Check the equipment WWN.
9576	x00B	The remote subsystem is undergoing hot replacement of the microprogram.	Retry after waiting for a while.
9576	x00C	A command error occurred.	Retry after waiting for a while.
9576	x00D	The optional feature of TrueCopy™ of the remote subsystem is invalid.	Unlock and validate the optional feature.
9576	x00E	The status of the S-VOL cannot be changed.	Retry after waiting for a while.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	x011	The object LU has already been organized into a TrueCopy™ or TCE pair. Besides, the serial number differs between the local and remote subsystems.	Check the pair status of the LU and serial number.
9576	x012	The number of TrueCopy or TCE pairs exceeded the maximum value that can be supported.	Check the number of TrueCopy or TCE pairs.
9576	x014	The current serial number differs from that at the time when it was set.	Check the serial.
9576	x015	The status of the object LU is other than normal and regressive.	Make the status of the LU normal or regressive.
9576	x017	The S-VOL is configured as RAID 0.	Check the RAID level of the specified LU
9576	x018	The number of data disks differs between the P-VOL and S-VOL	Equalize the numbers of data disks of the P-VOL and S-VOL.
9576	x019	The capacity differs between the P-VOL and S-VOL.	Equalize the capacities of the P-VOL and S-VOL.
9576	x01A	The S-VOL is a Cache Residency LU or has been set to the reserved Cache Residency LU.	Check the status of the LU.
9576	x01C	The object LU is a command device.	Specify an LU other than a command device.
9576	x01D	The change of the default owner controller is reserved for the object LU.	Cancel the reservation for changing the default owner controller or specify the LU for which the change of the default owner controller is not reserved.
9576	x01E	The object LU has been organized into a TrueCopy pair.	Check the pair status of the LU.
9576	x020	The object LU of the remote subsystem is being restored as a volume of ShadowImage™ or cannot accept Read/Write instructions.	Check the pair status of the LU.
9576	x021	The object LU has already been cascaded with a ShadowImage™ pair.	Check the pair status of the LU and check that its pair attribute is P-VOL.
9576	x032	The remote subsystem is receiving a command.	Retry after waiting.
9576	x03D	Pair status of corresponding LU does not match.	Confirm the pair status of LU and the other side's LUN.
9576	x03F	The LU assigned to a TrueCopy™ pair has already been paired by ShadowImage™.	Check the pair status of the LU.
9576	x040	The object LU of the remote subsystem is being restored as a volume of ShadowImage™ or cannot accept Read/Write instructions.	Check the pair status of the LU.
9576	x041	The process is in progress.	Retrying after waiting.
9576	x045	The stripe size of the object LU of the remote subsystem is other than 64 KB.	Make the stripe size of the LU of the remote subsystem 64 KB.
9576	x046	The object LU of the remote subsystem is being restored as a volume of SnapShot or cannot accept Read/Write instructions.	Place the SnapShot pair, which comprises the LU of the remote subsystem, in the SMPL status once and then operate the pair.

Sense Code	Detailed Code	Error Contents	Recommended Action
9576	x048	The specified LU is an S-VOL of ShadowImage™.	Split the ShadowImage™ pair that comprises an LU of the remote subsystem.
9576	x049	The object LU of the remote subsystem is being quick formatted.	Create the pair again after the quick formatting is completed.
9576	x04A	The S-VOL is in the S-VOL Disable mode.	Cancel the S-VOL Disable specified for the LU of the remote subsystem.
9576	x050	The object LU of the remote subsystem has not undergone the forced restoration by means of parity or it is undergoing the restoration above.	Make the status, which concerns the forced restoration by means of parity, of the LU of the remote subsystem to Restored or Skip.
9576	x053	The number of unified LUs of the remote subsystem is 17 or more.	Make the number of unified LUs of the remote subsystem 16 or less.
9576	x054	The V-VOL, which is paired with a SnapShot P-VOL of the remote subsystem has already been organized into a TrueCopy™ pair.	Split the TrueCopy™ pair comprising a SnapShot V-VOL that is an LU of the remote subsystem.
9576	x055	The object LU of the remote subsystem is a V-VOL of SnapShot (at the time of a pair formation).	Specify the LU of the remote subsystem to a volume other than a V-VOL of SnapShot.
9576	x059	The license validity of the remote subsystem is expired.	Purchase the license.
9576	x05A	The DM-LU is not set of the remote subsystem or the DM-LU was specified as S-VOL.	Retry after setting the DM-LU or check the status of the LU.
9576	x05B	The specified S-VOL is the pool LU.	Check the status of the LU.
9576	x05C	The specified S-VOL is the NAS LU.	Check the status of the LU.
9576	x0B3	The specified S-VOL is a unified LU including a SubLU with a capacity less than 1 GB.	Check whether the LU with a capacity less than 1 GB is included in each LU of the specified unified LU.
9576	x0C4	When a new pair, which is to be (or is) bi-directional, of a CTG is created, the cycle time that has been set for the remote subsystem is less than the minimum interval.	Check the cycle time that has been set for the remote subsystem.
9576	x0C6	The specified S-VOL is undergoing the migration.	Re-execute the migration after splitting the pair.
9576	x0C7	The specified S-VOL is the reserved LU.	Re-execute the migration specifying an LU other than the reserved LU for the S-VOL.
9576	x0CC	The specified S-VOL is an NAS user LU, or the version of the NAS OS of the remote side subsystem is less than 04-02.	Specify an LU other than the NAS user LU for the S-VOL, or request the service personnel to update the version of the NAS OS to 04-02 or later.
9576	x0CD	The specified S-VOL is an NAS user LU, or the version of the NAS OS of the remote side subsystem is less than 04-02.	Specify an LU other than the NAS user LU for the S-VOL, or request the service personnel to update the version of the NAS OS to 04-02 or later.
9576	x0CF	The disk drives that configure a RAID group, to which a target LU in the remote subsystem belongs have been spun down.	Perform the operation again after spinning up the disk drives that configure the RAID group.

Sense Code	Detailed Code	Error Contents	Recommended Action
9591		There exist maximum number of pairs already.	Split the unnecessary pairs.
9606		The P-VOL or S-VOL is an invalidated LU.	Check the status of the LU.
9607		The P-VOL or S-VOL is a P-VOL (other than SMPL, or the SMPL and a V-VOL that has been set) or a V-VOL of SnapShot.	Check the pair status.
9608	0000	The operation to change an ownership of LU is in progress.	Retry after waiting for a while.
9608	0000	In the operation to change an ownership of LU, an LU having pinned data was specified.	Retry after eliminating pinned data.
9608	0001	In the operation to change an ownership of LU, an LU with pinned data was specified.	Retry after eliminating pinned data.
9608	0001	The operation to change an ownership of LU is in progress.	Retry after waiting for a while.
9608	0002	The operation to change an ownership of LU is in progress.	Retry after waiting for a while.
9608	0003	There is no partition to which the current partition is to be changed.	Retry after waiting for a while.
9608	0004	The specified P-VOL or the specified S-VOL is the LU, for which a change of the cache partition(s) had been reserved.	Retry after releasing the reserved status.
9608	0004	The P-VOL is in a status other than normal and regressive.	Check the status of the LU.
9608	0005	The operation to change an ownership of LU is in progress.	Retry after waiting for a while.
9608	0005	The data pool LU being used is in a status other than normal and regressive.	Check the status of the LU.
9608	0006	The pair status of the P-VOL is other than SMPL, or a V-VOL does not exist.	Check the pair status of the LU.
9608	0007	The pair status is other than SMPL.	Check the pair status of the LU.
9608	0008	The specified P-VOL is a V-VOL.	Check the pair status of the LU.
9608	0009	The specified V-VOL is a P-VOL.	Check the pair status of the LU.
9608	000A	The specified LUN is not the same as the expected one.	Make sure of the specified LU.
9608	000B	The group ID number is 128 or higher.	Make sure of the specified group ID number.
9608	000D	The same MU number was specified within the same P-VOL.	Make sure of the specified MU number.
9608	000E	The process is in progress.	Retry after waiting for a while.
9608	0010	The pair status is other than PSUS.	Check the pair status of the LU.
9608	0011	The object LUN is not the same as the expected one.	Check the specified LU.
9608	0012	The pairsplit -E command (instruction of forced suspension) was received.	Make sure of the command.

Sense Code	Detailed Code	Error Contents	Recommended Action
9608	0014	The P-VOL is in a status other than normal and regressive.	Check the status of the LU.
9608	0015	The data pool LU being used is in a status other than normal and regressive.	Check the status of the pool LU.
9608	0016	There is no V-VOL corresponding to the specified P-VOL.	Check the status of the LU.
9608	0017	The pair attribute of the P-VOL is V-VOL.	Check the status of the LU.
9608	0018	The pair attribute of the V-VOL is P-VOL.	Check the status of the LU.
9608	0019	The object LUN is not the same as the expected one.	Check the specified LU.
9608	001A	The same MU number was specified within the same P-VOL.	Make sure of the specified MU number.
9608	001B	The process is in progress.	Retry after waiting for a while.
9608	001D	The object LUN is not the same as the expected one.	Check the specified LU.
9608	001E	The specified V-VOL is not specified to be grouped. (Group ID suspension)	Check the pair attribute of the LU.
9608	001F	The V-VOL, which is an object of the batch suspension, is in a status other than PAIR. (Group ID suspension)	Check the pair status of the LU.
9608	0020	The process is in progress.	Retry after waiting for a while.
9608	0021	The process is in progress.	Retry after waiting for a while.
9608	0022	The pair status of the V-VOL is illegal	Check the pair status of the LU.
9608	0023	The object LUN is not the same as the expected one.	Check the specified LU.
9608	0028	The specified MU number is different from that of the specified V-VOL.	Make sure of the specified MU number.
9608	0029	The specified MU number is different from that of the specified V-VOL.	Make sure of the specified MU number.
9608	002A	The specified MU number is different from that of the specified V-VOL.	Make sure of the specified MU number.
9608	002B	The pair status was changed to PSUE because the process terminated abnormally.	Place the pair concerned in the SMPL status once, and then create the pair again.
9608	002C	The specified P-VOL has excess pinned data (at the time of a restoration only).	Retry after eliminating pinned data.
9608	002E	CCI was received by the control information on 8-byte form.	Check the environment of CCI.
9608	002F	There are 64 or more LUs being restored.	Retry after the restoration is completed.
9608	0030	The P-VOL is being restored.	Retry after the restoration is completed.
9608	0031	Data of the V-VOL is partially destroyed.	Make a backup from the S-VOL to a tape device, etc. and then restore the data to the P-VOL.
9608	0032	The process is in progress.	Retry after waiting for a while.

Sense Code	Detailed Code	Error Contents	Recommended Action
9608	0033	Because the process terminated abnormally, the pair status was changed to PSUE and the P-VOL became unable to accept Read/Write instructions.	Change the statuses of all V-VOLs of the P-VOL concerned to SMPL, and create the pair again.
9608	0034	Because the process terminated abnormally, the pair status was changed to PSUE and the P-VOL became unable to accept Read/Write instructions.	Change the statuses of all V-VOLs of the P-VOL concerned to SMPL, and create the pair again.
9608	0035	The MU number is other than 0 to 2.	Make sure of the specified MU number.
9608	0036	The MU number is other than 0 to 2.	Make sure of the specified MU number.
9608	0037	The MU number is other than 0.	Make sure of the specified MU number.
9608	0038	The V-VOL is a volume of TrueCopy™ and in a status other than SMPL.	Check the status of the TrueCopy™ pair.
9608	0039	The P-VOL of SnapShot is a P-VOL of TrueCopy™. It is in the PSUS status and prohibited from accepting Write instructions.	Check the pair status and pair attribute.
9608	003A	The P-VOL of SnapShot is a P-VOL of TrueCopy™. It is in the PSUS status and prohibited from accepting Write instructions.	Check the pair status and pair attribute.
9608	003B	The P-VOL of SnapShot is a volume of TrueCopy™ and it is in a status other than SMPL and PSUS.	Check the status of the TrueCopy™ pair.
9608	003C	Among the other S-VOLs of SnapShot, there are LUs of TrueCopy™ in a status other than PSUS and PSUE.	Check the status of the TrueCopy™ pair.
9608	003D	The V-VOL is a volume of TrueCopy™ and in a status other than PSUS and PSUE.	Check the status of the TrueCopy™ pair.
9608	003E	The V-VOL is a volume of TrueCopy™ and in a status other than SMPL.	Check the status of the TrueCopy™ pair.
9608	0044	The DM-LU is not set.	Retry after setting the DM-LU.
9608	0045	The DM-LU was specified as P-VOL.	Check the status of the LU.
9608	0046	The DM-LU was specified as V-VOL.	Check the status of the LU.
9608	0047	The DM-LU is not set.	Retry after setting the DM-LU.
9608	0048	The DM-LU was specified as P-VOL.	Check the status of the LU.
9608	0049	The DM-LU was specified as V-VOL.	Check the status of the LU.
9608	004A	Validity of the license expired.	Purchase the license.
9608	004B	Validity of the license expired.	Purchase the license.
9608	004C	The reverse resynchronization was executed for the system LU for the NAS while the NAS OS is running.	Check the operation status of the NAS OS.
9608	004D	The reverse resynchronization was executed for the user LU for the NAS while the NAS OS is running.	Check the operation status of the NAS OS.
9608	004E	The system LU for the NAS was specified the P-VOL.	Check the status of the LU.
9608	004F	The user LU for the NAS was specified the P-VOL.	Check the status of the LU.
9608	0050	The system LU for the NAS was specified the P-VOL.	Check the status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9608	0051	The user LU for the NAS was specified the P-VOL.	Check the status of the LU.
9608	0052	The specified P-VOL is a P-VOL of TCE and the status of the TCE pair is other than PSUS (at the time of restoration).	Check the status of the LU.
9608	0053	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is PSUS and writing to the S-VOL is prohibited (at the time of restoration).	Check the status of the LU.
9608	0054	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is SSWS(R) (at the time of restoration).	Check the status of the LU.
9608	0056	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is PSUS and reading/writing from/to the S-VOL is prohibited (at the time of restoration).	Check the status of the LU.
9608	0057	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is other than SMPL or PSUS (at the time of restoration).	Check the status of the LU.
9608	0058	The P-VOL of this SnapShot is the S-VOL of the TCE pair. It cannot be executed because the status of this TCE pair is COPY or PAIR.	Check the status of the LU.
9608	0059	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is PSUS and reading/writing from/to the S-VOL is prohibited.	Check the status of the LU.
9608	005A	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is COPY or PAIR.	Check the status of the LU.
9608	005B	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is PSUS and reading/writing from/to the S-VOL is prohibited.	Check the status of the LU.
9608	005C	The specified P-VOL is an S-VOL of TCE and the status of the TCE pair is PFUS (at the time of restoration).	Check the status of the LU.
9608	005D	The specified P-VOL is the reserved LU.	Check the status of the LU.
9608	005E	The specified P-VOL is the reserved LU.	Check the status of the LU.
9608	005F	Though the specified P-VOL requires a change of an ownership of LU, it has the pinned data.	Contact the service personnel.
9608	0060	Though the specified P-VOL requires a change of an ownership of LU, the segments are insufficient.	Check the status of the LU.
9608	0061	Though the specified P-VOL requires a change of an ownership of LU, the sequential buffer is being used.	Check the status of the LU.
9608	0063	Though the specified P-VOL requires a change of an ownership of LU, the directory structure is being changed.	Check the status of the LU.
9608	0064	Though the specified P-VOL requires a change of an ownership of LU, a time-out occurred in the ownership of LU changed.	Check the status of the LU.
9608	0065	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down (at the time of restoration).	Check the status of the RAID group.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	0001	The target LU is undergoing the change of an ownership of LU.	Retry after waiting for a while.
9609	0002	The target LU is undergoing the change of an ownership of LU.	Retry after waiting for a while.
9609	0004	The owner controller of the LUs to be paired is detached.	Retry.
9609	0005	The owner controller of the LUs to be paired is detached.	Retry.
9609	0006	The owner controller of the LUs to be paired is detached.	Retry.
9609	0007	The owner controller of the LUs to be paired is detached.	Retry.
9609	0009	The owner controller of the LUs to be paired is detached.	Retry after waiting for a while.
9609	000A	The owner controller of the LUs to be paired is detached.	Retry after waiting for a while.
9609	000B	The owner controller of the LUs to be paired is detached.	Retry after waiting for a while.
9609	0010	The model of the remote subsystem is not supported.	Check the equipment type of the remote subsystem.
9609	0016	The object LU is a unified LU.	Separate the unified LU of the remote subsystem.
9609	0019	The pair operation commands is a time-out.	Retry after waiting for a while.
9609	003B	Controller failures occurred intermittently.	Retry after waiting for a while.
9609	003C	A controller failure occurred.	Contact the service personnel.
9609	0060	The path of the local subsystem is abnormal.	Check the status of the path.
9609	0061	The path of the local subsystem is abnormal.	Check the status of the path.
9609	0062	The path of the local subsystem is abnormal.	Check the status of the path.
9609	0063	The path of the local subsystem is abnormal.	Check the status of the path.
9609	0065	Since the specified P-VOL requires a change of an ownership of LU, it is undergoing the execution of the ownership of LU change.	Retry after waiting for a while.
9609	0066	Though the specified P-VOL requires a change of an ownership of LU, the controller to be changed is blocked.	Retry after waiting for a while.
9609	0067	Since the specified P-VOL requires a change of an ownership of LU, the execution of the ownership of LU change has been started.	Retry after waiting for a while.
9609	x001	The path of the remote subsystem was detached.	Check the status of the path.
9609	x002	The process is in progress.	Retry after waiting for a while.
9609	x003	The process is in progress.	Retry after waiting for a while.
9609	x004	The process is in progress.	Retry after waiting for a while.
9609	x00A	The remote subsystem is receiving a command.	Retry after waiting for a while.
9609	x00F	The path of the remote subsystem was detached.	Check the status of the path.
9609	x022	The process is in progress.	Retry after waiting for a while.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	x023	The process is in progress.	Retry after waiting for a while.
9609	x024	The process is in progress.	Retry after waiting for a while.
9609	x025	The S-VOL of the remote subsystem is being formatted.	Retry after waiting for a while.
9609	x026	The remote subsystem is undergoing the pseudo deliberate shutdown.	Retry after the pseudo deliberate shutdown is completed.
9609	x027	The remote subsystem has undergone the pseudo deliberate shutdown.	Retry after waiting for a while.
9609	x028	The remote subsystem is executing a command of CCI.	Retry after waiting for a while.
9609	x029	A command error occurred.	Retry after waiting for a while.
9609	x02A	The optional feature of TrueCopy™ or TCE of the remote subsystem is invalid.	Unlock and validate the optional feature.
9609	x02B	The path of the remote subsystem was detached.	Check the status of the path.
9609	x02C	The process is in progress.	Retry after waiting for a while.
9609	x02D	The S-VOL of the remote subsystem is being formatted.	Retry after waiting for a while.
9609	x02E	The remote subsystem is undergoing the pseudo deliberate shutdown.	Retry after the pseudo deliberate shutdown is completed.
9609	x02F	The remote subsystem has undergone the pseudo deliberate shutdown.	Retry after waiting for a while.
9609	x030	The S-VOL is undefined.	Check the attribute of the LU.
9609	x031	The WWN of the remote subsystem is illegal.	Check the equipment WWN.
9609	x032	The remote subsystem is executing a command of CCI.	Retry after waiting for a while.
9609	x033	The remote subsystem is undergoing hot replacement of the microprogram.	Retry after waiting for a while.
9609	x034	A command error occurred.	Retry after waiting for a while.
9609	x035	The optional feature of TrueCopy™ or TCE of the remote subsystem is invalid.	Unlock and validate the optional feature.
9609	x036	The process is in progress.	Retry after waiting for a while.
9609	x037	The process is in progress.	Retry after waiting for a while.
9609	x038	Both of the two paths of the remote subsystem were detached.	Check the status of the path.
9609	x039	The process is in progress.	Retry after waiting for a while.
9609	x03A	The process is in progress.	Retry after waiting for a while.
9609	x03E	The S-VOL command is receiving a command.	Retry after waiting.
9609	x041	The S-VOL of the remote subsystem is doing a duplicate writing.	Retry after waiting for a while.
9609	x042	The capacity is beyond the limits of support.	Eliminate unnecessary pairs of the remote subsystem.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	x058	The ShadowImage P-VOL of the remote subsystem is in the PSUE (S-VOL Switch) status.	Contact the service personnel.
9609	x086	The S-VOL of the remote subsystem is specified as a command device.	Specify a volume other than a command device of the remote subsystem as the S-VOL.
9609	x087	The S-VOL of the remote subsystem is executing quick format.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x088	The S-VOL of the remote subsystem is specified as the DM-LU.	Specify a volume other than the DM-LU of the remote subsystem as the S-VOL.
9609	x089	The S-VOL of the remote subsystem is in the status of S-VOL Disable.	Check the status of the remote subsystem and cancel the access attribute.
9609	x08A	The S-VOL in the remote subsystem cannot be allocated the differential bit of TCE.	Check the status of the remote subsystem. In addition, delete unnecessary pairs of the remote subsystem.
9609	x08B	The S-VOL in the remote subsystem has no vacancy of the SnapShot cache block.	Check the pool LU status of the remote subsystem. In addition, delete unnecessary pairs of the remote subsystem.
9609	x08C	The SnapShot cache block for the S-VOL in the remote subsystem is being deleted.	Check the pool LU status of the remote subsystem and retry after waiting for a while.
9609	x08D	The S-VOL of the remote subsystem does not meet the conditions of cascading with a SnapShot pair.	Retry after checking the LU status of the remote subsystem and satisfying the conditions stated in the TrueCopy Extended Distance User's Guide.
9609	x08E	The S-VOL in the remote subsystem has created a ShadowImage pair.	The TCE and ShadowImage volumes cannot be cascaded with each other. Check the LU status of the remote subsystem.
9609	x08F	The S-VOL in the remote subsystem is an LU for the NAS.	This LU cannot be specified as an S-VOL. Use the other LU.
9609	x091	The serial number of the S-VOL in the remote subsystem is wrong.	Check the serial number of the remote subsystem.
9609	x094	The RAID level of the S-VOL in the remote subsystem is RAID 0.	Make the RAID level of the remote subsystem other than RAID 0.
9609	x095	The S-VOL in the remote subsystem is undergoing the forced parity correction.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x096	The S-VOL in the remote subsystem is a SnapShot V-VOL.	The TCE and SnapShot V-VOLs cannot be cascaded with each other. Check the LU status of the remote subsystem.
9609	x097	The S-VOL in the remote subsystem received an illegal command.	Check the status of the remote subsystem.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	x098	The S-VOL in the remote subsystem is changing the cache partition.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x09A	The LU status of the S-VOL in the remote subsystem is normal or other than regressed.	Check the LU status of the remote subsystem.
9609	x09B	The S-VOL in the remote subsystem is a unified LU consists of 17 or more LUs.	Make the number of the unified LUs that constitute the unified LU of the remote subsystem 16 or less.
9609	x09C	The LU capacity of the S-VOL in the remote subsystem is not the same as the P-VOL capacity.	Make the LU capacity of the remote subsystem the same as that of the P-VOL.
9609	x09D	The S-VOL in the remote subsystem is set to a Cache Residency LU.	Specify an LU other than a Cache Residency LU of the remote subsystem.
9609	x09E	An LU with a capacity less than 1 GB is included in the LUs in which the S-VOL is unified in the remote subsystem.	Check the status of the unified LU of the remote subsystem.
9609	x09F	The number of unused bit numbers of the S-VOL in the remote subsystem is insufficient.	Check the pool LU status of the remote subsystem.
9609	x0A0	The remote subsystem has no pool LU.	Make a pool LU for the remote subsystem.
9609	x0A1	The LU specified as the S-VOL in the remote subsystem is a pool LU.	The pool LU cannot be set to an S-VOL. Check the pool LU status of the remote subsystem.
9609	x0A2	The LU status of the pool LU in the remote subsystem is normal or other than regressed.	Check the pool LU status of the remote subsystem.
9609	x0A3	The pool LU in the remote subsystem is undergoing the forced parity correction.	Check the pool LU status of the remote subsystem and retry after waiting for a while.
9609	x0A4	The S-VOL in the remote subsystem exceeded the total allowable maximum number of TCE and SnapShot pairs.	Check the status of the remote subsystem. In addition, delete unnecessary pairs of the remote subsystem.
9609	x0A5	The TCE pair status of the S-VOL in the remote subsystem is PSUE.	Check the TCE pair status of the remote subsystem.
9609	x0A6	The TCE pair status of the S-VOL in the remote subsystem is PFUS.	Check the TCE pair status of the remote subsystem.
9609	x0A7	The TCE pair status of the S-VOL in the remote subsystem is PSUS (no reading/writing allowed).	Check the TCE pair status of the remote subsystem.
9609	x0A8	The TCE pair status of the S-VOL in the remote subsystem is SSWS (including SSWS(R)).	Check the TCE pair status of the remote subsystem.
9609	x0AA	The TCE pair status of the S-VOL in the remote subsystem is PSUS.	Check the TCE pair status of the remote subsystem.
9609	x0AB	The TCE pair status of the S-VOL in the remote subsystem is not SMPL.	Check the TCE pair status of the remote subsystem.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	x0B4	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, the special processing cannot be continued.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0B5	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, an ownership of LU change for it has been started.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0B6	The S-VOL in the remote subsystem does not exist on the default owner controller and it has started an ownership of LU change.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0B7	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, an ownership of LU to be changed is blocked.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0B8	The S-VOL in the remote subsystem cannot change an ownership of LU and, at the same time, it is using the sequential buffer.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0B9	The S-VOL in the remote subsystem cannot change an ownership of LU temporarily.	Retry after waiting for a while.
9609	x0BA	The S-VOL in the remote subsystem cannot change an ownership of LU and, at the same time, it has pinned data.	Contact the service personnel.
9609	x0BB	The S-VOL in the remote subsystem cannot change an ownership of LU temporarily.	Retry after waiting for a while.
9609	x0BC	The S-VOL in the remote subsystem cannot change an ownership of LU temporarily.	Retry after waiting for a while.
9609	x0BD	The S-VOL in the remote subsystem cannot change an ownership of LU and a time-out occurred.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0BE	The S-VOL in the remote subsystem cannot change an ownership of LU and, at the same time, the CTG# is illegal.	Check the status of the remote subsystem.
9609	x0C0	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, its disk drives are being spun up.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0C1	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, it is making the system copy.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0C2	The S-VOL in the remote subsystem does not exist on the default owner controller and, at the same time, it is writing the takeover information.	Check the status of the remote subsystem and retry after waiting for a while.
9609	x0C5	The cycle time that has been set for the remote subsystem is less than the minimum interval.	Check the cycle time that has been set for the remote subsystem.
9609	x0C6	The specified S-VOL is undergoing the migration.	Re-execute the migration after splitting the pair.
9609	x0C7	The specified S-VOL is the reserved LU.	Re-execute the migration specifying an LU other than the reserved LU for the S-VOL.
9609	x0CA	The specified S-VOL is undergoing the migration.	Re-execute the migration after splitting the pair.

Sense Code	Detailed Code	Error Contents	Recommended Action
9609	x0CB	The specified S-VOL is the reserved LU.	Re-execute the migration specifying an LU other than the reserved LU for the S-VOL.
9609	x0D1	The disk drives that configure a RAID group, to which a target LU in the remote subsystem belongs have been spun down.	Perform the operation again after spinning up the disk drives that configure the RAID group.
960A		This operation was specified to a data pool LU.	Check the attribute of the LU.
9611	0001	The object LU is an invalidated one.	Check the status of the LU.
9611	0002	The object LU is a SubLU of a unified LU.	Check the status of the LU.
9611	0003	The S-VOL Disable was specified for the S-VOL of ShadowImage™.	Check the pair status of the LU.
9611	0004	The S-VOL Disable was specified for the ShadowImage™ P-VOL that was undergoing a reverse resynchronization.	Check the pair status of the LU.
9611	0005	The S-VOL Disable was specified for the S-VOL of TrueCopy™.	Check the pair attribute of the LU.
9611	0006	The access attribute cannot be changed because it is within the Retention Term.	—
9611	0007	The S-VOL Disable was specified for the V-VOL of SnapShot.	Check the pair attribute of the LU.
9611	0008	The S-VOL Disable was specified for the SnapShot P-VOL that was being restored.	Check the pair attribute of the LU.
9611	0009	The Retention Term cannot be made shorter than the current one.	—
9611	000A	The access attribute cannot be changed because the Expiration Lock is turned on.	—
9611	000B	The Retention Term is beyond the limits of validity.	Check that the specified value that has been set is 0 to 21900.
9611	000C	The S-VOL Disable was specified for a ShadowImage S-VOL that is in a status other than SMPL and PSUS.	Check the pair attribute of the LU.
9611	000D	The S-VOL Disable was specified for a TrueCopy S-VOL that is in a status other than SMPL and PSUS.	Check the pair attribute of the LU.
9611	000E	The S-VOL Disable was specified for a SnapShot V-VOL that is in a status other than SMPL and PSUS.	Check the pair attribute of the LU.
9611	000F	Because the term of validity of the temporary key was expired, the setting of the access level that turns on the Write Inhibit cannot be made.	Check the term of validity of the license key, or use the Data Retention function with the permanent key.
9611	0010	The target LU is defined as the DM-LU.	Check the attribute of the LU.
9611	0011	The target LU is defined as the NAS system LU.	Check the attribute of the LU.
9611	0012	The target LU is defined as the NAS user LU.	Check the attribute of the LU.
9612	0001	The P-VOL is being quick formatted.	Retry after the quick formatting is completed.
9612	0002	The P-VOL or S-VOL (including the unified LU(s)) is being quick formatted.	Retry after the quick formatting is completed.

Sense Code	Detailed Code	Error Contents	Recommended Action
9612	0003	The P-VOL is being quick formatted.	Retry after the quick formatting is completed.
9612	0004	The P-VOL or S-VOL is being quick formatted.	Retry after the quick formatting is completed.
9613	0005	The S-VOL Disable was specified for an S-VOL when resynchronization with ShadowImage was directed.	Check the pair attribute of the LU.
9613	0006	The S-VOL Disable is specified for the S-VOL (at the time of a restoration only).	Check the pair attribute of the LU.
9618	0001	The P-VOL or S-VOL has not undergone the forced restoration by means of parity.	Retry after making the restoration by means of parity.
9618	0002	The P-VOL is undergoing the forced restoration by means of parity (at the time of a reverse resynchronization).	Retry after the restoration by means of parity is completed.
9618	0003	The S-VOL is undergoing the forced restoration by means of parity.	Retry after making the restoration by means of parity.
9618	0011	The P-VOL has not undergone the forced restoration by means of parity.	Retry after making the restoration by means of parity.
9618	0012	The P-VOL is undergoing the forced restoration by means of parity.	Retry after the restoration by means of parity is completed.
9618	0021	The P-VOL or data pool LU has not undergone the forced restoration by means of parity.	Retry after making the restoration by means of parity.
9618	0022	The P-VOL is undergoing the forced restoration by means of parity (at the time of a reverse resynchronization).	Retry after the restoration by means of parity is completed.
9618	0023	The data pool LU is undergoing the forced restoration by means of parity.	Retry after the restoration by means of parity is completed.
961C	0001	More LUs than supportable ones were specified for LUNs of the P-VOL.	Make sure of the number of the specified paired LU.
961C	0002	More LUs than supportable ones were specified for LUNs of the S-VOL.	Make sure of the number of the specified paired LU.
961C	0003	The P-VOL is in the status other than normal and regressive.	Check the status of the LU.
961C	0004	The S-VOL is in the status other than normal and regressive.	Check the status of the LU.
961C	0005	The primary sequence number is different from the own serial number.	Check the serial number.
961C	0006	The secondary sequence number is different from the own serial number.	Check the serial number.
961C	0007	The primary port number is not supported.	Check the specified port number.
961C	0008	The secondary port number is not supported.	Check the specified port number.
961C	0009	The P-VOL is a volume of ShadowImage™ and in the status other than SMPL.	Check the pair status of the LU.
961C	000A	The S-VOL is a volume of ShadowImage™ and in the status other than SMPL.	Check the pair status of the LU.
961C	000B	The P-VOL is a Sub LU of a unified LU.	Check the status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
961C	000C	The S-VOL is a Sub LU of a unified LU.	Check the status of the LU.
961C	000D	The default controllers controlling the P-VOL and S-VOL are not the same.	Make sure of the default controller controlling the LU.
961C	000E	The P-VOL is a Cache Residency LU.	Check the status of the LU.
961C	000F	The S-VOL is a Cache Residency LU.	Check the status of the LU.
961C	0010	The P-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
961C	0011	The S-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
961C	0012	The P-VOL is a command device.	Check the status of the LU.
961C	0013	The S-VOL is a command device.	Check the status of the LU.
961C	0014	The LUNs of the P-VOL and S-VOL are the same.	Check the specified LU.
961C	0015	The P-VOL is a volume of ShadowImage™ and in the pair status other than PSUS and PSUE.	Check the pair status.
961C	0016	The S-VOL is a volume of ShadowImage™ and in the pair status other than PSUS and PSUE.	Check the pair status.
961C	0017	The LU to be paired with the P-VOL is not an S-VOL.	Check the specified LU.
961C	0018	The LUN of the P-VOL is higher than 512 (1,023).	Make sure of the number of the specified paired LU.
961C	0019	The LUN of the S-VOL is higher than 512 (1,023).	Make sure of the number of the specified paired LU.
961C	001A	The primary sequence number is different from the own serial number.	Check the serial number.
961C	001B	The secondary sequence number is different from the own serial number.	Check the serial number.
961C	001C	The primary port number is not supported.	Check the specified port number.
961C	001D	The secondary port number is not supported.	Check the specified port number.
961C	001E	The P-VOL is a volume of ShadowImage™ and in the pair status of SMPL or PSUE.	Check the pair status of the LU.
961C	001F	The S-VOL is a volume of ShadowImage™ and in the pair status of SMPL or PSUE.	Check the pair status of the LU.
961C	0020	The LU to be paired with the P-VOL is not an S-VOL.	Check the specified LU.
961C	0021	The status of the P-VOL is other than normal and regressive.	Check the status of the LU.
961C	0022	The status of the S-VOL is other than normal and regressive.	Check the status of the LU.
961C	0023	The P-VOL is a Sub LU of a unified LU.	Check the status of the LU.
961C	0024	The S-VOL is a Sub LU of a unified LU.	Check the status of the LU.
961C	0025	The default controllers controlling the P-VOL and S-VOL are not the same.	Make sure of the default controller controlling the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
961C	0026	The P-VOL has been set to the current Cache Residency LU.	Check the status of the LU.
961C	0027	The S-VOL has been set to the current Cache Residency LU.	Check the status of the LU.
961C	0028	The P-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
961C	0029	The S-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
961C	0029	The S-VOL is reserved as a Cache Residency LU.	Check the status of the LU.
961C	002A	The P-VOL is defined as a command device.	Check the status of the LU.
961C	002B	The S-VOL is defined as a command device.	Check the status of the LU.
961C	002C	The LUNs of the P-VOL and S-VOL are the same.	Check the specified LU.
961C	002D	The number of the LU to be paired is different.	Check the specified LUN.
961C	002E	The number of the LU to be paired is different.	Check the specified LUN.
961C	002F	The pair status of the P-VOL/S-VOL is other than SMPL, PAIR, and COPY.	Check the pair status of the LU.
961C	0030	The LUN of the P-VOL is beyond the limits of support.	Check the specified LUN.
961C	0031	The LUN of the S-VOL is beyond the limits of support.	Check the specified LUN.
961C	0032	The pair attribute of the LU specified for a P-VOL is not a P-VOL.	Check the specified LUN.
961C	0033	The number of the LU to be paired is different.	Check the specified LUN.
961C	0034	The primary sequence number is different from the serial number.	Check the specified primary sequence number.
961C	0035	The secondary sequence number is different from the serial number.	Check the specified secondary sequence number.
961C	0036	The primary port number is beyond the limits of support.	Check the specified primary port number.
961C	0037	The secondary port number is beyond the limits of support.	Check the specified secondary port number.
961C	0038	A pair in the PSUE (S-VOL Switch) status received an instruction for reverse resynchronization.	Request that service personnel replace the drives that compose the P-VOL. Format them after the replacement, then resynchronize them.
961C	0039	The specified pair is in the PSUE (S-VOL Switch) status.	Request that service personnel replace the drives that compose the P-VOL. Format them after the replacement, and then resynchronize them.
961C	003A	The pair in the PSUE (S-VOL Switch) status is undergoing resynchronization.	Wait until the resynchronization is completed.
961C	003B	The pair in the PSUE (S-VOL Switch) status is undergoing resynchronization.	Wait until the resynchronization is completed.
961C	003C	The group ID number is 128 or higher.	Make sure of the specified group ID number.

Sense Code	Detailed Code	Error Contents	Recommended Action
961C	003D	The number of pairs having the same group ID exceeded 32.	Make sure of the specified group ID number.
961C	003E	The specified P-VOL/S-VOL is not specified to be grouped. (Group ID suspension)	Check the pair status of the LU.
961C	003F	The P-VOL/S-VOL, which is the object of the batch suspension, is in a status other than PAIR. (Group ID suspension)	Check the pair status of the LU.
961C	0044	A unified LU composed of 17 or more LUs was specified as a P-VOL.	Specify a unified LU that is composed of 16 or less LUs.
961C	0045	A unified LU composed of 17 or more LUs was specified as a S-VOL.	Specify a unified LU that is composed of 16 or less LUs.
961C	0046	The DM-LU is not set.	Retry after setting the DM-LU.
961C	0047	The DM-LU was specified as P-VOL.	Check the status of the LU.
961C	0048	The DM-LU was specified as S-VOL.	Check the status of the LU.
961C	0049	A unified LU composed of 17 or more LUs was specified as a P-VOL.	Specify a unified LU that is composed of 16 or less LUs.
961C	004A	A unified LU composed of 17 or more LUs was specified as a S-VOL.	Specify a unified LU that is composed of 16 or less LUs.
961C	004B	The DM-LU is not set.	Retry after setting the DM-LU.
961C	004C	The DM-LU was specified as P-VOL.	Check the status of the LU.
961C	004D	The DM-LU was specified as S-VOL.	Check the status of the LU.
961C	004E	Validity of the license expired.	Purchase the license.
961C	004F	Validity of the license expired.	Purchase the license.
961C	0050	An LU, for which a change of the cache partition(s) had been reserved, was specified as a P-VOL.	Check the status of the LU.
961C	0051	An LU, for which a change of the cache partition(s) had been reserved, was specified as a S-VOL.	Check the status of the LU.
961C	0052	An LU, for which a change of the cache partition(s) had been reserved, was specified as a P-VOL.	Check the status of the LU.
961C	0053	An LU, for which a change of the cache partition(s) had been reserved, was specified as a S-VOL.	Check the status of the LU.
961C	0054	The system LU for the NAS was specified the P-VOL.	Check the status of the LU.
961C	0055	The reverse resynchronization was executed for the system LU for the NAS while the NAS OS is running.	Check the operation status of the NAS OS.
961C	0056	The reverse resynchronization was executed for the user LU for the NAS while the NAS OS is running.	Check the operation status of the NAS OS.
961C	0057	The system LU for the NAS was specified the S-VOL.	Check the status of the LU.
961C	0058	The system LU for the NAS was specified the P-VOL.	Check the status of the LU.
961C	0059	The system LU for the NAS was specified the P-VOL.	Check the status of the LU.
961C	005A	The user LU for the NAS was specified the S-VOL.	Check the status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
961C	005B	The user LU for the NAS was specified the P-VOL.	Check the status of the LU.
961C	005C	The user LU for the NAS was specified the S-VOL.	Check the status of the LU.
961C	005D	The user LU for the NAS was specified the P-VOL.	Check the status of the LU.
961C	005E	The specified P-VOL is a TCE pair.	Check the status of the LU.
961C	005F	The specified S-VOL is a TCE pair.	Check the status of the LU.
961C	0060	The specified P-VOL is a TCE pair.	Check the status of the LU.
961C	0061	The specified S-VOL is a TCE pair.	Check the status of the LU.
961C	0064	The specified MU# is used within the specified P-VOL.	Check the specified MU number.
961C	0065	One or more volumes of PAIR/COPY/RCOPY are under the specified P-VOL.	Check the pair status of the LU.
961C	0066	One or more volumes of special PSUE are under the specified P-VOL.	Check the pair status of the LU.
961C	0067	One or more PSUE pairs that are not readable/writable (PSUE transition due to a failure during the reverse resynchronization) under the specified P-VOL.	Check the pair status of the LU.
961C	0068	The group ID overlaps within the specified P-VOL at the time of creating the pair of which the group is specified.	Make sure of the specified group ID number.
961C	0069	The pair attribute of the specified P-VOL is not a P-VOL or the pair attribute of the specified S-VOL is not a S-VOL.	Check the pair attribute of the LU.
961C	006A	The specified MU# and the MU# of the specified P-VOL are mismatched.	Check the specified MU number.
961C	006B	One or more volumes of PAIR/COPY/RCOPY are under the specified P-VOL.	Check the pair status of the LU.
961C	006C	One or more PSUE pairs that are not readable/writable (PSUE transition due to a failure during the reverse resynchronization) under the specified P-VOL.	Check the pair status of the LU.
961C	006D	The pair attribute of the specified P-VOL is not a P-VOL or the pair attribute of the specified S-VOL is not a S-VOL.	Check the pair attribute of the LU.
961C	006E	The specified MU# and the MU# of the specified S-VOL are mismatched.	Check the specified MU number.
961C	006F	The specified MU# and the MU# of the specified S-VOL are mismatched.	Check the specified MU number.
961C	0070	The specified MU# is used within the specified P-VOL.	Check the specified MU number.
961C	0071	One or more volumes of PAIR/COPY/RCOPY are under the specified P-VOL.	Check the pair status of the LU.
961C	0072	One or more volumes of special PSUE are under the specified P-VOL.	Check the pair status of the LU.
961C	0073	One or more PSUE pairs that are not readable/writable (PSUE transition due to a failure during the reverse resynchronization) under the specified P-VOL.	Check the pair status of the LU.
961C	0074	The specified MU# and the MU# of the specified S-VOL are mismatched.	Check the specified MU number.

Sense Code	Detailed Code	Error Contents	Recommended Action
961C	0075	The specified P-VOL is the user LU for the NAS and already comprised in a ShadowImage pair with other S-VOL.	Check the status of the LU. ShadowImage pair can comprise only one S-VOL for one P-VOL when the P-VOL is the user LU for the NAS.
961C	0075	The specified MU# and the MU# of the specified S-VOL are mismatched.	Check the specified MU number.
961C	0077	The specified P-VOL is the reserved LU.	Check the status of the LU.
961C	0078	The specified S-VOL is the reserved LU.	Check the status of the LU.
961C	0079	The specified S-VOL is undergoing the migration and its status is PSUS or PSUE.	Check the pair status of the LU.
961C	0080	The specified S-VOL is undergoing the migration and its status is COPY or PSUS.	Check the pair status of the LU.
961C	0081	The specified P-VOL is the reserved LU.	Check the pair status of the LU.
961C	0082	The specified S-VOL is the reserved LU.	Check the pair status of the LU.
961C	0083	The specified S-VOL is undergoing the migration and its status is COPY.	Check the pair status of the LU.
961C	0084	The specified S-VOL is undergoing the migration.	Check the pair status of the LU.
961C	0085	The specified P-VOL is undergoing the migration.	Check the pair status of the LU.
961C	0086	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
961C	0087	The disk drives that configure a RAID group, to which the specified S-VOL belongs have been spun down.	Check the status of the RAID group.
961C	0088	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
961C	0089	The disk drives that configure a RAID group, to which the specified S-VOL belongs have been spun down.	Check the status of the RAID group.
961C	008A	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
961C	008B	The disk drives that configure a RAID group, to which the specified S-VOL belongs have been spun down.	Check the status of the RAID group.
961C	0090	The specified P-VOL has been set to a ShadowImage S-VOL.	Check the status of the LU.
961C	0091	The specified P-VOL has been set to a ShadowImage S-VOL.	Check the status of the LU.
9622	0001	The specified P-VOL is normal or other than regressed.	Check the status of the LU.
9622	0002	The specified P-VOL has been set to the current Cache Residency LU.	Check the attribute of the LU.
9622	0003	The specified P-VOL has been set to the reserved Cache Residency LU.	Check the attribute of the LU.
9622	0004	The specified P-VOL has been defined to the command device.	Check the attribute of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9622	0005	The accepted sequence number is different from the serial number.	Check the serial number.
9622	0006	Both of the two paths are abnormal.	Check the status of the path.
9622	0007	The specified P-VOL is a Sub LU of a unified LU.	Check the attribute of the LU.
9622	0008	The swap command was accepted.	The swap command is not supported.
9622	0009	The status of the TCE pair of the specified P-VOL is other than SMPL.	Check the pair status of the LU.
9622	000A	The specified P-VOL is a ShadowImage pair.	Check the attribute of the LU.
9622	000B	The specified P-VOL is a SnapShot V-VOL.	Check the attribute of the LU.
9622	000C	The CTG ID is beyond the limits (more than 16) of support.	Check the CTG ID.
9622	000D	The pair status of the specified P-VOL is other than SSUS or PSUE.	Check the pair status of the LU.
9622	000E	The specified P-VOL status is normal or other than regressed.	Check the status of the LU.
9622	000F	The specified S-VOL is not a pair target LUN.	Check the LUN of the S-VOL.
9622	0010	The accepted sequence number is different from the serial number.	Check the serial number.
9622	0011	Both of the two paths are abnormal.	Check the status of the path.
9622	0012	When the unit of pair is specified, the pair status of the specified P-VOL is other than COPY and PAIR.	Check the pair status of the LU.
9622	0013	The capacity is beyond the limits of support.	Split the unnecessary pairs.
9622	0014	The accepted sequence number is different from the serial number.	Check the serial number.
9622	0015	The process is in progress.	Retry after waiting for a while.
9622	0016	When the unit of pair is specified, the specified S-VOL is not a pair target LUN.	Check the LUN of the specified S-VOL.
9622	0017	The accepted sequence number is different from the serial number.	Check the serial number.
9622	0018	The command with the -R option was issued to the P-VOL and that with the -S option was issued to the S-VOL.	Check the pair attribute of the LU.
9622	0019	The status of the TCE pair of the specified P-VOL is other than SMPL.	Check the pair status of the LU.
9622	0020	The pool LU is not defined.	Define the pool LU and retry.
9622	0021	The specified fence level is STATUS.	Make sure of the specified fence level.
9622	0022	The capacity is beyond the limits of support.	Split the unnecessary pairs.
9622	0023	The internal pair status of the specified P-VOL is “under pair deletion”.	Check the pair status of the LU.
9622	0025	The pairsplit -P (forced blockade of a P-VOL) command was accepted.	The pairsplit -P (forced blockade of a P-VOL) command is not supported.

Sense Code	Detailed Code	Error Contents	Recommended Action
9622	0026	The type of the pairsplit command is other than Drain (ordinary splitting).	Check the command line.
9622	0027	The S-VOL received an instruction.	Check the pair attribute of the LU.
9622	0029	The S-VOL received an instruction.	Check the pair attribute of the LU.
9622	002A	The P-VOL received an instruction.	Check the pair attribute of the LU.
9622	002B	When the unit of pair is specified, the pair status of the specified S-VOL is SMPL or COPY.	Check the pair status of the LU.
9622	002C	The accepted sequence number is different from the serial number.	Check the serial number.
9622	002D	The specified MU number is beyond the limits (0 to13) of support.	Check the specified MU number.
9622	0030	The S-VOL received an instruction.	Check the pair attribute of the LU.
9622	0032	The RAID group, to which the specified P-VOL belongs, is RAID 0.	Check the RAID level of the specified LU.
9622	0036	The specified P-VOL is a SnapShot P-VOL and it is being restored.	Check the pair status of the SnapShot.
9622	0037	The specified P-VOL is a SnapShot P-VOL and its status was changed to PSUE during restoration.	Check the pair status of the SnapShot.
9622	0038	There is no vacancy in the generation bits.	Retry after waiting for a while.
9622	0039	There is one or more pair(s) in the status of “under execution of pairsplit -mscas command” in the target CTG.	Check the pair status of each LU in the target CTG. It is required to wait until the process is completed.
9622	003A	There is one or more pair(s) in the status of “under pair splitting” in the target CTG.	Check the pair status of each LU in the target CTG. It is required to wait until the process is completed.
9622	003C	There is one or more pair(s) in the status of “under pair deletion” in the target CTG.	Check the pair status of each LU in the target CTG. It is required to wait until the process is completed.
9622	003D	The specified P-VOL is a SnapShot P-VOL and it is being restored.	Check the pair status of the SnapShot.
9622	003E	The specified P-VOL is a SnapShot P-VOL and its status was changed to PSUE during restoration.	Check the pair status of the SnapShot.
9622	003F	There is no pair, which is in the PAIR status, in the target CTG.	Check the pair status of each LU in the target CTG.
9622	0041	The specified P-VOL is a unified LU consists of 17 or more LUs.	Check the attribute of the LU.
9622	0042	When the unit of pair is specified, the pair status of the specified pair is PSUS (no reading/writing allowed).	Check the pair status.
9622	0044	When the unit of CTG is specified, there is one or more pair(s) placed in the PSUS status (no reading/writing allowed) in the CTG.	Check the pair status of each LU in the target CTG.
9622	0045	When the unit of CTG is specified, there is no pair that is in the PAIR, PSUS, or PSUE status in the CTG.	Check the pair status of each LU in the target CTG.

Sense Code	Detailed Code	Error Contents	Recommended Action
9622	0046	When the unit of CTG is specified, the internal status of the pair of the specified P-VOL is “under pair splitting”.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	0047	The specified P-VOL has the incomplete DDCB.	Check the status of the LU.
9622	0048	The specified P-VOL has unwritten data.	Contact the service personnel.
9622	0049	When the unit of pair is specified, the internal status of the pair of the specified P-VOL is “under pair deletion”.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	004B	When the unit of pair is specified, the internal status of the pair of the specified P-VOL is “under execution of the pairsplit -mscas command”.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	004C	When the unit of CTG is specified, there is one or more pair(s) that is in the status of “under pair splitting” in the CTG.	Check the pair status of each LU in the target CTG.
9622	004D	The DM-LU is not defined.	Define the DM-LU.
9622	004E	The specified P-VOL has been set to the DM-LU.	Check the attribute of the LU.
9622	004F	Validity of the license expired.	Purchase the license.
9622	0050	When the unit of CTG is specified, there is one or more pair(s) that is in the status of “under pair deletion” in the CTG.	Check the pair status of each LU in the target CTG.
9622	0052	When the unit of CTG is specified, there is one or more pair(s) that is in the status of “under execution of the pairsplit -mscas command” in the CTG.	Check the pair status of each LU in the target CTG.
9622	0053	When the unit of CTG is specified, there is no pair, which is in the COPY or PAIR status, in the target CTG.	Check the pair status of each LU in the target CTG.
9622	0054	The range of the DELETE is other than 00 (LU) and 10 (Group).	Retry it after checking the option and the parameter.
9622	0055	When the unit of pair is specified, the internal status of the pair of the specified P-VOL is “under pair splitting”.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	0057	When the unit of pair is specified, the internal status of the pair of the specified P-VOL is “under execution of the pairsplit -mscas command”.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	0059	When the unit of pair is specified, the internal status of the pair of the specified S-VOL is SSWS(R).	Check the pair status of the LU.
9622	005A	When the unit of CTG is specified, there is one or more pair(s) that is in the status of “under pair splitting” in the CTG.	Check the pair status of each LU in the target CTG.
9622	005C	When the unit of CTG is specified, there is one or more pair(s) that is in the status of “under execution of the pairsplit -mscas command” in the CTG.	Check the pair status of each LU in the target CTG.
9622	005E	When the unit of CTG is specified, there is one or more pair(s) placed in the SSWS(R) status in the CTG.	Check the pair status of each LU in the target CTG.
9622	0068	It is already used as an S-VOL.	Check the CTG ID.

Sense Code	Detailed Code	Error Contents	Recommended Action
9622	0069	The partition to which the LU belongs is being changed to the other directory.	Retry after waiting for a while.
9622	006B	There is no pair, which is in the PAIR status, in the target CTG.	Check the pair status of each LU in the target CTG.
9622	006C	The subsystem has not been rebooted after the TCE option was unlocked.	Reboot the subsystem.
9622	006D	The specified P-VOL is a unified LU including an LU with a capacity less than 1 GB.	Check the attribute of the LU.
9622	006E	The specified P-VOL is the pool LU.	Check the attribute of the LU.
9622	006F	The pool LU status is normal or other than regressed.	Check the status of the pool LU.
9622	0070	The pool LU is undergoing the forced parity correction.	Check the status of the pool LU.
9622	0071	It is exceeded the total allowable maximum number of TCE and SnapShot pairs.	Delete unnecessary pairs.
9622	0072	The -mscas command was accepted with the usual process code (12H).	Check the CCI version.
9622	0073	A pair was formed with an S-VOL that was placed in the SMPL status by the pair ending (pairsplit -R) command and its pair status became inconsistent.	Check the pair status of the specified S-VOL.
9622	0074	The suspension command was accepted with a specification of the unit of pair.	The specification of the unit of pair is not supported.
9622	0075	The specified P-VOL is a unified LU whose component LUs include an LU for which the quick format operation is being performed.	Check the attribute of the LU.
9622	0076	The specified P-VOL is being quick formatted.	Check the attribute of the LU.
9622	0077	The state of the forced parity correction for the specified P-VOL is Uncorrected or Uncorrected 2.	Check the status of the LU.
9622	0078	The specified P-VOL has not undergone the forced parity correction.	Retry it after executing the forced parity correction.
9622	0079	The specified P-VOL is defined as the NAS system LU.	Check the attribute of the LU.
9622	007A	The specified P-VOL is defined as the NAS user LU.	Check the attribute of the LU.
9622	007B	There is one or more pair(s) in the status of PSUS or PSUE of “under pair deletion” in the target CTG.	Check the pair status of the LU. It is required to wait until the process is completed.
9622	007C	The number of the unused bit numbers is insufficient.	Retry after waiting for a while.
9622	007D	The pool LU status is normal or other than regressed.	Check the status of the pool LU.
9622	007E	The pool LU is undergoing the forced parity correction.	Retry after waiting for a while.
9622	007F	There is one or more P-VOL(s), the status of the forced parity correction for which is Uncorrected or Uncorrected 2, in the target CTG.	Check the status of each LU in the target CTG.
9622	0080	There is one or more P-VOL(s), status is normal or other than regressed, in the target CTG	Check the status of each LU in the target CTG.

Sense Code	Detailed Code	Error Contents	Recommended Action
9622	0081	There is one or more TCE P-VOL(s), which is cascaded with a SnapShot P-VOL being restored, in the target CTG.	Check the status of each LU in the target CTG.
9622	0082	There is one or more TCE P-VOL(s), which is cascaded with a SnapShot P-VOL that was placed in the PSUE status during restoration, in the target CTG.	Check the status of each LU in the target CTG.
9622	0083	There is no pair, which is in the PSUS or PSUE status, in the target CTG.	Check the pair status of each LU in the target CTG.
9622	0084	When a pair is created in the new CTG, the cycle time that has been set is less than “30 x number of CTGs” seconds.	Check the cycle time that has been set.
9622	0085	When the unit of pair is specified, the S-VOL of the target pair has not completed the resynchronization after it accepted the resync command.	Check the TCE pair status of the remote subsystem.
9622	0086	When the unit of CTG is specified, there is one or more S-VOL(s), which has not completed the resynchronization after it accepted the resync command, in the target CTG.	Check the TCE pair status of the remote subsystem.
9622	0087	There are one or more pairs in the status of “under pair splitting” or “under pair competing” in the CTG.	Retry after waiting for a while.
9622	0088	The specified P-VOL is the reserved LU.	Check the status of the LU.
9622	0089	The specified P-VOL is undergoing the migration.	Check the pair status of the LU.
9622	008A	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down	Check the status of the RAID group.
9622	008B	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
9622	008C	There are one or more TCE P-VOLs corresponding to a RAID group that belongs to the CTG concerned and the disk drives that configure the RAID group have been spun down.	Check the status of the RAID group.
9623	0001	The CCI command cannot be executed via the NAS port.	Check the environment of CCI.
9629	0001	The Volume Migration optional feature is invalid.	Install the Volume Migration optional feature.
9629	0002	The temporary key of the Volume Migration was expired.	Purchase the license.
9629	0003	The status of the specified P-VOL is other than normal and regressive.	Check the status of the LU.
9629	0004	The status of the specified S-VOL is other than normal and regressive.	Check the status of the LU.
9629	0005	The status of the parity correction of the specified P-VOL is Uncorrected or Uncorrected 2.	Skip the parity correction or execute the parity correction, and wait for the completion of the correction. Re-execute it after performing the operation.
9629	0006	The status of the parity correction of the specified S-VOL is correcting, waiting correction, Uncorrected, or Uncorrected 2.	Skip the parity correction or execute the parity correction, and wait for the completion of the correction. Re-execute it after performing the operation.
9629	0007	The specified P-VOL has created a Volume Migration pair.	Check the pair status of the LU.

Sense Code	Detailed Code	Error Contents	Recommended Action
9629	0008	The specified S-VOL has created a Volume Migration pair.	Check the pair status of the LU.
9629	0009	The specified P-VOL has created a ShadowImage pair.	Check the pair status of the LU.
9629	000A	The specified P-VOL has created a ShadowImage pair.	Check the pair status of the LU.
9629	000B	The specified P-VOL is a command device.	Check the status of the LU.
9629	000C	The specified S-VOL is a command device.	Check the status of the LU.
9629	000D	The specified P-VOL has created a TrueCopy pair.	Check the pair status of the LU.
9629	000E	The specified S-VOL has created a TrueCopy pair.	Check the pair status of the LU.
9629	000F	The specified P-VOL has created a TCE pair.	Check the pair status of the LU.
9629	0010	The specified S-VOL has created a TCE pair.	Check the pair status of the LU.
9629	0011	The P-VOL is a Cache Residency LU or has been set to the reserved Cache Residency LU.	Check the status of the LU.
9629	0012	The S-VOL is a Cache Residency LU or has been set to the reserved Cache Residency LU.	Check the status of the LU.
9629	0013	The specified P-VOL has created a SnapShot pair.	Check the pair status of the LU.
9629	0014	The specified S-VOL has created a SnapShot pair.	Check the pair status of the LU.
9629	0015	The specified P-VOL is the pool LU.	Check the pair status of the LU.
9629	0016	The specified S-VOL is the pool LU.	Check the pair status of the LU.
9629	0017	The specified P-VOL is being quick formatted.	Retry after the quick formatting is completed.
9629	0018	The specified P-VOL is being quick formatted.	Retry after the quick formatting is completed.
9629	0019	The specified P-VOL is the DM-LU.	Check the status of the LU.
9629	001A	The specified S-VOL is the DM-LU.	Check the status of the LU.
9629	001B	The DM-LU is not set.	Retry after setting the DM-LU.
9629	001C	The specified P-VOL has unwritten data.	Check the status of the LU.
9629	001D	The pair cannot be allocated the differential bit map.	Split the unnecessary pairs.
9629	001E	The specified P-VOL is a SubLU of a unified LU.	Check the status of the LU.
9629	001F	The specified S-VOL is a SubLU of a unified LU.	Check the status of the LU.
9629	0020	The size of the specified P-VOL and the S-VOL are not the same.	Specify an LU that the same size.
9629	0021	The DIRs in charge of the specified P-VOL and the S-VOL are not the same.	Specify an LU that belongs to the same DIR.
9629	0022	The LUNs of the specified P-VOL and S-VOL are the same.	Check the specified LUN.
9629	0023	There exist maximum number of pairs already (included ShadowImage pairs).	Split the unnecessary pairs.

Sense Code	Detailed Code	Error Contents	Recommended Action
9629	0024	The specified P-VOL is the LU, for which a change of the cache partition(s) had been reserved.	Retry after releasing the reserved status.
9629	0025	The specified S-VOL is the LU, for which a change of the cache partition(s) had been reserved.	Retry after releasing the reserved status.
9629	0026	The RAID group of the specified P-VOL and S-VOL are the same.	Specify a different RAID group.
9629	0027	The specified P-VOL is the reserved LU.	Check the status of the LU.
9629	0028	The specified S-VOL is the reserved LU.	Check the status of the LU.
9629	0029	The access level of the specified S-VOL is other than the ordinary one.	Check the access revel of the LU.
9629	002A	The specified S-VOL is the NAS system LU.	Check the status of the LU.
9629	002B	The specified S-VOL is the NAS user LU.	Check the status of the LU.
9629	002C	The specified MU number is 3 or higher.	Make sure of the specified MU number.
9629	002D	The specified primary port number is beyond the limits of support.	Check the specified primary port number.
9629	002E	The specified secondary port number is beyond the limits of support.	Check the specified secondary port number.
9629	002F	The specified primary sequence number is different from the own serial number.	Check the specified primary sequence number.
9629	0030	The specified secondary sequence number is different from the own serial number.	Check the specified secondary sequence number.
9629	0031	The pair concerned is the one that the instruction to start the migration was issued by Navigator or HiCommand.	Check the owner ID of the specified pair.
9629	0032	The disk drives that configure a RAID group, to which the specified P-VOL belongs have been spun down.	Check the status of the RAID group.
9629	0033	The disk drives that configure a RAID group, to which the specified S-VOL belongs have been spun down.	Check the status of the RAID group.

A.5 Logging a Command

Normally, logging of a command collects the error information when an error occurs in the command execution. In addition, it provides a function of logging all commands for the purpose of the examination and the verification of the command issued by the user script. The logging of all the commands can be done through the setting of the following control valuables.

- HORCC_LOGSZ=file size: valuable

  This valuable specifies the maximum size of the command log file. The $HORCC_LOG/horcc_HOST.log file is moved to the $HORCC_LOG/horcc_HOST.oldlog file when its size (in KB) exceeds the specified size.

This variable can be defined as an environmental variable or the following $HORCC_LOG/horcc_HOST.conf file. When this variable is not specified or the size is specified as zero, the logging is done as a default operation only when an error occurs.

Setting example:

```
HORCC_LOGSZ=2048
Export HORCC_LOGSZ
```

- $HORCC_LOG/horcc_HOST.conf file

  This file describes the HORCC_LOGSZ variable and the variable for masking the logging. Specify the maximum size. When the variable is not specified as the environmental variable, the HORCC_LOGSZ variable described in this file is used. When neither of them is specified, the logging is done as a default operation only when an error occurs.

  - HORCC_LOGSZ variable

    Describes as following:

    ```
    # For example
    HORCC_LOGSZ=2048
    ```

  - Masking variable

    This masking variable specifies a command name and a return value. However, the `inqraid` command and error codes are excluded. For example, when the user script tests the return value of the `pairvolchk` command at regular intervals, the log data may overflow. In this case, the logging can be masked through the specification of the HORCC_LOGSZ environmental variable as zero, but the script must be changed as shown below.

    ```
    # For example masking pairvolchk on the script
    export HORCC_LOGSZ=0
    Pairvolchk -g xxx -s
    Unset HORCC_LOGSZ
    ```

    This function validates logging of a command without changing the user script.

    ```
    # For example,
    # if you want to mask pairvolchk (returns 22) and raidqry,
    # you can specify as below.

    pairvolchk=22
    raidqry=0
    ```

    The user decides whether or not to mask the user script after tracking the $HORCC_LOG/horcc_HOST.conf file without masking the user script.

- Relation between the environmental variable and the $HORCC_LOG/horcc_HOST.conf file

  When the HORCC_LOGSZ environmental variable is not specified, the HORCC_LOGSZ variable described in the $HORCC_LOG/horcc_HOST.conf file is used. When neither of them is specified, the logging is done as a default operation only when an error occurs.

Table A.6 Relation between Environmental Variable and $HORCC_LOG/horcc_HOST.conf file

$HORCC_LOGSZ	HORCC_HOST.conf	Operation
$HORCC_LOGSZ=size	It is not influenced specification.	The logging is valid in the specified script.
$HORCC_LOGSZ=0		The logging is invalid in the specified script.
It is not specified	HORCC_LOGSZ=size	The logging is valid in the instance.
	HORCC_LOGSZ=0	The logging is invalid in the instance.
	It is not specified or no file exists.	Default logging (logging is done only when an error occurs)

Example:

– \HORCM\log* directory:

```
[root@raidmanager log9]#  ls -l
total 16
drwxr-xr-x  3 root root    4096 Oct 27 17:33 curlog
-rw-r--r--  1 root root    3936 Oct 27 17:36 horcc_raidmanager.log
-rw-r--r--  1 root root 2097452 Oct 27 17:29 horcc_raidmanager.oldlog
-rw-r--r--  1 root root      46 Oct 27 17:19 horcc_raidmanager.conf
drwxr-xr-x  3 root root    4096 Oct 27 17:19 tmplog
```

– \HORCM\log*\horcc_HOST.log file:

```
COMMAND NORMAL : EUserId for HORC : root (0)  Tue Nov  1 12:21:53 2005
CMDLINE : pairvolchk -ss -g URA
12:21:54-2d27f-10090- [pairvolchk][exit(32)]
COMMAND NORMAL : EUserId for HORC : root (0)  Thu Oct 27 17:36:32 2005
CMDLINE : raidqry -l
17:36:32-3d83c-17539- [raidqry][exit(0)]
COMMAND ERROR  : EUserId for HORC : root (0)  Thu Oct 27 17:31:28 2005
CMDLINE : pairdisplay -g UR
17:31:28-9a206-17514- ERROR:cm_sndrcv[rc < 0 from HORCM]
17:31:28-9b0a3-17514- [pairdisplay][exit(239)]
[EX_ENOGRP] No such group
[Cause ]:The group name which was designated or the device name doesn't exist
in the configuration file, or the network address for remote communication
doesn't exist.
[Action]:Please confirm if the group name exists in the configuration file
of the local and remote host.
```

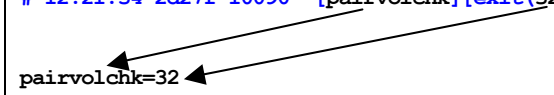
– \HORCM\log*\horcc_HOST.conf file:

```
# For Example
HORCC_LOGSZ=2048


# The masking variable
# This variable is used to disable the logging by the command and exit code.
# For masking below log pairvolchk returned '32'(status is "SVOL_COPY")
# COMMAND NORMAL : EUserId for HORC : root (0)  Tue Nov  1 12:21:53 2005
# CMDLINE : pairvolchk -ss -g URA
# 12:21:54-2d27f-10090- [pairvolchk][exit(32)]


pairvolchk=32

pairvolchk=22
```



Appendix B Uninstalling and Upgrading CCI

B.1 Uninstalling UNIX® CCI Software

After verifying that the CCI software is not running, you can uninstall the CCI software. If the CCI software is still running when you want to uninstall, shut down the CCI software using the horcmshutdown.sh command to ensure a normal end to all Hitachi replication software functions.

Caution: Before uninstalling the CCI software, make sure that all device pairs are in simplex status.

To uninstall the CCI software from a root directory (see Figure B.1): Issue the uninstall command, go to the root directory, and delete the HORCM directory.

To uninstall the CCI software from a non-root directory (see Figure B.2): Issue the uninstall command, go to the root directory, delete the HORCM link, and delete the HORCM directory.

```
#/HORCM/horcmuninstall.sh    ← Issue the uninstall command.
#cd  /                       ← Change directories.
#rm -rf /HORCM               ← Delete the CCI directory.
```

Figure B.1 Uninstalling CCI Software from a Root Directory

```
#/HORCM/horcmuninstall.sh    ← Issue the uninstall command.
#cd  /          ← Change directories.
#rm    /HORCM   ← Delete the CCI link.
#rm  -rf   /non-root_directory_name/HORCM    ← Delete the CCI directory.
```

Figure B.2 Uninstalling CCI Software from a Non-root Directory

B.2 Upgrading UNIX CCI Software

After verifying that CCI is not running, you can upgrade the CCI software. If CCI is still running when you want to upgrade software versions, shut down the CCI software using the horcmshutdown.sh command to ensure a normal end to all Hitachi replication software functions. For instructions on upgrading the CCI software in a UNIX environment, refer to Chapter 3.

B.3 Uninstalling Windows® NT/2000/ Windows Server 2003 CCI Software

After verifying that the CCI software is not running, you can uninstall the CCI software. If the CCI software is still running when you want to uninstall, shut down the CCI software using the horcmshutdown command to ensure a normal end to all Hitachi replication software functions.

Caution: Before uninstalling the CCI software, make sure that all device pairs are in simplex mode.

To uninstall the CCI software:

1. On the **Control** panel, select the **Add/Remove** programs option.
2. When the Add/Remove Program Properties panel opens, choose the **Install/Uninstall** tab and select **CCI** from the program products list.
3. Select the **Add/Remove** button to remove the CCI software.

B.4 Upgrading Windows NT/2000/ Windows Server 2003 Software

After verifying that the CCI software is not running, you can upgrade the CCI software. If the CCI software is still running when you want to upgrade software versions, shut down the CCI software using the horcmshutdown command to ensure a normal end to all Hitachi replication software functions. To upgrade the CCI software:

1. On the **Control** panel, select the **Add/Remove programs** option.
2. When the Add/Remove Program Properties dialog box displays, choose the **Install/Uninstall** tab and select **CCI** from the program products list.
3. Select the **Add/Remove** button to remove the CCI software.
4. Insert the installation medium in the proper I/O device.
5. From the **Start** menu, select **Run**.
6. When the Run window displays, enter **x:\Setup.exe** (where **x:** is a CD drive) in the **Open** drop-down list box.
7. An InstallShield® dialog box displays. Follow the on screen instructions to install the CCI software.
8. Reboot the Windows NT®/2000/ Windows Server 2003 server, and verify that the correct version of the CCI software is running on your system by executing the **raidqry -h** command.

Appendix C Fibre-to-SCSI Address Conversion

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

Table C.1 Limits for Target IDs

	HP-UX and other Systems		Solaris™, IRIX® 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 C.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#[75003005] 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 C.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:

- **Using default conversion table.** The TID# and LU# indicated by the raidscan command are used in the HORCM configuration definition file.
- **Changing default conversion table.** The HORCMFCTBL environmental variable enables you to change the default conversion table as shown in Figure C.2.

```
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#[75003005] 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 C.2 Using HORCMFCTBL to Change Default Fibre Conversion Table

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

- Table number 0 = HP-UX systems
- Table number 1 = Solaris systems
- Table number 2 = Windows NT®/2000/ Windows Server 2003 systems

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 NT/2000/ Windows Server 2003 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 NT/2000/ Windows Server 2003 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.

Table C.2 Fibre Address Conversion Table for HP-UX Systems

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	--	--

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

Table C.3 Fibre Address Conversion Table for Solaris and IRIX Systems

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	--	--

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

Table C.4 Fibre Address Conversion Table for Windows NT/2000/ Windows Server 2003 Systems

C5(Phld5)				C4(Phld4)				C3(Phld3)				C2(Phld2)				C1(Phld1)			
AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	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

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

Appendix D CCI Operation on Windows® NT/2000/ Windows Server 2003 Systems

D.1 LDM Volume Search and Flush

Windows Server™ 2000/ Windows Server 2003 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 subsystem with LDM volume. Linking physical volumes in the subsystem with LDM volume is necessary when creating the configuration definition file, as shown in Figure D.1.

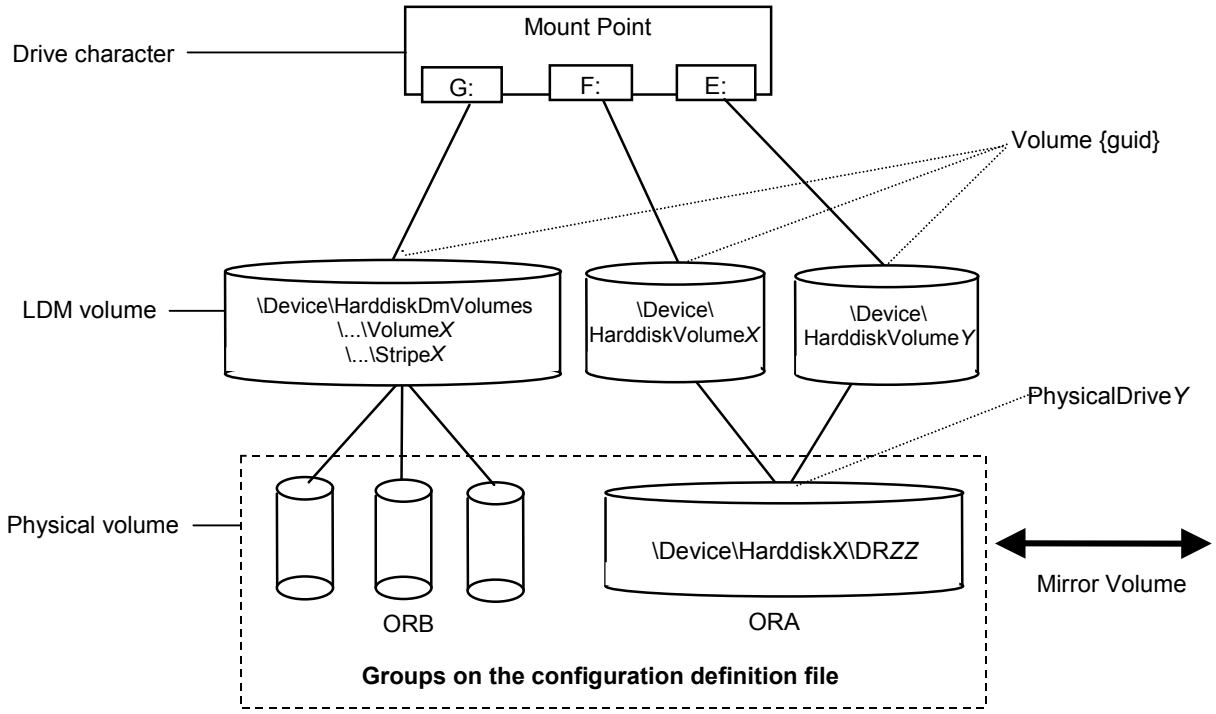


Figure D.1 LDM Volume Configuration

D.1.1 Single Host Configuration

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

- Physical

  Using $Physical as a search condition, the CCI displays the relation between the physical drive and the LDEV configuration of the subsystem.

- LDM Volume

  Using $Volume as a search condition, the CCI displays the relation between the LDM volume/physical drive and the LDEV configuration of the subsystem. Note that Windows NT® does not support LDM volumes. For Windows NT systems, use $LETALL for the search condition instead of $Volume.

- **Logical Device** (drive character)

  Using $LETALL as a search condition, the CCI displays the relation between the logical device and directory-mounted volume/LDM volume/physical drive and the LDEV configuration of the subsystem.

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

- **For Windows NT**
  - Device object name for Windows NT partition: **\Device\HarddiskX\PartitionY → \DskX\pY**
  - Device object name for Windows NT physical drive: **\Device\HarddiskX\Partition0 → HarddiskX**

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

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       -         -       -   -     -       -     -    DDRS-34560D
Harddisk1       CL2-A   75006145      7   -   s/s/ss  0000 1:01-00 DF600F
```

Figure D.2 Inqraid Command using $Physical for Search Condition (Windows NT)

```
inqraid $LETALL -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
D:\Dsk0\p1      -         -       -   -     -       -     -    DDRS-34560D
E:\Dsk1\p1      CL2-A   75006145      7   -   s/s/ss  0000 1:01-00 DF600F
F:\Dsk1\p2      CL2-A   75006145      7   -   s/s/ss  0000 1:01-00 DF600F
```

Figure D.3 Inqraid Command using $Physical for Search Condition (Windows NT)

- **For Windows 2000/ Windows Server 2003**
  - LDM device object name for Windows 2000/ Windows Server 2003:
    \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 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 subsystem.

```
inqraid $Phy -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
Harddisk0       CL2-A    75006145     7    -  s/s/ss  0000 1:01-00 DF600F
Harddisk1       CL2-A    75006145     8    -  s/s/ss  0000 1:01-00 DF600F
Harddisk2       CL2-A    75006145     9    -  s/s/ss  0000 1:01-00 DF600F
Harddisk3       CL2-A    75006145    10    -  s/s/ss  0000 1:01-00 DF600F
```

Figure D.4 Inqraid Command using $Physical for Search Condition (Windows 2000/ Windows Server 2003)

```
inqraid $Volume -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
\Vol44\Dsk0     CL2-A    75006145     7    -  s/s/ss  0000 1:01-00 DF600F
\Vol45\Dsk0     CL2-A    75006145     7    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk1      CL2-A    75006145     8    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk2      CL2-A    75006145     9    -  s/s/ss  0000 1:01-00 DF600F
\Dmt1\Dsk3      CL2-A    75006145    10    -  s/s/ss  0000 1:01-00 DF600F
```

Figure D.5 Inqraid Command using $Volume for Search Condition (Windows 2000/ Windows Server 2003)

```
inqraid $LETALL -CLI
DEVICE_FILE     PORT    SERIAL  LDEV CTG  H/M/12  SSID R:Group PRODUCT_ID
E:\Vol44\Dsk0   CL2-A    75006145     7   -  s/s/ss  0000 1:01-00 DF600F
F:\Vol45\Dsk0   CL2-A    75006145     7   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk1    CL2-A    75006145     8   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk2    CL2-A    75006145     9   -  s/s/ss  0000 1:01-00 DF600F
G:\Dmt1\Dsk3    CL2-A    75006145    10   -  s/s/ss  0000 1:01-00 DF600F
```

Figure D.6 Inqraid Command using $LETALL for Search Condition (Windows 2000/ Windows Server 2003)

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 -    75006145   7
F:\Vol45\Dsk0        ORA      ORA_000     CL2-A     7    2 -    75006145   7
G:\Dmt1\Dsk1         ORB      ORB_000     CL2-A     7    4 -    75006145   8
G:\Dmt1\Dsk2         ORB      ORB_001     CL2-A     7    5 -    75006145   9
G:\Dmt1\Dsk3         ORB      ORB_002     CL2-A     7    6 -    75006145   10
```

Figure D.7 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      75006145    7    DF600F
F:\Vol45\Dsk0         0   F  CL2-A    7    2      75006145    7    DF600F
G:\Dmt1\Dsk1          0   F  CL2-A    7    4      75006145    8    DF600F
G:\Dmt1\Dsk2          0   F  CL2-A    7    5      75006145    9    DF600F
G:\Dmt1\Dsk3          0   F  CL2-A    7    5      75006145   10    DF600F
```

Figure D.8 Raidscan –find Command using $LETALL for Search Condition

```
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   75006145    48   -  s/s/ss  0000 1:01-00 DF600F
D:\hd2\Vol9\Dsk1 CL2-B   75006145    49   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk2    CL2-A    75006145    56   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk3    CL2-A    75006145    57   -  s/s/ss  0000 1:01-00 DF600F
G:\Dms1\Dsk4    CL2-A    75006145    58   -  s/s/ss  0000 1:01-00 DF600F
```

Figure D.9 Inqraid Command using $LETALL for Search Condition (Windows 2000/ Windows Server 2003)

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

D.1.2 Mountvol Command on Windows 2000/ Windows Server 2003

Note that the mountvol command attached on Windows 2000/ Windows Server 2003 does not flush the NT file system buffer to the corresponding specified drive. Therefore, you cannot flush an unwritten data to P-VOL nor browse S-VOL by using this 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 D.10 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    75006145   6     -   S/s/ss  0000 1:01-00 DF600F
```

Figure D.11 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     75006145       6  DF600F
```

Figure D.12 Raidscan Command Displaying Mounted Volumes

D.1.3 Flushing System Buffer

There are two methods for sending (flushing) unwritten data remaining on Windows NT 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.

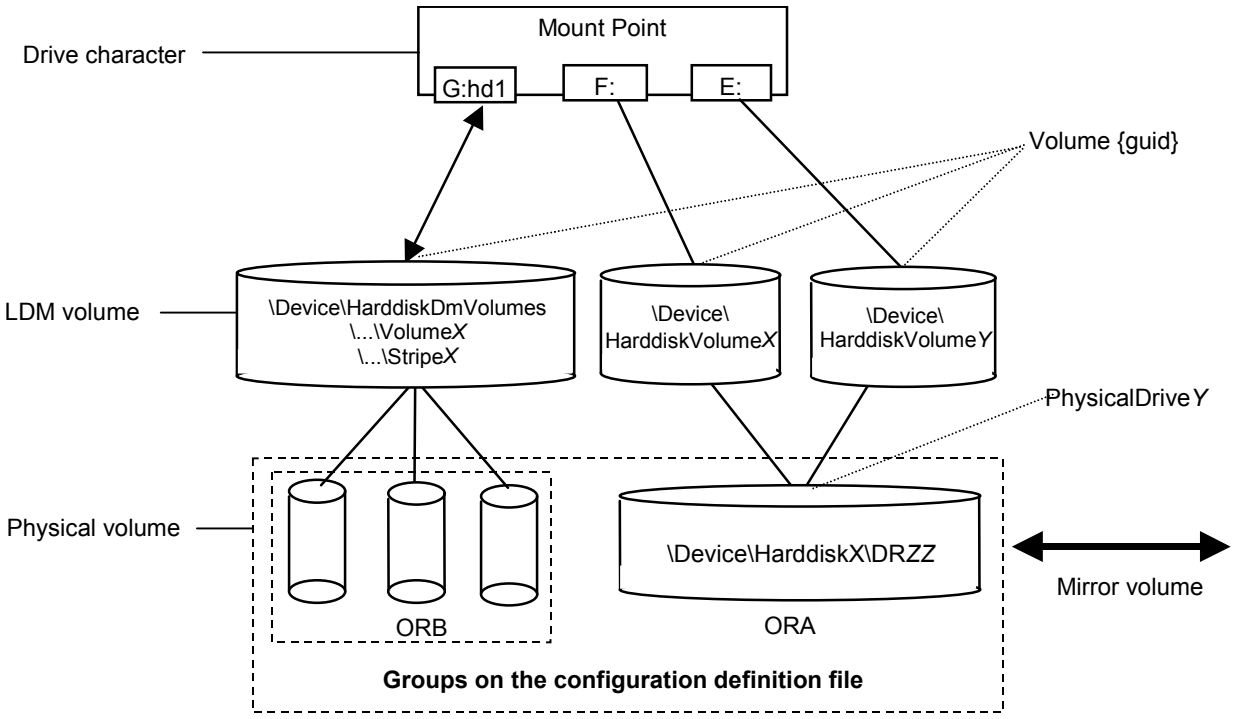


Figure D.13 LDM Volume Flush

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 D.14 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 D.15 Flushing System Buffer Example (2)

Note: The Windows NT system does not support LDM volumes. Use $LETALL for search conditions, instead of $Volume.

- Instantaneous Offline Backup on Windows NT

The following shows an example of flushing the system buffer that corresponds to the logical device of group ORB in the configuration definition file using raidscan –find sync command (rather than –x mount or –x umount).

Table D.1 Instantaneous Offline Backup on Windows NT

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 $LETALL –find sync –g ORB	—
3	Splits the pair with Read/Write enabled pairsplit –g ORB	—
4	The application opens all logical drives on P-VOL, and restarts.	—
5	—	Executes the S-VOL backup
6		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 $LETALL –find sync –g ORB
7	Resynchronizes the paired volume pairresync –g ORB	

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

- Instantaneous Offline Backup on Windows 2000/ Windows Server 2003

The following 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 D.2 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: The logical device of group ORB in S-VOL must be closed.

- Online Backup on Windows NT

The following shows an example of flushing the system buffer that corresponds to the logical device of group ORB in the configuration definition file using raidscan -find sync command (rather than -x mount or -x umount).

Table D.3 Online Backup on Windows NT

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 $LETALL –find sync –g ORB	
3	Splits the pair with Read/Write enabled pairsplit –g ORB	
4	The application de-freezes the database and enables the Write access.	—
5	—	Executes the S-VOL backup
6		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 $LETALL –find sync –g ORB
7	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.

- Online Backup on Windows 2000/ Windows Server 2003

The following 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 D.4 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.

D.2 Dynamic Disk and Copy Function

D.2.1 Environments

In an environment of the Windows Server 2000, you cannot make a P-VOL and an S-VOL (V-VOL) into a dynamic disk. In an environment of the Windows Server 2003, you can use a P-VOL and an S-VOL (V-VOL) as a dynamic disk.

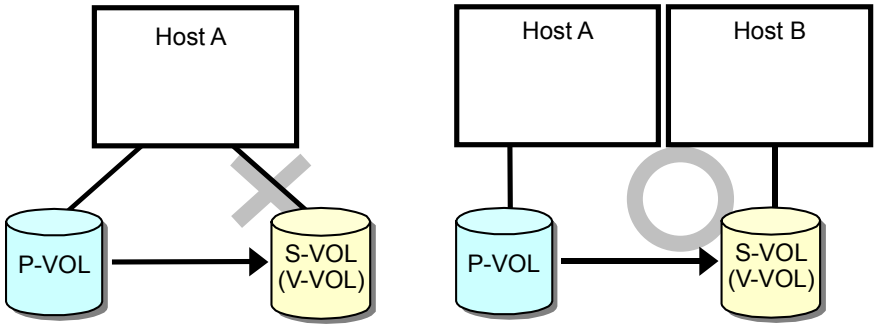
Note: A dynamic disk is a function of Windows 2000/ Windows Server 2003.

D.2.2 Environments

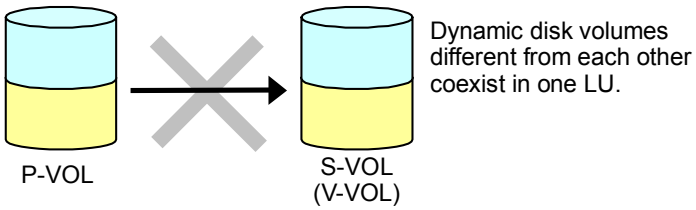
Observe the following when you use a dynamic disk with Windows Server 2003.

Follow the restrictions of the copy functions (ShadowImage, SnapShot, and TrueCopy/TCE) in addition to the following restrictions. For the restrictions of the each copying function, refer to the corresponding manual.

- 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.
- One host cannot recognize both a P-VOL and an S-VOL (V-VOL).



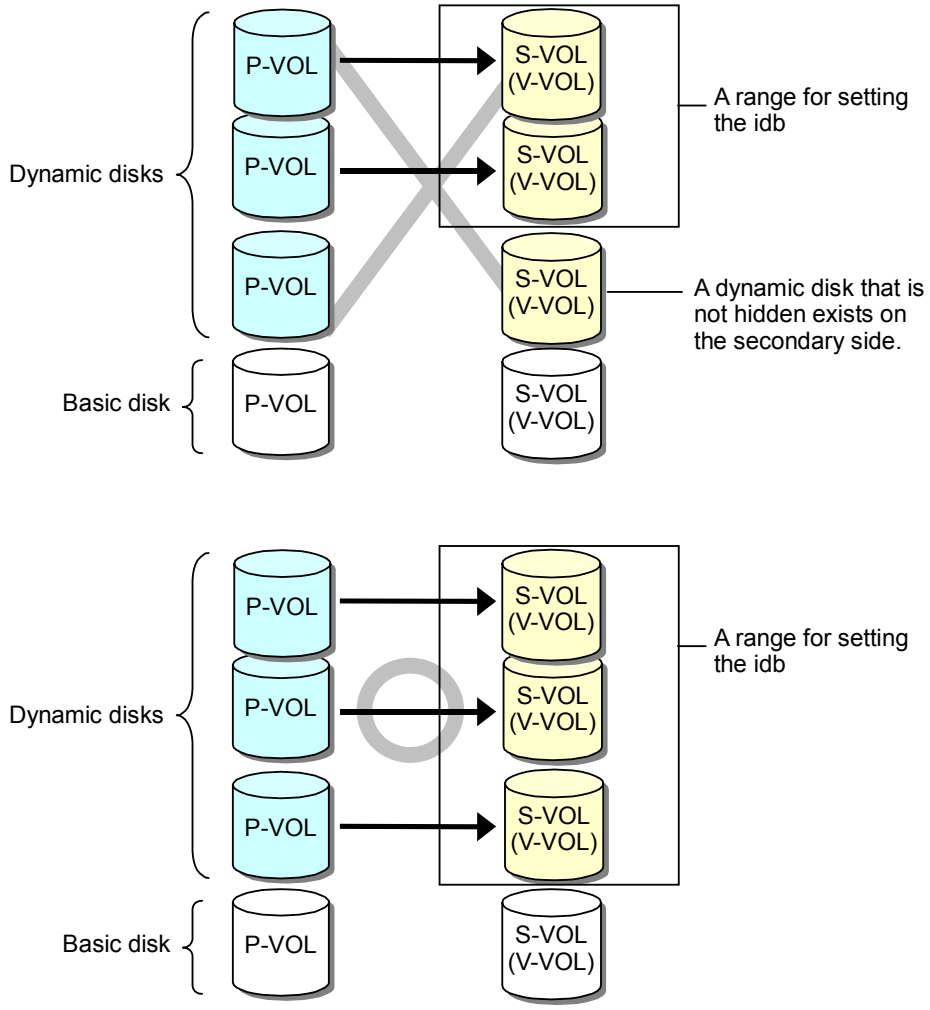
- An LU, in which two or more dynamic disk volumes coexist, cannot be copied.



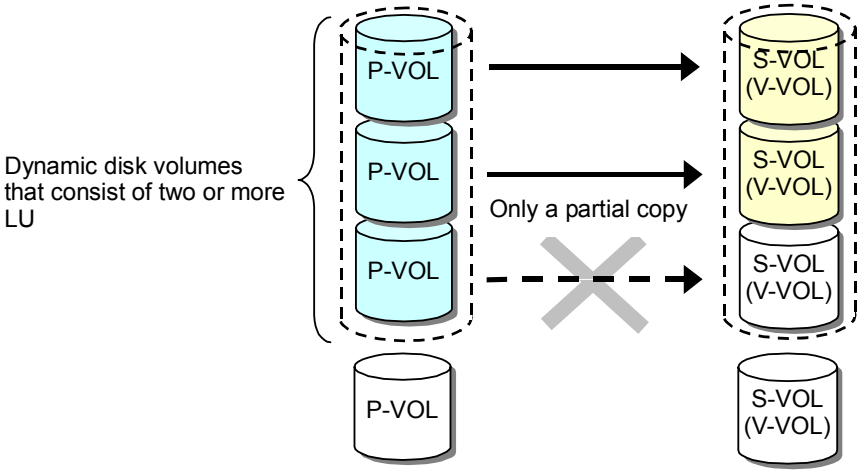
- Do not use a dynamic disk function for volumes other than an S-VOL (V-VOL) on the secondary host side.

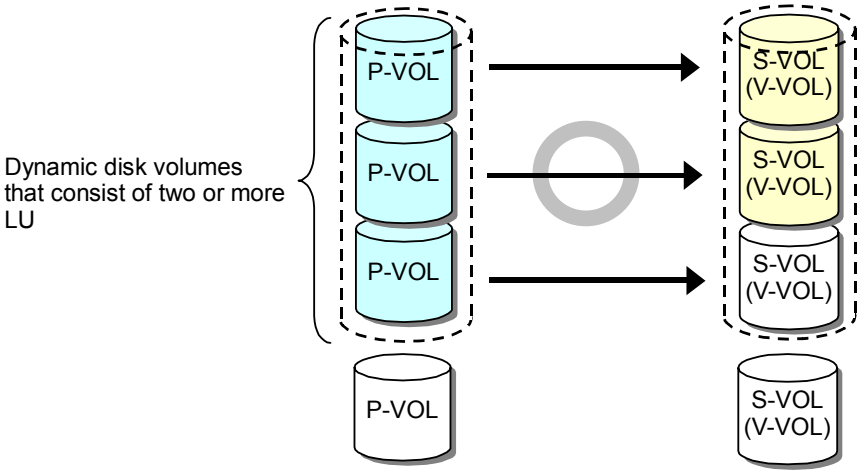
When copying, hide all the dynamic disks existing on the primary side using **raidvchkset -vg idb**. No restriction is placed on the primary side. (Hide all the dynamic disk volumes to be restored on the primary side at the time of restoration.)

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.

D.2.3 Environments

Table D.5 Initial Operation on Windows 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 recognized by a secondary host side, set the pair state to PSUS.

Note 2: The diskpart is a command of Windows 2000/ Windows Server 2003. 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 D.6 Copy Operation on Windows 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***)

Note1: Diskpart is a command of Windows 2000/ Windows Server 2003. 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 the hiding, the LU that was recognized is hidden.

Table D.7 Restore Operation on Windows 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	—
8	Umount of an LU to be restored pairsplit -x umount	—

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 the 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.

D.2.4 Recovery Procedure

- When an operation written in D.2.3 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.
- ***Note:*** Concerning 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, discontinue hiding using the raidvchkset –vg.

Appendix E RM Shadow Copy Provider for VSS

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

Table E.1 Relationship between RM Shadow Copy Provider and Windows Enterprise Server

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)
01-01-03/02	Available	Not available	Not available
01-02-03/05	Available	Available	Available

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

Enable the following services for the Volume Shadow Copy Service (VSS) hardware provider installation on Windows Enterprise Server™ 2003. Refer to section E.5 for details.

Table E.2 Conditions 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

- Shadow Copy Provider and subsystem microprogramRM

Table E.3 shows relationship of the RM Shadow Copy Provider attached to CCI delivered with microprogram of the subsystem.

Table E.3 Related Version of RM Shadow Copy Provider attached to CCI versus Micro Program

RM Shadow Copy Provider Version	CCI Version	Micro Program			
		AMS200	AMS500	WMS100	AMS1000
01-01-03/02	01-12-03/06 01-13-03/00	None	None	None	None
01-02-03/01 01-02-03/01/IA64	01-15-03/03	None	None	None	None
01-02-03/05 01-02-03/05/IA64	01-16-03/06	0712/A	0712/A	0712/A	None
	01-17-03/05	0712/A	0712/A	0720/A	0732/A
01-02-03/07 01-02-03/07/IA64	01-19-03/04	0750/A	0750/A	0750/A	0750/A

E.1 Introduction

Windows Server™ 2003 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), writers (e.g., Database applications), 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.

E.2 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.

E.2.1 Single Host Configuration

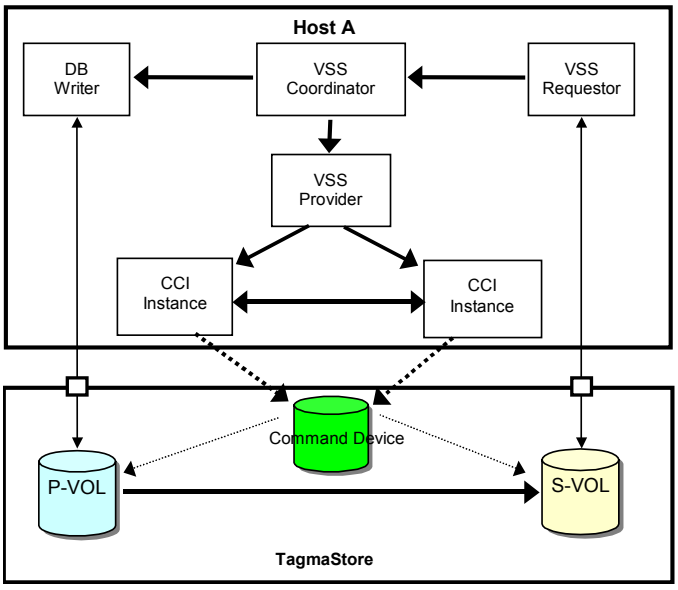


Figure E.1 Single Host Configuration for VSS

E.2.2 Export and Import Host Configuration VSS Defined

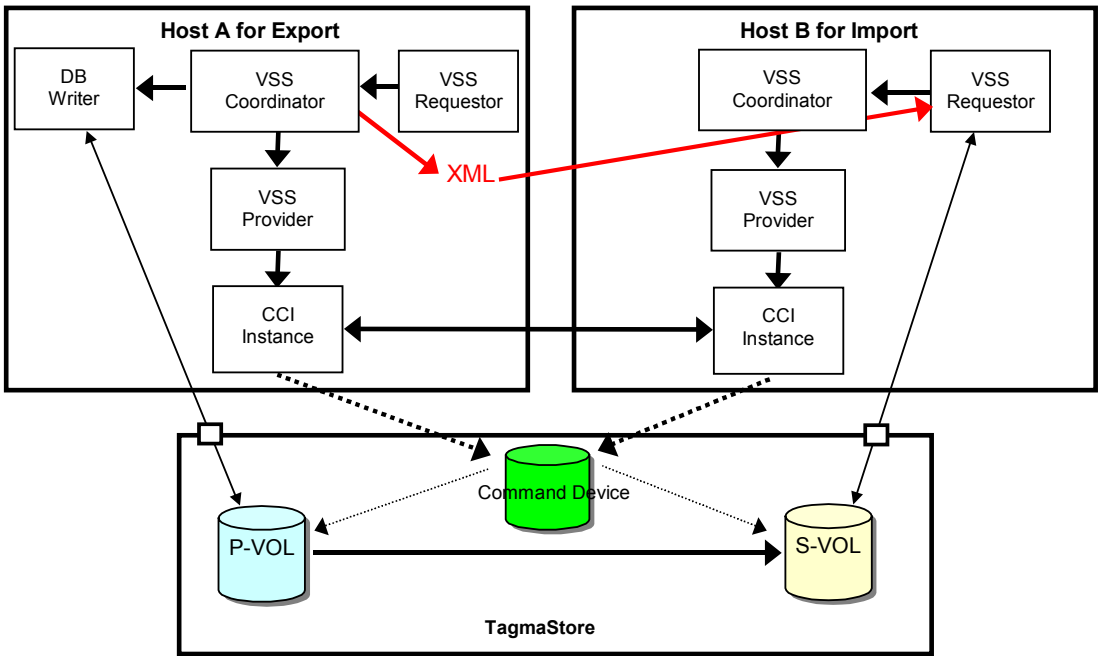


Figure E.2 Export and Import Host Configuration for VSS

E.2.3 Coordination of Shadow Copy Creation

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.

1. A backup application notifies you to prepare a volume that will be backed up to the VSS coordinator service.
2. The VSS coordinator notifies the application-specific writer to prepare its data for making a shadow copy.
3. 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.
4. 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).
5. The writer prepares the data appropriately for the application (ex: completing all open transactions, rolling transaction logs, and flushing caches). When the data is prepared for shadow copy creation, the writer notifies the VSS coordinator.
6. 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).
7. 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.
8. RM Shadow Copy Provider notifies the snapshot disks that match a designated disk to the VSS coordinator.
9. The VSS coordinator creates the XML document file describing the snapshot set in order to export the transportable snapshot volume.
10. The RM Shadow Copy Provider performs to map (Unmask) the designated disk by the VSS coordinator to the LUN.
11. 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, Steps 10 through 11 above will be performed on Import host, but a backup requestor should support this configuration.

E.2.4 Transportable Configuration

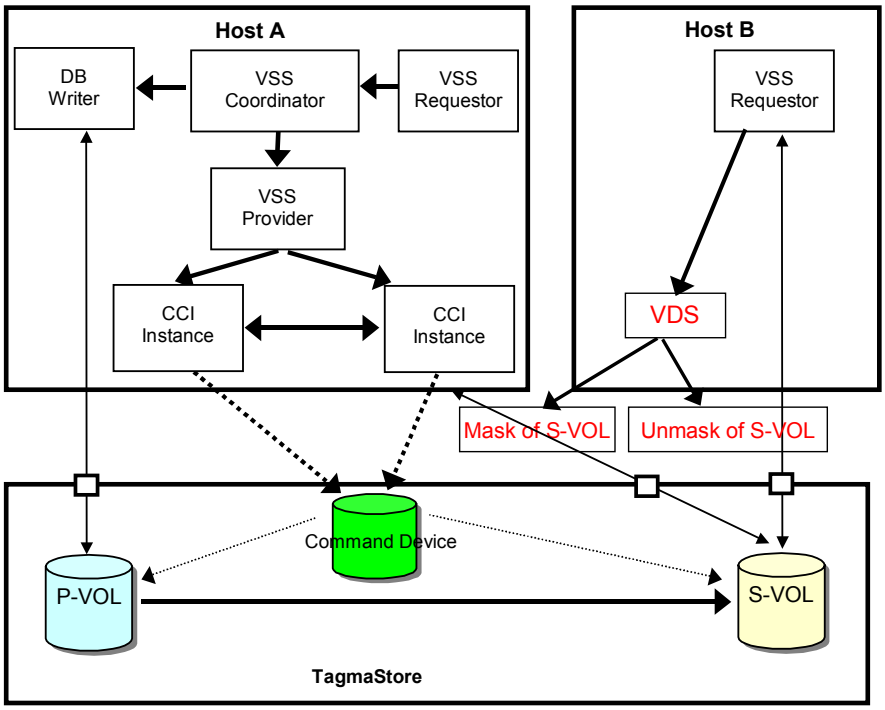


Figure E.3 Transportable Configuration for VSS

Note: This configuration will be required when the setting functions of VDS (Diskraid command) are supported by VDS provider. This should be supported by a backup requestor.

E.3 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. 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 that HDLM (JP1/HiCommand Dynamic Link Manager) does not support all of Deviceiocontrol functions that will be using by VSS.

E.4 Relationship between Backup Software and Configurations

Table E.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 E.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	▪

E.5 Installation Procedure

This product provides a file shown below:

No.	Title	File Name	Installation Place
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

Note: DIR shows an installation directory and default directory is \Program Files.

E.5.1 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 E.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 automatic start or manual start by 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.

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

To start:

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

To stop:

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

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

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

E.5.2 Procedure for Version Up

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

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

To start:

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

To stop:

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

1. Delete the installed RM Shadow Copy Provider using **Addition and deletion of application** on the control panel.
2. Change the current directory to '\HORCM\Tool\' where CCI has been installed.
3. Execute the appropriate RMVSSPRV.exe setup program:
   - For a 32-bit system, run RMVSSPRV.exe.
   - For an IA64 system, run RMVSSPRV64.exe.

4. Restart Microsoft Volume Shadow Copy Service by using the following command if VSS will not be started.

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

E.5.3 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
```

E.5.4 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
```

E.6 Uninstallation Procedure

1. Using the following command, stop Microsoft Volume Shadow Copy Service.

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

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.

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

E.7 VSS Start-up Procedures

E.7.1 Setting System Environment Variables

1. Define the system environment variables as displayed below:

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 Windows.
3. The VSS service will start automatically.

E.7.2 Setting the CCI Environment

This example assumes the Instance Number and the target volume for backup as below.

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    75002496     16   -      -     -        - DF600F-CM
Harddisk1       CL2-A    75002496     18   -  s/s/ss  0000 5:01-04 DF600F
Harddisk2       CL2-A    75002496     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    75002496     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
\\.\PhysicalDrive0
```

1. Execute a horcmstart 50 as background.

```
C:\HORCM\etchorcmstart 50
starting HORCM inst 50
HORCM inst 50 starts successfully.
```

2. 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    0    75002496    16  DF600F-CM
Harddisk1           0   F  CL2-A    25    1    75002496    18  DF600F
Harddisk2           0   F  CL2-A    25    2    75002496    19  DF600F
```

3. Shut down a horcmstart 50.

```
C:\HORCM\etc>horcmshutdown 50
   inst 50:
   HORCM Shutdown inst 50 !!!
```

4. 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
\\.\PhysicalDrive0

HORCM_DEV
#dev_group    dev_name     port#     TargetID       LU#    MU#
```

```
snap          snapdev1     CL2-A           25         1      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
\\.\PhysicalDrive0

HORCM_DEV
#dev_group    dev_name     port#     TergetID       LU#    MU#
snap          snapdev1     CL2-A           25         2      0

HORCM_INST
#dev_group       ip_address      service
snap             127.0.0.1       52050
```

1. 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      75002496   19.SMPL  ----,----- ----  -
snap    snapdev(L/R) Harddisk1      75002496   18.SMPL  ----,----- ----  -
```

2. 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
sanp    snapdev1(L) (CL2-A  ,25,  2-0)75002496  19.S-VOL PAIR,-----    18  -
sanp    snapdev1(R) (CL2-A  ,25,  1-0)75002496  18.P-VOL PAIR,75002496    19  N
```

3. 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.
```

4. 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:

- Steps (1) – (9) in section E.7.2, for the CCI Environment, will need to be done for each changes 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 will be executed. Therefore, CCI must be started prior to executing 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.

E.7.3 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.

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).

   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.

E.8 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

  Note that RM Shadow Copy Provider and CCI does not use the VDS interface.

  RM Shadow Copy Provider and CCI can support two server configurations for the OFF HOST Backup (one is export server, another is import server), but these configurations must be supported via the back-up requestor by transporting the XML file between export and import server.

E.9 Known Problems and Concerns

- **NTBackup cannot cancel a snapshot**
  - Problem: NTbackup does not cancel after the cancel button is pushed.
  - Solution: This is 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 to 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 H/W 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:
    - Set MSDTC and COMSysApp to either automatic start or manual start using the Computer Management. Confirm the services in Table E.2.
    - Uninstall and then reinstall RM Shadow Copy Provider.

E.10 Error Messages on Event Log

For detailed information on RM Shadow Copy Provider error messages that identify a failure to the Event log, refer to section 4.2 of *Hitachi TagmaStore Adaptable Modular Storage (AMS) and Workgroup Modular Storage (WMS) Storage Navigator Modular Error Codes (MK-96DF788)*.

Table E.5 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	Insufficient memory	Couldn't retain the memory for executing an RM Shadow Copy Provider.	Increase system virtual memory capacity, or terminate unnecessary programs or daemon processes
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 the cause of an error after confirming with system error code

Message ID	Error Message	Condition	Recommended Action
EV_CMDERR	VSS has detected a RAID Manager Command error	RAID Manager Command returns an error.	Remove the cause of the error after confirming with system error code of RAID Manager.
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 the 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 the 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 the 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 the 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.
EV_ENRMPH	RAID Manager was 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 the 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 the 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 the 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 the 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 the 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.

Appendix F Difference between Group Defined in a Configuration File of CCI and Consistency Group

In TCE, multiple pairs are managed as a group. A configuration file of CCI defines a group as a set of pairs. TagmaStore also manages and operates a set of TCE pairs as a consistency group. The differences between two types of groups are explained by using Figure F.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 TagmaStore 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 TagmaStore.

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 TagmaStore interpret an operation request for a group as a request for a CTG to which the specified group belongs.

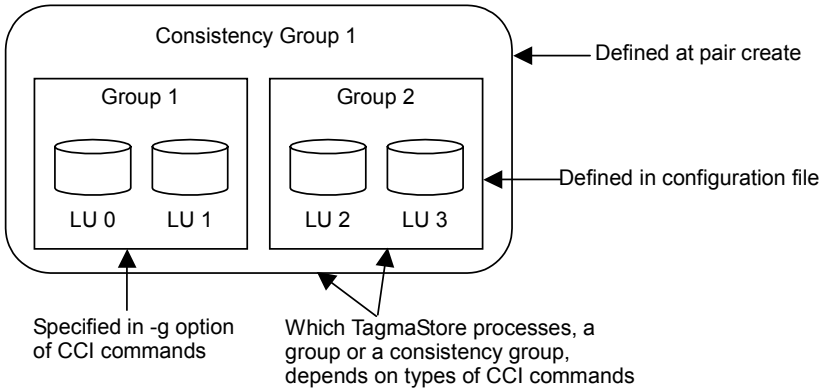


Figure F.1 Group and Consistency Groups

Table F.1 shows which TagmaStore 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 F.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 F.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 a case of Figure F.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.

Note: Splitting each pair does not guarantee data consistency across the split pairs.

Note: Only one pair per a CTG is processed at a time.

Table F.1 The CCI -g Option and Its Target

	TCE	TrueCopy	Snapshot	ShadowImage
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	Group	CTG	CTG
pairresync	CTG	Group	Group	Group
horctakeover	CTG	Group	-	-
PSUE (Failure Occurred)	CTG	Pair	Pair	Pair
PFUS (Pool Empty)	CTG&CTL	-	CTL	-

CTG: All pairs in a CTG
Group: All pairs in a group
Pair: Only the specified pair
CTL: All pairs, which are using a pool owned by a failed controller
CTG&CTL: All pairs which are using a pool owned by a failed controller and all pairs which belong to CTGs to which the former pairs belong

Appendix G Command Options Execution

The following table shows the command options execution for all copy features.

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
paircreate	-h	O		O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g [s] <group>	O	O	O	O
	-d [s] <pair Vol>	O	O	O	O
	-d [g] [s] <drive#(0-N)> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-vl	O	O	O	O
	-vr	O	O	O	O
	-f <fence> [CTGID]	O	O	×	×
	-jp <jid> -js <jid>	×	×	×	×
	-c <size>	O	O	O	O
	-cto <o-time> [c-time] [r-time]	×	×	×	×
	-nocopy	O	O	×	×
	-m <mode>	O	O	O	O
	-split	×	×	O	O
	-fq <mode>	×	×	×	×
	-pid <id#>	×	×	×	×
	-nocsus	×	×	×	×
pairsplit	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-r	O	O	×	×
	-rw	O	O	×	×
	-S	O	O	O	O
	-R	O	O	×	×
	-RS	×	×	×	×
	-RB	×	×	×	×
	-P	O	×	×	×
	-l	O	O	O	O
	-FHORC [MU#]	×	×	O	O
	-FMRCF [MU#]	O	O	×	×
	-ms <Split-Maker> [MU#]	×	×	×	×
	-mscas <Split-Maker> [MU#]	×	O	×	×
	-C <size>	×	×	O	O
	-E	×	×	O	O
	-fq <mode>	×	×	×	×
pairresync	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-c <size>	O	O	O	O
	-cto <o-time> [c-time] [r-time]	×	×	×	×
	-l	O	O	O	O
	-FHORC [MU#]	×	×	O	O
	-FMRCF [MU#]	O	O	×	×
	-swapp	O	×	×	×
	-swaps	O	×	×	×
	-restore	×	×	O	O
	-fq <mode>	×	×	×	×
pairevtwait	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-nowait	O	O	O	O
	-nowait [s]	O	O	O	O
	-s <status>	O	O	O	O
	-ss <status>	O	O	O	O
	-t <timeout> [interval]	O	O	O	O
	-l	O	O	O	O
	-FHORC [MU#]	×	×	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-FMRCF [MU#]	O	O	×	×
pairmon	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-D	O	O	O	O
	-allsnd	O	O	O	O
	-resevt	O	O	O	O
	-nowait	O	O	O	O
	-s <status>	O	O	O	O
pairvolchk	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-c	O	O	O	O
	-ss	O	O	O	O
	-FHORC [MU#]	×	×	O	O
	-FMRCF [MU#]	O	O	×	×
pairdisplay	-h	O	O	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-c	O	O	O	O
	-l	O	O	O	O
	-m <mode>	O	O	O	O
	-f [x]	O	O	O	O
	-f [c]	O	O	O	O
	-f [d]	O	O	O	O
	-f [m]	×	×	×	×
	-f [e]	O	O	O	O
	-CLI	O	O	O	O
	-FHORC [MU#]	×	×	O	O
	-FMRCF [MU#]	O	O	×	×
	-v jnl [t]	×	×	×	×
	-v ctg	×	×	×	×
	-v smk	×	×	×	O
	-v jnl[t]	×	×	×	×
	-v pid	×	×	×	×
paircurchk	-h	O	O	×	×
	-z	O	O	×	×
	-zx	O	O	×	×
	-I[instance#]	O	O	×	×
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	×	×

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-q	O	O	×	×
	-xh	O	O	×	×
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	×	×
	-d <pair Vol>	O	O	×	×
	-d [g] <drive#(0-N)> [MU#]	O	O	×	×
	-d [g] <seq#> <LDEV#> [MU#]	O	O	×	×
	-nomsg	O	O	×	×
horctakeover	-h	O	O	×	×
	-z	O	O	×	×
	-zx	O	O	×	×
	-I[instance#]	O	O	×	×
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	×	×
	-q	O	O	×	×
	-xh	O	O	×	×
	-x <command> <arg>	O	O	×	×
	-g <group>	O	O	×	×
	-d <pair Vol>	O	O	×	×
	-d [g] <drive#(0-N)> [MU#]	O	O	×	×
	-d [g] <seq#> <LDEV#> [MU#]	O	O	×	×
	-nomsg	O	O	×	×
	-S	O	O	×	×
	-I	O	O	×	×
	-t <timeout>	O	O	×	×
raidscan	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-p <port> [hgrp]	O	O	O	O
	-pd [g] <drive#(0-N)>	O	O	O	O
	-pi [g] <strings>	O	O	O	O
	-t <targ>	O	O	O	O
	-l <lun>	O	O	O	O
	-m <mun>	O	O	O	O
	-s <seq#>	O	O	O	O
	-f [f]	O	O	O	O
	-f [x]	O	O	O	O
	-f [g]	O	O	O	O
	-f [d]	O	O	O	O
	-f [e]	O	O	O	O
	-CLI	O	O	O	O
	-find [g]	O	O	O	O
	-find inst	O	O	O	O
	-find verify	O	O	O	O
	-find [g] conf	O	O	O	O
	-find sync	O	O	O	O
raidar	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-s <interval> [count]	O	O	O	O
	-sm <interval> [count]	O	O	O	O
	-p <port> <targ> <lun>	O	O	O	O
	-pd [g] <drive#(0-N)>	O	O	O	O
raidqry	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g	O	O	O	O
	-l	O	O	O	O
	-r <group>	O	O	O	O
	-f	O	O	O	O
raidvchkset	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-g <group>	×	×	×	×
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-nomsg	O	O	O	O
	-vt [type]	×	×	×	×
	-vs <bsize> [SLBA] [ELBA]	×	×	×	×
	-vg [type] [rtime]	O	O	O	O
raidvchkdsp	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-x <command> <arg>	×	×	×	×
	-g <group>	O	O	O	O
	-d <pair Vol>	O	O	O	O
	-d [g] <drive#(0-N)> [MU#]	O	O	O	O
	-d [g] <seq#> <LDEV#> [MU#]	O	O	O	O
	-f [x]	O	O	O	O
	-f [d]	O	O	O	O
	-f [e]	×	×	×	×
	-v <op>	×	×	×	×
	-c	O	O	O	O
raidvchkscan	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O
	-q	O	O	O	O
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-p <port> [hgrp]	O	O	O	O
	-pd [g] <drive#(0-N)>	O	O	O	O
	-t <targ>	O	O	O	O
	-l <lun>	O	O	O	O
	-s <seq#>	O	O	O	O
	-f [x]	O	O	O	O
	-v flag	O	O	O	O
	-v pid [unit#]	×	×	×	×
	-v jnl [t]	×	×	×	×
horcctl	-h	O	O	O	O
	-z	O	O	O	O
	-zx	O	O	O	O
	-I[instance#]	O	O	O	O
	-IH[instance#] | -ITC[instance#]	O	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	O	O

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-q	O	O	O	O
	--num	×	×	×	×
	-xh	O	O	O	O
	-x <command> <arg>	×	×	×	×
	-d	O	O	O	O
	-c	O	O	O	O
	-S	O	O	O	O
	-D	O	O	O	O
	-C	O	O	O	O
	-u <unitid>	O	O	O	O
	-ND	O	O	O	O
	-NC	O	O	O	O
	-g <group>	×	×	×	×
	-l <level>	O	O	O	O
	-b <y/n>	O	O	O	O
	-s <size(KB)>	O	O	O	O
	-t <type>	O	O	O	O
pairsyncwait	-h	×	O	×	×
	-z	×	O	×	×
	-zx	×	O	×	×
	-I[instance#]	×	O	×	×
	-IH[instance#] | -ITC[instance#]	×	O	×	×
	-IM[instance#] | -ISI[instance#]	×	×	×	×
	-q	×	O	×	×
	-xh	×	O	×	×
	-x <command> <arg>	×	×	×	×
	-g <group>	×	O	×	×
	-d <pair Vol>	×	O	×	×
	-d [g] <drive#(0-N)> [MU#]	×	O	×	×
	-d [g] <seq#> <LDEV#> [MU#]	×	O	×	×
	-nomsg	×	×	×	×
	-nowait	×	O	×	×
	-t <timeout> [interval]	×	O	×	×
	-m <Q-Maker>	×	O	×	×

Command	Options	TrueCopy	TCE	ShadowImage	SnapShot
	-fq	×	×	×	×
horctakeoff	-h	×	×	×	×
	-z	×	×	×	×
	-zx	×	×	×	×
	-I[instance#]	×	×	×	×
	-IH[instance#] | -ITC[instance#]	×	×	×	×
	-IM[instance#] | -ISI[instance#]	×	×	×	×
	-q	×	×	×	×
	-xh	×	×	×	×
	-x <command> <arg>	×	×	×	×
	-g [s] <group>	×	×	×	×
	-d [s] <pair Vol>	×	×	×	×
	-d [g][s] <drive#(0-N)> [MU#]	×	×	×	×
	-d [g][s] <seq#> <LDEV#> [MU#]	×	×	×	×
	-nomsg	×	×	×	×
	-l	×	×	×	×
	-t <timeout>	×	×	×	×
	-jp	×	×	×	×

Acronyms and Abbreviations

AMS	Adaptable Modular Storage
CCI	Command Control Interface
CM	cluster manager
CTG	consistency group
CTL	controller
CVS	custom volume size (also called Virtual LUN)
HA	high availability
HORCM	Hitachi Open Remote Copy Manager
I/O	input / output
LDEV	logical device
LU	logical unit
LUN	logical unit number
LVM	logical volume manager
MU	mirrored unit
PSUE	pair suspended-error status
P-VOL	primary volume
SCSI	small computer system interface
S-VOL	secondary volume
TID	target ID
V-VOL	virtual volume (Snapshot Image)
WMS	Workgroup Modular Storage