

Command Control Interface

01-68-03/01

Installation and Configuration Guide

This document describes and provides instructions for installing the Command Control Interface (CCI) software for the Hitachi RAID storage systems, including upgrading and removing CCI.

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Preface

This document describes and provides instructions for installing the Command Control Interface (CCI) software for the Hitachi RAID storage systems, including upgrading and removing CCI.

Please read this document carefully to understand how to use this product, and maintain a copy for your reference.

Intended audience

This document is intended for system administrators, Hitachi Vantara representatives, and authorized service providers who install, configure, and use the Command Control Interface software for the Hitachi RAID storage systems.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The Hitachi RAID storage system and the *Hardware Guide* for the storage system.
- The management software for the storage system (for example, *Hitachi Device Manager - Storage Navigator*).
- The host systems attached to the Hitachi RAID storage system.

Product version

This document revision applies to the CCI software version 01-68-03/01 or later.

Changes in this revision

- Added a note for when a dialog box is missing while installing CCI in Windows.
- Added support for Windows 11.

Release notes







Read the release notes before installing and using this product. They may contain requirements or restrictions that are not fully described in this document or updates or corrections to this document. Release notes are available on the Hitachi Vantara Support Website: <https://knowledge.hitachivantara.com/Documents>.

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	<ul style="list-style-type: none"> Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click OK. Indicates emphasized words in list items.
<i>Italic</i>	<ul style="list-style-type: none"> Indicates a document title or emphasized words in text. Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: <pre>pairedisplay -g group</pre> (For exceptions to this convention for variables, see the entry for angle brackets.)
Monospace	Indicates text that is displayed on screen or entered by the user. Example: <code>pairedisplay -g oradb</code>
< > angle brackets	<p>Indicates variables in the following scenarios:</p> <ul style="list-style-type: none"> Variables are not clearly separated from the surrounding text or from other variables. Example: <pre>Status-<report-name><file-version>.csv</pre> Variables in headings.
[] square brackets	Indicates optional values. Example: [a b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a b } indicates that you must choose either a or b.
vertical bar	<p>Indicates that you have a choice between two or more options or arguments. Examples:</p> <p>[a b] indicates that you can choose a, b, or nothing.</p> <p>{ a b } indicates that you must choose either a or b.</p>

This document uses the following icons to draw attention to information:

Icon	Label	Description
	Note	Calls attention to additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Important	Highlights information that is essential to the completion of a task.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations, data loss, or a system crash).
	CAUTION	Warns the user of a hazardous situation that, if not avoided, could result in major or minor injury.
	WARNING	Warns the user of a hazardous situation which, if not avoided, could result in death or serious injury.

Conventions for storage capacity values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 kilobyte (KB)	1,000 (10^3) bytes
1 megabyte (MB)	1,000 KB or $1,000^2$ bytes
1 gigabyte (GB)	1,000 MB or $1,000^3$ bytes
1 terabyte (TB)	1,000 GB or $1,000^4$ bytes
1 petabyte (PB)	1,000 TB or $1,000^5$ bytes
1 exabyte (EB)	1,000 PB or $1,000^6$ bytes

Logical capacity values (for example, logical device capacity, cache memory capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes

Logical capacity unit	Value
1 cylinder	Mainframe: 870 KB Open-systems: <ul style="list-style-type: none"> OPEN-V: 960 KB Others: 720 KB
1 KB	1,024 (2 ¹⁰) bytes
1 MB	1,024 KB or 1,024 ² bytes
1 GB	1,024 MB or 1,024 ³ bytes
1 TB	1,024 GB or 1,024 ⁴ bytes
1 PB	1,024 TB or 1,024 ⁵ bytes
1 EB	1,024 PB or 1,024 ⁶ bytes

Accessing product documentation

Product user documentation is available on the Hitachi Vantara Support Website: <https://knowledge.hitachivantara.com/Documents>. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

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Thank you!

Chapter 1: Installation requirements for Command Control Interface

The installation requirements for the Command Control Interface (CCI) software include host requirements, storage system requirements, and requirements and restrictions for specific operational environments.

System requirements for CCI

The following table lists and describes the system requirements for Command Control Interface.

Item	Requirement
Command Control Interface software product	The CCI software is supplied on the media for the product (for example, DVD-ROM). The CCI software files require 2.5 MB of space, and the log files require 3 MB of space.

Item	Requirement
Hitachi RAID storage systems	<p>The requirements for the RAID storage systems are:</p> <ul style="list-style-type: none"> ▪ Microcode. The availability of features and functions depends on the level of microcode installed on the storage system. ▪ Command device. The CCI command device must be defined and accessed as a raw device (no file system, no mount operation). ▪ License keys. The software products to be used (for example, Universal Replicator, Dynamic Tiering) must be enabled on the storage system. ▪ System option modes. Before you begin operations, the system option modes (SOMs) must be set on the storage system by your Hitachi Vantara representative. For details about the SOMs, contact customer support. <p>Note: Check the appropriate manuals (for example, <i>Hitachi TrueCopy® for Mainframe User Guide</i>) for SOMs that are required or recommended for your operational environment.</p> <ul style="list-style-type: none"> ▪ Hitachi software products. Make sure that your system meets the requirements for operation of the Hitachi software products. For example: <ul style="list-style-type: none"> • TrueCopy, Universal Replicator, global-active device: Bi-directional swap must be enabled between the primary and secondary volumes. The port attributes (for example, initiator, target, RCU target) and the MCU-RCU paths must be defined. • Copy-on-Write Snapshot: ShadowImage is a prerequisite for Copy-on-Write Snapshot. • Thin Image: Dynamic Provisioning is a prerequisite for Thin Image. <p>Note: Check the appropriate manuals (for example, <i>Hitachi Universal Replicator User Guide</i>) for the system requirements for your operational environment.</p>
Host platforms	<p>CCI operations are supported on the following host platforms:</p> <ul style="list-style-type: none"> ▪ AIX® ▪ HP-UX ▪ Red Hat Enterprise Linux (RHEL) ▪ Oracle Linux (OEL) ▪ Solaris ▪ SUSE Linux Enterprise Server (SLES) ▪ Windows ▪ z/Linux

Item	Requirement
	<p>When a vendor discontinues support of a host OS version, CCI that is released at or after that time will not support that version of the host software.</p> <p>For physical or virtual server to have the CCI software installed, the system image should not be put on any SAN volumes that would be impacted by the managed replications.</p> <p>For detailed host support information (for example, OS versions), refer to the Hitachi Vantara Product Compatibility Guide at https://compatibility.hitachivantara.com/.</p>
I/O interface	For details about I/O interface support (Fibre, SCSI, iSCSI), refer to the Hitachi Vantara Product Compatibility Guide at https://compatibility.hitachivantara.com/ .
Host access	Root/administrator access to the host is required to perform host-based CCI operations.
Host memory	<p>CCI requires static memory and dynamic memory for executing the load module.</p> <ul style="list-style-type: none"> Static memory capacity: minimum 600 KB, maximum 1200 KB Dynamic memory capacity: determined by the description of the configuration file. The minimum is: $(number_of_unit_IDs \times 200 \text{ KB}) + (number_of_LDEVs \times 360 \text{ B}) + (number_of_entries \times 180 \text{ B})$ <p>where:</p> <ul style="list-style-type: none"> <i>number_of_unit_IDs</i>: number of storage chassis <i>number_of_LDEVs</i>: number of LDEVs (each instance) <i>number_of_entries</i>: number of paired entries (pairs) <p>Example: For a 1:3 pair configuration, use the following values for <i>number_of_LDEVs</i> and <i>number_of_entries</i> for each instance:</p> <ul style="list-style-type: none"> <i>number_of_LDEVs</i> in the primary instance = 1 <i>number_of_entries</i> (pairs) in the primary instance = 3 <i>number_of_LDEVs</i> in the secondary instance = 3 <i>number_of_entries</i> (pairs) in the secondary instance = 3
Host disk	<ul style="list-style-type: none"> Capacity required for running CCI: 20 MB (varies depending on the platform: average = 20 MB, maximum = 30 MB) Capacity of the log file that is created after CCI starts: 3000 KB (when there are no failures, including command execution errors)

Item	Requirement
IPv6, IPv4	<p>The minimum OS platform versions for CCI/IPv6 support are:</p> <ul style="list-style-type: none"> ▪ HP-UX: HP-UX 11.23 (PA/IA) or later ▪ Solaris: Solaris 9/Sparc or later, Solaris 10/x86/64 or later ▪ AIX®: AIX® 5.3 or later ▪ Windows: Windows 2008(LH) ▪ Linux: Linux Kernel 2.4 (RH8.0) or later ▪ Tru64: Tru64 v5.1A or later. Note that v5.1A does not support the getaddrinfo() function, so this must be specified by IP address directly. ▪ OpenVMS: OpenVMS 8.3 or later <p>UDP ports: Contact your network administrator for appropriate UDP port numbers to use in your network. The network administrator must enable these ports to allow traffic between CCI servers.</p>
Supported guest OS for VMware	<p>CCI needs to use guest OS that is supported by CCI, and also VMware supported guest OS (for example, Windows Server, Red Hat Linux, SUSE Linux). For details about guest OS support for VMware, refer to the interoperability matrix at https://support.hitachivantara.com.</p>
Failover	<p>CCI supports many industry-standard failover products. For details about supported failover products, refer to the Hitachi Vantara Product Compatibility Guide at https://compatibility.hitachivantara.com/.</p>
Volume manager	<p>CCI supports many industry-standard volume manager products. For details about supported volume manager products, refer to the Hitachi Vantara Product Compatibility Guide at https://compatibility.hitachivantara.com/.</p>
High availability (HA) configurations	<p>The system that runs and operates TrueCopy in an HA configuration must be a duplex system having a hot standby or mutual hot standby (mutual takeover) configuration. The remote copy system must be designed for remote backup among servers and configured so that servers cannot share the primary and secondary volumes at the same time. The HA configuration does not include fault-tolerant system configurations such as Oracle Parallel Server (OPS) in which nodes execute parallel accesses. However, two or more nodes can share the primary volumes of the shared OPS database, and must use the secondary volumes as exclusive backup volumes.</p> <p>Host servers that are combined when paired logical volumes are defined should run on operating systems of the same architecture. If not, one host might not be able to recognize a paired volume of another host, even though CCI runs properly.</p>

CCI operating environment

This section describes the supported operating systems, failover software, and I/O interfaces for CCI. For the latest information about CCI host software version support, refer to the Hitachi Vantara Product Compatibility Guide at <https://compatibility.hitachivantara.com/>.

Platforms that use CCI

The following tables list the host platforms that support CCI.

CCI can run on the OS version listed in the table or later.

For the latest information about host OS version and storage system connectivity support, contact customer support.



Note: When a vendor discontinues support of a host OS version, CCI that is released at or after that time will not support that version of the host OS.

Supported platforms for CCI

Vendor	Operating system ¹
Oracle	Solaris 10, 11
	Solaris 10 on x86
	OEL 6.x (6.2 or later)
	Solaris 11 on x64
HP	HP-UX 11.3x on IA-64 ⁴
IBM [®]	AIX [®] 6.1, 7.1
	z/Linux (SUSE 8)
	For details, see Requirements and restrictions for CCI on z/Linux (on page 17) .
Microsoft	Windows Server 2012 on x64
	Windows Server 2012(R2) on x64
	Windows Server 2016 on x64
	Windows Server 2019 on x64
	Windows Server 2022 on x64 ⁵
	Windows 8.1 on x64 ^{2,3}
	Windows 10 on x64 ^{2,3}

Vendor	Operating system ¹
	Windows 11 on x64 ^{2,3}
Red Hat	RHEL 6.x on x64
	RHEL 7.x on x64
	RHEL 8.x on x64 ⁶
Novell (SUSE)	SLES 11
	SLES 11 on x64
	SLES 12 SP3 on x64
	SLES 15
<p>Notes:</p> <ol style="list-style-type: none"> OS service packs (SP), update programs, or patch programs are not considered as requirements if they are not listed. For the connection between storage systems and CCI, only the LAN connection is supported. Some commands and options are not supported. For details, see Requirements and restrictions for CCI on Windows 8.1, Windows 10, and Windows 11 (on page 20). IA-32 EL is used on IA-64 (except for CCI for Linux/IA-64). Supported by CCI version 01-45-03/00 or later. (For VSP E series, VSP G1x00, VSP F1500, and VSP 5000 series only). On RHEL8.2 and RHEL8.4, a namespace for NVMe-oF is defined as a command device to support a configuration using in-band communication. The other RHEL versions and other OSs do not support this configuration. The VM environment is also not supported. 	

Applicable platforms for CCI on VM

The following table lists the applicable platforms for CCI on VM.

CCI can run on the guest OS of the version listed in the table or later. For the latest information on the OS versions and connectivity with storage systems, contact customer support.

VM vendor ¹	Layer	Guest OS ^{2, 3}	Volume mapping	I/O interface
VMware ESXi 6.x or later, VMware ESXi 7.x or later	Guest	Among the Platforms that use CCI (on page 14) , guest OS supported by VMWare.	RDM ⁴	Fibre/iSCSI

VM vendor ¹	Layer	Guest OS ^{2, 3}	Volume mapping	I/O interface
Windows Server 2012 Hyper-V For details, see Restrictions for Windows Hyper-V (Windows) (on page 22) .	Child	Windows Server 2012	Path-thru	Fibre
		SLES10 SP2	Path-thru	Fibre
Hitachi	Virtage (58-12)	RHEL5.4	Use LPAR	Fibre
Oracle VM 3.1 or later (Oracle VM Server for SPARC)	Guest	Solaris 11.1	See Restrictions for Oracle VM (on page 23)	See Restrictions for Oracle VM (on page 23)
HPVM 6.3 or later	Guest	HP-UX 11.3	Mapping by NPIV	Fibre
IBM® VIOS 2.2.0.0	VIOC	AIX® 7.1 TL01	Mapping by NPIV	Fibre
Notes: <ol style="list-style-type: none"> 1. VM must be versions listed in this table or later. 2. Service packs (SP), update programs, or patch programs are not considered as requirements if they are not listed. 3. Operations on the guest OS that is not supported by VM are not supported. 4. RDM: Raw Device Mapping using Physical Compatibility Mode is used. 				

Supported platforms for IPv6

The IPv6 functionality for CCI can be used on the OS versions listed in the following table or later. For details about the latest OS versions, refer to the Hitachi Vantara Product Compatibility Guide at <https://compatibility.hitachivantara.com/>.

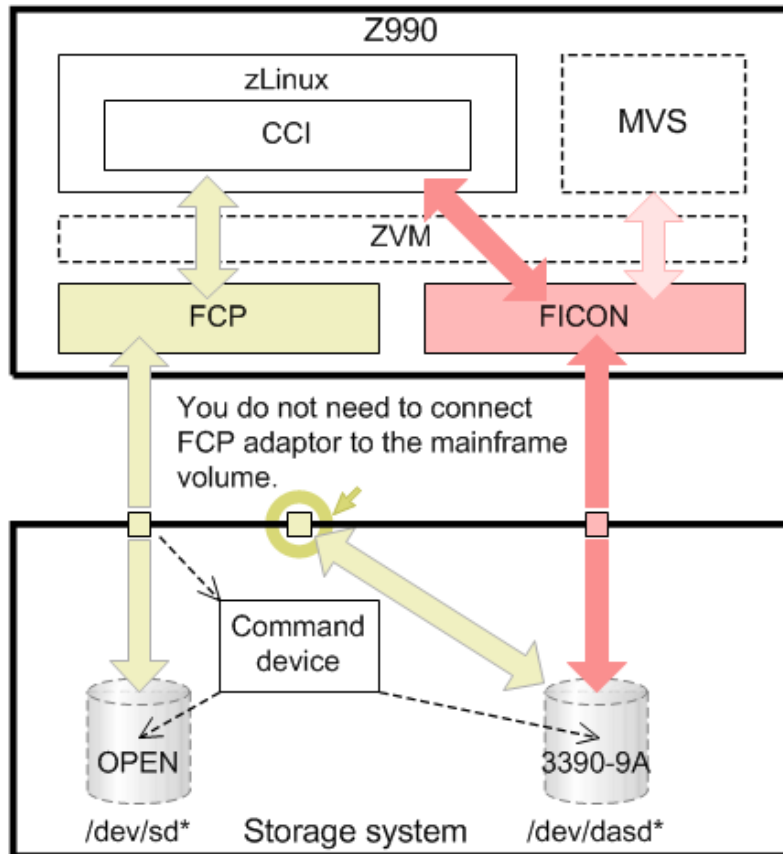
Vendor	OS ¹	IPv6 ²	IPv4 mapped to IPv6
Oracle	Solaris 10/11	Supported	Supported
	Solaris 10/11 on x86	Supported	Supported
	OEL 6.x	Supported	Supported
HP	HP-UX 11.23(PA/IA)	Supported	Supported

Vendor	OS ¹	IPv6 ²	IPv4 mapped to IPv6
IBM [®]	AIX [®] 6.x	Supported	Supported
	z/Linux (SUSE 8, SUSE 9) on Z990	Supported	Supported
Microsoft	Windows Server 2012 on x64	Supported	Not supported
Red Hat	RHEL6.x/7.x	Supported	Supported
Notes: <ol style="list-style-type: none"> 1. Service packs (SP), update programs, or patch programs are not considered as requirements if they are not listed. 2. For details about IPv6 support, see About platforms supporting IPv6 (on page 24). 			

Requirements and restrictions for CCI on z/Linux

In the following example, z/Linux defines the open volumes that are connected to FCP as `/dev/sd*`. Also, the mainframe volumes (3390-xx) that are connected to FICON[®] are defined as `/dev/dasd*`.

The following figure is an example of a CCI configuration on z/Linux.



The restrictions for using CCI with z/Linux are:

- **SSB information.** SSB information might not be displayed correctly.
- **Command device.** CCI uses a SCSI Path-through driver to access the command device. As such, the command device must be connected through FCP adaptors.
- **Open Volumes via FCP.** Same operation as the other operating systems.

- **Mainframe (3390-9A) Volumes via FICON®.** You cannot control the volumes (3390-9A) that are directly connected to FICON® for ShadowImage pair operations. Also, mainframe volumes must be mapped to a CHF(FCP) port to access target volumes using a command device, as shown in the above figure. The mainframe volume does not have to be connected to an FCP adaptor.



Note: ShadowImage supports only 3390-9A multiplatform volumes. TrueCopy and Universal Replicator do not support multiplatform volumes (including 3390-9A) via FICON®.

- **Volume discovery via FICON®.** When you discover volume information, the **inqraid** command uses SCSI inquiry. Mainframe volumes connected by FICON® do not support the SCSI interface. Because of this, information equivalent to SCSI inquiry is obtained through the mainframe interface (Read_device_characteristics or Read_configuration_data), and the available information is displayed similarly as the open volume. As a result, information displayed by executing the **inqraid** command cannot be obtained, as shown below. Only the last five digits of the FICON® volume's serial number, which is displayed by the **inqraid** command, are displayed.

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

The **inqraid** command displays only five-digit number at the end of serial number of the FICON® volume.

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

- C019: Serial number
- 3390: System type
- 0A: System model

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

- `raidscan -pd <raw_device>`
- `raidar -pd <raw_device>`
- `raidvchkscan -pd <raw_device>`
- `raidscan -find`
- `raidscan -find conf`
- `mkconf`

Requirements and restrictions for CCI on Windows 8.1, Windows 10, and Windows 11

When you use CCI on Windows 8.1, Windows 10, or Windows 11, you cannot use some commands, subcommands, and command options.

The following commands are not supported when using CCI on Windows 8.1, Windows 10, and Windows 11:

- `inqraid`
- `mkconf`

The following subcommands are not supported when using CCI on Windows 8.1, Windows 10, and Windows 11:

- `findcmddev`
- `drivescan`
- `portscan`
- `sync, syncd`
- `mount`

The following command options are not supported when using CCI on Windows 8.1, Windows 10, and Windows 11:

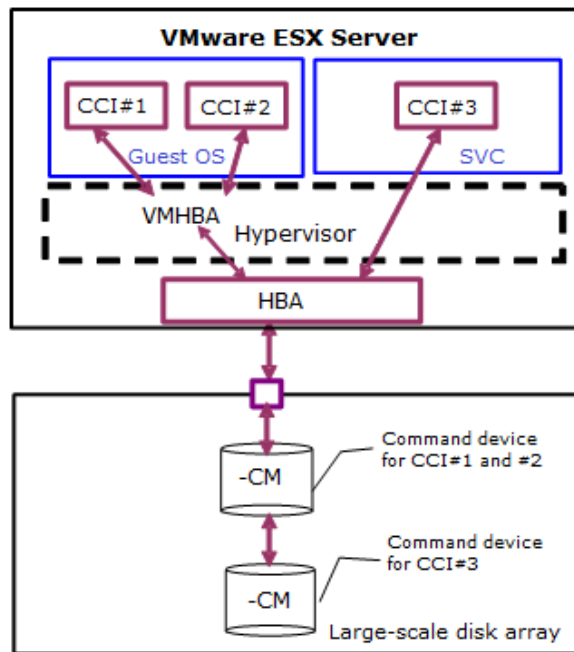
- `-d[g] <raw_device> [MU#]`
- `-d[g] <seq#> <LDEV#> [MU#]`
- `-find [op] [MU#]`
- `-find[g]`
- `-pd[g] <raw_device> [mun]`

Requirements and restrictions for CCI on VM

Restrictions for VMware ESX Server

Whether CCI can run properly depends on the support of guest OS by VMware. In addition, the guest OS depends on VMware support of virtual hardware (HBA). Therefore, the guest OS supporting VMware and supported by CCI (such as Windows Server, Red Hat Linux, or SUSE Linux) must be used, and the restrictions below must be followed when using CCI on VMware.

The following figure shows the CCI configuration on guest OS/VMware.



The restrictions for using CCI with VMware are:

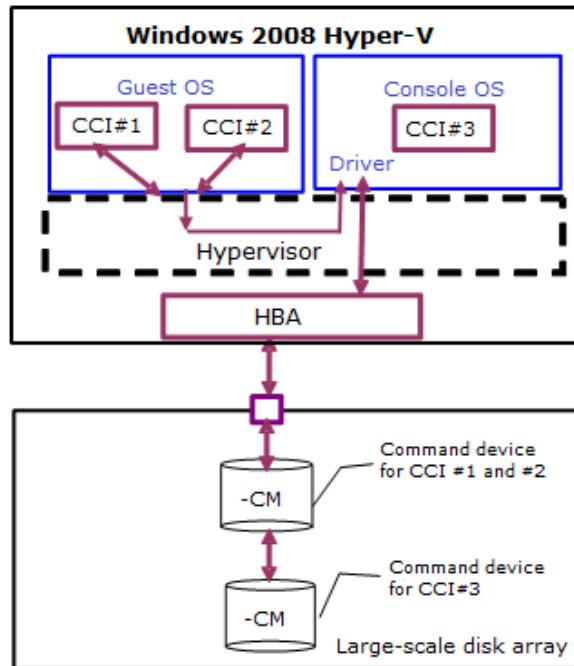
- **Guest OS.** CCI needs to use guest OS that is supported by CCI, and also VMware supported guest OS (for example, Windows, Red Hat Linux). For specific support information, refer to the Hitachi Vantara Product Compatibility Guide at <https://compatibility.hitachivantara.com/>.
- **Command device.** CCI uses SCSI path-through driver to access the command device. Therefore, the command device must be mapped as Raw Device Mapping using Physical Compatibility Mode. At least one command device must be assigned for each guest OS.

CCI instance numbers among different guest OS must be different, even if the command device is assigned for each guest OS, because the command device cannot distinguish a difference among guest OS due to the same WWN as VMHBA.
- **About invisible LUN.** Assigned LUN for the guest OS must be visible from SCSI Inquiry when VMware (host OS) is started. For example, the S-VOL on VSS is used as Read Only and Hidden, and this S-VOL is hidden from SCSI Inquiry. If VMware (host OS) is started on this volume state, the host OS will hang.
- **LUN sharing between Guest and Host OS.** It is not supported to share a command device or a normal LUN between guest OS and host OS.
- **About running on SVC.** The ESX Server 3.0 SVC (service console) is a limited distribution of Linux based on Red Hat Enterprise Linux 3, Update 6 (RHEL 3 U6). The service console provides an execution environment to monitor and administer the entire ESX Server host. The CCI user can run CCI by installing "CCI for Linux" on SVC. The volume mapping (`/dev/sd`) on SVC is a physical connection without converting SCSI Inquiry, so CCI will perform like running on Linux regardless of guest OS. However, VMware protects the service console with a firewall. According to current documentation, the firewall allows only PORT# 902, 80, 443, 22(SSH) and ICMP(ping), DHCP, DNS as defaults, so the CCI user must enable a PORT for CCI (HORCM) using the iptables command.

Restrictions for Windows Hyper-V (Windows)

Whether CCI can run properly depends on the support of the guest OS by Windows Hyper-V, and then the guest OS depends on how Hyper-V supports front-end SCSI interfaces.

The following figure shows the CCI configuration on Hyper-V.



The restrictions for using CCI on Hyper-V are:

- **Guest OS.** CCI needs to use the guest OS that is supported by CCI and also the Hyper-V supported guest OS (for example, Windows Server, SUSE Linux). For specific support information, refer to the Hitachi Vantara Product Compatibility Guide at <https://compatibility.hitachivantara.com/>.
- **Command device.** CCI uses the SCSI path-through driver to access the command device. Therefore the command device must be mapped as RAW device of the path-through disk. At least one command device must be assigned for each guest OS (Child Partition).

The CCI instance number among different guest OSs must be used as a different instance number even if the command is assigned for each guest OS. This is because the command device cannot distinguish a difference among the guest OSs because the same WWN via Fscsi is used.

- **LUN sharing between guest OS and console OS.** It is not possible to share a command device as well as a normal LUN between a guest OS and a console OS.
- **Running CCI on console OS.** The console OS (management OS) is a limited Windows, like Windows Server, and the Windows standard driver is used. Also the console OS provides an execution environment to monitor and administer the entire Hyper-V host.

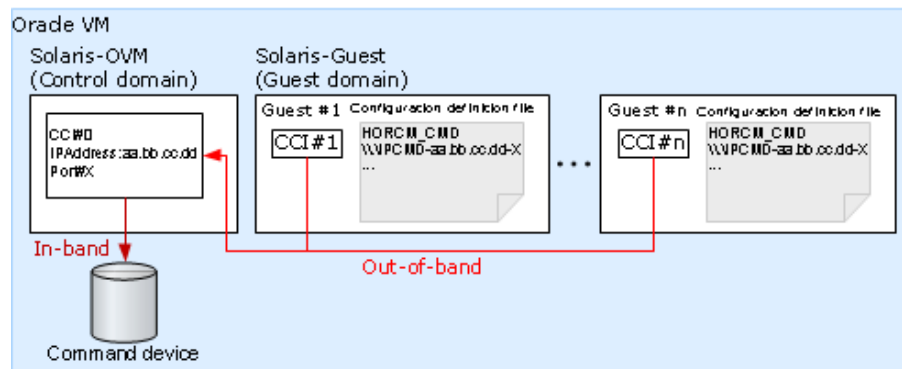
Therefore, you can run CCI by installing "CCI for Windows NT" on the console OS. In that case, the CCI instance number between the console OS and the guest OS must be a different instance number, even if the command is assigned for each console and guest OS.

Restrictions for Oracle VM

Whether Command Control Interface can run properly depends on the guest OS supported by Oracle VM.

The restrictions for using CCI with Oracle VM are:

- **Guest OS.** CCI must use the guest OS supported by CCI and the guest OS supported by Oracle VM.
- **Command device.** You cannot connect the command device of Fibre Channel directly to the guest OS. If you have to execute commands by the in-band method, you must configure the system as shown in the following figure.



In this configuration, CCI on the guest domain (CCI#1 to CCI#n) transfers the command to another CCI on the control domain (CCI#0) by an Out-of-Band method. CCI#0 executes the command by In-Band method, and then transfer the result to CCI#1 to CCI#n. CCI#0 fulfills the same role as a virtual command device in the SVP/GUM/CCI server.

- **Volume mapping.** Volumes on the guest OS must be mapped physically to the LDEVs on the disk machine.
- **System disk.** If you specify the OS system disk as an object of copying, the OS might not start on the system disk of the copy destination.

About platforms supporting IPv6

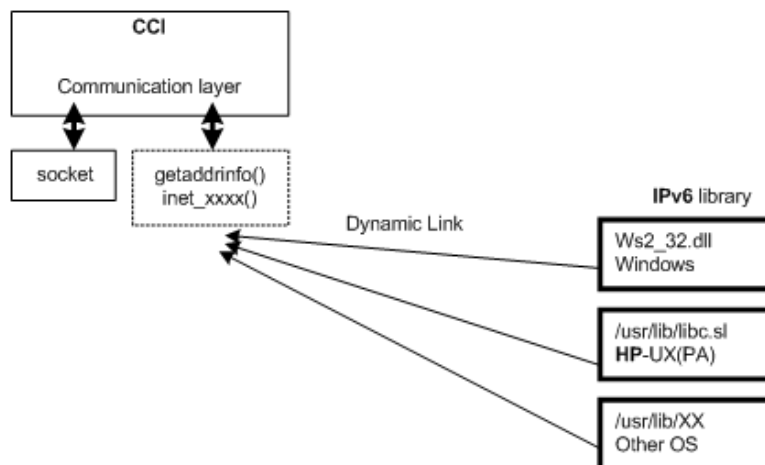
Library and system call for IPv6

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

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

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

The following figure shows the library and system call for IPv6.



Environment variables for IPv6

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

- For Windows systems: `Ws2_32.dll`
- For HP-UX (PA/IA) systems: `/usr/lib/libc.sl`

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

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

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

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

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

HORCM start-up log for IPv6

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

/HORCM/log/curlog/horcm_HOST NAME.log

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

Startup procedures using detached process on DCL for OpenVMS

Procedure

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

CCI needs to define the physical device (**\$1\$DGA145...**) as either DG* or DK* or GK* by using the **show device** and **DEFINE/SYSTEM** commands, but then does not need to be mounted in CCI version 01-12-03/03 or earlier.

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

2. Define the CCI environment in LOGIN.COM.

You need to define the Path for the CCI commands to **DCL\$PATH** as the foreign command. See the section about Automatic Foreign Commands in the OpenVMS user documentation.

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

If CCI and HORCM are executing in different jobs (different terminal), then you must redefine **LN\$TEMPORARY_MAILBOX** in the **LN\$PROCESS_DIRECTORY** table as follows:

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

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

```
$ inqraid DKA145-151 -CLI
DEVICE_FILE PORT  SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID
DKA145      CL1-H   30009 145  -    -    -      -    OPEN-9-CM
DKA146       CL1-H    30009  146  -  s/S/ss 0004 5:01-11 OPEN-9
DKA147       CL1-H    30009  147  -  s/P/ss 0004 5:01-11 OPEN-9
DKA148       CL1-H    30009  148  -  s/S/ss 0004 5:01-11 OPEN-9
DKA149       CL1-H    30009  149  -  s/P/ss 0004 5:01-11 OPEN-9
DKA150       CL1-H    30009  150  -  s/S/ss 0004 5:01-11 OPEN-9
DKA151       CL1-H    30009  151  -  s/P/ss 0004 5:01-11 OPEN-9
SYS$POSIX_ROOT:[etc]horcm0.conf
HORCM_MON
#ip_address      service          poll(10ms)      timeout(10ms)
127.0.0.1        30001            1000             3000
HORCM_CMD
```

```
#dev_name      dev_name      dev_name
DKA145
```

You will have to start HORCM without a description for HORCM_DEV and HORCM_INST because the target ID and LUN are Unknown. You can determine a mapping of a physical device with a logical name easily by using the **raidscan -find** command.

4. Execute an 'horcmstart 0'.

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

5. Verify a physical mapping of the logical device.

```
$ HORCMINST := 0
$ raidscan -pi DKA145-151 -find
DEVICE_FILE      UID  S/F  PORT  TARG  LUN  SERIAL  LDEV  PRODUCT_ID
DKA145           0   F   CL1-H  0     1   30009   145   OPEN-9-CM
DKA146           0   F   CL1-H  0     2   30009   146   OPEN-9
DKA147           0   F   CL1-H  0     3   30009   147   OPEN-9
DKA148           0   F   CL1-H  0     4   30009   148   OPEN-9
DKA149           0   F   CL1-H  0     5   30009   149   OPEN-9
DKA150           0   F   CL1-H  0     6   30009   150   OPEN-9
DKA151           0   F   CL1-H  0     7   30009   151   OPEN-9

$ horcmshutdown 0
inst 0:
HORCM Shutdown inst 0 !!!
```

6. Describe the known HORCM_DEV on SYS\$POSIX_ROOT:[etc]horcm*.conf.

For horcm0.conf

```
HORCM_DEV
#dev_group  dev_name  port#  TargetID  LU#  MU#
VG01        oradb1    CL1-H  0         2    0
VG01        oradb2    CL1-H  0         4    0
VG01        oradb3    CL1-H  0         6    0

HORCM_INST
#dev_group  ip_address  service
VG01        HOSTB      horcm1
```

For horcm1.conf

```
HORCM_DEV
#dev_group  dev_name  port#  TargetID  LU#  MU#
VG01        oradb1    CL1-H  0         3    0
VG01        oradb2    CL1-H  0         5    0
VG01        oradb3    CL1-H  0         7    0
```

```

HORCM_INST
#dev_group      ip_address      service
VG01            HOSTA           horcm0

```

Defines the UDP port name for HORCM communication in the SYS\$SYSROOT:
[000000.TCPIP\$ETC]SERVICES.DAT file, as in the example below.

```
horcm0 30001/udp horcm1 30002/udp
```

7. Start horcm0 and horcm1 as the Detached process.

```

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

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

```

You can verify that HORCM daemon is running as Detached Process by using the **show process** command.

```

$ show process horcm0
25-MAR-2003 23:27:27.72  User: SYSTEM      Process ID: 0004160
                        Node: VMS4        Process name:"HORCM0"

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

Soft CPU Affinity: off

```

Command examples in DCL for OpenVMS

(1) Setting the environment variable by using Symbol

```

$ HORCMINST := 0$ HORCC_MRCF := 1
$ raidqry -l
No Group  Hostname  HORCM_ver  Uid  Serial#  Micro_ver  Cache(MB)
1 ---    VMS4      01-29-03/05  0    30009    50-04-00/00  8192
$
$ pairedisplay -g VG01 -fdc
Group PairVol(L/R) Device_File M,Seq#,LDEV#.P/S,Status, % ,P-LDEV# M
VG01 oradb1(L)    DKA146    0 30009 146..S-VOL PAIR, 100 147 -

```

```

VG01  oradb1(R)      DKA147      0 30009  147..P-VOL PAIR, 100  146 -
VG01  oradb2(L)      DKA148      0 30009  148..S-VOL PAIR, 100  149 -
VG01  oradb2(R)      DKA149      0 30009  149..P-VOL PAIR, 100  148 -
VG01  oradb3(L)      DKA150      0 30009  150..S-VOL PAIR, 100  151 -
VG01  oradb3(R)      DKA151      0 30009  151..P-VOL PAIR, 100  150 -
$

```

(2) Removing the environment variable

```

$ DELETE/SYMBOL HORCC_MRCF
$ pairdisplay -g VG01 -fdc
Group PairVol(L/R) Device_File ,Seq#,LDEV#.P/S,Status,Fence, % ,P-LDEV# M
VG01 oradb1(L) DKA146 30009 146..SMPL ---- -,----- ---- -
VG01 oradb1(R) DKA147 30009 147..SMPL ---- -,----- ---- -
VG01 oradb2(L) DKA148 30009 148..SMPL ---- -,----- ---- -
VG01 oradb2(R) DKA149 30009 149..SMPL ---- -,----- ---- -
VG01 oradb3(L) DKA150 30009 150..SMPL ---- -,----- ---- -
VG01 oradb3(R) DKA151 30009 151..SMPL ---- -,----- ---- -
$

```

(3) Changing the default log directory

```

$ HORCC_LOG := /horcm/horcm/TEST
$ pairdisplay
PAIRDISPLAY: requires '-x xxx' as argument
PAIRDISPLAY: [EX_REQARG] Required Arg list
Refer to the command log(SYS$POSIX_ROOT:[HORCM.HORCM.TEST]HORCC_VMS4.LOG (/HORCM
/HORCM/TEST/horcc_vms4.log)) for details.

```

(4) Turning back to the default log directory

```

$ DELETE/SYMBOL HORCC_LOG

```

(5) Specifying the device described in scandev.LIS

```

$ define dev_file SYS$POSIX_ROOT:[etc]SCANDEV
$ type dev_file
DKA145-150
$
$ pipe type dev_file | inqraid -CLI
DEVICE_FILE  PORT  SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID
DKA145      CL1-H  30009  145  -   -   -   -   - OPEN-9-CM
DKA146      CL1-H  30009  146  -   s/S/ss 0004 5:01-11 OPEN-9
DKA147      CL1-H  30009  147  -   s/P/ss 0004 5:01-11 OPEN-9
DKA148      CL1-H  30009  148  -   s/S/ss 0004 5:01-11 OPEN-9
DKA149      CL1-H  30009  149  -   s/P/ss 0004 5:01-11 OPEN-9
DKA150      CL1-H  30009  150  -   s/S/ss 0004 5:01-11 OPEN-9

```

(6) Making the configuration file automatically

You can omit steps from (3) to (6) on the Start-up procedures by using the mkconf command.

```
$ type dev_file
DKA145-150
$
$ pipe type dev_file | mkconf -g URA -i 9
starting HORCM inst 9
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
HORCM inst 9 finished successfully.
starting HORCM inst 9
```

DEVICE_FILE	Group	PairVol	PORT	TARG	LUN	M	SERIAL	LDEV
DKA145	-	-	-	-	-	-	30009	145
DKA146	URA	URA_000	CL1-H	0	2	0	30009	146
DKA147	URA	URA_001	CL1-H	0	3	0	30009	147
DKA148	URA	URA_002	CL1-H	0	4	0	30009	148
DKA149	URA	URA_003	CL1-H	0	5	0	30009	149
DKA150	URA	URA_004	CL1-H	0	6	0	30009	150

```
HORCM Shutdown inst 9 !!!
Please check 'SYS$SYSROOT:[SYSMGR]HORCM9.CONF', 'SYS$SYSROOT:[SYSMGR.LOG9.CURLOG]
HORCM_*.LOG', and modify 'ip_address & service'.
HORCM inst 9 finished successfully.
$
SYS$SYSROOT:[SYSMGR]horcm9.conf (/sys$sysroot/sysmgr/horcm9.conf)

# Created by mkconf on Thu Mar 13 20:08:41

HORCM_MON
#ip_address      service      poll(10ms)      timeout(10ms)
127.0.0.1        52323                1000              3000

HORCM_CMD
#dev_name        dev_name        dev_name
#UnitID 0 (Serial# 30009)
DKA145

# ERROR [CMDDEV] DKA145          SER =      30009  LDEV =  145 [ OPEN-9-CM
HORCM_DEV
#dev_group  dev_name      port#      TargetID      LU#      MU#
# DKA146      SER =      30009  LDEV =  146 [ FIBRE FCTBL = 3 ]
URA          URA_000      CL1-H              0          2          0
# DKA147      SER =      30009  LDEV =  147 [ FIBRE FCTBL = 3 ]
URA          URA_001      CL1-H              0          3          0
# DKA148      SER =      30009  LDEV =  148 [ FIBRE FCTBL = 3 ]
URA          URA_002      CL1-H              0          4          0
# DKA149      SER =      30009  LDEV =  149 [ FIBRE FCTBL = 3 ]
URA          URA_003      CL1-H              0          5          0
# DKA150      SER =      30009  LDEV =  150 [ FIBRE FCTBL = 3 ]
URA          URA_004      CL1-H              0          6          0
```

```

HORCM_INST
#dev_group      ip_address      service
URA            127.0.0.1        52323

```

(7) Using \$1\$* naming as native device name

You can use the native device without DEFINE/SYSTEM command by specifying \$1\$* naming directly.

```

$ inqraid $1$DGA145-155 -CLI
DEVICE_FILE  PORT  SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID
$1$DGA145    CL2-H  30009  145  -   -   -   -   OPEN-9-CM
$1$DGA146    CL2-H  30009  146  - s/P/ss 0004 5:01-11 OPEN-9
$1$DGA147    CL2-H  30009  147  - s/S/ss 0004 5:01-11 OPEN-9
$1$DGA148    CL2-H  30009  148  0 P/s/ss 0004 5:01-11 OPEN-9

$ pipe show device | INQRAID -CLI
DEVICE_FILE  PORT  SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID
$1$DGA145    CL2-H  30009  145  -   -   -   -   OPEN-9-CM
$1$DGA146    CL2-H  30009  146  - s/P/ss 0004 5:01-11 OPEN-9
$1$DGA147    CL2-H  30009  147  - s/S/ss 0004 5:01-11 OPEN-9
$1$DGA148    CL2-H  30009  148  0 P/s/ss 0004 5:01-11 OPEN-9

$ pipe show device | MKCONF -g URA -i 9
starting HORCM inst 9
HORCM Shutdown inst 9 !!!
A CONFIG file was successfully completed.
HORCM inst 9 finished successfully.
starting HORCM inst 9
DEVICE_FILE  Group  PairVol  PORT  TARG  LUN M  SERIAL  LDEV
$1$DGA145    -      -        -      -      - -   30009  145
$1$DGA146    URA    URA_000  CL2-H  0      2 0   30009  146
$1$DGA147    URA    URA_001  CL2-H  0      3 0   30009  147
$1$DGA148    URA    URA_002  CL2-H  0      4 0   30009  148
HORCM Shutdown inst 9 !!!
Please check 'SYS$SYSROOT:[SYSMGR]HORCM9.CONF', 'SYS$SYSROOT:[SYSMGR.LOG9.CURLOG]
HORCM_*.LOG', and modify 'ip_address & service'.
HORCM inst 9 finished successfully.
$

$ pipe show device | RAIDSCAN -find
DEVICE_FILE  UID  S/F PORT  TARG  LUN  SERIAL  LDEV  PRODUCT_ID
$1$DGA145    0   F  CL2-H  0      1   30009  145  OPEN-9-CM
$1$DGA146    0   F  CL2-H  0      2   30009  146  OPEN-9
$1$DGA147    0   F  CL2-H  0      3   30009  147  OPEN-9
$1$DGA148    0   F  CL2-H  0      4   30009  148  OPEN-9

$ pairedisplay -g BCFG -fdc
Group PairVol(L/R) Device_File M ,Seq#,LDEV#..P/S,Status, % ,P-LDEV# M
BCVG oradb1(L) $1$DGA146 0 30009 146..P-VOL PAIR, 100 147 -

```

```
BCVG oradb1(R) $1$DGA147 0 30009 147..S-VOL PAIR, 100 146 -
$
$ pairdisplay -dg $1$DGA146
Group PairVol(L/R) (Port#,TID, LU-M) ,Seq#,LDEV#..P/S,Status, Seq#,P-LDEV# M
BCVG oradb1(L) (CL1-H,0, 2-0) 30009 146..P-VOL PAIR, 30009 147 -
BCVG oradb1(R) (CL1-H,0, 3-0) 30009 47..S-VOL PAIR, ----- 146 -
$
```

Start-up procedures in bash for OpenVMS

Do not use CCI through the bash, because the bash is not provided as an official release in OpenVMS.

Procedure

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

You need to define the Physical device (**\$1\$DGA145...**) as either DG* or DK* or GK* by using the **show device** command and the **DEFINE/SYSTEM** command, but then it does not need to be mounted.

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

2. Define the CCI environment in LOGIN.COM.

If CCI and HORCM are executing in different jobs (different terminal), then you must redefine **LNMT\$TEMPORARY_MAILBOX** in the **LNMT\$PROCESS_DIRECTORY** table as follows:

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

3. Discover and describe the command device on `/etc/horcm0.conf`.

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


DKA149	CL1-H	30009	149	- s/P/ss	0004	5:01-11	OPEN-9
DKA150	CL1-H	30009	150	- s/S/ss	0004	5:01-11	OPEN-9
DKA151	CL1-H	30009	151	- s/P/ss	0004	5:01-11	OPEN-9

/etc/horcm0.conf

```

HORCM_MON
#ip_address      service      poll(10ms)      timeout(10ms)
127.0.0.1        52000          1000             3000

HORCM_CMD
#dev_name        dev_name        dev_name
DKA145

HORCM_DEV
#dev_group       dev_name        port#           TargetID        LU#           MU#

HORCM_INST
#dev_group       ip_address      service

```

You will have to start HORCM without a description for HORCM_DEV and HORCM_INST **because target ID and LUN are Unknown**. You can determine a mapping of a physical device with a logical name easily by using the **raidscan -find** command.

4. Execute an 'horcmstart 0' as background.

```

bash$ horcmstart 0 &
18
bash$
      starting HORCM inst 0

```

5. Verify a physical mapping of the logical device.

```

bash$ export HORCMINST=0
bash$ raidscan -pi DKA145-151 -find
DEVICE_FILE  UID  S/F PORT  TARG  LUN  SERIAL  LDEV  PRODUCT_ID
DKA145       0   F  CL1-H    0     1   30009   145   OPEN-9-CM
DKA146       0   F  CL1-H    0     2   30009   146   OPEN-9
DKA147       0   F  CL1-H    0     3   30009   147   OPEN-9
DKA148       0   F  CL1-H    0     4   30009   148   OPEN-9
DKA149       0   F  CL1-H    0     5   30009   149   OPEN-9
DKA150       0   F  CL1-H    0     6   30009   150   OPEN-9
DKA151       0   F  CL1-H    0     7   30009   151   OPEN-9

```

6. Describe the known HORCM_DEV on /etc/horcm*.conf.

For horcm0.conf

```

HORCM_DEV
#dev_group    dev_name    port#    TargetID    LU#    MU#
VG01         oradb1     CL1-H      0         2      0

```

```

VG01      oradb2      CL1-H      0      4      0
VG01      oradb3      CL1-H      0      6      0
HORCM_INST
#dev_group      ip_address      service
VG01      HOSTB      horcm1

```

For horcm1.conf

```

HORCM_DEV
#dev_group      dev_name      port#      TargetID      LU#      MU#
VG01      oradb1      CL1-H      0      3      0
VG01      oradb2      CL1-H      0      5      0
VG01      oradb3      CL1-H      0      7      0
HORCM_INST
#dev_group      ip_address      service
VG01      HOSTA      horcm0

```

7. Start 'horcmstart 0 1'.

The subprocess(HORCM) created by bash is terminated when the bash is EXIT.

```

bash$ horcmstart 0 &
19
bash$
      starting HORCM inst 0
bash$ horcmstart 1 &
20
bash$
      starting HORCM inst 1

```

Using CCI with Hitachi and other storage systems

The following table shows the related two controls between CCI and the RAID storage system type (Hitachi or HPE). The following figure shows the relationship between the application, CCI, and RAID storage system.

VSP 5000 series, Virtual Storage Platform F1500, VSP G1x00

Version	Installation order	RAID system	Common API/CLI	XP API/CLI
CCI 01-08-03/00 or later	CCI	Hitachi	Allowed	Cannot use (CLI options can be used)
		HPE	Allowed ¹	
	Install CCI after installing RAID Manager XP	Hitachi	Allowed	
		HPE	Allowed	

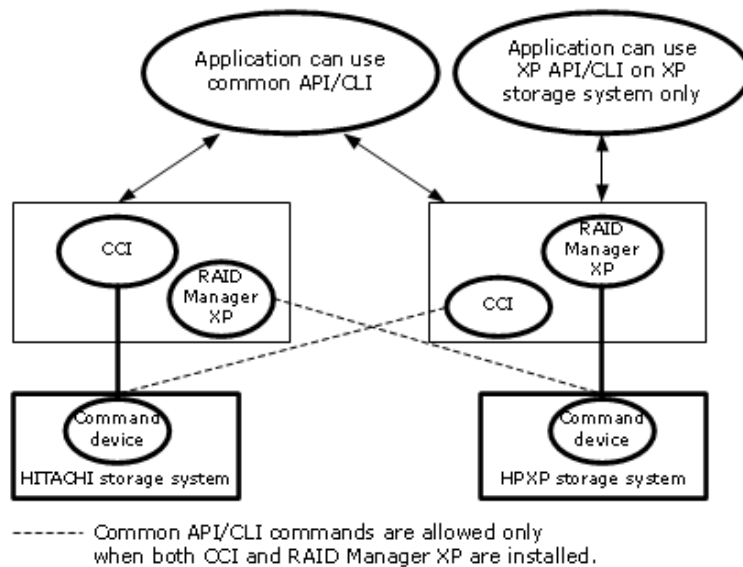
Version	Installation order	RAID system	Common API/CLI	XP API/CLI
RAID Manager XP 01.08.00 or later (provided by HPE)	RAID Manager XP	HPE	Allowed	Allowed
		Hitachi	Allowed ¹	Allowed ²
	Install RAID Manager XP after installing CCI	HPE	Allowed	Allowed
		Hitachi	Allowed	Allowed ²

Notes:

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

horctakeover, paircurchk, paircreate, pairsplit, pairresync, pairvolchk, pairevtwait, pairdisplay, raidscan (except the **-find** option), **raidar, raidvchkset, raidvchkdsp, raidvchkscan**
- The following XP API/CLI commands are rejected with EX_ERPERM on the storage system even when both CCI and RAID Manager XP (provided by HPE) are installed:

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



Chapter 2: Installing and configuring CCI

You must install and configure CCI hardware and software before using CCI.

Installing the CCI hardware

Installation of the hardware required for CCI is performed by the user and the Hitachi Vantara representative.

Procedure

1. User:
 - a. Make sure that the UNIX/PC server hardware and software are properly installed and configured. For specific support information, refer to the Hitachi Vantara Product Compatibility Guide at <https://compatibility.hitachivantara.com/>.
 - b. If you will be performing remote replication operations (for example, Universal Replicator, TrueCopy), identify the primary and secondary volumes, so that the hardware and software components can be installed and configured properly.
2. Hitachi Vantara representative or user:
 - a. Connect the RAID storage systems to the hosts. For the host group or FC-NVMe subsystem used for host connection, you need to set the appropriate host mode and host mode options for the host to connect to. For details on the host modes and host mode options, see the Provisioning Guide.
 - b. Configure the RAID storage systems that will contain primary volumes for replication to report sense information to the hosts.
 - c. Set the SVP time to the local time so that the time stamps are correct. For VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800, use the maintenance utility to set the system date and time to the local time.
 - d. Remote replication: Install the remote copy connections between the RAID storage systems. For detailed information, see the applicable user guide (for example, *Hitachi Universal Replicator User Guide*).
3. User and Hitachi Vantara representative:
 - a. Ensure that the storage systems are accessible via Hitachi Device Manager - Storage Navigator. For details, see the *System Administrator Guide* for your storage system.
 - b. (Optional) Ensure that the storage systems are accessible by the management software (for example, Hitachi Ops Center Administrator, Hitachi Command Suite). For details, see the user documentation for the software product.

- c. Install and enable the applicable license key of your program product (for example, TrueCopy, ShadowImage, LUN Manager, Universal Replicator for Mainframe, Data Retention Utility) on the storage systems. For details about installing license keys, see the *System Administrator Guide* or *Storage Navigator User Guide*.
4. User: Configure the RAID storage systems for operations as described in the user documentation. For example, before you can create TrueCopy volume pairs using CCI, you need to configure the ports on the storage systems and establish the MCU-RCU paths.

Installing the CCI software

To install CCI, log in with "root user" or "administrator" privileges. The login user type is determined by the operating system. You can install the CCI software on the host servers with assistance as needed from the Hitachi Vantara representative.

The installation must be done in the following order:

1. Install the CCI software.
2. Set the command device.
3. Create the configuration definition files.
4. Set the environmental variables.

UNIX installation

If you are installing CCI from the media for the program product, use the RMinstsh and RMuninst scripts on the program product media to automatically install and remove the CCI software. (For LINUX/IA64 or LINUX/X64, move to the LINUX/IA64 or LINUX/X64 directory and then execute `../RMinstsh`.)

For other media, use the following instructions as given below in the two methods. The following instructions refer to UNIX commands that might be different on your platform. Consult your OS documentation (for example, UNIX man pages) for platform-specific command information.

Installing the CCI software into the root directory

Procedure

1. Insert the installation media into the I/O device properly.
2. Move to the current root directory: `# cd /`
3. Copy all files from the installation media using the `cpio` command:

```
# cpio -idmu < /dev/XXXX
```

where `XXXX` = I/O device

Preserve the directory structure (d flag) and file modification times (m flag), and copy unconditionally (u flag).

4. Execute the CCI installation command:

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

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

```
# raidqry -h
Model: RAID-Manager/HP-UX
Ver&Rev: 01-40-03/03
Usage: raidqry [options]
```

Installing the CCI software into a non-root directory

Procedure

1. Insert the installation media 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 media using the **cpio** command:

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

Preserve the directory structure (d flag) and file modification times (m flag), and copy unconditionally (u flag).

4. Make a symbolic link for /HORCM:

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

5. Execute the CCI installation command:

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

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

```
# raidqry -h
Model: RAID-Manager/HP-UX
Ver&Rev: 01-40-03/03
Usage: raidqry [options]
```

Changing the CCI user (UNIX systems)

Just after installation, CCI can be operated only by the root user. When operating CCI by assigning a different user for CCI management, you need to change the owner of the CCI directory and owner's privilege, specify environment variables, and so on. Use the following procedure to change the configuration to allow a different user to operate CCI.

Procedure

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
 - /HORCM/log directory
 - All CCI log directories in the /HORCM/log* directories
 - /HORCM/.uds directory
 - /HORCM/usr/var directory
2. Give the newly assigned user the privilege of writing to the following CCI directories:
 - /HORCM/log
 - /HORCM/log* (when the /HORCM/log* directory exists)
 - /HORCM (when the /HORCM/log* directory does not exist)
3. Change the owner of the raw device file of the HORCM_CMD (control device) command device in the configuration definition file from the root user to the desired user name.
4. Optional: Establishing the HORCM (/etc/horcmgr) start environment: If you have designation of the full environment variables (HORCM_LOG HORCM_LOGS), then start the horcmstart.sh command without an argument. In this case, the HORCM_LOG and HORCM_LOGS directories must be owned by the CCI administrator. The environment variable (HORCMINST, HORCM_CONF) establishes as the need arises.
5. Optional: Establishing the command execution environment: If you have designation of the environment variables (HORCC_LOG), then the HORCC_LOG directory must be owned by the CCI administrator. The environment variable (HORCMINST) establishes as the need arises.
6. Establish UNIX domain socket: If the execution user of CCI is different from user of the command, a system administrator needs to change the owner of the following directory, which is created at each HORCM (/etc/horcmgr) start-up:
 - /HORCM/.uds/.lcmcl directory

To reset the security of UNIX domain socket to OLD version, perform the following:

 - a. Give writing permission to /HORCM/.uds directory.
 - b. Start horcmstart.sh ., and set the "HORCM EVERYCLI=1" environment variable.

Next steps



Note: In UNIX systems, to access command devices, you need to set user privileges for CCI management you created in addition to the root user (depending on the operating system). For some operating system versions, you do not need to set privileges.

The following are examples for each operating system:

For Linux: 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, you 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 CCI command.

For AIX: AIX® does not allow `ioctl()` with the exception of the root user. CCI tries to use `ioctl(DK_PASSTHRU)` or `SCSI_Path_thru` as much as possible, if it fails, changes to `RAW_IO` follows conventional ways. Even so, CCI might encounter the AIX® FCP driver, which does not support `ioctl(DK_PASSTHRU)` fully in the customer site. After this consideration, CCI also supports by defining either the following environment variable or `/HORCM/etc/USE_OLD_IOCTLfile(size=0)` that uses the RAW_IO forcibly.

For Solaris: You need to set the `sys_devices` privilege so that both the user for CCI management (general user) created in Solaris 10 or 11 and the root user can recognize command devices of the storage system.

To set the `sys_devices` privilege for a general user, such as username, perform the following steps:

1. As a user, perform the `ppriv $$` command to check the privileges status.

Example:

```
% ppriv $$
1234: /bin/csh
flags = <none>
E: basic
I: basic
P: basic
L: all
```

2. As a system administrator (root), execute the following command to set the

sys_devices privilege for the user.

```
# usermod -K defaultpriv=basic,sys_devices username
```

3. Log in again as the user, and then execute the `ppriv $$` command to make sure that the sys_devices privilege is set.

Example:

```
% ppriv $$
1234: /bin/csh
flags = <none>
E: basic,sys_devices
I: basic,sys_devices
P: basic,sys_devices
L: all
```

Example

```
export USE_OLD_IOCTL=1
horcmstart.sh 10
HORCM/etc:
-rw-r--r--  1 root root      0 Nov 11 11:12 USE_OLD_IOCTL
-r--r--r--  1 root sys    32651 Nov 10 20:02 horcm.conf
-r-xr--r--  1 root sys   282713 Nov 10 20:02 horcmgr
```

Windows installation

Use this procedure to install CCI on a Windows system.

Make sure to install CCI on all servers involved in CCI operations.



Caution:

- Installing CCI in multiple drives is not recommended. If you install CCI in multiple drives, CCI installed in the smallest drive might be used preferentially.
- If CCI is already installed and you are upgrading or downgrading the CCI version, you must remove the installed version first and then install the new version. For instructions, see [Upgrading or downgrading CCI in a Windows environment \(on page 61\)](#).

Before you begin

The network of Windows attachment with TCP/IP protocol must already be installed and established.

Procedure

1. Insert the media for the product into the proper I/O device.

2. Execute `Setup.exe` (`\program\RM\WIN_NT\RMHORC\Setup.exe` or `\program\RM\WIN_NT\RMHORC_X64\Setup.exe` on the CD), and follow the instructions on the screen to complete the installation. The installation directory is HORCM (fixed value) at the root directory.
3. Reboot the Windows server, and then start up CCI.
A warning message for security might appear at the initial start-up depending on the OS settings. Specify "Temporarily Allow" or "Always Allow" in the dialog box.
4. Verify that the correct version of the CCI software is running on your system by executing the **raidqry** command:

```
D:\HORCM\etc> raidqry -h
Model: RAID-Manager/WindowsNT
Ver&Rev: 01-41-03/xx
Usage: raidqry [options] for HORC
```



Note: If CCI with CCI version 01-68-03/00 or later is installed, the CCI version applies to the CCI version information displayed in the **Programs and Features** window in Control Panel in Windows. Make sure to verify that the installed CCI version applies to the CCI version information.

Next steps

Users who execute CCI commands need "administrator" privileges and the right to access the log directory and the files in it. For instructions on specifying a CCI administrator, see [Changing the CCI user \(Windows systems\) \(on page 42\)](#).


Changing the CCI user (Windows systems)

Users who execute CCI commands need "administrator" privileges and the right to access a log directory and the files under it.

The following privileges are required to perform operations using CCI. If you want a user other than the administrator to perform the operations, grant the following required privileges to that user.

Command/ Operation	Connection method with storage	Privileges required to execute commands
horcmstart/ Start instance as a service	In-band	Administrator privileges ^{1, 2}

Command/ Operation	Connection method with storage	Privileges required to execute commands
	Out-of-band	Administrator privileges ² or the following privileges are necessary. ¹ <ul style="list-style-type: none">▪ Read privileges for the configuration definition file³▪ Read/write privileges for the log directories and log files³▪ Execute privilege for executable files³
inraid	In-band	Administrator privileges ²
Windows subcommands	In-band	Administrator privileges ²
Other commands	In-band	Administrator privileges ² or the following privileges are necessary. ¹ <ul style="list-style-type: none">▪ Read/write privileges for the log directories and log files³▪ Execute privilege for executable files³
	Out-of-band	



Note:

1. If the user who boots the CCI instance and the user who executes the commands are different, the HORCM_EVERYCLI environment variable needs to be set at booting the CCI instance.
2. Windows User Account Control might suppress the operations by a user with administrator privileges. In that case, elevate the user privilege to administrator before executing the operation. For example, when operating a command prompt, you can elevate user privilege to administrator by specifying "Run as administrator" within that command prompt, and then execute the operations.
3. See "Additional information regarding privileges to execute commands" in the following section.

Additional information regarding privileges to execute commands

Read privileges for the configuration definition file

By default, save the configuration definition file to the "%SystemDrive%\windows" directory. If you do not have privileges to access the "%SystemDrive%\windows" directory, specify any configuration definition file path in the HORCM_CONF environment variable. If you use the HORCM_CONF environment variable, specify the instance number in the HORCMINST environment variable (execute horcmstart command without specifying the instance number).

For example:

```
C:\HORCM\etc\>set HORCM_CONF=C:\Documents and Settings\RMadmin\horcm10.conf
C:\HORCM\etc\>set HORCMINST=10
C:\HORCM\etc\>set HORCM_EVERYCLI=1 ... (A)
C:\HORCM\etc\>horcmstart
```

(A) : Set this environment variable if the user who boots the instance and the user who executes other commands are different.

Read/write privileges for the log directories and log files

The user who executes the commands needs the privileges to access and read/write to the following log directories and the logfiles in it.

Log file storage location:

- When the instance number is not specified

```
\HORCM\log
```

- When the instance number is specified

```
\HORCM\log* [*:1, 2...]
```

Execute privilege for executable files

The execute privilege for the executable files stored in the following directories is necessary to execute commands.

```
\HORCM\usr\bin
\HORCM\etc
```

Installing CCI on the same PC as the storage management software

CCI is supplied with the storage management software for VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800. Installing CCI and the storage management software on the same PC allows you to use CCI of the appropriate version.



Caution: If CCI is already installed and you are upgrading or downgrading the CCI version, you must remove the installed version first and then install the new version. For instructions, see [Upgrading or downgrading CCI installed on the same PC as the storage management software \(on page 63\)](#).

Before you begin

The network of Windows attachment with TCP/IP protocol must already be installed and established.

Procedure

1. Right-click `<storage-management-software-installation-path>\wk\supervisor\restapi\uninstall.bat` to run as administrator.
2. Install CCI in the same drive as the storage management software as follows:
 - a. Insert the media for the product into the proper I/O device.
 - b. Execute `Setup.exe` (`\program\RM\WIN_NT\RMHRC\Setup.exe` or `\program\RM\WIN_NT\RMHRC_X64\Setup.exe` on the CD), and follow the instructions on the screen to complete the installation. The installation directory is HORCM (fixed value) at the root directory.
 - c. Reboot the Windows server, and then start up CCI.
A warning message for security might appear at the initial start-up depending on the OS settings. Specify "Temporarily Allow" or "Always Allow" in the dialog box.
 - d. Verify that the correct version of the CCI software is running on your system by executing the `raidqry` command:

```
D:\HORCM\etc> raidqry -h
Model: RAID-Manager/WindowsNT
Ver&Rev: 01-41-03/xx
Usage: raidqry [options] for HRC
```

3. Right-click `<storage-management-software-installation-path>\wk\supervisor\restapi\install.bat` to run as administrator.
4. Reboot the Windows server.

OpenVMS installation

Make sure to install CCI on all servers involved in CCI operations. Establish the network (TCP/IP), if not already established. CCI is provided as the following PolyCenter Software Installation (PCSI) file:

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

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

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

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

Follow the steps below to install the CCI software on an OpenVMS system.

Procedure

1. Insert and mount the provided CD or diskette.
2. Execute the following command:

```
$ PRODUCT INSTALL RM /source=Device:[PROGRAM.RM.OVMS]/LOG -
```

```
_ $ /destination=SYS$POSIX_ROOT:[000000]  
      Device:[PROGRAM.RM.OVMS] where HITACH-ARMVMS-RM-V0122-2-1.PCSI  
exists
```

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

```
$ raidqry -h  
Model: RAID-Manager/OpenVMS  
Ver&Rev: 01-40-03/03  
Usage: raidqry [options]
```

In-band and out-of-band operations

CCI operations can be performed using either the in-band method (all storage systems) or the out-of-band method (VSP and later).

- In-band (host-based) method. CCI commands are transferred from the client or server to the command device in the storage system via the host Fibre-Channel or iSCSI interface. The command device must be defined in the configuration definition file (as shown in the figure below).

If the CCI version is 01-68-03/00 or later, a volume (namespace) connected using NVMe-oF can be defined as a command device. For more information about the platforms supported when a namespace is used as a command device, see [Platforms that use CCI \(on page 14\)](#).

A volume (namespace) connected using NVMe-oF cannot be defined as a remote command device regardless of the CCI version.

- Out-of-band (LAN-based) method. CCI commands are transferred from a client PC via the LAN. For CCI on USP V/VM, to execute a command from a client PC that is not connected directly to a storage system, you must write a shell script to log in to a CCI server (in-band method) via Telnet or SSH.

For CCI on VSP and later, you can create a virtual command device by specifying the IP address in the configuration definition file. For CCI on VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800, you can create a virtual command device on GUM in a storage system by specifying the IP address of the storage system.

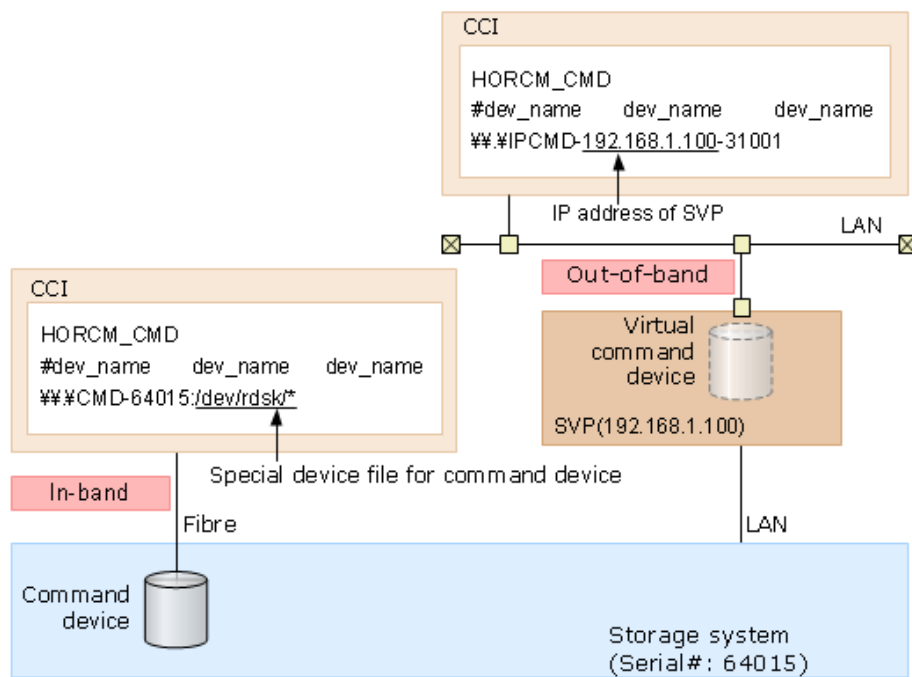
By creating a virtual command device, you can execute the same script as the in-band method from a client PC that is not connected directly to the storage system. CCI commands are transferred to the virtual command device from the client PC and then executed in storage systems.

A virtual command device can also be created on the CCI server, which is a remote CCI installation that is connected by LAN. The location of the virtual command device depends on the type of storage system. The following table lists the storage system types and indicates the allowable locations of the virtual command device.

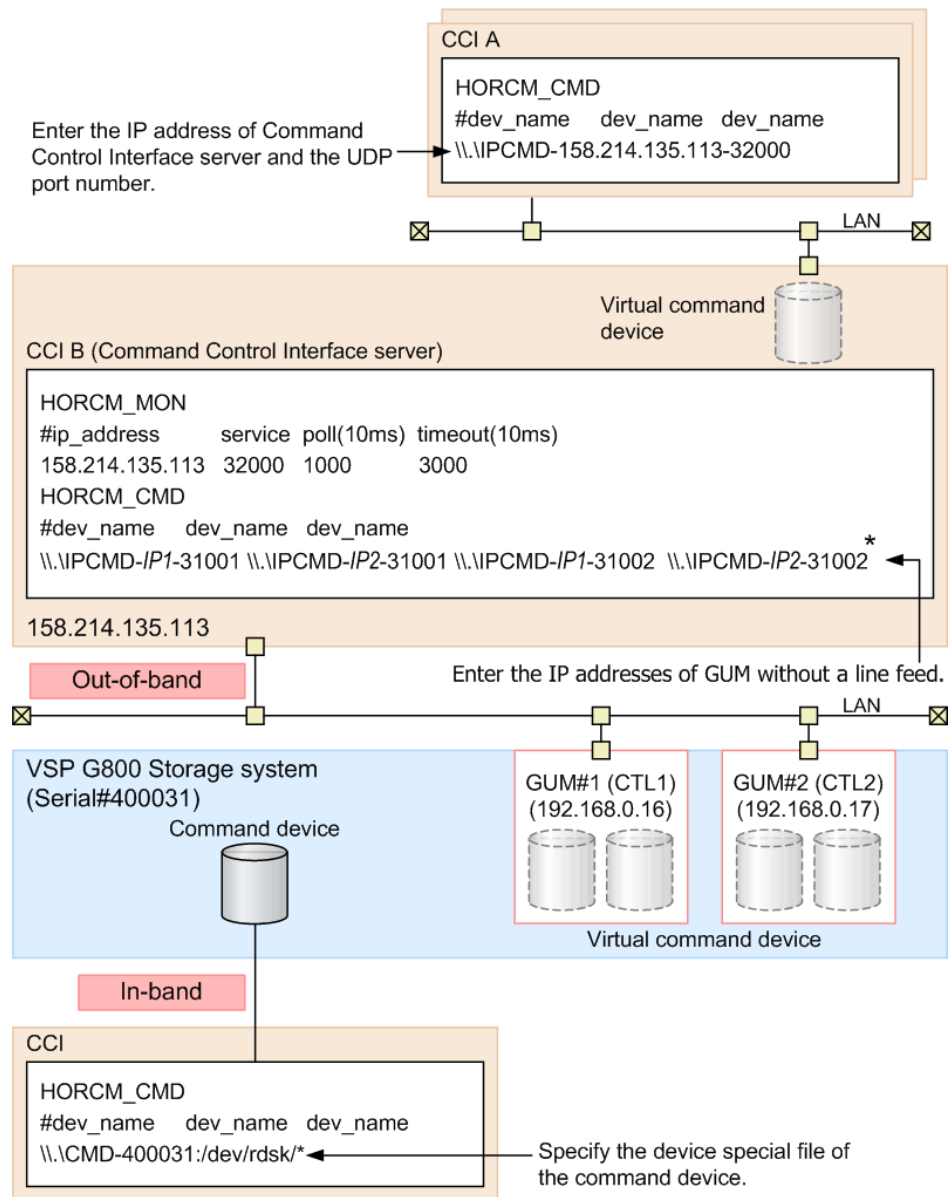
Storage system type	Location of virtual command device		
	SVP	GUM	CCI server
VSP 5000 series	OK	Not applicable	OK
VSP G1x00, VSP F1500	OK	Not applicable	OK
VSP	OK	Not applicable	OK
VSP E990 and VSP E1090	OK*	OK	OK
VSP E590, VSP E790	Not supported	OK	OK
VSP G130, G/F350, G/F370, G/F700, G/F900	OK*	OK	OK

Storage system type	Location of virtual command device		
	SVP	GUM	CCI server
VSP G200, G400, G600, G800, and VSP F400, F600, F800	OK*	OK	OK
HUS VM	OK	Not applicable	OK
* CCI on the SVP must be configured as a CCI server in advance.			

The following figure shows a sample system configuration with the command device and virtual command device settings for the in-band and out-of-band methods.

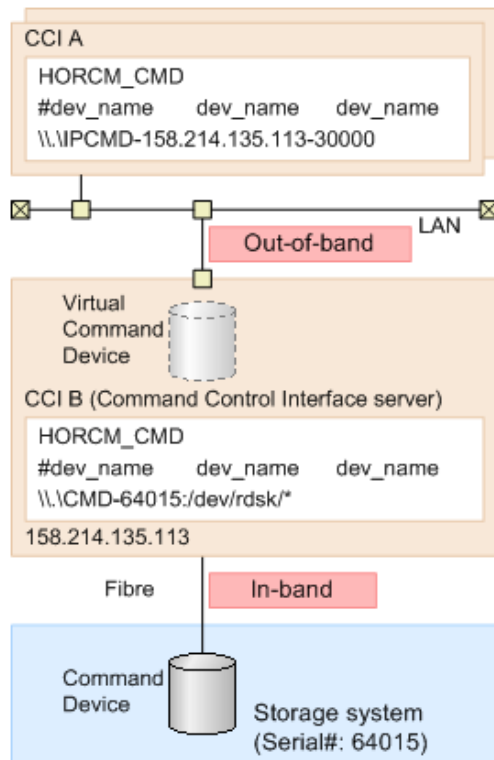


The following figure shows a sample system configuration with the command device and virtual command device settings for the in-band and out-of-band methods. In the following figure, CCI B is the CCI server for CCI A. You can issue commands from CCI A to the storage system through the virtual command device of CCI B. You can also issue commands from CCI B directly to the storage system (without CCI A). When you issue commands directly from CCI B, CCI A is optional.



* When you write the configuration definition file, replace *IP1* with IP address of GUM#1 and *IP2* with IP address of GUM#2.

The following figure shows a sample system configuration with a CCI server connected by the in-band method.



Setting up UDP ports

If you do not have a `HORCM_MON` IP address in your configuration definition file, CCI (horcm) opens the following ports on horcmstart:

- For in-band or out-of-band: $[31000 + \text{horcminstance} + 1]$
- For out-of-band: $[34000 + \text{horcminstance} + 1]$

If you have a `HORCM_MON` IP address in your configuration definition file, you need to open up the port that is defined in this entry.

Setting the command device

For in-band CCI operations, commands are issued to the command device and then executed on the RAID storage system. The command device is a user-selected, dedicated logical volume on the storage system that functions as the interface to the CCI software on the host. The command device is dedicated to CCI operations and cannot be used by any other applications. You should use a volume that does not contain user data as the command device because the host can no longer access the data area on a volume that is set as the command device. The command device accepts read and write commands that are executed by the storage system and returns read requests to the host.

The command device can be any OPEN-V device that is accessible to the host. A LUSE volume cannot be used as a command device. For the OPEN-V device, the volume capacity used as the command device requires 48 MB or more. Non-OPEN-V devices require 36 MB or more.

First you set the command device using Device Manager - Storage Navigator, and then you define the command device in the HORCM_CMD section of the configuration definition file for the CCI instance on the attached host.

For specifying the command device and the virtual command device, you can enter up to 511 characters on a line.

Procedure

1. When you set an existing volume as a command device, make sure that the volume does not contain any user data. Once a volume is set as a command device, it is inaccessible to the host.
2. Log on to Storage Navigator, and connect to the storage system on which you want to set a command device.
3. Create a volume that will be set as a command device. For example, you can create a custom-size volume that has 36 MB of storage capacity for use as a command device. For instructions, see the *Provisioning Guide* for your storage system. For Universal Storage Platform V/VM, see the *Hitachi Virtual LVI/LUN User's Guide*.
4. Locate and select the device, and set the device as a command device. For instructions, see the *Provisioning Guide* for your storage system. For Universal Storage Platform V/VM, see the *Hitachi LUN Manager User's Guide*.

If you plan to use the CCI Data Protection Facility, enable the command device security attribute of the command device. For details about the CCI Data Protection Facility, see the *Command Control Interface User and Reference Guide*.

If you plan to use CCI commands for provisioning (**raidcom** commands), enable the user authentication attribute of the command device.

If you plan to use device groups, enable the device group definition attribute of the command device.

5. If the LU path is not set for the command device volume, set the LU path in the **Add LUN Paths** wizard of LUN Manager. For details about the **Add LUN Paths** wizard, see the *Provisioning Guide* for your storage system. To define a namespace as a command device, use the **raidcom add namespace** command on CCI. For details about the procedure for setting a namespace, see the *Provisioning Guide* for your storage system. You can set a volume for which the LU path or the namespace has already been set as a command device, but a host (such as an ESXi host) that caches Inquiry/Identify information of the connected volumes might not recognize that volume as the command device. Therefore, set a volume as a command device first, and then set the LU path or the namespace to the volume.
6. Write down the system raw device name (character-type device file name) of the command device (for example, `/dev/rdisk/c0t0d1s2` in Solaris, `\\.\CMD-Ser#-ldev#-Port#` in Windows). You will need this information when you define the command device in the configuration definition file.
7. If you want to set an alternate command device, repeat this procedure for another volume.
8. If you want to enable dual pathing of the command device under Solaris systems, include all paths to the command device on a single line in the HORCM_CMD section of the configuration definition file.

The following example shows the two controller paths (c1 and c2) to the command device. Putting the path information on separate lines might cause parsing issues, and

failover might not occur unless the HORCM startup script is restarted on the Solaris system.

Example of dual path for command device for Solaris systems:

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

Specifying the command device and virtual command device in the configuration definition file

If you will execute commands by the in-band method to a command device on the storage system, specify the LU path for the command device in the configuration definition file. The command device in the storage system specified by the LU path accepts the commands from the client and executes the operation.

If you will execute commands by the out-of-band method, specify the virtual command device in the configuration definition file. The virtual command device is defined by the IP address of the SVP or GUM, the UDP communication port number (fixed at 31001), and the storage system unit ID* in the configuration definition file. When a virtual command device is used, the command is transferred from the client or server via LAN to the virtual command device specified by the IP address of the SVP, and an operation instruction is assigned to the storage system.

* The storage system unit ID is required only for configurations with multiple storage systems.

The following examples show how a command device and a virtual command device are specified in the configuration definition file. For details, see the *Command Control Interface User and Reference Guide*.

Example of command device in configuration definition file (in-band method)

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\CMD-64015:/dev/rdisk/*
```

Example of virtual command device in configuration definition file (out-of-band method with SVP)

Example for SVP IP address 192.168.1.100 and UDP communication port number 31001:

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\IPCMD-192.168.1.100-31001
```

Example of virtual command device in configuration definition file (out-of-band method with GUM)

Example for GUM IP addresses 192.168.0.16, 192.168.0.17 and UDP communication port numbers 31001, 31002. In this case, enter the IP addresses without line feed.

```
HORCM_CMD
#dev_name dev_name dev_name
```

```
\\.\IPCMD-192.168.0.16-31001 \\. \IPCMD-192.168.0.17-31001 \\.
\IPCMD-192.168.0.16-31002 \\. \IPCMD-192.168.0.17-31002
```

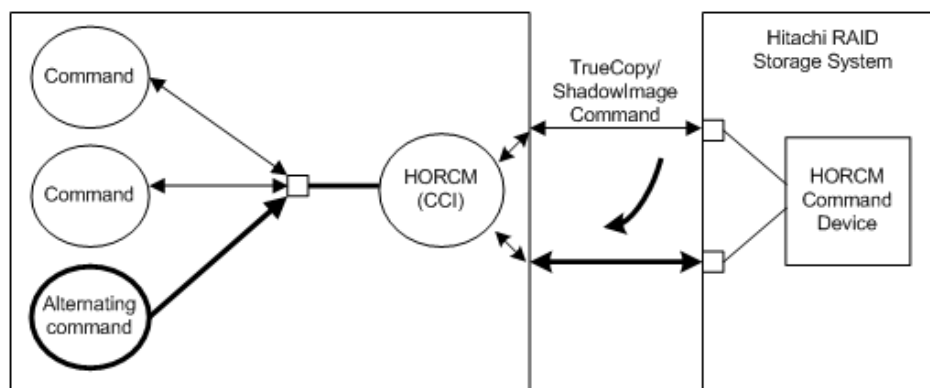
About alternate command devices

If CCI receives an error notification in reply to a read or write request to a command device, the CCI software can switch to an alternate command device, if one is defined. If a command device is unavailable (for example, blocked due to online maintenance), you can switch to an alternate command device manually. If no alternate command device is defined or available, all commands terminate abnormally, and the host cannot issue CCI commands to the storage system. To ensure that CCI operations continue when a command device becomes unavailable, you should set one or more alternate command devices.

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 prevent command device failure, CCI supports an alternate command device function.

- **Definition of alternate command devices.** To use an alternate command device, define two or more command devices for the HORCM_CMD item in the configuration definition file. When two or more devices are defined, they are recognized as alternate command devices. If an alternate command device is not defined in the configuration definition file, CCI cannot switch to the alternate command device.
- **Timing of alternate command devices.** When the HORCM receives an error notification in reply from the operating system via the raw I/O interface, the command device is alternated. It is possible to alternate the command device forcibly by issuing an alternating command provided by TrueCopy (horcctl -C).
- **Operation of alternating command.** If the command device is blocked due to online maintenance (for example, microcode replacement), the alternating command should be issued in advance. When the alternating command is issued again after completion of the online maintenance, the previous command device is activated again.
- **Multiple command devices on HORCM startup.** If at least one command device is available and one or more command devices are specified in the configuration definition file, then HORCM starts with a warning message to startup log by using available command device. Confirm that all command devices can be changed by using the horcctl -C command option, or HORCM has been started without warning message to the HORCM startup log.

The following figure shows the workflow for the alternate command device function.



Creating and editing the configuration definition file

The configuration definition file is a text file that is created and edited using any standard text editor (for example, UNIX vi editor, Windows Notepad). The configuration definition file defines correspondences between the server and the volumes used by the server. There is a configuration definition file for each host server. When the CCI software starts up, it refers to the definitions in the configuration definition file.

The configuration definition file defines the devices in copy pairs and is used for host management of the copy pairs, including ShadowImage, ShadowImage for Mainframe, TrueCopy, TrueCopy for Mainframe, Copy-on-Write Snapshot, Thin Image, Universal Replicator, and Universal Replicator for Mainframe. ShadowImage, ShadowImage for Mainframe, Copy-on-Write Snapshot, and Thin Image use the same configuration files and commands, and the RAID storage system determines the type of copy pair based on the S-VOL characteristics and (for Copy-on-Write Snapshot and Thin Image) the pool type.

The configuration definition file contains the following sections:

- **HORCM_MON:** Defines information about the local host.
- **HORCM_CMD:** Defines information about the command (CMD) devices.
- **HORCM_VCMD:** Defines information about the virtual storage machine.
- **HORCM_DEV** or **HORCM_LDEV:** Defines information about the copy pairs.
- **HORM_INST** or **INSTP:** Defines information about the remote host.
- **HORCM_LDEVG:** Defines information about the device group.
- **HORCM_ALLOW_INST:** Defines information about user permissions.
- **HORCM_NVME:** Defines information about the following operations:
 - Define a namespace for NVMe-oF as a command device.
 - Perform the pair operation on a LDEV with a namespace for NVMe-oF defined by enabling the command device security setting.

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 files. The system administrator should make a copy of the sample file, set the necessary parameters in the copied file, and place the file in the proper directory.

The following table lists the configuration parameters defined in the horcm.conf file and specifies the default value, type, and limit for each parameter. For details about parameters in the configuration file, see the *Command Control Interface User and Reference Guide*.

Parameter	Default	Type	Limit
ip_address	None	Character string	63 characters
service	None	Character string or numeric value	15 characters
poll (10 ms)	1000	Numeric value ¹	None
timeout (10 ms)	3000	Numeric value ¹	None
dev_name for HORCM_DEV	None	Character string	31 characters
dev_group	None	Character string	31 characters Recommended value = 8 char. or less
port #	None	Character string	31 characters
target ID	None	Numeric value ¹	7 characters
LU#	None	Numeric value ¹	7 characters
MU#	0	Numeric value ¹	7 characters
Serial#	None	Numeric value ¹	12 characters
CU:LDEV(LDEV#)	None	Numeric value ²	6 characters
dev_name for HORCM_CMD	None	Character string	63 characters Recommended value = 8 char. or less
<ol style="list-style-type: none"> 1. Use decimal notation (not hexadecimal) for these numeric values. 2. Use decimal or hexadecimal notation for this numeric value. For details, see HORCM_LDEV (on page 103). 			

Notes on editing configuration definition file

Follow the notes given below for editing configuration definition file.

- Do not edit the configuration definition file while CCI is running. Shut down CCI, edit the configuration file as needed, and then restart CCI. When you change the system configuration, it is required to shut down CCI once and rewrite the configuration definition file to match with the change and then restart CCI. When you change the storage system configuration (microprogram, cache capacity, LU path, and so on), you must restart CCI regardless of the necessity of the configuration definition file editing. When you restart CCI, confirm that there is no contradiction in the connection configuration by using the "-c" option of the **pairdisplay** command and the **raidqry** command. However, you cannot confirm the consistency of the P-VOL and S-VOL capacity with the "-c" option of **pairdisplay** command. Confirm the capacity of each volume by using the **raidcom** command.
- Do not mix pairs created with the "At-Time Split" option (-m grp) and pairs created without this option in the same group defined in the CCI configuration file. If you do, a pairsplit operation might end abnormally, or S-VOLs of the P-VOLs in the same consistency group (CTG) might not be created correctly at the time the pairsplit request is received.
- If the hardware configuration is changed during the time an OS is running in Linux, the name of a special file corresponding to the command device might be changed. At this time, if HORCM was started by specifying the special file name in the configuration definition file, HORCM cannot detect the command device, and the communication with the storage system might fail.

To prevent this failure, specify the path name allocated by udev to the configuration definition file before booting HORCM. Use the following procedure to specify the path name. In this example, the path name for /dev/sdgh can be found.

1. Find the special file name of the command device by using **inqraid** command.

Command example:

```
[root@myhost ~]# ls /dev/sd* | /HORCM/usr/bin/inqraid -CLI |
grep CM sda CL1-B 30095 0 - - 0000 A:00000 OPEN-V-CM sdgh CL1-
A 30095 0 - - 0000 A:00000 OPEN-V-CM [root@myhost ~]#
```

2. Find the path name from the **by-path** directory. Command example:

```
[root@myhost ~]# ls -l /dev/disk/by-path/ | grep sdgh
lrwxrwxrwx. 1 root root 10 Jun 11 17:04 2015 pci-0000:08:00.0-
fc-0x50060e8010311940-lun-0 -> ../../sdgh [root@myhost ~]#
```

In this example, "pci-0000:08:00.0-fc-0x50060e8010311940-lun-0" is the path name.

3. Enter the path name to HORCM_CMD in the configuration definition file as follows.

```
HORCM_CMD /dev/disk/by-path/pci-0000:08:00.0-
fc-0x50060e8010311940-lun-0
```

4. Boot the HORCM instance as usual.

Creating and editing CCI communication permission settings (firewall settings)

CCI uses the following UDP ports to communicate with remote instances.

If a firewall exists on the server on which CCI is installed and the communication network, you need to set the firewall not to block communication that uses these ports.

The following table shows the UDP ports used by CCI to communicate with remote instances.

UDP port	Description
UDP port defined in HORCM_MON in the configuration definition file	CCI uses this port for the following purposes: <ul style="list-style-type: none"> As the source port to a CCI instance on a remote server. As the receiving port of UDP packets from a CCI instance on a remote server.
UDP port defined in HORCM_INST or HORCM_INSTP in the configuration definition file	CCI uses this port as the destination port when communicating with a remote instance.



Note:

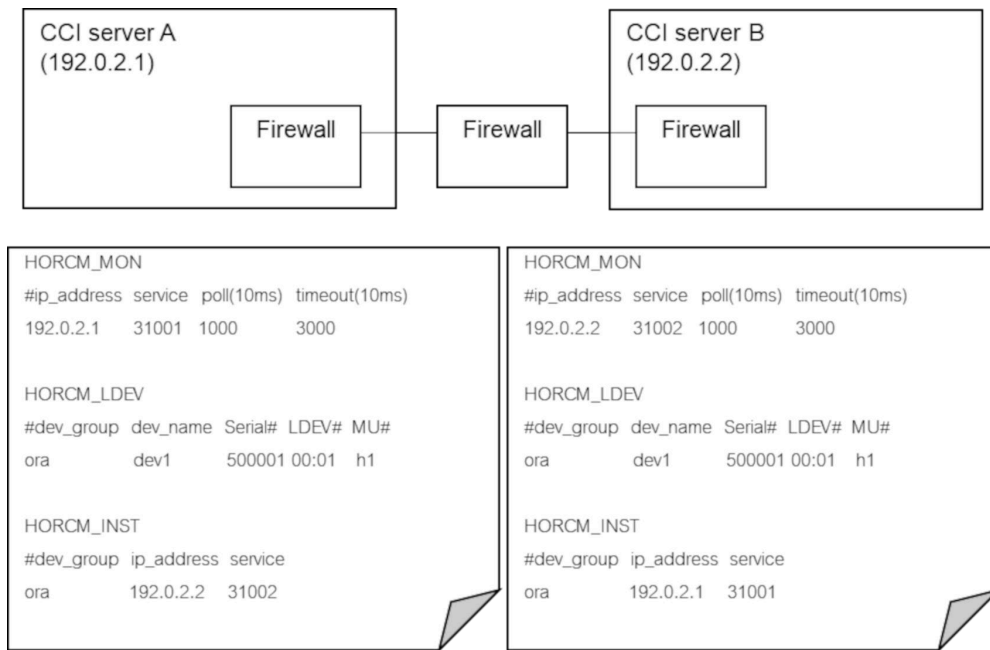
If HORCM_MON is not defined in the configuration definition file, CCI uses the following UDP port:

- If there is an instance number: UDP port of instance number + 31001
- If there is no instance number: UDP port of number 31000

The following is a configuration example of the firewall settings and an example of the communication list that needs to be allowed on the server on which CCI is installed.

Set all firewalls as shown in the configuration example to allow all communication in the table.

The following figure shows a configuration example of CCI server, network, and firewall.



The following table lists the communication that needs to be allowed.

Source		Destination	
IP address	Port number	IP address	Port number
192.0.2.1	UDP:31001	192.0.2.2	UDP:31002
192.0.2.2	UDP:31002	192.0.2.1	UDP:31002

The following example shows how to configure the firewall to allow CCI communication when the firewalld service is enabled on the RHEL 7 server with CCI installed. The firewall setting method and commands differ depending on the OS in use, so for the detailed procedures, see the manual of the OS.

1. Log in to the CCI server and use the following command to verify that the firewalld service is enabled:

```
systemctl status firewalld
```

If the firewalld service is stopped, enable it.

2. Use the following command to add a rule to firewalld for all ports used by the CCI

instances:

```
firewall-cmd --add-port=<port number in use>/udp --permanent
```

3. Use the following command to reload the firewalld service and enable the settings:

```
firewall-cmd --reload
```

4. Use the following command to confirm the settings are enabled:

```
firewall-cmd --list-all
```

Chapter 3: Upgrading or downgrading CCI

For upgrading or downgrading the CCI software, use the RMuninst scripts on the media for the program product. For other media, please use the following instructions to upgrade or downgrade the CCI software. The instructions might be different on your platform. Please consult your operating system documentation (for example, UNIX main pages) for platform-specific command information.

Upgrading or downgrading CCI in a UNIX environment

Follow the steps below to upgrade or downgrade the CCI software version on a UNIX system.

Procedure

1. Confirm that HORCM is not running. If it is running, shut it down.

One CCI instance: # **horcmshutdown.sh**

Two CCI instances: # **horcmshutdown.sh 0 1**

If CCI commands are running in the interactive mode, terminate the interactive mode and exit these commands using the **-q** option.

2. To install using RMinstsh, follow the procedure below.

If specifically directed to perform manual installation, follow the procedure in Step 3 instead.

- a. Insert the installation media into the proper I/O device. Use the RMinstsh (RMINSTSH) under the `./program/RM` directory on the media for the installation. For LINUX/IA64 and LINUX/X64, execute `../.. /RMinstsh` after moving to LINUX/IA64 or LINUX/X64 directory.
- b. Verify installation of the proper version using the **raidqry** command.

```
# raidqry -h
Model: RAID-Manager/HP-UX
Ver&Rev: 01-30-03/xx
Usage: raidqry [options]
```

- c. After upgrading or downgrading CCI, ensure that the CCI user is appropriately set for the upgraded/downgraded/installed files. For instructions, see [Changing the CCI user \(UNIX systems\) \(on page 38\)](#).
3. To perform a manual installation, follow the procedure below.
 - a. Insert the installation media into the proper I/O device.

- b. Move to the directory containing the HORCM directory (for example, # `cd /` for the root directory).
- c. Copy all files from the installation media using the `cpio` command: # `cpio -idmu < /dev/XXXX`, where `XXXX` = I/O device. Preserve the directory structure (d flag) and file modification times (m flag), and copy unconditionally (u flag).
- d. Execute the CCI installation command.
`/HORCM/horcminstall.sh`
- e. Verify installation of the proper version using the `raidqry` command.

```
# raidqry -h
Model: RAID-Manager/HP-UX
Ver&Rev: 01-30-03/xx
Usage: raidqry [options]
```

- f. After upgrading or downgrading CCI, ensure that the CCI user is appropriately set for the upgraded/downgraded/installed files. For instructions, see [Changing the CCI user \(UNIX systems\) \(on page 38\)](#).

Upgrading or downgrading CCI in a Windows environment

Use this procedure to upgrade or downgrade the CCI software version on a Windows system.

To upgrade or downgrade the CCI version, you must first remove the installed CCI version and then install the new CCI version.



Caution: When you upgrade or downgrade CCI, the configuration definition file and the sample script file, `HORCM0_run.txt` (if CCI is registered as a service) are overwritten. If you have edited the configuration definition file or the sample script file and want to keep your changes, first back up the files, and then restore them using the backup file after the upgrade or downgrade. For details about the configuration definition file and sample script file, see the *Command Control Interface User and Reference Guide*.



Caution: The following issues will occur if you perform an overwrite installation of CCI version 01-64-03/XX or earlier in a Windows environment that has CCI version 01-65-03/XX or later installed.

- The program for deletion will not start even if you uninstall a program in Control Panel.
- Information such as the CCI version displayed in **Programs and Features** in Control Panel will not be updated.

To resolve the issues, perform an overwrite installation of CCI version 01-65-03/XX or later, and delete CCI from Control Panel. Then install the downgraded version of CCI.

Use this procedure to upgrade or downgrade the CCI software version on a Windows system.

Procedure

1. You can upgrade or downgrade the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown` command to ensure a normal end to all functions.
2. Remove the installed CCI software using the Windows Control Panel.
For example, on a Windows 7 system:
 - a. Open the Control Panel.
 - b. Under **Programs**, click **Uninstall a program**.
 - c. In the program list, select **RAID Manager for WindowsNT**, and then click **Uninstall**.
3. Insert the installation media for the product into the proper I/O device.
4. Execute `Setup.exe` (`\program\RM\WIN_NT\RMHORC\Setup.exe` or `\program\RM\WIN_NT\RMHORC_X64\Setup.exe` on the CD), and follow the instructions on the screen to complete the installation. The installation directory is HORCM (fixed value) at the root directory.
5. In the **InstallShield** window, follow the instructions on screen to install the CCI software.
6. Reboot the Windows server, and verify that the correct version of the CCI software is running on your system by executing the `raidqry -h` command.

Example:

```
C:\HORCM\etc>raidqry -h
Model   : RAID-Manager/WindowsNT
Ver&Rev: 01-40-03/xx
Usage   : raidqry [options] for HORC
```



Note:

- If the CCI version is upgraded to 01-68-03/00 or later, the upgraded CCI version is displayed in the **Programs and Features** window in Control Panel in Windows. However, the CCI version actually installed might not be displayed in Control Panel due to a change processing issue during the CCI installation. The CCI operates normally even if the CCI version is not displayed. Therefore, check the CCI version displayed in the **Programs and Features** window in Control Panel in Windows, and if the CCI version differs from the installed version, correct the version information by following the procedures described in the table in [CCI version information errors \(on page 73\)](#). This also allows you to check the CCI version in Control Panel in Windows.
- If the CCI version is downgraded from 01-68-03/00 or later to a version earlier than 01-68-03/00, the CCI version before the downgrade is displayed in the **Programs and Features** window in Control Panel in Windows, and the version information might not be removed. The CCI operates normally even if the CCI version information is not removed. If the CCI version information has not been removed, remove the CCI version information displayed in Control Panel by following the procedures described in the table in [CCI version information errors \(on page 73\)](#).

Next steps

Users who execute CCI commands need "administrator" privileges and the right to access the log directory and the files in it. For instructions on specifying a CCI administrator, see [Changing the CCI user \(Windows systems\) \(on page 42\)](#).

Upgrading or downgrading CCI installed on the same PC as the storage management software

If CCI is installed on the same PC as the storage management software for VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800, use this procedure to upgrade or downgrade the CCI software.

To upgrade or downgrade the CCI version, you must first remove the installed CCI version and then install the new CCI version.



Note: Installing CCI on the same drive as the storage management software allows you to use CCI of the appropriate version. If CCI and the storage management software are installed on different drives, remove CCI, and then install it on the same drive as the storage management software.



Caution: When you upgrade or downgrade the CCI software, the sample script file is overwritten. If you have edited the sample script file and want to keep your changes, first back up the edited sample script file, and then restore the data of the sample script file using the backup file after the upgrade or downgrade installation. For details about the sample script file, see the *Command Control Interface User and Reference Guide*.

Procedure

1. You can upgrade or downgrade the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown` command to ensure a normal end to all functions.
2. Right-click `<storage-management-software-installation-path>\wk\supervisor\restapi\uninstall.bat` to run as administrator.
3. Remove the installed CCI software using the Windows Control Panel.
For example, on a Windows 7 system:
 - a. Open the Control Panel.
 - b. Under **Programs**, click **Uninstall a program**.
 - c. In the program list, select **RAID Manager for WindowsNT**, and then click **Uninstall**.
4. Insert the installation media for the product into the proper I/O device.
5. Execute `Setup.exe (\program\RM\WIN_NT\RMHORC\Setup.exe or \program\RM\WIN_NT\RMHORC_X64\Setup.exe` on the CD), and follow the instructions on the screen to complete the installation. The installation directory is HORCM (fixed value) at the root directory.
Make sure to select the drive on which the storage management software is installed.
6. In the **InstallShield** window, follow the instructions on screen to install the CCI software.
7. Reboot the Windows server, and verify that the correct version of the CCI software is running on your system by executing the `raidqry -h` command.

Example:

```
C:\HORCM\etc>raidqry -h
Model   : RAID-Manager/WindowsNT
Ver&Rev: 01-40-03/xx
Usage   : raidqry [options] for HORC
```

8. Right-click `<storage-management-software-installation-path>\wk\supervisor\restapi\install.bat` to run as administrator.
9. Reboot the Windows server.

**Note:**

- If you install the storage management software, CCI is installed as a component for the storage management software.
- If the CCI version is upgraded to 01-68-03/00 or later, the upgraded CCI version is displayed in the **Programs and Features** window in Control Panel in Windows. However, the CCI version actually installed might not be displayed in Control Panel due to a change processing issue during the CCI installation. The CCI operates normally even if the CCI version is not displayed. Therefore, check the CCI version displayed in the **Programs and Features** window in Control Panel in Windows, and if the CCI version differs from the installed version, correct the version information by following the procedures described in the table in [CCI version information errors \(on page 73\)](#). This also allows you to check the CCI version in Control Panel in Windows.
- If the CCI version is downgraded from 01-68-03/00 or later to a version earlier than 01-68-03/00, the CCI version before the downgrade is displayed in the **Programs and Features** window in Control Panel in Windows, and the version information might not be removed. The CCI operates normally even if the CCI version information is not removed. If the CCI version information has not been removed, remove the CCI version information displayed in Control Panel by following the procedures described in the table in [CCI version information errors \(on page 73\)](#).
- You can check the CCI version by using the `raidqry -h` command on CCI.

Next steps

Users who execute CCI commands need "administrator" privileges and the right to access the log directory and the files in it. For instructions on specifying a CCI administrator, see [Changing the CCI user \(Windows systems\) \(on page 42\)](#).

Upgrading or downgrading CCI in an OpenVMS environment

Follow the steps below to upgrade or downgrade the CCI software version on an OpenVMS system:

Procedure

1. You can upgrade or downgrade the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown` command to ensure a normal end to all functions:
`$horcmshutdown` for one HORCM instance and `$horcmshutdown 0 1` for two HORCM instances. When a command is being used in interactive mode, terminate it using the `-q` option.
2. Insert and mount the provided installation media.

3. Execute the following command:

```
$ PRODUCT INSTALL CCI /source=Device:[PROGRAM.CCI.OVMS]/LOG
                        Device:[PROGRAM.CCI.OVMS] where HITACH-ARMVMS-CCI-V0122-2-1.PCSI
exists
```

4. Verify installation of the proper version using the **raidqry command.**

```
$ raidqry -h
Model: CCI/OpenVMS
Ver&Rev: 01-29-03/05
Usage: raidqry [options]
```

Chapter 4: Removing CCI

The instructions for removing the CCI software might be different on your platform. Please consult your operating system documentation (for example, UNIX main pages) for platform-specific command information.

Removing CCI in a UNIX environment

Removing the CCI software on UNIX using `RMuninst`

Use this procedure to remove the CCI software on a UNIX system using the `RMuninst` script on the installation media.

Before you begin

- If you are discontinuing local or remote copy operations (for example, ShadowImage, TrueCopy), delete all volume pairs and wait until the volumes are in simplex status.
If you will continue copy operations (for example, using Storage Navigator), do not delete any volume pairs.

Procedure

1. If CCI commands are running in the interactive mode, use the `-q` option to terminate the interactive mode and exit `horcmshutdown.sh` commands.
2. You can remove the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown.sh` command to ensure a normal end to all functions:
One CCI instance: # `horcmshutdown.sh`
Two CCI instances: # `horcmshutdown.sh 0 1`
3. Use the `RMuninst` script on the CCI installation media to remove the CCI software.
4. After the CCI software has been removed, the CCI command devices (used for the in-band method) are no longer needed. If you want to configure the volumes that were used by CCI command devices for operations from the connected hosts, you must disable the command device setting on each volume.

To disable the command device setting:

- a. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Logical Devices**.

On the **LDEVs** tab, the CCI command devices are identified by **Command Device** in the **Attribute** column.

- b. Select the command device, and then click **More Actions > Edit Command Devices**.
- c. For **Command Device**, click **Disable**, and then click **Finish**.
- d. In the **Confirm** window, verify the settings, and enter the task name.

You can enter up to 32 ASCII characters and symbols, with the exception of: \ / : , ; * ? " < > |. The value "date-window name" is entered by default.

- e. Click **Apply**.

If **Go to tasks window for status** is selected, the **Tasks** window appears.

Removing the CCI software manually on UNIX

If you do not have the installation media for CCI, use this procedure to remove the CCI software manually on a UNIX system.

Before you begin

- If you are discontinuing local or remote copy operations (for example, ShadowImage, TrueCopy), delete all volume pairs and wait until the volumes are in simplex status.

If you will continue copy operations (for example, using Storage Navigator), do not delete any volume pairs.

Procedure

1. If CCI commands are running in the interactive mode, use the `-q` option to terminate the interactive mode and exit `horcmshutdown.sh` commands.
2. You can remove the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown.sh` command to ensure a normal end to all functions:

One CCI instance: # `horcmshutdown.sh`

Two CCI instances: # `horcmshutdown.sh 0 1`

3. When HORCM is installed in the root directory (/HORCM is not a symbolic link), remove the CCI software as follows:
 - a. Execute the `horcmuninstall` command: # `/HORCM/horcmuninstall.sh`
 - b. Move to the root directory: # `cd /`
 - c. Delete the product using the `rm` command: # `rm -rf /HORCM`

Example

```
#/HORCM/horcmuninstall.sh
#cd /
#rm -rf /HORCM
```

4. When HORCM is not installed in the root directory (/HORCM is a symbolic link), remove the CCI software as follows:
 - a. Execute the `horcmuninstall` command: # `HORCM/horcmuninstall.sh`
 - b. Move to the root directory: # `cd /`
 - c. Delete the symbolic link for /HORCM: # `rm /HORCM`

- d. Delete the product using the rm command: # rm -rf /Directory/HORCM

Example

```
#/HORCM/horcmuninstall.sh
#cd /
#rm /HORCM
#rm -rf /<non-root_directory_name>/HORCM
```

5. After the CCI software has been removed, the CCI command devices (used for the in-band method) are no longer needed. If you want to configure the volumes that were used by CCI command devices for operations from the connected hosts, you must disable the command device setting on each volume.

To disable the command device setting:

- a. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Logical Devices**.

On the **LDEVs** tab, the CCI command devices are identified by **Command Device** in the **Attribute** column.

- b. Select the command device, and then click **More Actions > Edit Command Devices**.

- c. For **Command Device**, click **Disable**, and then click **Finish**.

- d. In the **Confirm** window, verify the settings, and enter the task name.

You can enter up to 32 ASCII characters and symbols, with the exception of: \ / : , ; * ? " < > |. The value "date-window name" is entered by default.

- e. Click **Apply**.

If **Go to tasks window for status** is selected, the **Tasks** window appears.

Removing CCI on a Windows system

Use this procedure to remove the CCI software on a Windows system.

Before you begin

- If you are discontinuing local or remote copy operations (for example, ShadowImage, TrueCopy), delete all volume pairs and wait until the volumes are in simplex status.

If you will continue copy operations (for example, using Storage Navigator), do not delete any volume pairs.

Procedure

1. You can remove the CCI software only when CCI is not running. If CCI is running, shut down CCI using the **horcmshutdown** command to ensure a normal end to all functions:

One CCI instance: D:\HORCM\etc > horcmshutdown

Two CCI instances: D:\HORCM\etc > horcmshutdown 0 1

2. Remove the CCI software using the Windows Control Panel.

For example, perform the following steps on a Windows 7 system:

- a. Open the Control Panel.
- b. Under **Programs**, click **Uninstall a program**.
- c. In the program list, select **RAID Manager for WindowsNT**, and then click **Uninstall**.

If you do not follow the procedure in [Upgrading or downgrading CCI in a Windows environment \(on page 61\)](#) to upgrade or downgrade CCI, when you uninstall CCI, the displayed CCI version information might be different from the actual version of the installed CCI. However, you can uninstall CCI even if the displayed version information is different from the actual one.

3. After the CCI software has been removed, the CCI command devices (used for the in-band method) are no longer needed. If you want to configure the volumes that were used by CCI command devices for operations from the connected hosts, you must disable the command device setting on each volume.

To disable the command device setting:

- a. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Logical Devices**.

On the **LDEVs** tab, the CCI command devices are identified by **Command Device** in the **Attribute** column.

- b. Select the command device, and then click **More Actions > Edit Command Devices**.
- c. For **Command Device**, click **Disable**, and then click **Finish**.
- d. In the **Confirm** window, verify the settings, and enter the task name.

You can enter up to 32 ASCII characters and symbols, with the exception of: \ / : , ; * ? " < > |. The value "date-window name" is entered by default.

- e. Click **Apply**.

If **Go to tasks window for status** is selected, the **Tasks** window appears.



Note: If the CCI version is upgraded or downgraded by using any procedure other than the one described in [Upgrading or downgrading CCI in a Windows environment \(on page 61\)](#), the CCI version information displayed when the removal operation is performed might differ from the CCI version actually installed. Even if the displayed CCI version information is not correct, the removal operation can still be performed.

Removing CCI installed on the same PC as the storage management software

If CCI is installed on the same PC as the storage management software for VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800, use this procedure to remove the CCI software.

Before you begin

- If you are discontinuing local or remote copy operations (for example, ShadowImage, TrueCopy), delete all volume pairs and wait until the volumes are in simplex status.

If you will continue copy operations (for example, using Storage Navigator), do not delete any volume pairs.



Note: You can remove the CCI software from the PC on which the storage management software is installed by using the following procedure. If you want to update and remove the storage management software, contact customer support depending on the model. For more information, see the user guide for your storage system or the *System Administrator Guide*.

Procedure

1. You can remove the CCI software only when CCI is not running. If CCI is running, shut down CCI using the **horcmshutdown** command to ensure a normal end to all functions:
One CCI instance: `D:\HORCM\etc > horcmshutdown`
Two CCI instances: `D:\HORCM\etc > horcmshutdown 0 1`
2. Right-click `<storage-management-software-installation-path>\wk\supervisor\restapi\uninstall.bat` to run as administrator.
3. Remove the CCI software using the Windows Control Panel.
For example, perform the following steps on a Windows 7 system:
 - a. Open the Control Panel.
 - b. Under **Programs**, click **Uninstall a program**.
 - c. In the program list, select **RAID Manager for WindowsNT**, and then click **Uninstall**.
4. (VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800) Perform either of the following operations:
 - If you continue to use your PC as the SVP, follow the instructions for updating the storage management software, the SVP software, and the SVP firmware, and then reinstall the same versions of the storage management software and the SVP software as the installed software. The storage management software and the SVP software to be reinstalled are the same version as before the reinstallation, therefore the firmware update is not required.
 - If you do not continue to use your PC as the SVP, remove the storage management software and the SVP software.

Removing CCI on an OpenVMS system

Use this procedure to remove the CCI software on an OpenVMS system.

Before you begin

- If you are discontinuing local or remote copy operations (for example, ShadowImage, TrueCopy), delete all volume pairs and wait until the volumes are in simplex status.

If you will continue copy operations (for example, using Storage Navigator), do not delete any volume pairs.

Procedure

1. If CCI commands are running in the interactive mode, use the `-q` option to terminate the interactive mode and exit `horcmshutdown.sh` commands.
2. You can remove the CCI software only when CCI is not running. If CCI is running, shut down CCI using the `horcmshutdown` command to ensure a normal end to all functions:

For one instance: `$ horcmshutdown`

For two instances: `$ horcmshutdown 0 1`

3. Remove the installed CCI software by using the following command:

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

4. After the CCI software has been removed, the CCI command devices (used for the in-band method) are no longer needed. If you want to configure the volumes that were used by CCI command devices for operations from the connected hosts, you must disable the command device setting on each volume.

To disable the command device setting:

- a. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Logical Devices**.

On the **LDEVs** tab, the CCI command devices are identified by **Command Device** in the **Attribute** column.

- b. Select the command device, and then click **More Actions > Edit Command Devices**.

- c. For **Command Device**, click **Disable**, and then click **Finish**.

- d. In the **Confirm** window, verify the settings, and enter the task name.

You can enter up to 32 ASCII characters and symbols, with the exception of: \ / : , ; * ? " < > |. The value "date-window name" is entered by default.

- e. Click **Apply**.

If **Go to tasks window for status** is selected, the **Tasks** window appears.

Chapter 5: Troubleshooting for CCI installation

If you have a problem installing, upgrading, or downgrading the CCI software, make sure that all system requirements and restrictions have been met (see [System requirements for CCI \(on page 10\)](#)).

If you are unable to resolve an error condition, contact customer support for assistance.

CCI version information errors

The following table lists error conditions for CCI installation and provides the recommended action to resolve the error conditions.

Error condition	Recommended action
The CCI version differs from the version information displayed in Control Panel in Windows	If the CCI version displayed by using the <code>raidqry -h</code> command on CCI differs from the one displayed in the Programs and Features window in Control Panel in Windows, take the following actions:

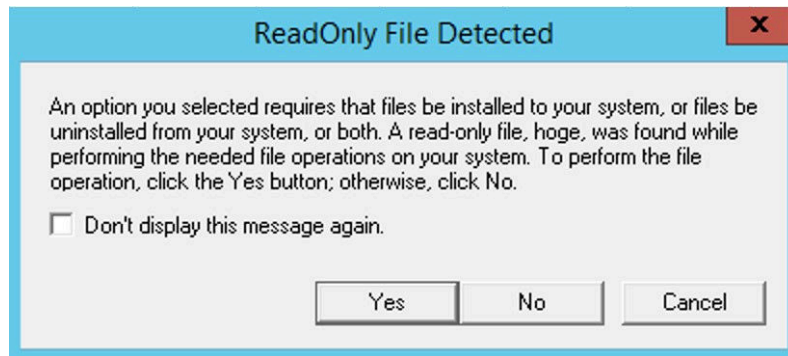
Error condition	Recommended action
	<p>If the CCI version is upgraded to 01-68-03/00 or later, correct the version information as follows:</p> <ol style="list-style-type: none"> 1. Log in to the host for which the Windows-based CCI is installed, and then open a command prompt with administrator privileges. 2. Move to the directory for which the CCI tools are installed (for example, <code>cd/d C:\HORCM\Tool</code>). 3. Correct the version by using the version information edit tool. When you run the tool, the CCI version displayed by using the raidqry -h command is applied to the Programs and Features window in Control Panel (for example, <code>RMVersionEdit.bat</code> modify version). 4. Verify that the CCI version has been updated in the Programs and Features window in Control Panel. 5. Move to the etc folder (for example, <code>cd/d C:\HORCM\etc</code>). 6. Run the raidqry -h command, and then verify that the displayed CCI version is the same as the one verified in step 4.

Error condition	Recommended action
	<p>If the CCI version is downgraded from 01-68-03/00 or later to a version earlier than 01-68-03/00, remove the CCI version information displayed in Control Panel as follows:</p> <ol style="list-style-type: none"> 1. Log in to the host for which the Windows-based CCI is installed, and then open a command prompt with administrator privileges. 2. Move to the directory for which the CCI tools are installed (for example, <code>cd/d C:\HORCM\Tool3</code>). 3. Correct the version by using the version information edit tool. When you run the tool, the CCI version is removed from the Programs and Features window in Control Panel (for example, <code>RMVersionEdit.bat delete version</code>). 4. Verify that the CCI version is not displayed in the Programs and Features window in Control Panel.

Error condition	Recommended action
The CCI version is not applied to the CCI version information displayed in Control Panel in Windows	<p>If both of the following conditions are met, correct the CCI version information displayed in the Programs and Features window in Control Panel in Windows by following the procedure below:</p> <ul style="list-style-type: none"> ▪ The CCI version displayed by using the raidqry -h command on CCI is 01-68-03/00 or later. ▪ The CCI version displayed by using the raidqry -h command on CCI differs from the one displayed in the Programs and Features window in Control Panel in Windows. <ol style="list-style-type: none"> 1. Log in to the host for which the Windows-based CCI is installed, and then open a command prompt with administrator privileges. 2. Move to the directory for which the CCI tools are installed (for example, <code>cd/d C:\HORCM\Tool</code>). 3. Correct the version by using the version information edit tool. When you run the tool, the CCI version displayed by using the raidqry -h command is applied to the Programs and Features window in Control Panel (for example, <code>RMVersionEdit.bat</code> modify version). 4. Verify that the CCI version has been updated in the Programs and Features window in Control Panel. 5. Move to the etc folder (for example, <code>cd/d C:\HORCM\etc</code>). 6. Run the raidqry -h command, and then verify that the displayed CCI version is the same as the one verified in step 4.

Error condition	Recommended action
The CCI version information displayed in Control Panel in Windows is not removed	<p>If both of the following conditions are met, remove the version information displayed in the Programs and Features window in Control Panel in Windows by following the procedure below:</p> <ul style="list-style-type: none"> ▪ The CCI version displayed by using the raidqry -h command on CCI is earlier than 01-68-03/00. ▪ The CCI version is displayed in the Programs and Features window in Control Panel in Windows. <ol style="list-style-type: none"> 1. Log in to the host for which the Windows-based CCI is installed, and then open a command prompt with administrator privileges. 2. Move to the directory for which the CCI tools are installed (for example, <code>cd/d C:\HORCM\Tool13</code>). 3. Correct the version by using the version information edit tool. When you run the tool, the CCI version is removed from the Programs and Features window in Control Panel (for example, <code>RMVersionEdit.bat delete version</code>). 4. Verify that the CCI version is not displayed in the Programs and Features window in Control Panel.
Part of a dialog box displayed when installing CCI in Windows is missing	<p>When installing CCI in Windows, if a file locked by other applications or a file with only read permission is detected, dialog boxes with messages are displayed (see "Locked File Detected dialog box" and "ReadOnly File Detected dialog box" below). Depending on the Windows environment, the entire dialog box might not be displayed, and part of the dialog box might be missing.</p>

Locked File Detected dialog box

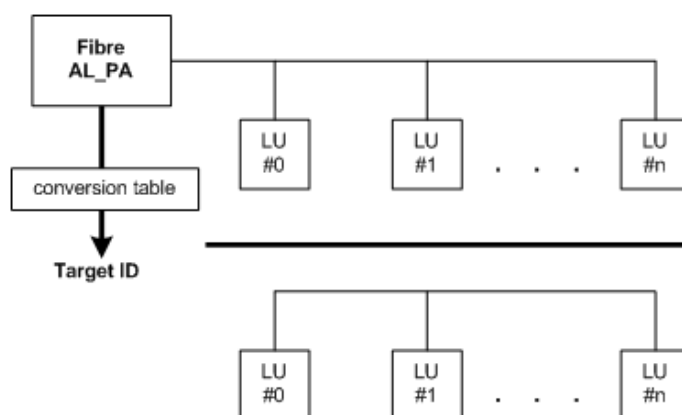
**ReadOnly File Detected dialog box**

Appendix A: Fibre-to-SCSI address conversion

Disks connected with Fibre Channel display as SCSI disks on UNIX hosts. Disks connected with Fibre Channel connections can be fully utilized. CCI converts Fibre-Channel physical addresses to SCSI target IDs (TIDs) using a conversion table.

Fibre/FCoE-to-SCSI address conversion

The following figure shows an example of Fibre-to-SCSI address conversion.



For iSCSI, the AL_PA is the fixed value 0xFE.

The following table lists the limits for target IDs (TIDs) and LUNs.

Port	HP-UX, other systems		Solaris systems		Windows systems	
	TID	LUN	TID	LUN	TID	LUN
Fibre	0 to 15	0 to 1023	0 to 125	0 to 1023	0 to 31	0 to 1023
SCSI	0 to 15	0 to 7	0 to 15	0 to 7	0 to 15	0 to 7

Conversion table for Windows

The conversion table for Windows is based on conversion by an Emulex driver. If the Fibre Channel adapter is different (for example, Qlogic, HPE), the target ID that is indicated by the `raidscan` command might be different from the target ID on the Windows host.

The following shows an example of using the **raidscan** command to display the TID and LUN of Harddisk6 (HP driver). You must start HORCM without the descriptions of HORCM_DEV or HORCM_INST in the configuration definition file because of the unknown TIDs and LUNs.

Using raidscan to display TID and LUN for FC devices

```
C:\>raidscan -pd hd6 -x drivescan hd6
Harddisk 6... Port[ 2] PhId[ 4] TId[ 3] Lun[ 5] [HITACHI      ] [OPEN-3      ]
          Port[CL1-J] Ser#[ 30053] LDEV#[ 14(0x00E)]
          HORC = SMPL HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
          RAID5[Group 1- 2] SSID = 0x0004
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....) ...P/S, Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-J / e2/4, 29, 0.1(9).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 1.1(10).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 2.1(11).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 3.1(12).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 4.1(13).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 5.1(14).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/4, 29, 6.1(15).....SMPL ---- - - - - - , - - - - -
Specified device is LDEV# 0014
```

In this case, the target ID indicated by the **raidscan** command must be used in the configuration definition file. This can be accomplished using either of the following two methods:

- **Using the default conversion table:** Use the TID# and LU# indicated by the **raidscan** command in the HORCM configuration definition file (TID=29 LUN=5 in the example above).
- **Changing the default conversion table:** Change the default conversion table using the HORCMFCTBL environmental variable (TID=3 LUN=5 in the following example).

Using HORCMFCTBL to change the default fibre conversion table

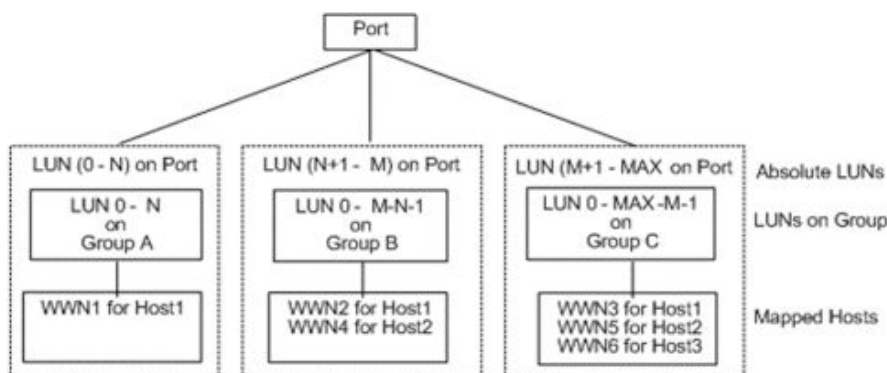
```
C:\>set HORCMFCTBL=X      <-- X=fibre conversion table #
C:\>horcmstart ...       <-- Start of HORCM.
:
:
Result of "set HORCMFCTBL=X" command:
C:\>raidscan -pd hd6 -x drivescan hd6
Harddisk 6... Port[ 2] PhId[ 4] TId[ 3] Lun[ 5] [HITACHI      ] [OPEN-3      ]
          Port[CL1-J] Ser#[ 30053] LDEV#[ 14(0x00E)]
          HORC = SMPL HOMRCF[MU#0 = SMPL MU#1 = SMPL MU#2 = SMPL]
          RAID5[Group 1- 2] SSID = 0x0004
PORT# /ALPA/C,TID#,LU#.Num(LDEV#....) ...P/S,Status,Fence,LDEV#,P-Seq#,P-LDEV#
CL1-J / e2/0, 3, 0.1(9).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/0, 3, 1.1(10).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/0, 3, 2.1(11).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/0, 3, 3.1(12).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/0, 3, 4.1(13).....SMPL ---- - - - - - , - - - - -
CL1-J / e2/0, 3, 5.1(14).....SMPL ---- - - - - - , - - - - -
```



```
CL1-J / e2/0, 3, 6.1(15).....SMPL -----, -----
Specified device is LDEV# 0014
```

LUN configurations on the RAID storage systems

The RAID storage systems (9900V and later) manage the LUN configuration on a port through the LUN security as shown in the following figure.



Explanation of terms:

Group: A Group name registered by LUN security configuration on the port.

WWN: WWN list on a Group registered by LUN security configuration on the port.

MAX: The maximum LUN number

CCI uses absolute LUNs to scan a port, whereas the LUNs on a group are mapped to the host system so that the TID and LUN indicated by the **raidscan** command are different from the TID and LUN displayed by the host system. In this case, the TID and LUN indicated by the **raidscan** command should be used.

In the following example, you must start HORCM without a description for HORCM_DEV and HORCM_INST because the TID and LUN are not known. Use the port, TID, and LUN displayed by the **raidscan -find** or **raidscan -find conf** command for HORCM_DEV (see the example for displaying the port, TID, and LUN using **raidscan**).

For details about LUN discovery based on a host group, see Host Group Control in the *Command Control Interface User and Reference Guide*.

Displaying the port, TID, and LUN using raidscan

```
# ls /dev/rdsd/* | raidscan -find
DEVICE_FILE  UID  S/F PORT  TARG  LUN   SERIAL  LDEV  PRODUCT_ID
/dev/rdsd/c0t0d4  0   S  CL1-M    0     4    31168   216  OPEN-3-CVS-CM
/dev/rdsd/c0t0d1  0   S  CL1-M    0     1    31168   117  OPEN-3-CVS
/dev/rdsd/c1t0d1  -   -  CL1-M    -     -    31170   121  OPEN-3-CVS
```

UID: Displays the UnitID for multiple RAID configuration. A hyphen (-) is displayed when the command device for HORCM_CMD is not found.

S/F: S indicates that the port is SCSI, and F indicates that the port is Fibre Channel.

PORT: Displays the RAID storage system port number

TARG: Displays the target ID (converted by the fibre conversion table)

LUN: Displays the logical unit number (converted by the fibre conversion table).

SERIAL: Displays the production number (serial#) of the RAID storage system.

LDEV: Displays the LDEV# within the RAID storage system.

PRODUCT_ID: Displays product-id field in the STD inquiry page.

Fibre address conversion tables

Following are the fibre address conversion tables:

- Table number 0 = HP-UX systems
- Table number 1 = Solaris systems
- Table number 2 = Windows systems

The conversion table for Windows systems is based on the Emulex driver. If a different Fibre-Channel adapter is used, the target ID indicated by the **raidscan** command might be different than the target ID indicated by the Windows system.



Note: Table 3 for other Platforms is used to indicate the LUN without target ID for unknown FC_AL conversion table or Fibre-Channel fabric (Fibre-Channel worldwide name). In this case, the target ID is always zero, thus **Table 3 is not described in this document**. Table 3 is used as the default for platforms other than those listed above. If the host will use the WWN notation for the device files, then this table number should be changed by using the \$HORCMFCTBL variable.

If the TID displayed on the system is different than the TID indicated in the fibre conversion table, you must use the TID (or LU#) returned by the **raidscan** command to specify the device(s).

Fibre address conversion table for HP-UX systems (Table 0)

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID	AL-PA	TID
EF	0	CD	0	B2	0	98	0	72	0	55	0	3A	0	25	0
E8	1	CC	1	B1	1	97	1	71	1	54	1	39	1	23	1
E4	2	CB	2	AE	2	90	2	6E	2	53	2	36	2	1F	2
E2	3	CA	3	AD	3	8F	3	6D	3	52	3	35	3	1E	3
E1	4	C9	4	AC	4	88	4	6C	4	51	4	34	4	1D	4
E0	5	C7	5	AB	5	84	5	6B	5	4E	5	33	5	1B	5
DC	6	C6	6	AA	6	82	6	6A	6	4D	6	32	6	18	6

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TID
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	-	-

Fibre address conversion table for Solaris systems (Table 1)

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TI D	AL-PA	TID	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	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

C0		C1		C2		C3		C4		C5		C6		C7	
AL-PA	TI D	AL-PA	TID	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TID	AL-PA	TID
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	-	-

Fibre address conversion table for Windows systems (Table 2)

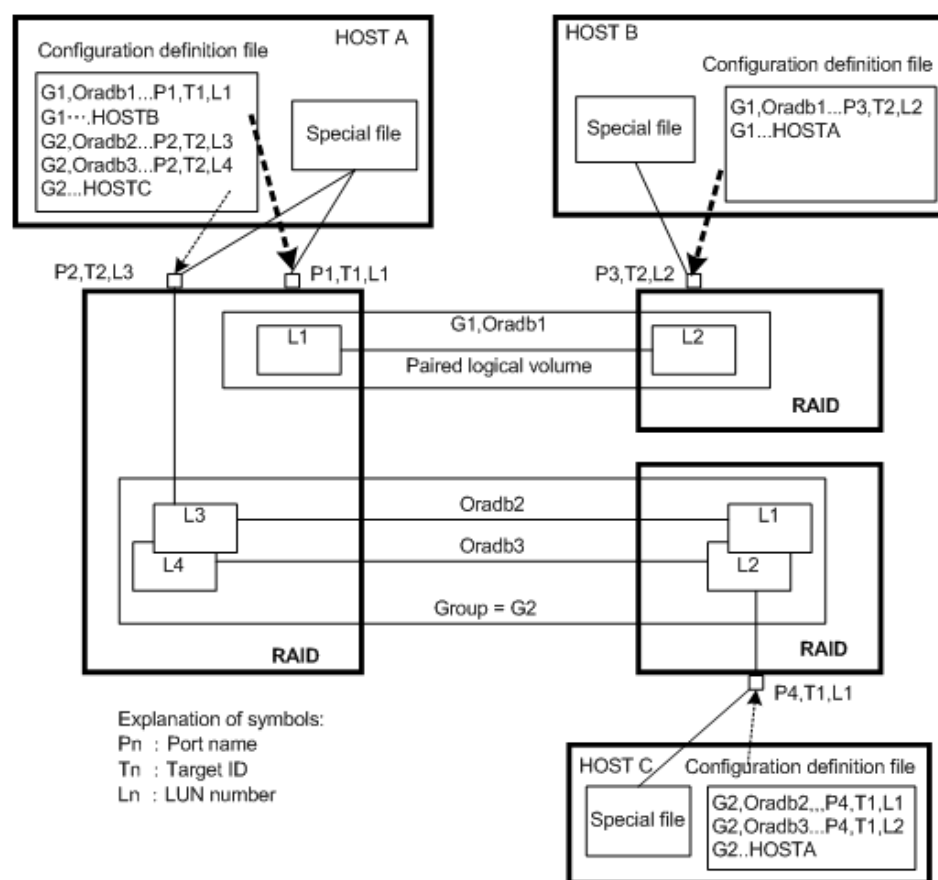
C5 (PhId5)		C4 (PhId4)				C3 (PhId3)				C2 (PhId2)				C1 (PhId1)			
AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D	AL-PA	TI D
-	-	-	-	CC	15	-	-	98	15	-	-	56	15	-	-	27	15
-	-	E4	30	CB	14	B1	30	97	14	72	30	55	14	3C	30	26	14
-	-	E2	29	CA	13	AE	29	90	13	71	29	54	13	3A	29	25	13
-	-	E1	28	C9	12	AD	28	8F	12	6E	28	53	12	39	28	23	12
-	-	E0	27	C7	11	AC	27	88	11	6D	27	52	11	36	27	1F	11
-	-	DC	26	C6	10	AB	26	84	10	6C	26	51	10	35	26	1E	10
-	-	DA	25	C5	9	AA	25	82	9	6B	25	4E	9	34	25	1D	9
-	-	D9	24	C3	8	A9	24	81	8	6A	24	4D	8	33	24	1B	8
-	-	D6	23	BC	7	A7	23	80	7	69	23	4C	7	32	23	18	7
-	-	D5	22	BA	6	A6	22	7C	6	67	22	4B	6	31	22	17	6
-	-	D4	21	B9	5	A5	21	7A	5	66	21	4A	5	2E	21	10	5
-	-	D3	20	B6	4	A3	20	79	4	65	20	49	4	2D	20	0F	4
-	-	D2	19	B5	3	9F	19	76	3	63	19	47	3	2C	19	08	3
-	-	D1	18	B4	2	9E	18	75	2	5C	18	46	2	2B	18	04	2
EF	1	CE	17	B3	1	9D	17	74	1	5A	17	45	1	2A	17	02	1
E8	0	CD	16	B2	0	9B	16	73	0	59	16	43	0	29	16	01	1

Appendix B: Sample configuration definition files

See the following sample configuration definition files for typical CCI configurations.

Sample configuration definition files

The following figure illustrates the configuration definition of paired volumes.



The following example shows a sample configuration file for a UNIX-based operating system.

Configuration file example – UNIX-based servers (# indicates a comment)

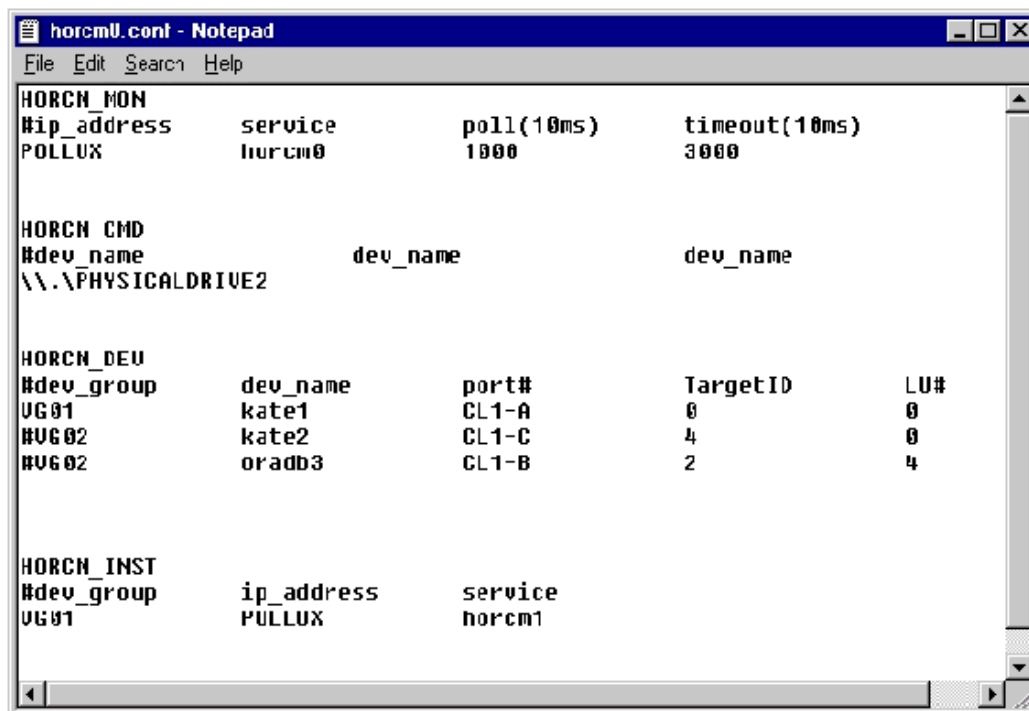
```
HORCM_MON
#ip_address    service    poll(10ms)    timeout(10ms)
HST1           horcm      1000          3000
HORCM_CMD
```

```

#unitID 0... (seq#30014)
#dev_name dev_name dev_name
/dev/rdisk/c0t0d0
#unitID 1... (seq#30015)
#dev_name dev_name dev_name
/dev/rdisk/clt0d0
HORCM_DEV
#dev_group dev_name port# TargetID LU# MU#
oradb oradb1 CL1-A 3 1 0
oradb oradb2 CL1-A 3 1 1
oralog oralog1 CL1-A 5 0
oralog oralog2 CL1-A1 5 0
oralog oralog3 CL1-A1 5 1
oralog oralog4 CL1-A1 5 1 h1
HORCM_INST
#dev_group ip_address service
oradb HST2 horcm
oradb HST3 horcm
oralog HST3 horcm

```

The following figure shows a sample configuration file for a Windows operating system.



Configuration file parameters

The configuration file sets the following parameters:

- [HORCM_MON](#) (on page 87)
- [HORCM_CMD](#) (in-band method) (on page 87)

- [HORCM_CMD \(out-of-band method\) \(on page 93\)](#)
- [HORCM_VCMD \(on page 95\)](#)
- [HORCM_DEV \(on page 96\)](#)
- [HORCM_INST \(on page 99\)](#)
- [HORCM_INSTP \(on page 102\)](#)
- [HORCM_LDEV \(on page 103\)](#)
- [HORCM_LDEVG \(on page 104\)](#)
- [HORCM_ALLOW_INST \(on page 104\)](#)
- [HORCM_NVME \(on page 104\)](#)

HORCM_MON

The monitor parameter (HORCM_MON) in the CCI configuration definition file defines the following values:

- `ip_address`: Specifies the local host name or the IP address of the local host. When you specify the name of a local host that has multiple IP addresses, one of the IP addresses is selected at random and used. If you want to use all IP addresses, specify NONE for IPv4 or NONE6 for IPv6.
- `service`: Specifies the UDP port name assigned to the HORCM communication path, which is registered in `/etc/services` in UNIX (`%windir%\system32\drivers\etc\services` in Windows, `SYS$SYSROOT:[000000.TCPIP$ETC]SERVICES.DAT` in OpenVMS). If a port number is specified instead of a port name, the port number is used.
- `poll`: Specifies the interval for monitoring paired volumes in increments of 10 ms. To reduce the HORCM daemon load, make this interval longer. When 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.
- `timeout`: The time-out period of communication with the remote server.

If HORCM_MON is not specified, then the following defaults are set:

```
#ip_address service      poll(10ms) timeout(10ms)
NONE          default_port 1000      3000
```

`default_port`:

- For no specified HORCM instance: $31000 + 0$
- For instance HORCM X: $31000 + X + 1$

HORCM_CMD (in-band method)

When the in-band method is used, the command device parameter (HORCM_CMD) defines the UNIX device path or Windows physical device number of each command device that can be accessed by CCI. You can specify multiple command devices in HORCM_CMD to provide failover in case the primary command device becomes unavailable.

**Tip:**

- To enhance redundancy, you can make multiple command devices available for a single storage system. This configuration is called alternate command device configuration. For this configuration, command devices are listed horizontally on a line in the configuration definition file. In the following example, CMD1 and CMD2 are command devices in the same storage system:

```
HORCM_CMD
CMD1 CMD2
```

- To control multiple storage systems in one configuration definition file, you can list the command devices for each storage system in the configuration definition file. In this case, the command devices are listed vertically. CMD1 and CMD2 in the following example are command devices in different storage systems:

```
HORCM_CMD
CMD1
CMD2
```

- When you specify a command device or a virtual command device, you can enter a maximum of 4095 characters for each line in the configuration definition file. If you enter more than 4095 characters in a line, the exceeding part is processed as the characters in the next line.

The command device must be mapped to the SCSI/fibre using LUN Manager first. The mapped command devices are identified by "-CM" appended to the PRODUCT_ID displayed by the **inqraid** command, as shown in the following examples.

Viewing the command device using inqraid (UNIX host)

```
# ls /dev/rdisk/clt0* | /HORCM/usr/bin/inqraid -CLI -sort
DEVICE_FILE PORT SERIAL LDEV CTG H/M/12 SSID R:Group PRODUCT_ID
clt0d0s2 CL2-E 63502 576 - - - - OPEN-V-CM
clt0d1s2 CL2-E 63502 577 - s/s/ss 0006 1:02-01 OPEN-V -SUN
clt0d2s2 CL2-E 63502 578 - s/s/ss 0006 1:02-01 OPEN-V -SUN
```

In this example, the command device is `/dev/rdisk/clt0d2s2`.

Viewing the command device using inqraid (Windows host)

```
D:\HORCM\etc>inqraid $Phys -CLI
\\.\PhysicalDrive1:
# Harddisk1 -> [VOL61459_449_DA7C0D92] [OPEN-3 ]
\\.\PhysicalDrive2:
# Harddisk2 -> [VOL61459_450_DA7C0D93] [OPEN-3-CM ]
```

In this example, the command device is `\\.\PhysicalDrive2`.

After mapping the command device, set the HORCM_CMD parameter in the configuration definition file as follows:

```
\\.\CMD-<Serial Number>:<Device special file name>
```

- **<Serial Number>:** Specifies the serial number of the storage system.
 - For VSP G1x00 and VSP F1500, add a “3” at the beginning of the serial number. For example, for serial number 12345, enter 312345.
 - For VSP 5000 series, add a “5” at the beginning of the serial number. For example, for serial number 12345, enter 512345.
- **<Device special file name>:** Specifies the device special file name of the command device.

For example, specify the following for serial number 64015 and device special file name `/dev/rdisk/*`:

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\CMD-64015:/dev/rdisk/*
```



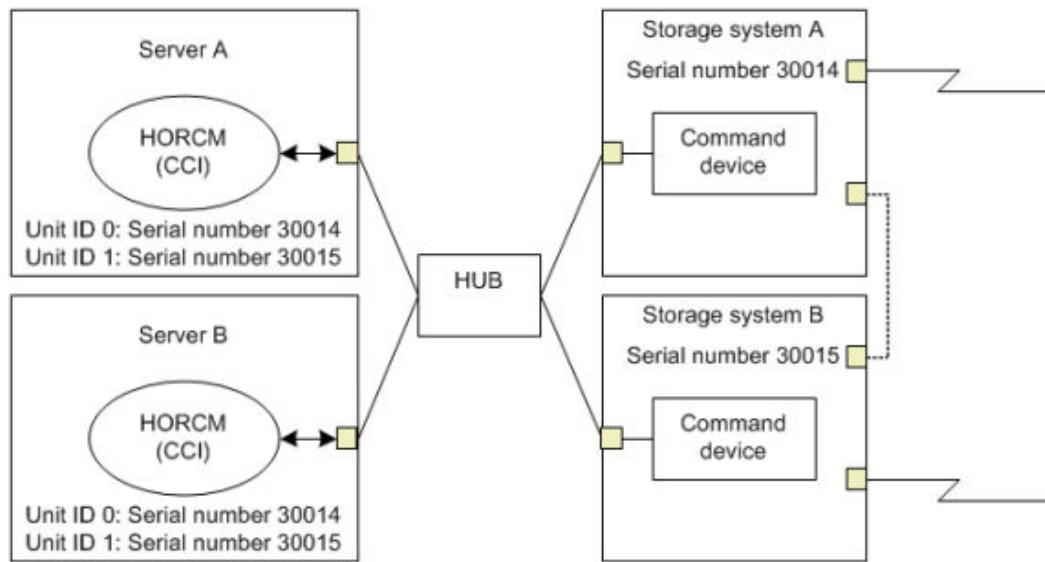
Caution: To enable dual path of the command device under UNIX systems, make sure to include all paths to the command device on a single line in the HORCM_CMD section of the configuration definition file. Entering path information on separate lines might cause syntax parsing issues, and failover might not occur unless the HORCM startup script is restarted on the UNIX system.

When two or more storage systems are connected, CCI identifies each storage system using unit IDs. The unit ID is assigned sequentially in the order described in HORCM_CMD of the configuration definition file. For a command device alternative configuration, a special file for multiple command devices is written.



Caution: When storage systems are shared by two or more servers, unit IDs and serial numbers must be consistent among the servers. List serial numbers of the storage systems in HORCM_CMD of the configuration definition file in the same order. The following figure illustrates unit IDs when multiple servers share multiple storage systems.

The following figure shows the configuration and unit IDs for multiple storage systems.



For Windows

Normally, physical drives are specified for command devices in storage systems. However, CCI provides a method that is not affected by changes of physical drives in Windows by using the following naming format to specify the serial number, LDEV number, and port number in that order:

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

- For VSP G1x00 and VSP F1500, add a “3” at the beginning of the serial number. For example, for serial number 12345, enter 312345.
- For VSP 5000 series, add a “5” at the beginning of the serial number. For example, for serial number 12345, enter 512345.

The following example specifies 30095 for the storage system's serial number, 250 for the LDEV number, and CL1-A for the port number:

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

- **Minimum specification**

For the command device with serial number 30095, specify as follows:

```
\\.\CMD-30095
```

- **Command devices in the multi-path environment**

Specify serial number 30095, and LDEV number 250 as follows:

```
\\.\CMD-30095-250
```

- **Other specifications**

Specify serial number 30095, LDEV number 250, and port number CL1-A as follows:

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

or

```
\\.\CMD-30095-250-CL1
```

For UNIX

Device files are specified for command devices in UNIX. However, CCI provides a method that is not affected by changes of device files in UNIX by using the following naming format specifying the serial number, LDEV number, and port number in that order:

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

- For VSP G1x00 and VSP F1500, add a “3” at the beginning of the serial number. For example, for serial number 12345, enter 312345.
- For VSP 5000 series, add a “5” at the beginning of the serial number. For example, for serial number 12345, enter 512345.

The following example specifies 30095 for the storage system's serial number, 250 for the LDEV number, and CL1-A for the port number:

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

HINT provides a path to scan and specifies a directory ending with a slash (/) or a name pattern including the directory. Device files are searched using a name filter similar to the **ingraid** command.

- To find command devices from ' /dev/rdisk/* , enter /dev/rdisk/.
- To find command devices from ' /dev/rdisk/c10* , enter /dev/rdisk/c10.
- To find command devices from ' /dev/rhdisk* , enter /dev/rhdisk.

For an alternate command device configuration, HINT of the second command device can be omitted. In this case, command devices are searched from the device file that was scanned first.

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

- **Minimum specification**

For the command device of a storage system with serial number 30095, specify as follows:

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

- **Command devices in a multi-path environment**

Specify storage system serial number 30095 and LDEV number 250 as follows:

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

- **Other specifications**

Specify an alternate path with storage system serial number 30095 and LDEV number 250 as follows:

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

For Linux

Note the following important information when using CCI on a Linux host.



Note: If the hardware configuration is changed while an OS is running in Linux, the name of a special file corresponding to the command device might be changed. At this time, if HORCM was started by specifying the special file name in the configuration definition file, HORCM cannot detect the command device, and the communication with the storage system might fail.

To prevent this failure, specify the path name allocated by udev to the configuration definition file before booting HORCM. Use the following procedure to specify the path name. In this example, the path name for `/dev/sdgh` can be found.

1. Find the special file name of the command device by using `inqraid` command:

```
[root@myhost ~]# ls /dev/sd* | /HORCM/usr/bin/inqraid -CLI | grep CM
sda CL1-B 30095 0 - - 0000 A:00000 OPEN-V-CM sdgh CL1-A 30095 0 - -
0000 A:00000 OPEN-V-CM [root@myhost ~]#
```

2. Find the path name from the `by-path` directory:

```
[root@myhost ~]# ls -l /dev/disk/by-path/ | grep sdgh lrwxrwxrwx. 1
root root 10 Jun 11 17:04 2015 pci-0000:08:00.0- fc-
0x50060e8010311940-lun-0 -> ../../sdgh [root@myhost ~]#
```

In this example, `pci-0000:08:00.0-fc-0x50060e8010311940-lun-0` is the path name.

3. Enter the path name in `HORCM_CMD` in the configuration definition file as follows:

```
HORCM_CMD /dev/disk/by-path/pci-0000:08:00.0-fc-0x50060e8010311940-
lun-0
```

4. Boot the HORCM instance as usual.

When you are using NVMe-oF, udev does not create a symbolic link to the device file for NVMe-oF in the `by-path` directory by default. In that case, use a symbolic link created in the `by-id` directory.

HORCM_CMD (out-of-band method)

For the out-of-band method, a virtual command device is used instead of a command device. By specifying the location of the virtual command device in `HORCM_CMD`, you can create a virtual command device.

The location where the virtual command device can be created is different according to the type of the storage system. For details about locations, see the section *System configuration using CCI* in the *Command Control Interface User and Reference Guide*.



Tip: When you specify a virtual command device, you can enter a maximum of 511 characters for each line.

Create a virtual command device on an SVP (VSP, HUS VM, VSP G1x00, VSP F1500, VSP 5000 series)

Specify the following to HORCM_CMD of the configuration definition file:

```
\\.\IPCMD-<SVP IP address>-<UDP communication port number>[-unit ID]
```

- <SVP IP address>: Sets an IP address of SVP.
- <UDP communication port number>: Sets the UDP communication port number. This value (31001) is fixed.
- [-unit ID]: Sets the unit ID of the storage system for the multiple units connection configuration. This can be omitted.

Create a virtual command device on a GUM (VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800)

Specify the following to HORCM_CMD of the configuration definition file:

```
\\.\IPCMD-<GUM IP address>-<UDP communication port number>[-unit ID]
```

- <GUM IP address>: Sets an IP address of GUM.
- <UDP communication port number>: Sets the UDP communication port number. These values (31001 and 31002) are fixed.
- [-unit ID]: Sets the unit ID of the storage system for the multiple units connection configuration. This can be omitted.



Note: To use GUM, we recommend that you set the combination of all GUM IP addresses in the storage system and the UDP communication port numbers by an alternate command device configuration. See the following examples for how to set the combination.

Use a CCI server port as a virtual command device

Specify the following in HORCM_CMD of the configuration definition file:

```
\\.\IPCMD-<CCI server IP address>-<CCI port number>[-Unit ID]
```

- <CCI server IP address>: Sets the IP address of the CCI server.
- <CCI port number>: Sets the CCI port number.
- [-Unit ID]: Sets the unit ID of the storage system for the multiple units connection configuration. This can be omitted.

Examples

This example shows the case of IPv4.

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\IPCMD-158.214.135.113-31001
```

This example shows the case of IPv6.

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\IPCMD-fe80::209:6bff:febe:3c17-31001
```

This example shows the case when both the in-band and out-band methods are used:

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\CMD-64015:/dev/rdisk/*  \\.\IPCMD-158.214.135.113-31001
```

This example shows the case when both the in-band and out-band methods are used in an alternate command device configuration:

```
HORCM_CMD
#dev_name dev_name
\\.\CMD-64015:/dev/rdisk/*  \\.\IPCMD-158.214.135.113-31001
HORCM_CMD
#dev_name dev_name
\\.\IPCMD-158.214.135.113-31001  \\.\CMD-64015:/dev/rdisk/*
```

This example shows the case of virtual command devices in a cascade configuration (three units):

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\IPCMD-158.214.135.113-31001
\\.\IPCMD-158.214.135.114-31001
\\.\IPCMD-158.214.135.115-31001
```

(VSP E series, VSP G130, G/F350, G/F370, G/F700, G/F900, VSP G200, G400, G600, G800, and VSP F400, F600, F800) This example shows the case of alternate command device configuration of the combination of all GUM IP addresses in the storage system and the UDP communication port numbers. In this case, enter the IP addresses without a line feed.

```
HORCM_CMD
#dev_name dev_name dev_name
\\.\IPCMD-192.168.0.16-31001 \\.\IPCMD-192.168.0.17-31001 \\.\IPCMD-192.168.0.16-
31002 \\.\IPCMD-192.168.0.17-31002
```

An IP address and a port number can be expressed using a host name and a service name.

HORCM_VCMD

The HORCM_VCMD parameter specifies the serial number of the virtual storage machine to be operated by this CCI instance.

You can only use virtual storage machines whose serial numbers are specified in HORCM_VCMD. To use more than one virtual storage machine from a CCI instance, specify each serial number on a separate line in HORCM_VCMD.



Note: If you want to use the virtual storage machine specified on the second or subsequent line of HORCM_VCMD, you must use the command options (for example, `-s <seq#>` or `-u <unit id>`). If you omit these command options, the virtual storage machine specified on the first line is used. If you specify a virtual storage machine whose serial number is not specified in HORCM_VCMD using the command option (`-s <seq#>` or `-u <Unit ID>`), the EX_ENOUNT error occurs.

HORCM_DEV

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

The following values are defined in the HORCM_DEV parameter:

- `dev_group`: Names a group of paired logical volumes. A command is executed for all corresponding volumes according to this group name.
- `dev_name`: Names the paired logical volume within a group (i.e., name of the special file or unique logical volume). The name of paired logical volume must be different than the "dev name" on another group.
- `Port#`: Defines the RAID storage system port number of the volume that corresponds with the `dev_name` volume.

For details about specifying `Port#`, see [Specifying Port# \(on page 98\)](#) below.

- `Target ID`: Defines the SCSI/fibre target ID number of the physical volume on the specified port.
- `LU#`: Defines the SCSI/fibre logical unit number (LU#) of the physical volume on the specified target ID and port.

For Fibre Channel, if the TID and LU# displayed on the system are different from the TID in the fibre address conversion table, then use the TID and LU# indicated by the **raidscan** command in the CCI configuration definition file.

- **MU# for ShadowImage/Copy-on-Write Snapshot:** Defines the mirror unit number (0 to 2) if using redundant mirror for the identical LU on ShadowImage. 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 to 2) in the configuration definition file. The MU#0 of a mirror descriptor is used for connection of the S-VOL. The mirror descriptor (MU#0 to 2) can be used on ShadowImage and Copy-on-Write Snapshot. MU#3 to 63 can be used only on Copy-on-Write Snapshot. When you enter the MU number for a ShadowImage/Copy-on-Write Snapshot pair into the configuration definition file, specify only the number, for example, "0" or "1".



Note: When you enter the MU number for a ShadowImage/Copy-on-Write Snapshot pair into the configuration definition file, if you add an "h" before the number, for example, "h0" or "h1", it might not be recognized as aShadowImage/Copy-on-Write Snapshot pair and might not be operated.

Feature	SMPL		P-VOL		S-VOL	
	MU#0 to 2	MU#3 to 63	MU#0 to 2	MU#3 to 63	MU#0	MU#1 to 63
ShadowImage	Valid	Not valid	Valid	Not valid	Valid	Not valid
Copy-on-Write Snapshot	Valid	Valid	Valid	Valid	Valid	Not valid

- **MU# for TrueCopy/Universal Replicator/global-active device:** Defines the mirror unit number (0 to 3) if using redundant mirror for the identical LU on TC/UR/GAD. If this number is omitted, it is assumed to be (MU#0). You can specify only MU#0 for TrueCopy, and 4 MU numbers (MU#0 to 3) for Universal Replicator and global-active device. When you enter the MU number for a TC/UR/GAD pair into the configuration definition file, add an "h" before the number, for example, "h0" or "h1".



Note: When you enter the MU number for a TC/UR/GAD pair into the configuration definition file, if you specify the number without adding an "h" before, for example, "0" or "1", it might not be recognized as a TC/UR/GAD pair and might not be operated.

State/ Feature	SMPL		P-VOL		S-VOL	
	MU#0	MU#1 to 3	MU#0	MU#1 to 3	MU#0	MU#1 to 3
TrueCopy	Valid	Not valid	Valid	Not valid	Valid	Not valid
Universal Replicator/ global-active device	Valid	Valid	Valid	Valid	Valid	Valid

Specifying Port#

The following "n" shows unit ID when the server is connected to two or more storage systems (for example, CL1-A1 = CL1-A in unit ID 1). If the "n" option is omitted, the unit ID is 0. The port is not case sensitive (for example, CL1-A = cl1-a = CL1-a = cl1-A).

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

The following ports can only be specified for 9900V:

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

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

- Specifying the port name without a host group:
CL1-A for a RAID storage system
CL1-An, where n = unit ID for multiple RAID storage systems
- Specifying the port with a host group:
CL1-A-g, where g = host group
CL1-An-g, where n-g = host group g on CL1-A in unit ID n

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

Port	Basic				Option				Option				Option			
CL5	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL6	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL7	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL8	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CL9	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLA	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn

Port	Basic				Option				Option				Option			
CLB	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLC	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLD	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLE	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLF	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn
CLG	an	bn	cn	dn	en	fn	gn	hn	jn	kn	ln	mn	nn	pn	qn	rn

HORCM_INST

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

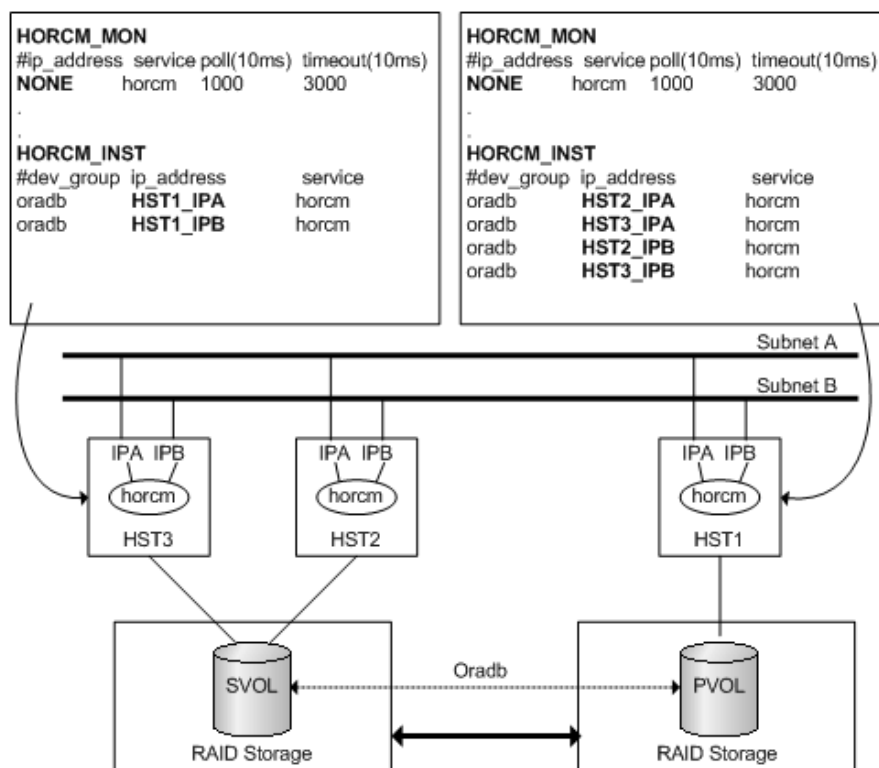
The following values are defined in the HORCM_INST parameter:

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

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

When you use all IP addresses of the local host in the configuration for multiple networks, specify `NONE` (IPv4) or `NONE6` (IPv6) as the `ip_address` of `HORCM_MON` parameter.

The following figure shows the configuration for multiple networks.

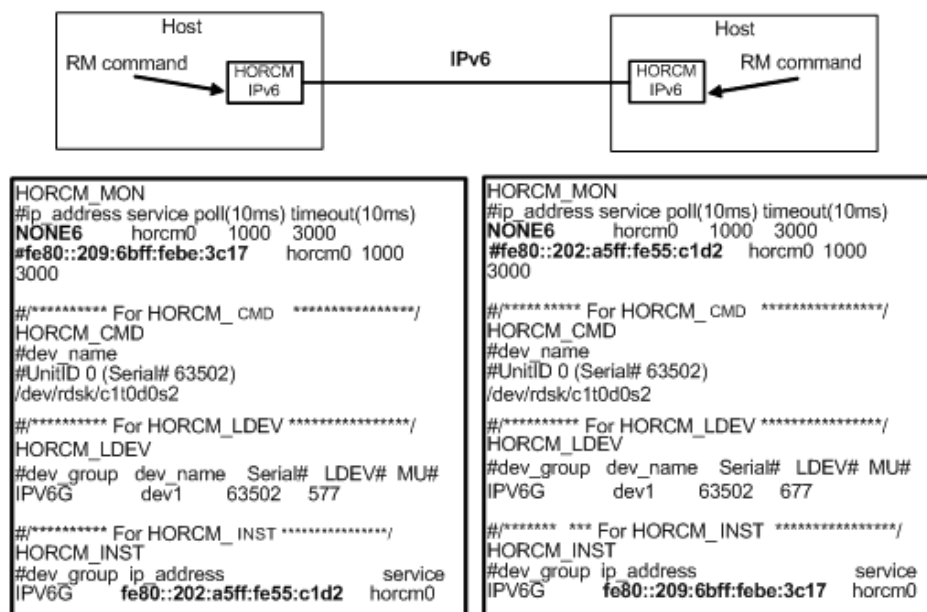


```
# horcctl -ND -g IP46G
```

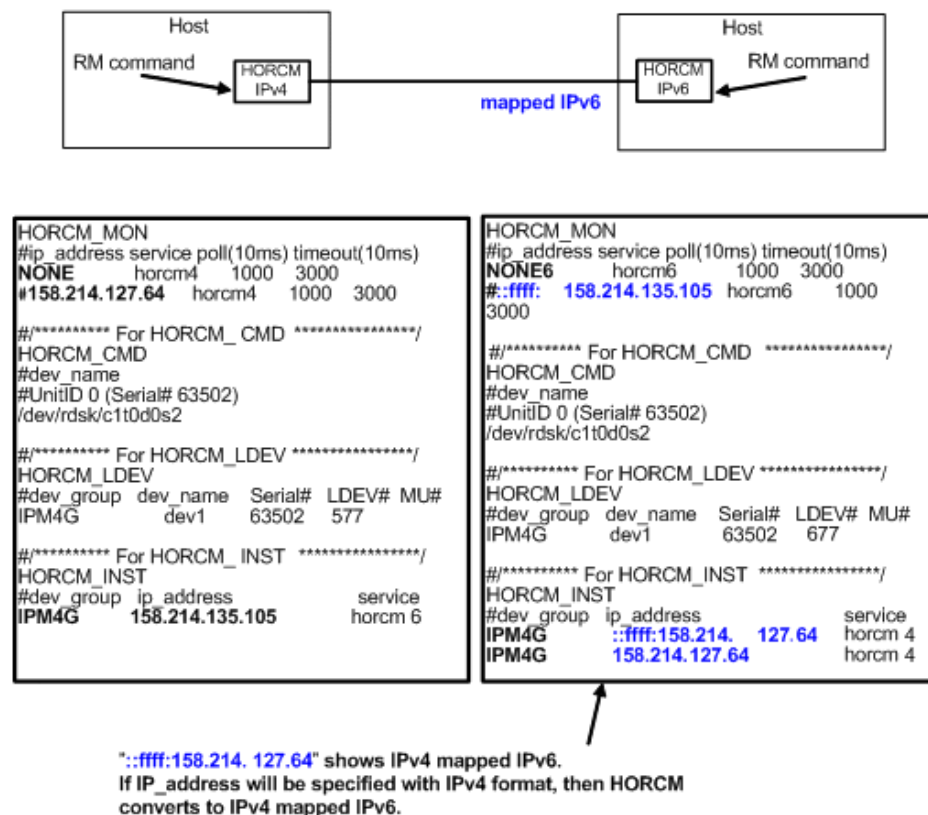
```
Current network address = 158.214.135.106, services = 50060# horcctl -NC -g IP46G
```

```
Changed network address(158.214.135.106,50060 -> fe80::39e7:7667:9897:2142,50060)
```

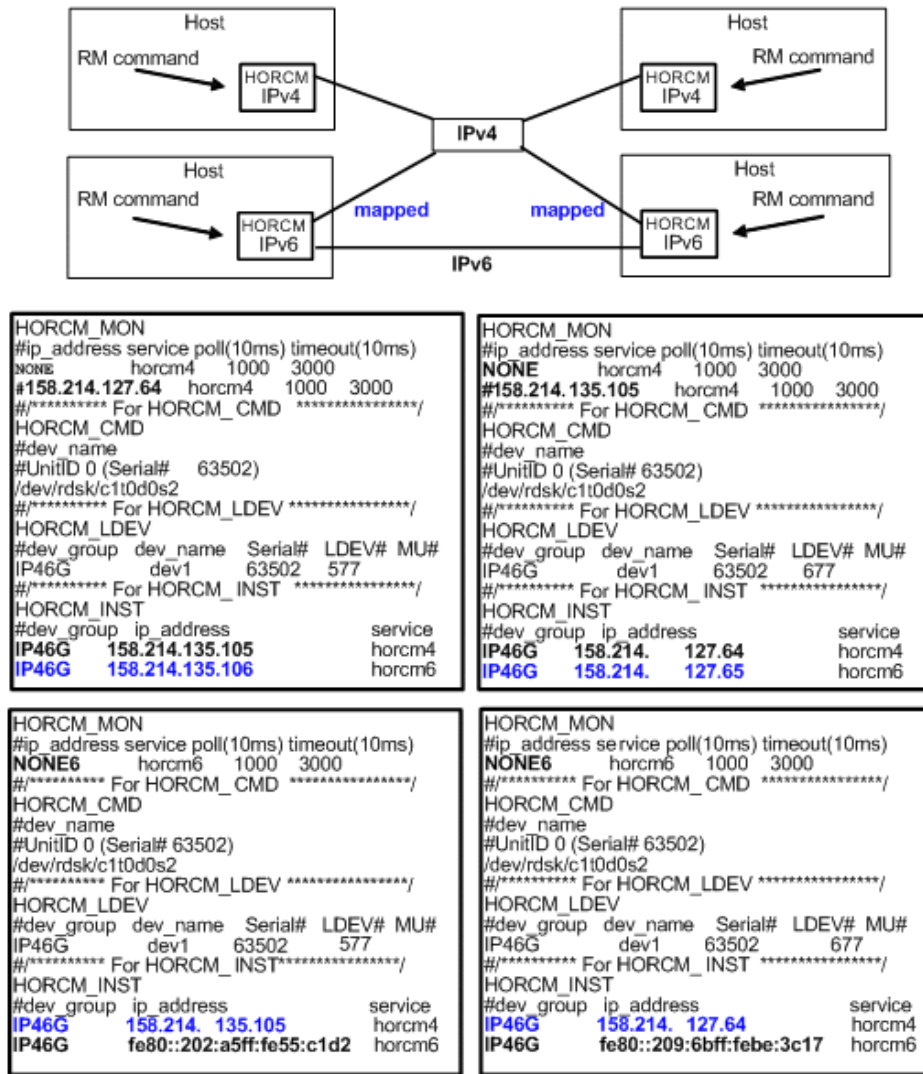
For IPv6 only, the configuration must be defined as HORCM/IPv6. The following figure shows the network configuration for IPv6.



It is possible to communicate between HORCM/IPv4 and HORCM/IPv6 using IPv4 mapped to IPv6. The following figure shows the network configuration for mapped IPv6.



In the case of mixed IPv4 and IPv6, HORCM/IPv4 and HORCM/IPv6 can be connected via IPv4 mapped IPv6, and native IPv6 is used for connecting HORCM/IPv6 and HORCM/IPv6. The following figure shows the network configuration for mixed IPv4 and IPv6.



HORCM_INSTP

The HORCM_INSTP parameter is used to specify "pathID" for TrueCopy, Universal Replicator, and global-active device link as well as HORCM_INST. The value for pathID must be specified from 1 to 255. If you do not specify the pathID, the behavior is the same as when HORCM_INST is used.

```

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

```



Note: The path ID can be specified for TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and global-active device. However, the path ID cannot be specified for UR/URz when connecting TagmaStore USP/TagmaStore NSC or USP V/VM.

The same path ID must be specified between the site of P-VOL and S-VOL because the path ID is used by the paircreate command.

HORCM_LDEV

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

- **dev_group:** (same as HORCM_DEV parameter) Names a group of paired logical volumes. The command is executed for all corresponding volumes according to this group name.
- **dev_name:** (same as HORCM_DEV parameter) Names the paired logical volume within a group (i.e., name of the special file or unique logical volume). The name of paired logical volume must be different than the "dev name" on another group.
- **MU#:** (same as HORCM_DEV parameter)
- **Serial#:** Describes the serial number of the RAID storage system.
 - For VSP G1x00 and VSP F1500, add a "3" at the beginning of the serial number (for example, enter "312345" for serial number 12345).
 - For VSP 5000 series, add a "5" at the beginning of the serial number (for example, enter "512345" for serial number 12345).
- **CU:LDEV (LDEV#):** Describes the LDEV number in the RAID storage system, and supports three types of format as LDEV#.
 - Specifying "CU:LDEV" in hex.
Example for LDEV# 260: 01:04
 - Specifying "LDEV" in decimal used by the **inqraid** command.
Example for LDEV# 260: 260
 - Specifying "LDEV" in hex used by the **inqraid** command.
Example for LDEV# 260: 0x104

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

HORCM_LDEVG

The HORCM_LDEVG parameter defines the device group information that the CCI instance reads. For details about device groups, see the *Command Control Interface User and Reference Guide*.

The following values are defined:

- **Copy_Group:** Specifies the name of the copy group. This is equivalent to `dev_group` of the HORCM_DEV and HORCM_LDEV parameters.

CCI operates by using the information defined here.

- **ldev_group:** Specifies the name of the device group that the CCI instance reads.
- **Serial#:** Specifies the storage system serial number.
 - For VSP G1x00 and VSP F1500, add a “3” at the beginning of the serial number (for example, enter “312345” for serial number 12345).
 - For VSP 5000 series, add a “5” at the beginning of the serial number (for example, enter “512345” for serial number 12345).

```
HORCM_LDEVG
#Copy_Group  ldev_group  Serial#
ora          grp1       64034
```

HORCM_ALLOW_INST

The HORCM_ALLOW_INST parameter is used to restrict the users using the virtual command device. The following IP addresses and port numbers are allowed:

For IPv4:

```
HORCM_ALLOW_INST
#ip_address      service
158.214.135.113  34000
158.214.135.114  34000
```

For IPv6:

```
HORCM_ALLOW_INST
#ip_address      service
fe80::209:6bff:febe:3c17  34000
```

`service` in the above example means the initiator port number of HORCM.

If CCI clients are not defined in HORCM_ALLOW_INST, HORCM instance starting up is rejected by SCSI check condition (SKEY=0x05, ASX=0xfe) and CCI cannot be started up.

HORCM_NVME

The HORCM_NVME parameter is used to perform the following operations:

- Define a namespace for NVMe-oF as a command device.
- Perform the operation on a pair volume with a namespace for NVMe-oF defined by enabling the command device security setting.

To perform these operations, specify the following:

```
HORCM_NVME  
ENABLE
```

To cancel these operations, specify the following:

```
HORCM_NVME  
DISABLE
```

If HORCM_NVME is omitted, the same processing as when DISABLE is specified is running.

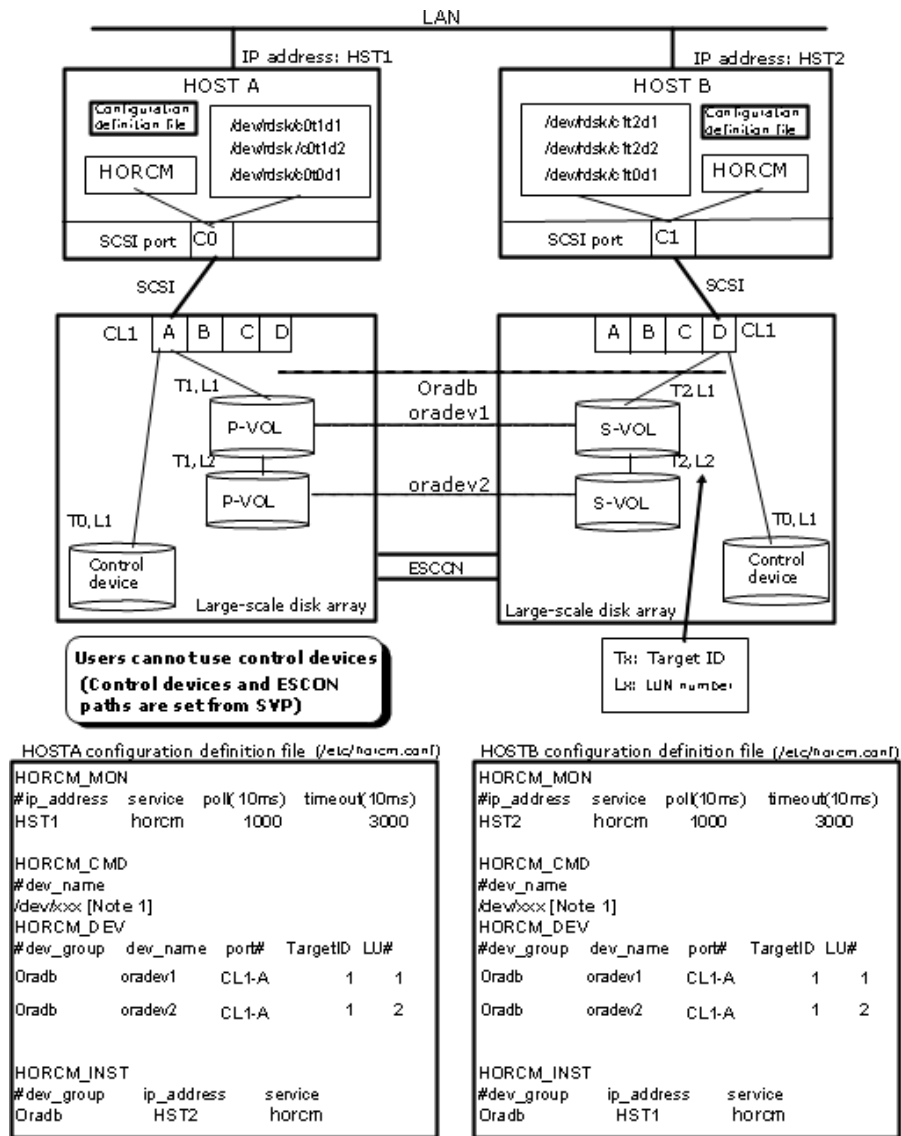
For more information about the CCI versions supported when a namespace is defined as a command device, see [In-band and out-of-band operations \(on page 47\)](#).

Examples of CCI configurations

The following examples show CCI configurations, the configuration definition file(s) for each configuration, and examples of CCI command use for each configuration.

Example of CCI commands for TrueCopy remote configuration

The following figure shows the TrueCopy remote configuration that is used in the following examples.



Example of CCI commands with HOSTA

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

```
# 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 the above figure).

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

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

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

- Designate a group name and display pair status.

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

Example of CCI commands with HOSTB

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

```
# 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 the above figure).

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

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

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

- Designate a group name and display pair status.

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

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

- HP-UX:

```
HORCM_CMD of HOSTA = /dev/rdisk/c0t0d1
HORCM_CMD of HOSTB = /dev/rdisk/c1t0d1
```

- Solaris:

```
HORCM_CMD of HOSTA = /dev/rdisk/c0t0d1s2
HORCM_CMD of HOSTB = /dev/rdisk/c1t0d1s2
```

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

- AIX®:

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

where XX = device number assigned by AIX®

- Tru64 UNIX:

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

where XX = device number assigned by Tru64 UNIX

- Windows:

```
HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
```

- Linux:

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

where X = disk number assigned by Linux

Example of CCI commands with HOSTA

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

```
# 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 above figure).

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

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

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

- Designate a group name and display pair status.

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

Example of CCI commands with HOSTB

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

```
# 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 above).

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

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

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

- Designate a group name and display pair status.

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

The command device is defined using the system raw device name (character-type device file name). For example, the command devices can be defined as follows:

- HP-UX:

```
HORCM_CMD of HORCMINST0 = /dev/rdisk/c0t0d1
HORCM_CMD of HORCMINST1 = /dev/rdisk/c1t0d1
```

- Solaris:

```
HORCM_CMD of HORCMINST0 = /dev/rdisk/c0t0d1s2
HORCM_CMD of HORCMINST1 = /dev/rdisk/c1t0d1s2
```

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

- AIX®:

```
HORCM_CMD of HORCMINST0 = /dev/rhdiskXX
HORCM_CMD of HORCMINST1 = /dev/rhdiskXX
```

where XX = device number assigned by AIX®

- Tru64 UNIX:

```
HORCM_CMD of HORCMINST0 = /dev/rrzbXXc
HORCM_CMD of HORCMINST1 = /dev/rrzbXXc
```

where XX = device number assigned by Tru64 UNIX

- Windows:

```
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
```

- Linux:

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

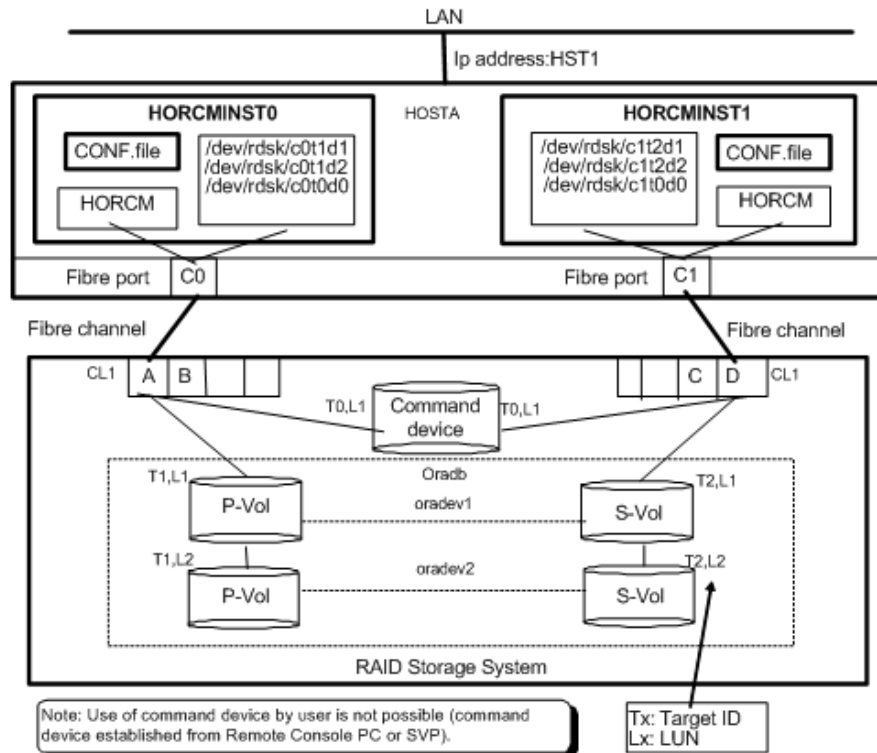
where X = device number assigned by Linux

Example of CCI commands for TrueCopy configuration with two instances

The following figure shows the TrueCopy configuration example for two instances.



Note: Input the raw device (character device) name of UNIX/Windows system for command device.



Configuration file for HORCMINST0(horcm0.conf)

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

HORCM_CMD
#dev_name
/dev/xxx [Note 1]

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

HORCM_INST
#dev_group ip_address service
Oradb HST1 horcm1
```

Configuration file for HORCMINST1(horcm1.conf)

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

HORCM_CMD
#dev_name
/dev/xxx [Note 1]

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

HORCM_INST
#dev_group ip_address service
Oradb HST1 horcm0
```

Example of CCI commands with Instance-0 on HOSTA

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

For C shell: # setenv HORCMINST 0

For Windows: set HORCMINST=0

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

```
# 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 above figure).

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

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

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

- Designate a group name and display pair status.

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

Example of CCI commands with Instance-1 on HOSTA

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

For C shell: # setenv HORCMINST 1

For Windows: set HORCMINST=1

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

```
# 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 above figure).

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

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

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

- Designate a group name and display pair status.

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

The command device is defined using the system raw device name (character-type device file name) of UNIX/Windows system. For example, the command devices for this configuration would be:

- **HP-UX:**

```
HORCM_CMD of HOSTA = /dev/rdisk/c0t0d1
HORCM_CMD of HOSTB = /dev/rdisk/c1t0d1
HORCM_CMD of HOSTC = /dev/rdisk/c1t0d1
HORCM_CMD of HOSTD = /dev/rdisk/c1t0d1
```

- **Solaris:**

```
HORCM_CMD of HOSTA = /dev/rdisk/c0t0d1s2
HORCM_CMD of HOSTB = /dev/rdisk/c1t0d1s2
HORCM_CMD of HOSTC = /dev/rdisk/c1t0d1s2
HORCM_CMD of HOSTD = /dev/rdisk/c1t0d1s2
```

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

- **AIX®:**

```
HORCM_CMD of HOSTA = /dev/rhdiskXX
HORCM_CMD of HOSTB = /dev/rhdiskXX
HORCM_CMD of HOSTC = /dev/rhdiskXX
HORCM_CMD of HOSTD = /dev/rhdiskXX
```

where XX = device number created automatically by AIX®

- **Tru64 UNIX:**

```
HORCM_CMD of HOSTA = /dev/rrzbXXc
HORCM_CMD of HOSTB = /dev/rrzbXXc
HORCM_CMD of HOSTC = /dev/rrzbXXc
HORCM_CMD of HOSTD = /dev/rrzbXXc
```

where XX = device number defined by Tru64 UNIX

- **Windows:**

```
HORCM_CMD of HOSTA = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTB = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTC = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTD = \\.\CMD-Ser#-ldev#-Port#
```

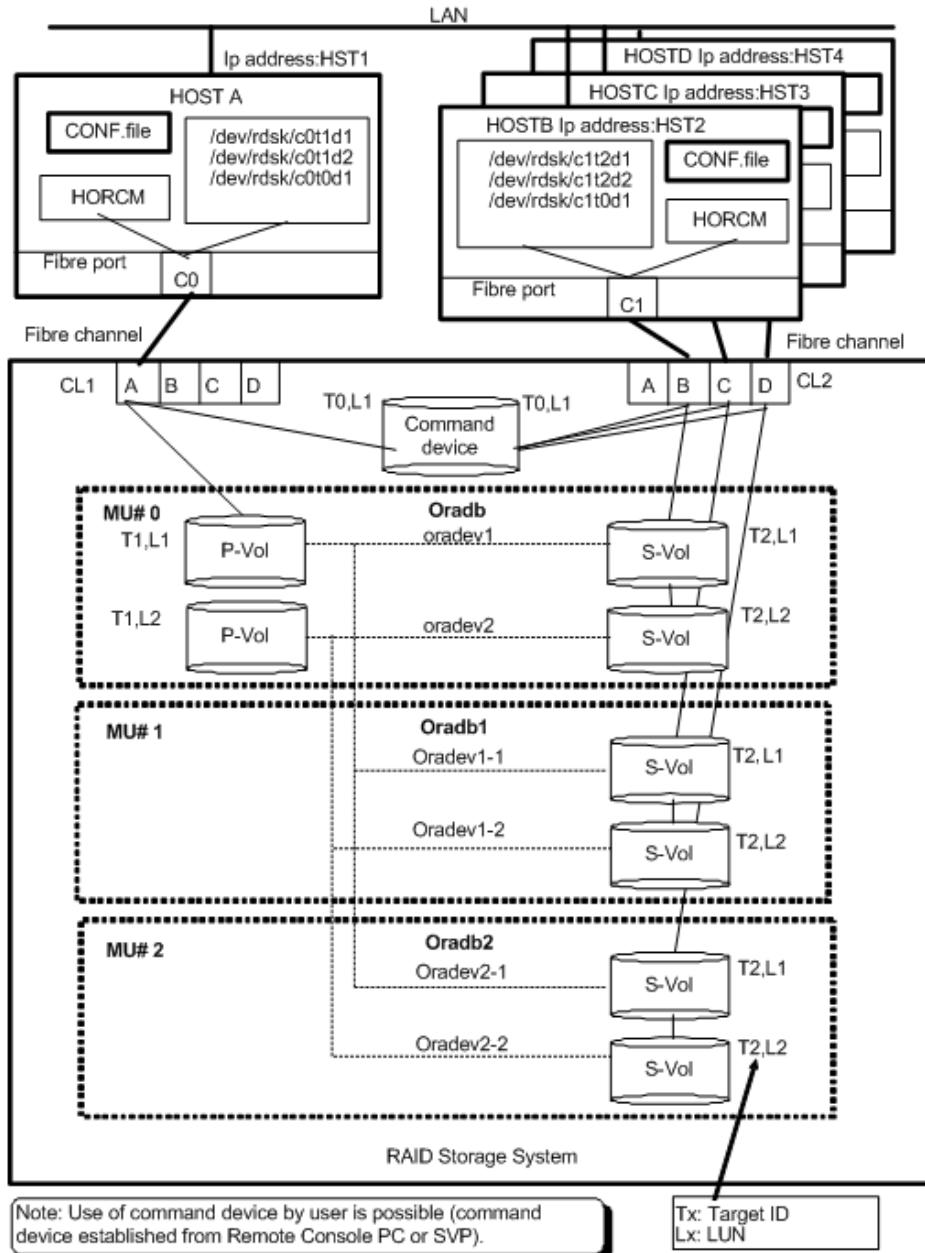
- **Linux:**

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

where X = disk number defined by Linux

Example of CCI commands for ShadowImage configuration

The following figure shows the ShadowImage configuration example.



<p>Configuration file for HOSTA (/etc/horcm.conf)</p> <pre> HORCM_MON #ip_address service poll(10ms) timeout(10ms) HST1 horcm 1000 3000 HORCM_CMD #dev_name /dev/xxx [Note 1] HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-A 1 1 0 Oradb oradev2 CL1-A 1 2 0 Oradb1 oradev1-1 CL1-A 1 1 1 Oradb1 oradev1-2 CL1-A 1 2 1 Oradb2 oradev2-1 CL1-A 1 1 2 Oradb2 oradev2-2 CL1-A 1 2 2 HORCM_INST #dev_group ip_address service Oradb HST2 horcm Oradb1 HST3 horcm Oradb2 HST4 horcm </pre>	<p>Configuration file for HOSTB (/etc/horcm.conf)</p> <pre> HORCM_MON #ip_address service poll(10ms) timeout(10ms) HST2 horcm 1000 3000 HORCM_CMD #dev_name /dev/xxx [Note 1] HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL2-B 2 1 Oradb oradev2 CL2-B 2 2 HORCM_INST #dev_group ip_address service Oradb HST1 horcm </pre>
	<p>Configuration file for HOSTC (/etc/horcm.conf)</p> <pre> HORCM_MON #ip_address service poll(10ms) timeout(10ms) HST3 horcm 1000 3000 HORCM_CMD #dev_name /dev/xxx [Note 1] HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb1 oradev1-1 CL2-C 2 1 Oradb1 oradev1-2 CL2-C 2 2 HORCM_INST #dev_group ip_address service Oradb1 HST1 horcm </pre>
	<p>Configuration file for HOSTD (/etc/horcm.conf)</p> <pre> HORCM_MON #ip_address service poll(10ms) timeout(10ms) HST4 horcm 1000 3000 HORCM_CMD #dev_name /dev/xxx [Note 1] HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb2 oradev2-1 CL2-D 2 1 Oradb2 oradev2-2 CL2-D 2 2 HORCM_INST #dev_group ip_address service Oradb2 HST1 horcm </pre>

Example of CCI commands with HOSTA (group Oradb)

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

For C shell: # setenv HORCC_MRCF 1

Windows: set HORCC_MRCF=1

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

```
# paircreate -g Oradb -v1
```

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

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

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

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

- Designate a group name and display pair status.

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

Example of CCI commands with HOSTB (group Oradb)

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

For C shell: # setenv HORCC_MRCF 1

Windows: set HORCC_MRCF=1

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

```
# paircreate -g Oradb -vr
```

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

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

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

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

- Designate a group name and display pair status.

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

Example of CCI commands with HOSTA (group Oradb1)

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

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

- Designate a group name (Oradb1) and a local host as P-VOL.

```
# paircreate -g Oradb1 -vl
```

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

- Designate a volume name (oradev1-1) and a local host as P-VOL.

```
# paircreate -g Oradb1 -d oradev1-1 -vl
```

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

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb1
```

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

Example of CCI commands with HOSTC (group Oradb1)

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

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

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

```
# paircreate -g Oradb1 -vr
```

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

- Designate a volume name (oradev1-1) and a remote host as P-VOL.

```
# paircreate -g Oradb1 -d oradev1-1 -vr
```

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

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb1
Group    PairVol (L/R) (Port#,TID,LU-M), Seq#, LDEV#..P/S, Status, Seq#, P-LDEV#
M
oradb1   oradev1-1 (L) (CL2-C, 2, 1 - 0) 30053 22..S-VOL COPY ----- 18
-
oradb1   oradev1-1 (R) (CL1-A, 1, 1 - 1) 30053 18..P-VOL COPY 30053 22
-
oradb1   oradev1-2 (L) (CL2-C, 2, 2 - 0) 30053 23..S-VOL COPY ----- 19
-
oradb1   oradev1-2 (R) (CL1-A, 1, 2 - 1) 30053 19..P-VOL COPY 30053 23 -
```

Example of CCI commands with HOSTA (group Oradb2)

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

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

- Designate a group name (Oradb2) and a local host as P-VOL.

```
# paircreate -g Oradb2 -vl
```

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

- Designate a volume name (oradev2-1) and a local host as P-VOL.

```
# paircreate -g Oradb2 -d oradev2-1 -vl
```

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

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb2
Group   PairVol (L/R) (Port#,TID,LU-M), Seq#, LDEV#..P/S, Status, Seq#, P-LDEV# M
oradb2  oradev2-1 (L) (CL1-A, 1, 1 - 2) 30053 18..P-VOL COPY 30053 24
-
oradb2  oradev2-1 (R) (CL2-D, 2, 1 - 0) 30053 24..S-VOL COPY ----- 18
-
oradb2  oradev2-2 (L) (CL1-A, 1, 2 - 2) 30053 19..P-VOL COPY 30053 25
-
oradb2  oradev2-2 (R) (CL2-D, 2, 2 - 0) 30053 25..S-VOL COPY ----- 19
-
```

Example of CCI commands with HOSTD (group Oradb2)

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

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

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

```
# paircreate -g Oradb2 -vr
```

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

- Designate a volume name (oradev2-1) and a remote host as P-VOL.

```
# paircreate -g Oradb2 -d oradev2-1 -vr
```

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

- Designate a group name and display pair status.

```
# pairdisplay -g Oradb2
Group   PairVol (L/R) (Port#,TID,LU-M), Seq#, LDEV#..P/S, Status, Seq#,P-LDEV# M
oradb2  oradev2-1 (L) (CL2-D, 2, 1 - 0) 30053 24..S-VOL COPY ----- 18 -
oradb2  oradev2-1 (R) (CL1-A, 1, 1 - 2) 30053 18..P-VOL COPY 30053 24 -
oradb2  oradev2-2 (L) (CL2-D, 2, 2 - 0) 30053 25..S-VOL COPY ----- 19 -
oradb2  oradev2-2 (R) (CL1-A, 1, 2 - 2) 30053 19..P-VOL COPY 30053 25 -
```

The command device is defined using the system raw device name (character-type device file name) of UNIX/Windows system. For example, the command devices for this configuration would be:

- HP-UX:

HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1

HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1

- Solaris:

HORCM_CMD of HORCMINST0 = /dev/rdsk/c0t0d1s2

HORCM_CMD of HORCMINST1 = /dev/rdsk/c1t0d1s2

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

- AIX®:

HORCM_CMD of HORCMINST0 = /dev/rhdiskXX

HORCM_CMD of HORCMINST1 = /dev/rhdiskXX

where XX = device number assigned by AIX®

- Tru64 UNIX:

HORCM_CMD of HORCMINST0 = /dev/rrzbXXc

HORCM_CMD of HORCMINST1 = /dev/rrzbXXc

where XX = device number assigned by Tru64 UNIX

- Windows:

HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-Idev#-Port#

HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-Idev#-Port#

- Linux:

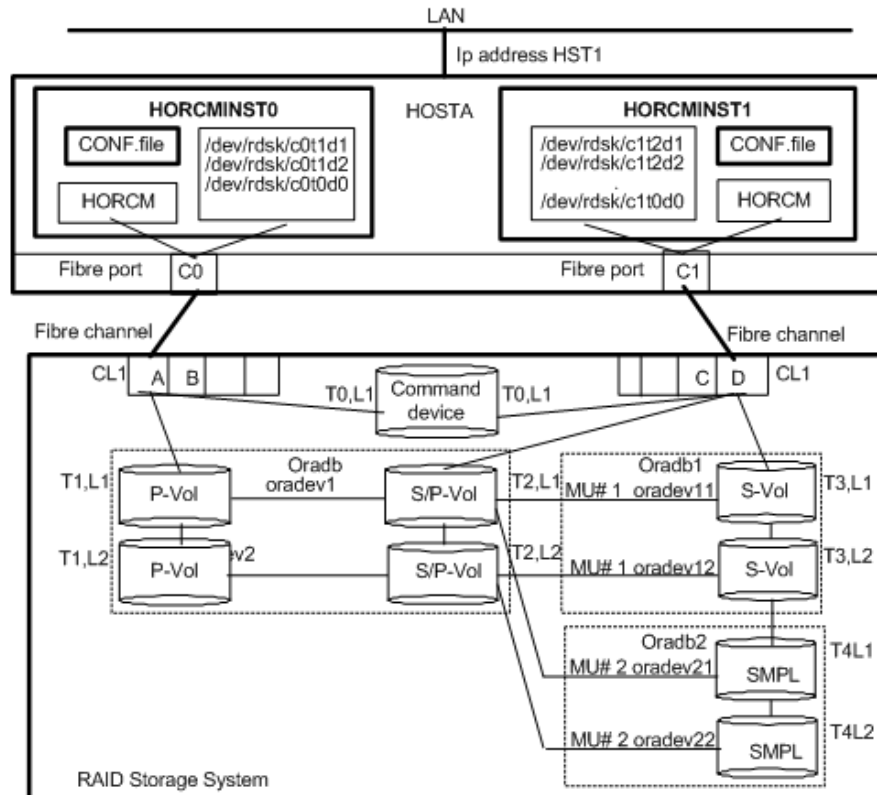
HORCM_CMD of HORCMINST0 = /dev/sdX

HORCM_CMD of HORCMINST1 = /dev/sdX

where X = disk number defined by Linux

Example of CCI commands for ShadowImage cascade configuration

The following figure shows the ShadowImage configuration example with cascade pairs.



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

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HOST1 horcm0 1000 3000
HORCM_CMD
#dev_name
/dev/xxx [Note 1]
HORCM_DEV
#dev_group dev_name port# TargetID LU# MU#
Oradb oradb1 CL1-A 1 1 0
Oradb oradb2 CL1-A 1 2 0
Oradb1 oradb11 CL1-D 3 1 0
Oradb1 oradb12 CL1-D 3 2 0
Oradb2 oradb21 CL1-D 4 1 0
Oradb2 oradb22 CL1-D 4 2 0
HORCM_INST
#dev_group ip_address service
Oradb HST1 horcm1
Oradb1 HST1 horcm1
Oradb2 HST1 horcm1
```

Configuration file for HOSTB (/etc/horcm1.conf)

```
HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST1 horcm1 1000 3000
HORCM_CMD
#dev_name
/dev/xxx [Note 1]
HORCM_DEV
#dev_group dev_name port# TargetID LU# MU#
Oradb oradb1 CL1-D 2 1 0
Oradb oradb2 CL1-D 2 2 0
Oradb1 oradb11 CL1-D 2 1 1
Oradb1 oradb12 CL1-D 2 2 1
Oradb2 oradb21 CL1-D 2 1 2
Oradb2 oradb22 CL1-D 2 2 2
HORCM_INST
#dev_group ip_address service
Oradb HST1 horcm0
Oradb1 HST1 horcm0
Oradb2 HST1 horcm0
```

Example of CCI commands with Instance-0 on HOSTA

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

For C shell: # setenv HORCMINST 0 # setenv HORCC_MRCF 1

For Windows: set HORCMINST=0 set HORCC_MRCF=1

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

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

These commands create pairs for all LUs assigned to groups Oradb and Oradb1 in the configuration definition file.

- Designate a group name and display pair status.

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

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

Example of CCI commands with Instance-1 on HOSTA

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

For C shell: # setenv HORCMINST 1 # setenv HORCC_MRCF 1

For Windows: set HORCMINST=1 set HORCC_MRCF=1

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

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

These commands create pairs for all LUs assigned to groups Oradb and Oradb1 in the configuration definition file.

- Designate a group name and display pair status.

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


The command device is defined using the system raw device name (character-type device file name) of UNIX/Windows system. For example, the command devices for this configuration would be:

- HP-UX:

HORCM_CMD of HOSTA (/etc/horcm.conf) ... /dev/rdisk/c0t0d1
HORCM_CMD of HOSTB (/etc/horcm.conf) ... /dev/rdisk/c1t0d1
HORCM_CMD of HOSTB (/etc/horcm0.conf) ... /dev/rdisk/c1t0d1

- Solaris:

HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rdisk/c0t0d1s2
HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rdisk/c1t0d1s2
HORCM_CMD of HOSTB(/etc/horcm0.conf) ... /dev/rdisk/c1t0d1s2

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

- AIX®:

HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rhdiskXX
HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rhdiskXX
HORCM_CMD of HOSTB(/etc/horcm0.conf)... /dev/rhdiskXX
where XX = device number assigned by AIX®

- Tru64 UNIX:

HORCM_CMD of HOSTA(/etc/horcm.conf) ... /dev/rrzbXXc
HORCM_CMD of HOSTB(/etc/horcm.conf) ... /dev/rrzbXXc
HORCM_CMD of HOSTB(/etc/horcm0.conf)... /dev/rrzbXXc
where XX = device number assigned by Tru64 UNIX

- Windows:

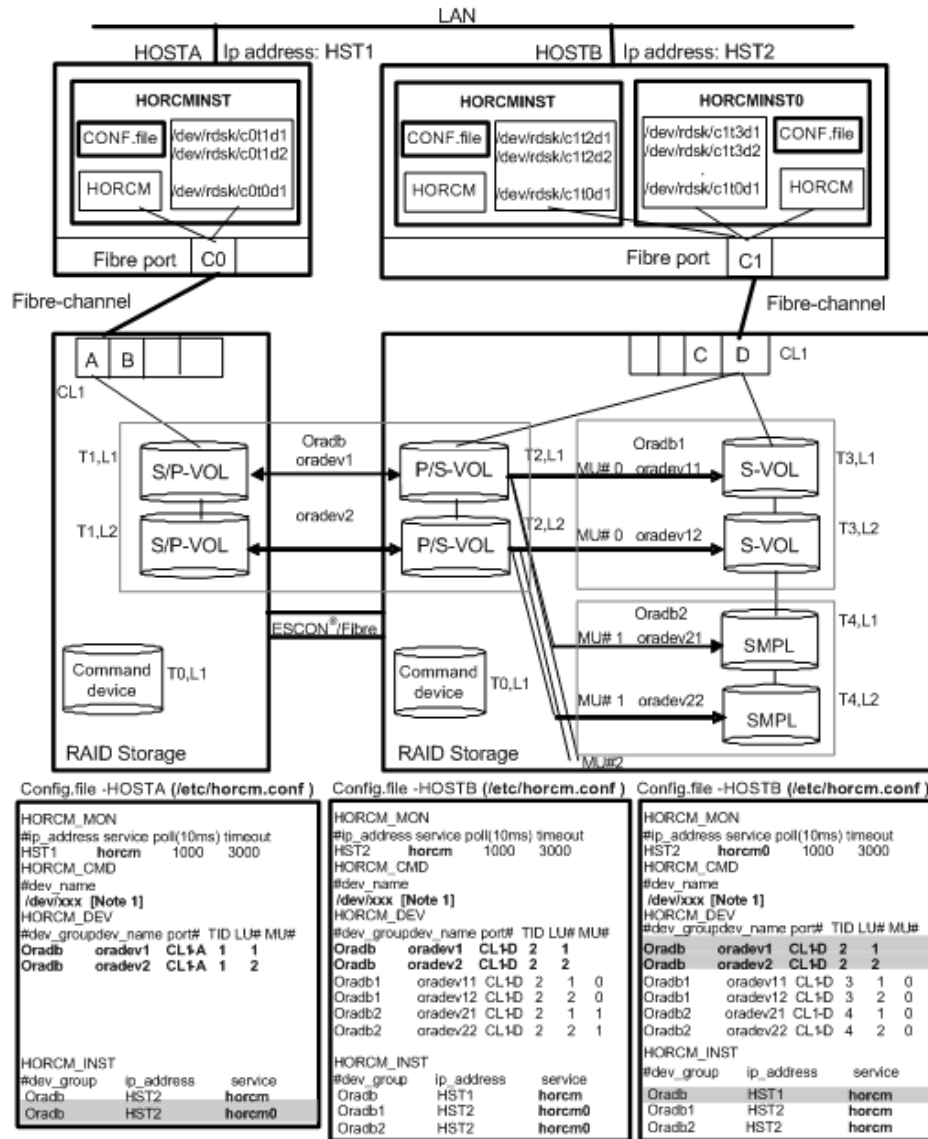
HORCM_CMD of HOSTA(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTB(/etc/horcm.conf) ... \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HOSTB(/etc/horcm0.conf) ... \\.\CMD-Ser#-ldev#-Port#

- Linux:

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

Example of CCI commands for TC/SI cascade configuration

The following figure shows the TC/SI configuration example with cascade pairs.



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

Example of CCI commands with HOSTA and HOSTB

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

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

- Designate a group name (Oradb1) on ShadowImage environment of HOSTB. When the command execution environment is not set, set HORCC_MRCF.

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

```
# paircreate -g Oradb1 -vl
```

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

- Designate a group name and display pair status on HOSTA.

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

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

Example of CCI commands with HOSTB

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

```
# paircreate -g Oradb -vr
```

- Designate a group name (Oradb1) on ShadowImage environment of HOSTB. When the command execution environment is not set, set HORCC_MRCF.

For C shell: # setenv HORCC_MRCF 1

For Windows: set HORCC_MRCF=1

```
# paircreate -g Oradb1 -vl
```

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

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

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

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

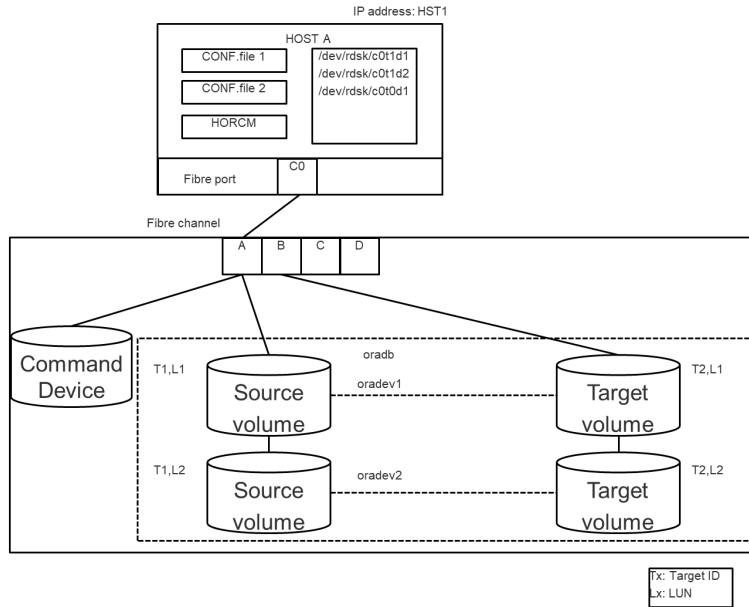
```
# pairdisplay -g oradb1 -m cas
Group   PairVol (L/R) (Port#,TID,LU-M),Seq#,LDEV#.P/S,Status, Seq#,P-LDEV# M
oradb1  oradev11(L) (CL1-D , 2, 1-0)30053 268..P-VOL PAIR,30053 270 -
oradb2  oradev21(L) (CL1-D , 2, 1-1)30053 268..SMPL ----,----- ---- -
oradb   oradev1(L) (CL1-D , 2, 1) 30053 268..S-VOL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

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

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

Example of CCI commands for Volume Migration configuration

The following figure shows an example of a Volume Migration configuration.



Configuration file for source

```

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

HORCM_CMD
#dev_name
/dev/xxx(Notel)

HORCM_DEV
#dev_group dev_name port# TargetID LUN#
oradb oradev1 CLI-A 1 1
oradb oradev2 CLI-A 1 2

HORCM_INST
#dev_group ip_address service
oradb HST1 horcm1
    
```

Configuration file for target

```

HORCM_MON
#ip_address service poll(10ms) timeout(10ms)
HST1 horcm2 1000 3000

HORCM_CMD
#dev_name
/dev/xxx(Notel)

HORCM_DEV
#dev_group dev_name port# TargetID LUN#
oradb oradev1 CLI-B 2 1
oradb oradev2 CLI-B 2 2

HORCM_INST
#dev_group ip_address service
oradb HST1 horcm1
    
```

[Note1]: Describes the raw device (character device) name of the UNIX/Windows system corresponding to the command device.

Example of CCI commands with HOSTA

- Designate a group name (oradb)

```
# paircreate -g oradb -m cc -vl
```

This command creates pairs for all LUs assigned to group oradb in the configuration definition file

- Designate a volume name (oradev1)

```
# paircreate -g oradb -d oradev1 -m cc -vl
```

This command creates pairs for all LUs assigned to oradev1 in the configuration definition file

- Designate a group name and display pair status.

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

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

- **HP-UX:**

```
HORCM_CMD of HORCMINST0 = /dev/rdisk/c0t0d1
HORCM_CMD of HORCMINST1 = /dev/rdisk/c1t0d1
```

- **Solaris:**

```
HORCM_CMD of HORCMINST0 = /dev/rdisk/c0t0d1s2
HORCM_CMD of HORCMINST1 = /dev/rdisk/c1t0d1s2
```

- **AIX®:**

```
HORCM_CMD of HORCMINST0 = /dev/rhdiskXX
HORCM_CMD of HORCMINST1 = /dev/rhdiskXX
```

where XX = device number created automatically by AIX®

- **Windows:**

```
HORCM_CMD of HORCMINST0 = \\.\CMD-Ser#-ldev#-Port#
HORCM_CMD of HORCMINST1 = \\.\CMD-Ser#-ldev#-Port#
```

- **Linux:**

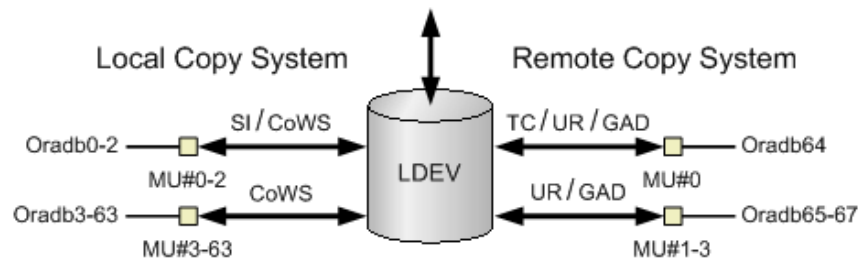
```
HORCM_CMD of HORCMINST0 = /dev/sdX
HORCM_CMD of HORCMINST1 = /dev/sdX
```

where X = disk number defined by Linux

Correspondence of the configuration definition file for cascading volume and mirror descriptors

The CCI software (HORCM) is capable of keeping a record of the multiple pair configurations per LDEV. CCI distinguishes the records of the each pair configuration by MU#. You can assign 64 MU#s (MU#0 to 63) for local copy products and 4 MU#s (MU#0 to 3) for remote copy products as the following figure, you can define up to 68 device groups (records of pair configuration) in the configuration definition file.

The following figure shows the management of pair configuration by mirror descriptors.

**Legend**

SI: ShadowImage CoWS: Copy-on-Write Snapshot
 TC: TrueCopy UR: Universal Replicator GAD: global-active device

The group name and MU# that are noted in the HORCM_DEV section of the configuration definition file are assigned to the corresponding mirror descriptors. This outline is described in the following table. "Omission of MU#" is handled as MU#0, and the specified group is registered to MU#0 on ShadowImage/Copy-on-Write Snapshot and TrueCopy/Universal Replicator/global-active device. Also, when you note the MU# in HORCM_DEV, the sequence of the MU# can be random (for example, 2, 1, 0).

HORCM_DEV Parameter in Configuration File	MU#0		SI/Copy-on-Write Snapshot only	UR/GAD
	TC/ UR/ GAD	SI	MU#1 to 2 (MU#3 to 63)	MU#1 to 3
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1	oradev1	oradev1	-	-
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 1 Oradb2 oradev21 CL1-D 2 1 2	oradev1	oradev1	oradev11 oradev21	-
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 0 Oradb2 oradev21 CL1-D 2 1 1 Oradb3 oradev31 CL1-D 2 1 2	oradev1	oradev11	oradev21 oradev31	-

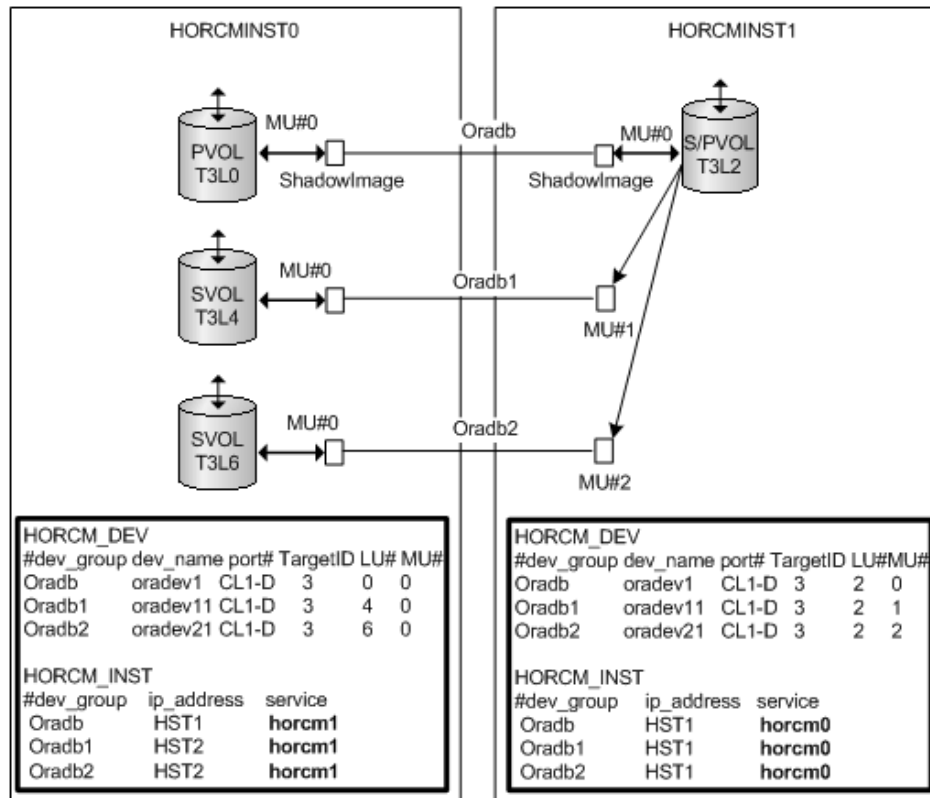
HORCM_DEV Parameter in Configuration File	MU#0		SI/Copy-on-Write Snapshot only	UR/GAD
	TC/ UR/ GAD	SI	MU#1 to 2 (MU#3 to 63)	MU#1 to 3
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 0	-	oradev1	-	-
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 h0	oradev1	-	-	-
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 0 Oradb1 oradev1 CL1-D 2 1 1 Oradb2 oradev21 CL1-D 2 1 2	-	oradev1	oradev11 oradev21	-
HORCM_DEV #dev_group dev_name port# TargetID LU# MU# Oradb oradev1 CL1-D 2 1 Oradb1 oradev11 CL1-D 2 1 0 Oradb2 oradev21 CL1-D 2 1 h1 Oradb3 oradev31 CL1-D 2 1 h2 Oradb4 oradev41 CL1-D 2 1 h3	oradev1	oradev11	-	oradev21 oradev31 oradev41

Configuration definition files for cascade configurations

Each volume in a cascading connection is described by an entry in the configuration definition file on each HORCM instance, and each connection of the volume is specified by mirror descriptor. In the case of a ShadowImage/TrueCopy cascading connection, too, the volume is described in the configuration definition file on the same instance. The following topics present examples of ShadowImage and ShadowImage/TrueCopy cascading configurations.

Configuration definition files for ShadowImage cascade configuration

The following figure shows an example of a ShadowImage cascade configuration and the associated entries in the configuration definition files. ShadowImage is a mirror configuration within one storage system, so the volumes are described in the configuration definition file for each HORCM instance: volumes T3L0, T3L4, and T3L6 in HORCMINST0, and volume T3L2 in HORCMINST1. As shown in this ShadowImage cascading connection example, the specified dev group is assigned to the ShadowImage mirror descriptor: MU#0 in HORCMINST0, and MU#0, MU#1, and MU#2 in HORCMINST1.



The following figures show the pairedisplay information for this example of a ShadowImage cascading configuration.

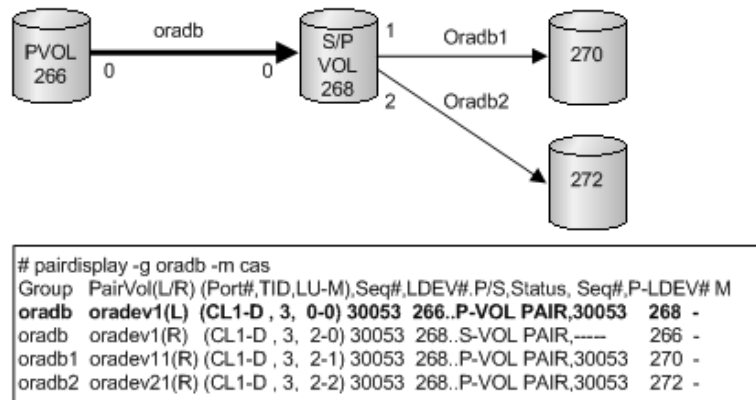


Figure 1 Pairedisplay -g on HORCMINST0

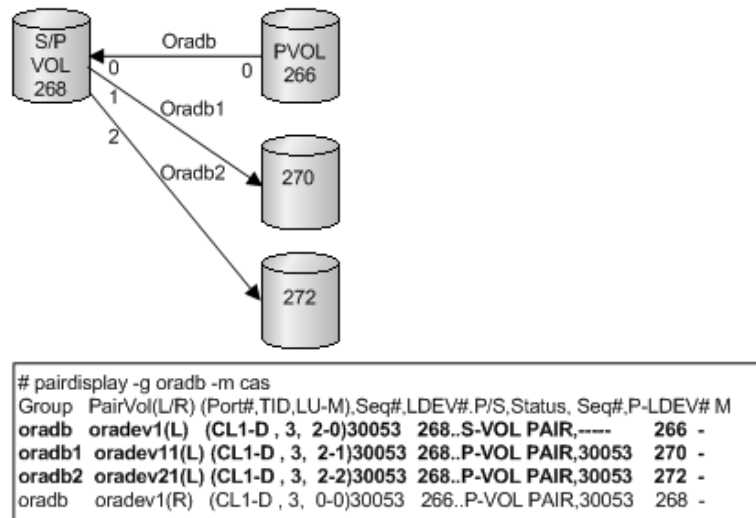


Figure 2 Pairedisplay -g on HORCMINST1

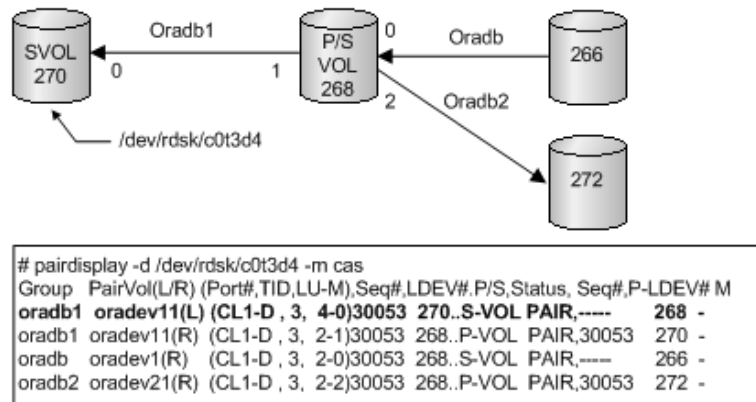
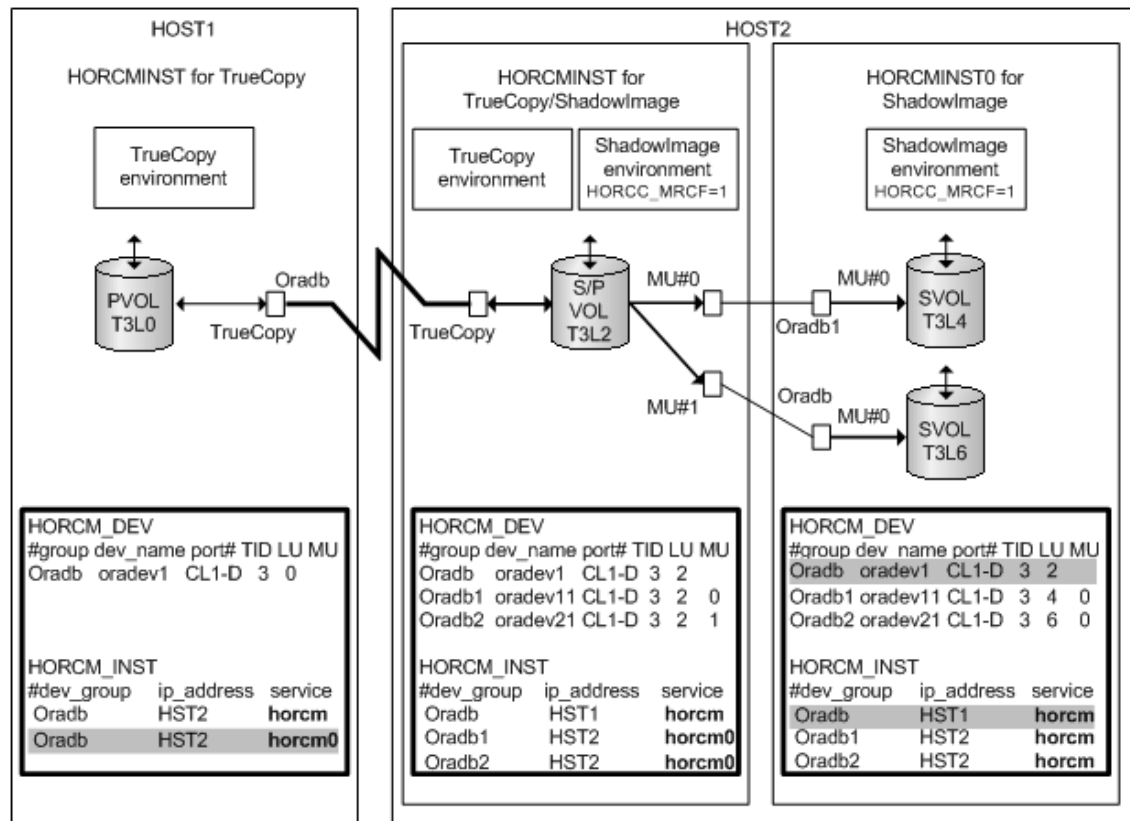


Figure 3 Pairedisplay -d on HORCMINST0

Configuration definition files for TrueCopy/ShadowImage cascade configuration

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

The following figure shows the TC/SI cascading connection and configuration file.



Shaded portions: If HORCMINST0 needs to operate TrueCopy's paired volume, then "oradb" must describe that there is a connection to HST1 via HORCMINST0.

The following figures show the cascading configurations and the pairedisplay information for each configuration.

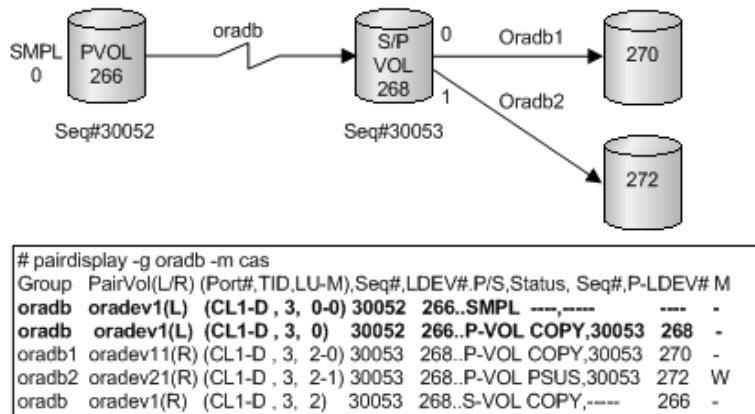


Figure 4 Pairedisplay for TrueCopy on HOST1

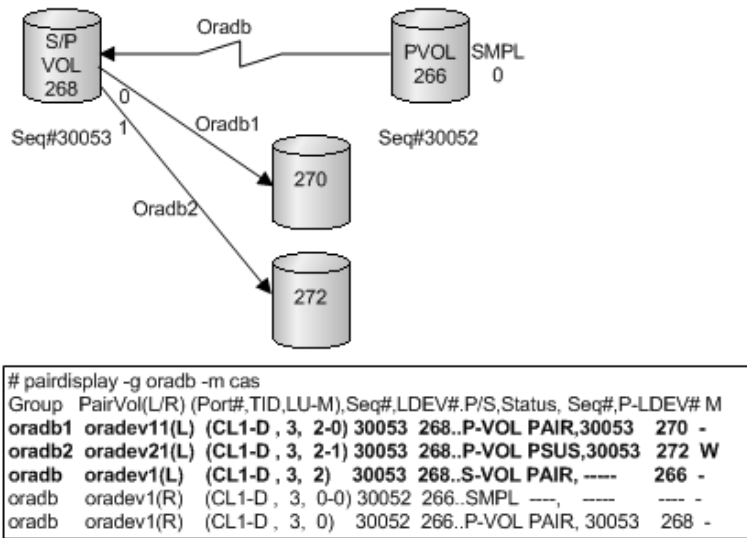


Figure 5 Pairdisplay for TrueCopy on HOST2 (HORCMINST)

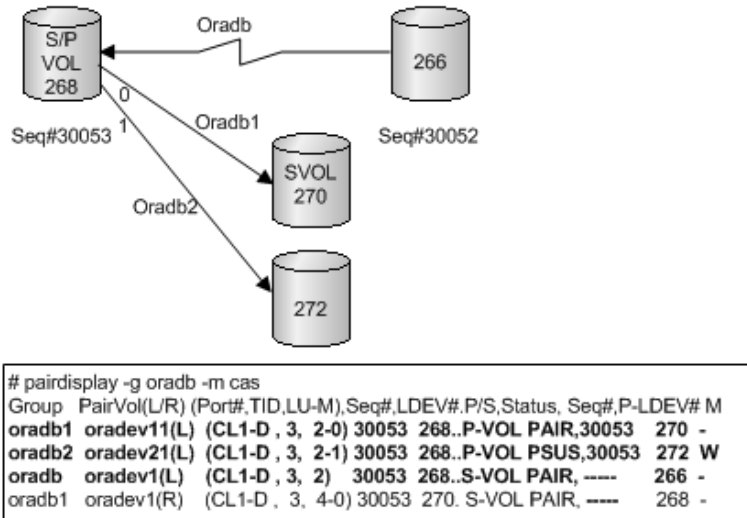


Figure 6 Pairdisplay for ShadowImage on HOST2 (HORCMINST)

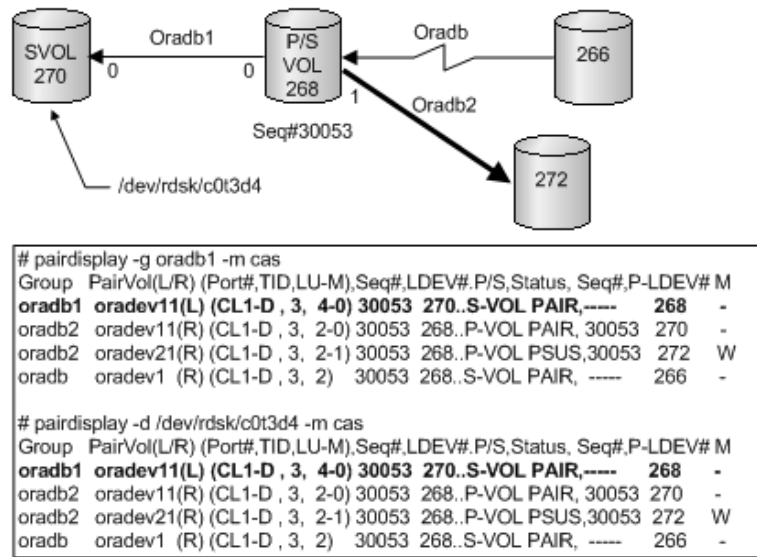


Figure 7 Pairdisplay for ShadowImage on HOST2 (HORCMINST0)

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