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Hitachi Universal Volume Manager

User Guide

Hitachi Virtual Storage Platform G1000 and G1500

Hitachi Virtual Storage Platform F1500

Hitachi Virtual Storage Platform G200, G400, G600, G800

Hitachi Virtual Storage Platform F400, F600, F800

Hitachi Data Systems

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Contents

Preface

This guide provides information and instructions for planning, setting up, maintaining, and troubleshooting external volumes connected to Hitachi storage systems.

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and authorized service providers.

Readers of this document should be familiar with the following:

- Data processing, RAID storage systems, and their basic functions.
- The Hitachi Virtual Storage Platform.
- The storage systems connected for external storage.
- Hitachi Device Manager - Storage Navigator
- The following documents:
  - *Product Overview*
  - *System Administrator Guide*

Product version

This document revision applies to the following microcode or firmware:

- Hitachi Virtual Storage Platform G1000, G1500, and Hitachi Virtual Storage Platform F1500: microcode 80-05-4*x* or later
- Hitachi Virtual Storage Platform G200, G400, G600, G800, Hitachi Virtual Storage Platform F400, F600, F800: firmware 83-04-4*x* or later
- SVOS 7.2 or later

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 Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

Changes in this revision

- Added prerequisites for V-VOLs with Compression or Deduplication and Compression enabled (Prerequisites for disconnecting external systems on page 92).

Referenced documents

The following documents are referenced in this guide:

None

Document conventions

This document uses the following terminology conventions:

Convention	Description
VSP Gx00 models	Refers to all of the following storage systems: • Hitachi Virtual Storage Platform G200 • Hitachi Virtual Storage Platform G400 • Hitachi Virtual Storage Platform G600 • Hitachi Virtual Storage Platform G800
VSP G series	Refers to all of the following storage systems: • VSP Gx00 models • VSP G1000 and G1500
VSP Fx00 models	Refers to all of the following storage systems: • Hitachi Virtual Storage Platform F400 • Hitachi Virtual Storage Platform F600 • Hitachi Virtual Storage Platform F800
VSP F series	Refers to all of the following storage systems: • VSP Fx00 models • Hitachi Virtual Storage Platform F1500
Hitachi Virtual Storage Platform family (VSP family)	Refers to all of the following storage systems: • VSP Gx00 models • VSP G1000 and G1500 • VSP F1500 • VSP Fx00 models

This document uses the following typographic conventions:

Convention	Description
Bold	• Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click **OK**. • Indicates emphasized words in list items.
Italic	• 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: `pairdisplay -g group` (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: `pairdisplay -g oradb`
< > angle brackets	Indicates variables in the following scenarios: • Variables are not clearly separated from the surrounding text or from other variables. Example: `Status-<report-name><file-version>.csv`

Convention	Description
	• 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	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.

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

Icon	Label	Description
	Note	Calls attention to important or additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations, data loss, or a system crash).
	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
1 cylinder	Mainframe: 870 KB Open-systems: • 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 Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

Hitachi Data Systems Support Connect is the destination for technical support of products and solutions sold by Hitachi Data Systems. To contact technical support, log on to Hitachi Data Systems Support Connect for contact information: https://support.hds.com/en_us/contact-us.html.

Hitachi Data Systems Community is a global online community for HDS customers, partners, independent software vendors, employees, and prospects. It is the destination to get answers, discover insights, and make connections. **Join the conversation today!** Go to community.hds.com, register, and complete your profile.

Comments

Please send us your comments on this document to doc.comments@hds.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Data Systems Corporation.

Thank you!

1

Overview

Hitachi Universal Volume Manager enables you to connect volumes in external storage systems to your storage system, and manage those volumes as if they were one system.

- Features
- System components
- Interfaces
- License
- How Universal Volume Manager works

Features

Typically, if a system consists of multiple storage systems, the host must be connected to each of the storage systems. When configuring the connections from the host to the volumes, the system administrator must follow specific instructions for each of the storage systems.

With Universal Volume Manager, the administrator configures the connection from the host to your storage system, and then uses mapped volumes in an external storage system in the same way as volumes in the local storage system.

With Universal Volume Manager, you can perform all procedures in external storage with the same Hitachi software as when you use the local storage system.

For example, you can use a replication program to perform copy operations between the local storage system and external systems, including the following:

- Copying data from a volume in the local storage system to a volume in the external system
- Copying data from a volume in one external system to a volume in another external system

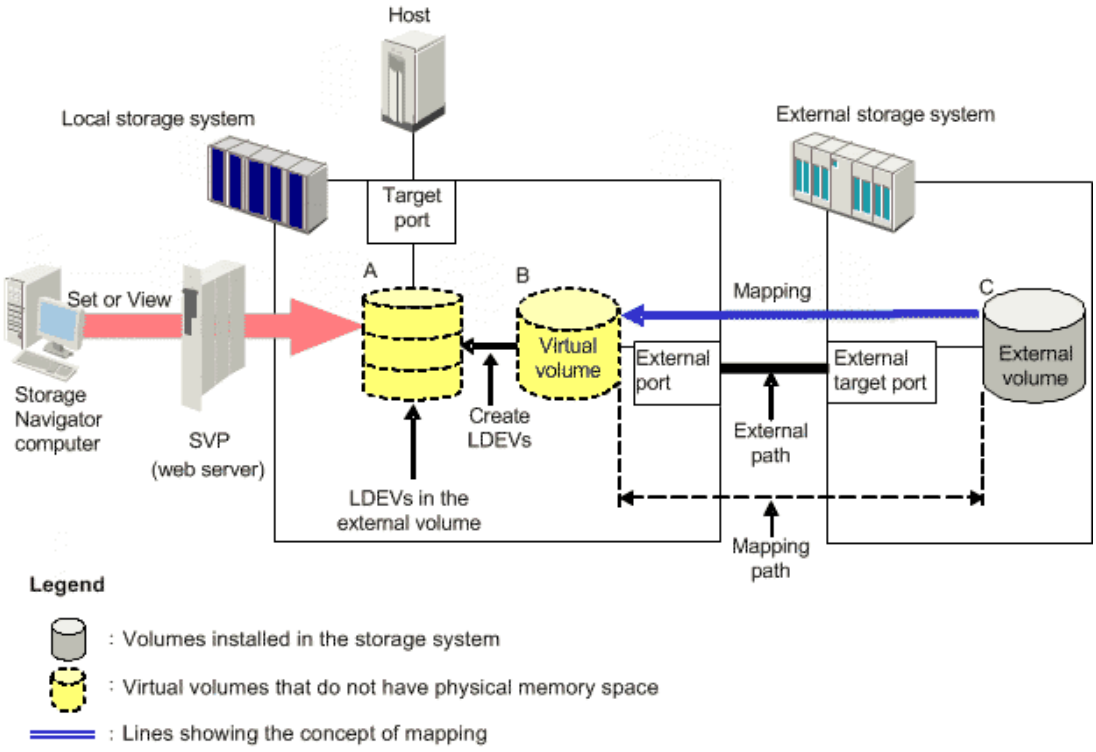
System components

Universal Volume Manager consists of several components, including the following:

- A *local storage system* (a Hitachi Virtual Storage Platform G200, G400, G600, G800, Hitachi Virtual Storage Platform F400, F600, F800, or Hitachi Virtual Storage Platform G1000, Hitachi Virtual Storage Platform G1500, or Hitachi Virtual Storage Platform F1500 storage system)
- One or more external storage systems
  The local storage system can connect to many different storage systems, included ones manufactured by Hitachi, IBM®, and EMC. Hosts recognize the volumes in these systems as internal volumes of the local storage system.
- External volumes
  A volume in an external storage system that is mapped to the local storage system is referred to as a *mapped external volume*. After an external volume is mapped, it is used as an *internal volume*, which is a virtual representation of the external volume.
- Internal volumes
  A volume managed by the local storage system. An internal volume can be a physical volume or the virtual representation of an external volume.

- Logical devices (LDEVs)
- External path
- Mapping path

The following figure provides an overview of these components:



Interfaces

You can use different components to schedule and perform Universal Volume Manager operations.

Command Control Interface software

You can use the Command Control Interface software (CCI) CLI to perform most of the operations you perform using Device Manager - Storage Navigator. CCI operations are initiated from the host and can be automated using scripts. You can use external volumes as remote command devices.

Hitachi Device Manager - Storage Navigator

Use Hitachi Device Manager - Storage Navigator to manage the local storage system and the connected external storage volumes. Device Manager - Storage Navigator is run from a browser on the user-supplied computer. The

operations described in this document are performed using Device Manager - Storage Navigator.

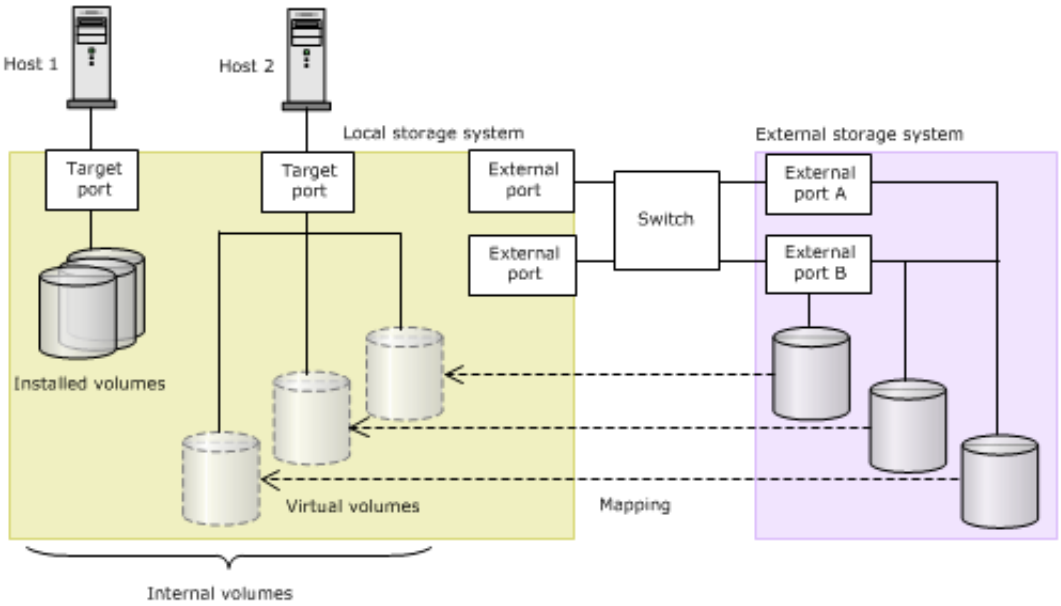
License

To use Universal Volume Manager, you must procure and install a license key. For details, see the *System Administrator Guide* for your storage system.

How Universal Volume Manager works

When you map to a volume in an external storage system, it becomes an internal volume in the local storage system.

- A local system port must be connected to the external storage system port with a Fibre Channel cable. This route between ports is the *external path*.
- The external volume is represented in the local storage system as an internal volume, and the path between them is the mapping path.
- The figure below shows the connection between the local and external storage systems. In this figure, the external system is connected to the local system's external ports via a switch. *External port* is an attribute assigned to ports on the local storage system.



You can connect multiple external storage systems to one external port even if the external port is already in use.

Note: Only hosts that are connected to the local storage system can access and copy mapped external volumes.

You can create LDEVs in two different ways:

- By using Universal Volume Manager during mapping
- By using the Virtual LVI/LUN (VLL) function after mapping. In this case, the internal volume (the internal volume to which an external volume is mapped) is the virtual device (VDEV) and the LDEV in the external volume is the LDEV.

As shown in the figure above, you must have LDEVs in the mapped external volumes for use in the local system.

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Requirements and planning

There are many factors to keep in mind in regards to Universal Volume Manager, including planning for the system and infrastructure, requirements for your system, and application performance. Proper planning and preparation can help you to avoid problems in the future.

- ☐ Planning workflow
- ☐ System requirements
- ☐ System option modes for Universal Volume Manager
- ☐ Planning considerations for external storage systems
- ☐ External volume requirements
- ☐ Considerations for external volume attributes
- ☐ Considerations for using iSCSI
- ☐ Additional considerations for VSP G1000 and G1500, and VSP F1500
- ☐ Copying external storage system data

Planning workflow

Before you map external volumes to the local storage system, review the information about the planning workflow to ensure that you understand the Universal Volume Manager requirements and implementation procedures.

Use the general order in the following to prepare for Universal Volume Manager:

Procedure

1. Review System requirements on page 23.
2. Verify that the external storage system whose volumes you want to map is supported by Universal Volume Manager. See Appendix A, Supported external storage systems on page 119.
3. Verify that the functionality you want is supported for mapped external volumes. See Supported software for external volumes on page 57.
4. In the external storage system, select a port and set parameters, as necessary. See Setting up ports on the external system (VSP G1000, G1500, and VSP F1500) on page 66.
5. In the local storage system, identify the port to be connected to the external storage system and make sure it is specified as an external port. See Setting port attributes on the local system (VSP G1000, G1500, and VSP F1500) on page 65.
6. Plan data paths from the local storage system to the external storage system. See External paths, path modes, and configurations on page 36.
7. In the external storage system, prepare volumes for use in the local storage system. For example, if you plan to use an external volume for replication, verify that it meets the requirements for replication software.

   For instructions and additional information for VSP Gx00 models and VSP Fx00 models, see External volume requirements on page 32.

   For instructions and additional information for VSP G1000 and G1500, and VSP F1500 , see:
   - Mainframe volumes on page 46
   - Open systems volumes on page 47
   - Capacity requirements for volumes on page 47
8. In the local storage system, configure the external volume groups to which you will assign the external volumes during the mapping operation. See External volume groups on page 35.
9. Optionally, change the default values of the mapping settings before performing the operation. See External volume policy settings and functions on page 76.

System requirements

You can perform Universal Volume Manager (UVM) operations between the local storage system and volumes in an external storage system.

The following table lists the general requirements for all UVM components.

Item	Description
VSP G1000, VSP G1500, VSP F1500 VSP G200, G400, G600, G800, VSP F400, F600, F800	• Required for the local storage system. • All hardware and microcode or firmware must be installed.
External storage systems	You must have at least one external storage system. For details about the supported external storage systems, see Supported external storage systems on page 119.
UVM license key	Required. For installation and operations instructions, see the *System Administrator Guide* for your storage system.
(VSP G1000, G1500, and VSP F1500) Other VSP G1000, VSP G1500, and VSP F1500 software licenses	As needed. For VSP G1000, VSP G1500, and VSP F1500 software and functions that can be used with external volumes, see Supported software for external volumes on page 57.
Device Manager - Storage Navigator	Required.
RAID level	The RAID level for all external volumes is RAID 1. RAID 1 is displayed or used in the following cases: • Internal processing of the local storage system. • Information about the external storage system that is reported to a higher-level device (OS). **Note:** The local storage system uses RAID 1 cache management for external volumes. However, the external storage controller manages the physical RAID method. In addition, a hyphen is displayed instead of the RAID level in Device Manager - Storage Navigator windows.
Maximum number of ports in external storage systems that can be mapped	• Fibre channel: 1,024 for each port • iSCSI: 512 for each port (127 or less is recommended)
Maximum number of mapped external volumes	VSP Gx00 models, VSP Fx00 models: • VSP G200: 2,048 • VSP G400, G600, VSP F400, F600: 4,096 • VSP G800, VSP F800: 14,080 • For Thin Image and Dynamic Provisioning, the total number of external and virtual volumes must not exceed 14,080. VSP G1000 and G1500, and VSP F1500: • 63,232 • For Thin Image and Dynamic Provisioning, the total number of external and virtual volumes must not exceed 63,232.

Item	Description
Maximum number of external volume groups	VSP Gx00 models, VSP Fx00 models: • VSP G200: 2,048 • VSP G400, G600, VSP F400, F600: 4,096 • VSP G800, VSP F800: 16,384 VSP G1000 and G1500, and VSP F1500: 16,384
Maximum number of volumes registered in each external volume group	VSP Gx00 models, VSP Fx00 models: • VSP G200: 2,048 • VSP G400, G600, G800, VSP F400, F600, F800: 4,096 VSP G1000 and G1500, and VSP F1500: 4,096
Number of mapping paths	• One required. • Two or more recommended • Maximum = 8 per external volume
Minimum capacity of an internal volume (VSP G1000, G1500, and VSP F1500)	The minimum capacity of an internal volume changes depending on the emulation type. See LDEV capacities per emulation type on page 49.
Maximum capacity of an internal volume (VSP Gx00 models and VSP Fx00 models)	If mapping an external volume of up to 4TB in an external storage system, the internal volume will be defined as 1 LDEV (LU), which is the same as the external volume. You cannot access data that exceeds the maximum capacity of the external volume.
Minimum capacity of an external volume	VSP Gx00 models, VSP Fx00 models: • If Data Direct Mapping is enabled: About 8,192 MB (16,777,216 blocks) per external volume • If Data Direct Mapping is disabled: About 47 MB (96,000 blocks) per external volume VSP G1000 and G1500, and VSP F1500: • For emulation types other than OPEN-V: About 41 MB (83,520 blocks) per external volume • If the emulation type is OPEN-V and Data Direct Mapping is enabled: About 8,192 MB (16,777,216 blocks) per external volume • If the emulation type is OPEN-V and Data Direct Mapping is disabled: About 47 MB (96,000 blocks) per external volume
Maximum capacity of an external volume	• If mapping an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled: 256 TB (549,755,813,888 blocks) per external volume You can create a volume larger than 256 TB, but can only use 256 TB as a mapped external volume. Data in the additional area cannot be accessed.

Item	Description
	• If mapping an external volume with more than 4 TB without using a virtual volume for which Data Direct Mapping is enabled: 59.99 TB (128,849,011,200 blocks) per external volume You can create a volume larger than 59.99 TB, but can only use 59.99 TB as a mapped external volume. Data in the additional area cannot be accessed. For details about mapping using virtual volumes for which Data Direct Mapping is enabled, see the *Provisioning Guide* for your storage system.
Maximum number of external volumes that can be mapped per port	If one external port is connected to several target ports through switches, the maximum number of LUs defined for the connected target ports is: • VSP G200: 2,048 • VSP G400, G600, G800, VSP F400, F600, F800: 4,096 • VSP G1000, VSP G1500, or VSP F1500: 4,096
Maximum LDEV capacity which can be created from an external volume (VSP G1000, G1500, and VSP F1500)	• If creating an LDEV from an external volume for which Data Direct Mapping is enabled: 256 TB (549,755,813,888 blocks) per external volume • If creating an LDEV from an external volume for which Data Direct Mapping is not enabled: 4 TB (8,589,934,592 blocks) per external volume For details about mapping using virtual volumes for which Data Direct Mapping is enabled, see the *Provisioning Guide for Open Systems*.
System Option Mode	Host I/O performance to mapped volumes (for sequential write performance only) can be improved by setting SOM 872 to ON. For more information, contact customer support.

System option modes for Universal Volume Manager

To provide greater flexibility, the storage systems have additional operational parameters called system option modes (SOMs) that allow you to tailor the storage system to your unique operating requirements. The SOMs are set on the service processor (SVP) by your service representative. Review the SOMs for your storage system, and work with your service representative to ensure that the appropriate SOMs for your operational environment are configured on your storage system.

The following table lists and describes the SOMs that apply to Universal Volume Manager. For a complete list of SOMs, see the *System Administrator Guide* for your storage system.

Note: The SOM information might have changed since this document was published. Contact customer support for the latest SOM information.

Mode	Category	Description	Default	MCU/RCU
457	Universal Volume Manager	This SOM has two purposes: High-Speed LDEV Format for External Volumes, and Support for Mainframe Control Block Write GUI. **Mode 457 = ON:** **1.** High-Speed LDEV Format for External Volumes. The high-speed LDEV format for external volumes is available by SOM 457 to ON. When SOM 457 is ON, if you select an external volume group and perform an LDEV format, any write processing on the external logical units will be skipped. However, if the external LDEV is a mainframe volume, the write processing for mainframe control information only will be performed after the write skip. **2.** Support for Mainframe Control Block Write GUI. Control Block Write of the external LDEVs in mainframe emulation is supported by Device Manager - Storage Navigator (GUI). • If the LDEV is not written with data "0" before performing the function, the LDEV format might fail. • After the format processing, make sure to set SOM 457 to OFF. **Mode 457 = OFF (default):** High-speed LDEV format for external volumes and support for mainframe control block write GUI are not available.	OFF	Both
467	ShadowImage ShadowImage for Mainframe Compatible FlashCopy® V2 Compatible FlashCopy® SE Snapshot Volume Migration Universal Volume Manager	For the following features, the current copy processing slows down when the percentage of "dirty" data is 60% or higher, and it stops when the percentage is 75% or higher. Mode 467 is provided to prevent the percentage from exceeding 60%, so that the host performance is not affected. • SI • SIz • FCv2, FCSE • Snapshot • UVM • Volume Migration **Mode 467 = ON (default):** Copy overload prevention. Copy processing stops when the percentage of "dirty" data reaches 60% or higher. When the percentage falls below 60%, copy processing restarts. **Mode 467 = OFF:** Normal operation. The copy processing slows down if the dirty percentage is 60% or larger, and it stops if the dirty percentage is 75% or larger. **Caution:** This mode must always be set to ON when using an external volume as the secondary volume of any of the applicable replication products. **Notes:** **1.** It takes longer to finish the copy processing because it stops for prioritizing the host I/O performance. **2.** This mode supports background copy only. The processing to copy the pre-update data to the S-VOL, which occurs when overwriting data to uncopied slots of	ON	-

Mode	Category	Description	Default	MCU/RCU
		P-VOL in Split processing or reading or writing data to uncopied slots of S-VOL, is not supported. **3.** Check the write pending rate of each CLPR per MP blade. Even though there is some free cache capacity in the entire system, if the write pending rate of an MP blade to which pairs* belong exceeds the threshold, the copy operation is stopped. *Applies to pairs of SI, SIz, FCv2, FCSE, Snapshot, and Volume Migration.		
561	ShadowImage Universal Volume Manager	Allows Quick Restore for external volumes with different Cache Mode settings. **Mode 561 = ON:** Quick Restore for external volumes with different Cache Mode settings is prevented. **Mode 561 = OFF (default):** Quick Restore for external volumes with different Cache Mode settings is allowed.	OFF	Both
589	Universal Volume Manager	When this mode is ON, the frequency of progress update of disconnection is changed. **Mode 589 = ON:** For each external volume, progress is updated only when the progress rate is 100%. **Mode 589 = OFF (default):** Progress is updated when the progress rate exceeds the previous level. **Notes:** **1.** Set this mode to ON when disconnecting an external volume while the specific host IO operation is online and its performance requirement is severe. **2.** Whether the disconnecting status for each external volume is progressed or not cannot be confirmed on Device Manager - Storage Navigator (It indicates "-"until just before the completion and at the last it changes to 100%).	OFF	Both
701	Universal Volume Manager	Issues the Read command at the logical unit discovery operation using UVM. **Mode 701 = ON:** The Read command is issued at the logical unit discovery operation. **Mode 701 = OFF (default):** The Read command is not issued at the logical unit discovery operation. **Notes:** **1.** When the external storage is USP/NSC and the Open LDEV Guard attribute (VMA) is defined on an external device, set the mode to ON. **2.** As the VMA information is USP/NSC specific, this mode does not need to be ON when the external storage is other thanUSP/NSC. **3.** When this mode is set to ON, it takes longer time to complete the logical unit discovery. The amount of time depends on external storages. **4.** With this mode OFF, if searching for external devices with VMA ia set, the VMA information cannot be read. **5.** When the mode is set to ON while the following conditions are met, the external volume is blocked:	OFF	-

Mode	Category	Description	Default	MCU/RCU
		• An external volume to which Nondisruptive migration (NDM) attribute is set exists. • The external volume is reserved by the host **6.** Set the mode to OFF when the following conditions are met: • An external volume to which Nondisruptive migration (NDM) attribute is set exists.		
725	Universal Volume Manager	This mode determines the action that will be taken when the status of an external volume is Not Ready. **Mode 725 = ON:** When Not Ready is returned, the external path is blocked and the path status can be automatically recovered (Not Ready blockade). Note that the two behaviors, automatic recovery and block, may be repeated. When the status of a device is Not Ready blockade, Device Health Check is executed after 30 seconds. **Mode 725 = OFF (default):** When Not Ready is returned three times in three minutes, the path is blocked and the path status cannot be automatically recovered (Response error blockade). **Notes:** **1.** Applying this SOM is prohibited when USP V/VM is used as an external storage system and its external volume is DP-VOL. **2.** Applying this SOM is recommended when the above condition (1) is not met and SUN storage is used as an external storage. **3.** Applying this SOM is recommended when the above condition (1) is not met and EMC CX series or Fujitsu Fibre CAT CX series is used as an external storage. **4.** Applying this SOM is recommended if the above condition (1) is not met and a maintenance operation such as firmware update causing controller reboot is executed on the external storage side while a storage system other than Hitachi product is used as an external storage system. **5.** While USP V/VM is used as an external storage system and its volume is DP-VOL, if some Pool-VOLs constituting the DP-VOL are blocked, external path blockade and recovery occurs repeatedly. **6.** When a virtual volume mapped by UVM is set to pool-VOL and used as DP-VOL in local storage system, this SOM can be applied without problem.	OFF	-
745	Universal Volume Manager	Enables to change the area where the information is obtained as the Characteristic1 item from SYMMETRIX. **Mode 745 = ON:** • The area where the information is obtained as the Characteristic1 item from SYMMETRIX is changed. • When CheckPaths or Device Health Check (1/hour) is performed, the information of an already-mapped external volume is updated to the one after change. **Mode 745 = OFF (default):**	OFF	-

Mode	Category	Description	Default	MCU/RCU
		• The area where the information is obtained as the Characteristic1 item from SYMMTRIX is set to the default. • When CheckPaths or Device Health Check (1/hour) is performed, the information of an already-mapped external volume is updated to the default. **Notes:** **1.** This mode is applied when the EMC SYMMETRIX is connected using UVM. **2.** Enable the setting of EMC SCSI Flag SC3 for the port of the EMC SYMMETRIX storage connected with the storage system and disable the setting of Flag SPC2. If the setting of EMC SCSI Flag SC3 is not enabled or the setting of Flag SPC2 is enabled, the effect of this mode may not be achieved. **3.** If you want to enable this mode immediately after setting, perform Check Paths on each path one by one for all the external ports connected to the EMC SYMMETRIX storage. But, without doing Check Paths, the display of Characteristic1 can automatically be changed by the Device Health Check to be performed once an hour. If SSB=AD02 occurs and a path is blocked, perform Check Paths on this path again. **4.** If the Check Paths is performed while ShadowImage for Mainframe pair and FlashCopy® Mirror pair are defined in the specified volume, the Check Paths operation is rejected with a message, "605 2518". If ShadowImage for Mainframe pair and FlashCopy® Mirror pair are defined in the specified volume, do not perform Check Paths but wait until the display is automatically changed.		
872	Universal Volume Manager	This mode applies only to VSP G1x00 and VSP F1500. When this mode is applied, the order of data transfer slots is guaranteed at the destaging from the storage system to an external storage system. **Mode 872 = ON (default*):** The order of data transfer slots from the storage system to an external storage is guaranteed. **Mode 872 = OFF:** The order of data transfer slots from the storage system to an external storage is not guaranteed. *The default is OFF for microcode earlier than 80-03-31. In 80-03-31 and later versions, this mode is set to ON before shipment. If the micro-program is exchanged to a supported version (80-03-31 or later), the setting remains OFF and needs to be set to ON manually. **Notes:** **1.** This mode is applied when performance improvement at sequential write in UVM configuration is required. **2.** By setting the mode to ON, the usage rate of MPs in MPB may become imbalanced, but the processing is balanced in the MPB and the performance per MPB is not affected.	ON	-

Mode	Category	Description	Default	MCU/RCU
1021	Universal Volume Manager	The mode can enable or disable the auto-recovery for external volumes of an EMC storage system. **Mode 0121 = ON:** An external volume that is blocked due to Not Ready status can be recovered automatically regardless of the type of external storage system. **Mode 1021 = OFF (default):** An external volume that is blocked due to Not Ready status might not be recovered automatically depending on the type of external storage system. **Notes:** **1.** This mode is applied when the auto-recovery of external volumes that are blocked due to Not Ready status is desired in UVM connection using an ECM storage system as an external storage system. **2.** When the mode is set to ON and the connected external storage system is not in stable status (such as failure and recovery from failure), a blockage due to Not Ready status and auto-recovery might occur repeatedly.	OFF	-
1080	Global-active device Universal Volume Manager	The mode is intended for a case that multiple external connection paths are connected to a Target port on an external system with a quorum disk and there is a path whose performance degrades. For such a case, the mode can eliminate impacts on commands run for other external devices that share the Target port with the quorum disk on the external system by setting the time to run a reset command for the Target port to be the same (15 seconds) as that to run other commands for the other external devices. Mode 1080 = ON: The time to run the reset command for the quorum disk on the external system is 15 seconds to eliminate the impacts on commands run for the other external devices that share the Target port with the quorum disk on the external system. If a response to ABTS is delayed for 12 seconds or longer, the quorum disk may be blocked. Mode 1080 = OFF (default): The time to run a reset command for the quorum disk when performance of a path degrades is 3 seconds so that a retry is performed by an alternate path to avoid quorum disk blockage. **Notes:** **1.** This mode is applied if avoiding impacts on commands for other external devices sharing a Target port on an external system side with a quorum disk is prioritized over preventing quorum disk blockage when a response to ABTS is delayed. The delay is caused due to path performance degradation in a configuration where the Target port is shared between external devices and the quorum disk. **2.** When connection performance degradation occurs, the quorum disk blockage is more likely to occur.	OFF	-

Mode	Category	Description	Default	MCU/RCU
1083	Dynamic Provisioning Universal Volume Manager	The mode enables or disables DP-VOL deletion while an external volume associated with the DP-VOL with data direct mapping attribute is not disconnected. Mode 1083 = ON: DP-VOL deletion is enabled. Mode 1083 = OFF (default): DP-VOL deletion is disabled. **Notes:** **1.** This mode is applied when the following conditions are met. • A DP-VOL with data direct mapping attribute is deleted. • The data of external volume with data direct mapping attribute associated with a deletion target DP-VOL with data direct mapping attribute will not be used again. **2.** When SOM 1083 is set to ON, the data of external volumes cannot be guaranteed. **3.** When DP-VOL deletion is performed without disconnecting an external volume, the data of the external volume cannot be guaranteed.	OFF	-
1086	Dynamic Provisioning Dynamic Provisioning for Mainframe Universal Volume Manager	This mode enables or disables the performance improvement for Dynamic Provisioning volumes that are Universal Volume Manager volumes used as pool volumes. **Mode 1086 = ON (default):** The performance improvement is enabled. **Mode 1086 = OFF:** The performance improvement is disabled. **Notes:** **1.** This mode is applied when the IOPS performance of an external storage system is higher than 80k x the number of installed MPBs, which is the value of IOPS that an entire local storage system sends to an external storage system. **2.** When it is required to set the mode to OFF, if IOPS sent from the local storage system to the external storage system is higher than 80k x the number of installed MPBs, reduce the IOPS to lower than 80k x the number of installed MPBs, and then set the mode to OFF. (Otherwise CWP increases and cache is overloaded.)	OFF	-

Planning considerations for external storage systems

The performance of an external storage system is affected by local system operations. Conversely, performance of the host and local system are affected by the attributes assigned to the external system.

Note the following regarding performance:

- The performance and status of the external system affects the performance of the mapped external volume. A high number of processes

running on the external system slows the processing speed of read/write requests and might cause a missing interrupt handler.
- If the host connected to the local storage system issues several I/O requests to be processed by the external storage system, the requests from the host might time out.
- When you run commands from the local storage system that result in more I/O requests being processed than the external storage system can handle, the commands might time out and an error might occur.
- When there is a process running between an external volume and the host, it is important that the Blocked Path Monitoring time of the external volume is the same as or shorter than the timeout period of the process that is running on the host. If the value of the Blocked Path Monitoring time setting is longer than the timeout period of the process running on the host, the process on the host might time out if the power supply is interrupted or if an error occurs in the external storage system.
- You can improve the host I/O performance for sequential writes to mapped volumes by setting the System Option Mode (SOM) 872 to ON. For more information, contact customer support.

External volume requirements

External volumes must meet the Universal Volume Manager requirements.

When planning external volumes, note the following:

- You can use existing data in an external volume after it is mapped to the local storage system, with the following restrictions:
  - (VSP G1000, G1500, and VSP F1500) You must set the emulation type to OPEN-V when you map the volume.
  - To perform host I/O operations, you must set an LU path from the target port to the mapped volume.
  - An external volume cannot be mapped to a DP Pool that has DP-VOLs with the capacity saving function enabled. Capacity saving features are not supported for external storage.
  - You cannot enable the capacity saving function on a DP-VOL from a DP Pool that has pool volumes from external storage.
- The maximum or minimum available capacity of an external volume depends on the emulation type you specify when mapping the volume. (VSP G1000, G1500, and VSP F1500) For more information, see Capacity requirements for volumes on page 47
- You cannot access data stored in an external volume that exceeds the allowed maximum capacity. See the Maximum capacity of an external volume row in System requirements on page 23.
- Make sure that a mapped external volume is accessed only from the local storage system.

- Make sure that a mapped external volume is not accessed from a host that is connected to the external storage system.
- Make sure that a mapped external volume is not manipulated by a copy function or any other functions of the external storage system.
- Accessing a mapped external volume from the external storage system requires that the volume mapping be disconnected first.

- External volumes that are reserved by a host cannot be mapped as internal volumes. To map these volumes, cancel the reserve settings, remove host access to the volumes, and then perform the mapping operation.
- Do not map multi-platform volumes of external storage systems as internal volumes.
- If an external storage system that uses control unit path ownership is connected to the local storage system, configure the external path to the primary controller in the external storage system as the primary path.
  Ownership is the exclusive right to control volumes. A controller that has ownership is called a *primary controller*. If the external path is connected to a controller that does not have ownership, and the path is configured as primary path, the ownership will be transferred, which might affect performance.
- A management LU cannot be used as an external volume.
  A management LU receives commands from an application, because it controls or manages the application, and stores control information from the application. An example of a management LU is a Universal Xport LU. (A CCI command device is not a management LU.)
  Before performing the external volume mapping operation, perform one of the following operations on the external storage system:
  - Delete the management LU from the port to be connected to the local storage system.
  - Make sure that at least one LU is used for data storage and has a smaller LUN (LU number) than the management LU's LUN. Also make sure that the data storage LU is set to the port connected to the local storage system.
  - Use the security function and configure the access attribute of the management LU to prohibit read and write operations.

  An external storage system that has a management LU might not be recognized by the local storage system.

The following requirements apply to only VSP Gx00 models, VSP Fx00 models:

- You cannot map an external volume whose capacity is smaller than the minimum capacity required for internal volumes.
- Before the settings of an external storage system are changed, mapping to volumes on the local storage system must be removed by selecting

Disconnect External Volumes. After the external storage system settings are changed, volumes can be remapped. Unless external volumes are remapped, they cannot be used on the local storage system.

- If an LU path is configured on an internal volume mapped to an external volume, the external volume mapping cannot be deleted.
- Mapping cannot be deleted for a volume used in a pair for the following programs:
  - TrueCopy
  - Universal Replicator
  - ShadowImage
  - Thin Image
  - Global-active device
- Mapping cannot be deleted for an external volume configured as a pool volume.
- Mapping cannot be deleted for an external volume configured as a quorum disk.

Cache use and external storage performance

If you enable Cache Mode, you must define a cache partition (CLPR). A CLPR helps to protect performance of the local storage system when the I/O rate exceeds the capabilities of the external storage system.

The Cache Mode setting, which you specify during a mapping operation, and a proper cache configuration affect the performance of the external storage used with the local storage system.

When data is written to a mapped external volume, Cache Mode controls when the write-complete response is sent to the host:

- If Cache Mode is enabled, the write-complete response is sent when the write data is in the cache of the local storage system.
- If Cache Mode is disabled, the write-complete response is sent when the write data is accepted by the external storage system.

Disabled is the safest setting and is recommended when there is a possibility that the I/O rate will exceed the short term capabilities of the external storage.

Enabled can adversely impact overall performance of the local storage system if the I/O rate exceeds the performance capabilities of the external system. If you enable Cache Mode, you must use the same formula for sizing cache in both the local and external storage systems.

Cache Mode effects with other Hitachi software

Note the following additional effects regarding the Cache Mode setting:

- Data that is not written by the host (for example, data written by ShadowImage) is asynchronously destaged to the external storage system regardless of the Cache Mode setting.
- When you enable the cache mode, consider the system load. Normally when you enable the cache mode, write response or host write performance improves because data written by the host is applied to the external storage system asynchronously by using the local storage system's cache.

  However, if the system load is high (for example, cache usage rate exceeds 60%), the local storage system suppresses write operations from the host in order to lower the load. Because of this, even if the cache mode is enabled, write responses from the host might become slower or host write performance might become lower than when the cache mode is disabled.

- **(VSP G1000, G1500, and VSP F1500):** If you perform the Cache Residency Manager bind mode operation on an external volume, your system must have twice as much cache capacity as user data area capacity. If the bind mode is set for Cache Residency, you cannot change the mode from Enable to Disable. If you want to change to Disable, either release the Cache Residency setting or change the Cache Residency operation mode to priority mode.
- **(VSP G1000, G1500, and VSP F1500):** When you set emulation type for a mainframe system, note the following:
  - Data written by a host using a Format Write command is asynchronously destaged to the external storage system regardless of the Cache Mode setting.
  - Data written by a host using other Write commands are destaged to the external storage system as configured in the Cache Mode setting.
- **(VSP Gx00 models and VSP Fx00 models):** The external volumes in a Dynamic Provisioning pool must all use the same Cache Mode setting, either Enabled or Disabled.
- **(VSP Gx00 models and VSP Fx00 models):** Dynamic Tiering pool volumes require Cache Mode to be set to Enabled.

External volume groups

During the mapping operation, you assign the external volume to an *external volume group* (ExG). This allows you to organize external volumes used for similar purposes to a particular group or groups.

For example, you might want to assign mapped volumes in the same external system to a specific ExG. Or, you might assign volumes used in a particular function, such as ShadowImage or Universal Replicator, to an ExG, even if the data is stored in different external storage systems.

You could also use ExGs to correspond to the external system's physical disk grouping, such as a RAID group.

You assign external volume group numbers during the mapping procedure.

External paths, path modes, and configurations

The external path is the physical link from the local storage system port to the external storage system port. You prepare the ports on the local and external systems and then set up the external path prior to mapping your external volumes.

To prepare and set up ports, see the following sections:

- Setting port attributes on the local system (VSP G1000, G1500, and VSP F1500) on page 65
- Setting up ports on the external system (VSP G1000, G1500, and VSP F1500) on page 66

External paths

A path consists of cables and possibly switches. You configure your path according to bandwidth considerations, which include distance, speed, and performance requirements.

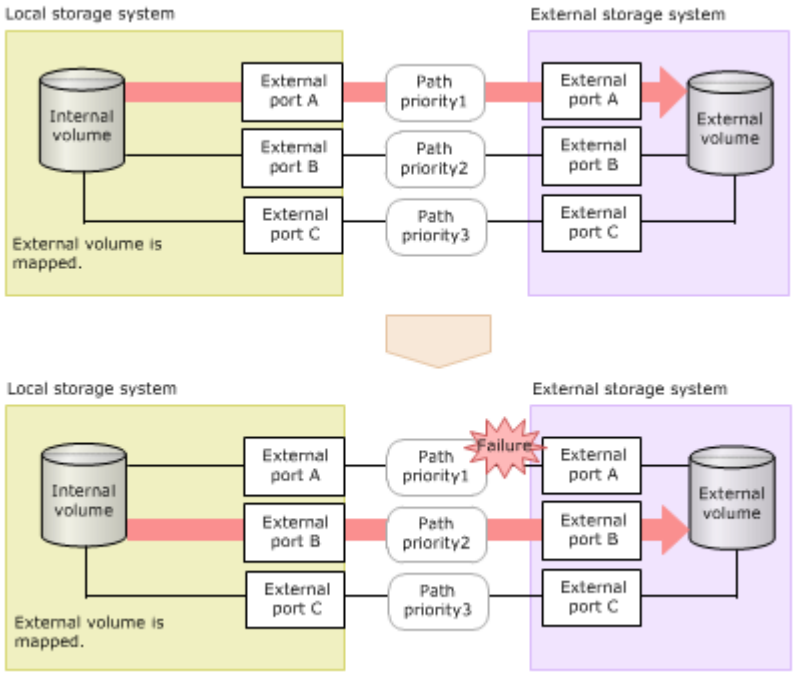
Because workload can spike and cable or switch failures can occur, we strongly recommend that you set up redundant external paths. A maximum of eight paths can be used per mapped external volume. Multiple paths (that is, *redundancy*) allows you to perform I/O operations with external volumes regardless of workload or path failure.

With multiple paths, the external storage system determines how they are used: some systems use one primary path with alternates available as backups (Single path mode); other systems allow all paths to be used at the same time, distributing I/O among them (Multi path mode). The path storage system's mode cannot be changed. With both modes, you place the paths in path groups and prioritize each path.

Single path mode

For Single path mode, the external path with the highest priority (primary path) is used for I/O to the external volume. If the primary path cannot be used, the path with the second highest priority is used.

The following figure illustrates how failure is handled with redundant paths in Single path mode.

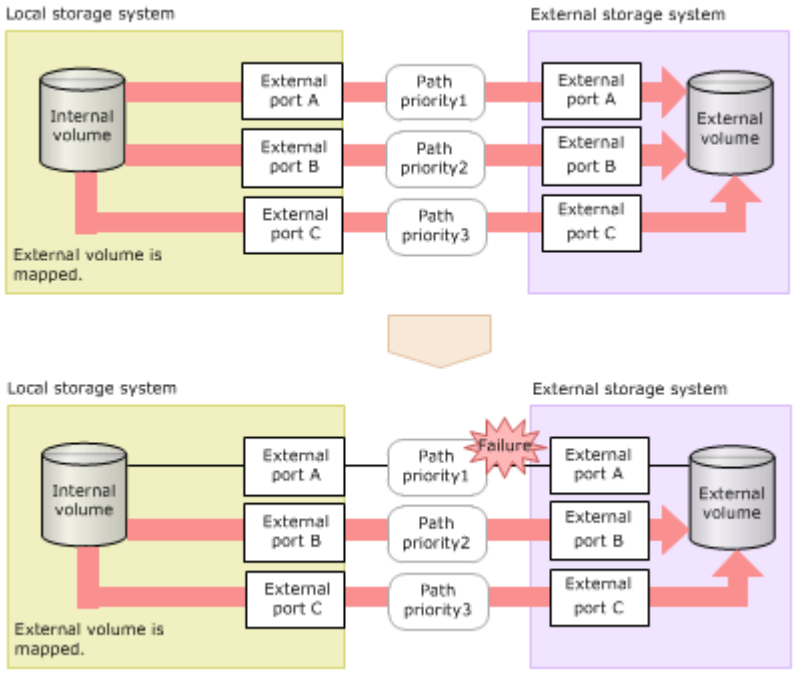


When you restore a path with higher priority than the currently-used path, I/O is switched to the restored path.

Multi path mode

For Multi path mode, all paths are used for I/O to the external volume. This distributes workload in a round-robin process.

The following figure illustrates how failure is handled with redundant paths in Multi mode.



Note: When you restore a path, use of the restored path is resumed.

Supported external system path mode for external volumes

Single or Multi path mode displays in Device Manager - Storage Navigator for external volumes on the **External Path Group** window. Path modes are based on the external storage system and cannot be changed.

In ALUA mode, the storage system uses all paths that are defined. The storage system performs I/O operations for external volumes through load balancing with the use of several paths (round-robin control). The storage system does not use external paths connected to ports that are in Passive status.

Load Balance Mode

When the path mode of an external volume is Multi or ALUA, you can select an I/O mode for the external storage system.

- Depends on the selected external volume(s): If Enable is set for ALUA Settable on the external volume, Normal Round-robin is set for Load Balance Mode automatically. If Disable is set for ALUA Settable, Disable is set for Load Balance Mode automatically.
- Normal Round-robin: Normal multi-path I/O control system. This distributes I/O to several paths on which I/O operation is enabled for the external storage system. Specify this if Extended Round-robin might lower I/O performance. This mode is recommended when the number of sequential I/O operations is small.

- Extended Round-robin: Extended multi-path I/O control system. I/O is distributed to several paths on which I/O operation is enabled for the external storage system. For sequential I/O, the external volume is divided into sections at regular intervals. In this case, the same path is used for I/O within the same section which reduces the frequency of I/O distribution. You can improve the read speed by using the cache function of the external storage system for sequential I/O operations. This mode is recommended when the number of sequential I/O operations is large.
- Disable: I/O operation is performed with only one path that is normal and has the highest priority. The same operation applies as that for Single path mode. When Disable is set for Load Balance Mode, load distribution is not performed. This mode is not recommended.

Caution: Depending on the external storage type and system configuration, performance might not be improved when Extended Round-robin is set. In that case, Normal Round-robin is recommended.

The following table shows the path mode for many of the supported external storage systems. The table also shows the abbreviation used in Device Manager - Storage Navigator. If your system is not shown below, refer to https://support.hds.com/en_us/interoperability.html.

Storage System	Reference
Hitachi Virtual Storage Platform G200, G400, G600, G800, Hitachi Virtual Storage Platform F400, F600, F800	• Path Mode: Multi • Displays as VSP Gx00
Hitachi Virtual Storage Platform G1000, G1500, F1500	• Path Mode: Multi • Displays as VSP G1000
Unified Storage VM	• Path Mode: Multi • Displays as HUS VM
Hitachi Virtual Storage Platform	• Path Mode: Multi • Displays as VSP
Hitachi Universal Storage Platform V	• Path Mode: Multi • Displays as USP V
Hitachi Universal Storage Platform VM	• Path Mode: Multi • Displays as USP VM
Hitachi TagmaStore® Universal Storage Platform	• Path Mode: Multi • Displays as USP

Storage System	Reference
Hitachi TagmaStore® Universal Storage Platform	• Path Mode: Multi • Displays as NSC
Hitachi Unified Storage	• Path Mode: Multi • Displays as HUS
Hitachi Adaptable Modular Storage	• Path Mode: - Multi: AMS2500, AMS2300, AMS2100, or AMS2010 - Single: AMS1000, AMS500, or AMS200 • Displays as AMS
Hitachi Workgroup Modular Storage	• Path Mode: Single • Displays as WMS
Hitachi Simple Modular Storage	• Path Mode: Multi • Displays as SMS
Hitachi Lightning 9900 V Series	• Path Mode: Multi • Displays as 9970V and 9980V
Hitachi Lightning 9900 Series	• Path Mode: Multi • Displays as: - Lightning 9960: 0400 - Lightning 9910: 0401
Hitachi Thunder 9500V series	• Path Mode: Single • Displays as 9500V
Hitachi SANRISE Universal Storage Platform	• Path Mode: Multi • Displays as USP
Hitachi SANRISE Network Storage Controller	• Path Mode: Multi • Displays as NSC
Hitachi SANRISE 9900V series	• Path Mode: Multi • Displays as 9970V and 9980V
Hitachi SANRISE 9500V series	• Path Mode: Single • Displays as 9500V
Hitachi SANRISE 2000 series	• Path Mode: Multi • Displays as: - SANRISE 2800: 0400 - SANRISE 2200: 0401
HP Virtual Storage Platform VX7	• Path Mode: Multi • Displays as XP7
HP Virtual Storage Platform VP9500	• Path Mode: Multi • Displays as P9500
A/H-6593	• Path Mode: Multi • Displays as 300

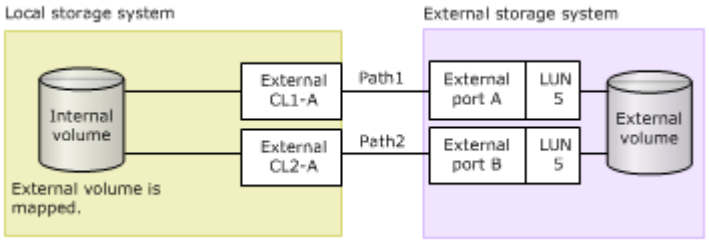
Storage System	Reference
HP H24000	• Path Mode: Multi • Displays as 24000
HP H20000	• Path Mode: Multi • Displays as 20000
HP SANRISE H12000	• Path Mode: Multi • Displays as 12000
HP SANRISE H10000	• Path Mode: Multi • Displays as 10000
HP SANRISE H1024/ H128	• Path Mode: Multi • Displays as 1024 and 128
HP SANRISE H512/H48	• Path Mode: Multi • Displays as 512 and 48
HP SANRISE H256	• Path Mode: Multi • Displays as 256
HP XP7	• Path Mode: Multi • Displays as XP7
HP StorageWorks P9500	• Path Mode: Multi • Displays as P9500
HP XP24000	• Path Mode: Multi • Displays as 24000
HP XP20000	• Path Mode: Multi • Displays as 20000
HP XP12000	• Path Mode: Multi • Displays as 12000
HP XP10000	• Path Mode: Multi • Displays as 10000
HP XP1024/XP128	• Path Mode: Multi • Displays as 1024 and 128
HP XP512/XP48	• Path Mode: Multi • Displays as 512 and 48
HP XP256	• Path Mode: Multi • Displays as 256
HP StorageWorks Enterprise Virtual Array 3000/4000/5000/6000/8000	• Path Mode: Single • Displays as EVA
SVS200	• Path Mode: Multi • Displays as SVS200

External path configurations - direct and switch

Recommendations for setting up direct and switch external path configurations.

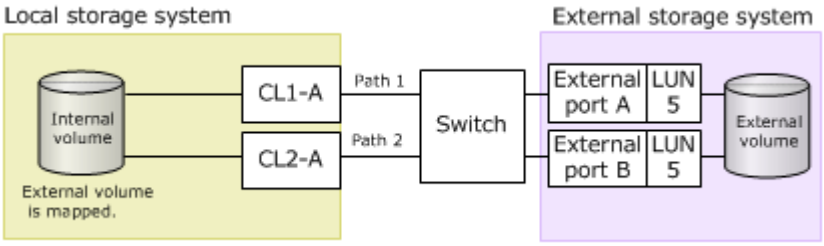
Direct connection

The following figure shows redundant paths in a direct connection configuration. External storage system ports, External port A and External port B, are connected to the local system ports, CL1-A and CL2-A (which are specified as external ports). For greater redundancy, Path 2, the alternate path, uses ports of a different cluster in both the local and external storage systems.

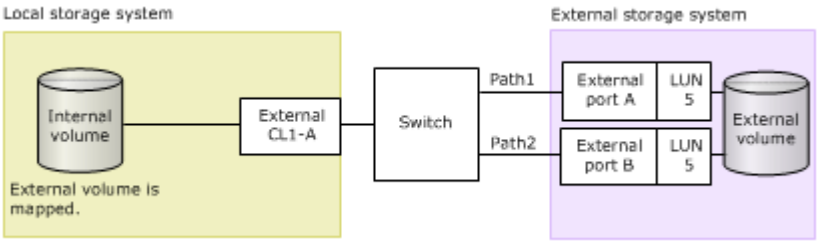


Switch connection

The following figure shows redundant paths with switches. Ports in the local system are connected to ports in the external system through the switch. The paths use ports of different clusters for increased redundancy.



The following figure shows an invalid configuration. Two paths are set between the internal and external volumes, but only one port is specified for the local storage system. The port is connected to ports in the external storage system through the switch. Because ports of two different clusters must be set in the local storage system, the following configuration is not recommended.



Mapping policy

The mapping policy is a list of settings that are required for mapping external volumes. Setting mapping policies before you perform a mapping operation is

the easiest way to configure your mapping settings. Policies are already available and the user can change the default value. See External volume policy settings and functions on page 76 to review the settings and edit them if desired.

Considerations for external volume attributes

- All the external volume attributes of an LDEV created within the external volume are the same. These attributes persist even when an LDEV is recreated with the VLL function.
- All LDEVs within an external volume have the same cache mode.
- Attributes, such as port or LUN security, set for a volume on the external storage system side persist when the volume is mapped.
- Mapped volume settings can be made on the local storage system side as necessary.
- Volumes for which the T10 P1 attribute is enabled cannot be specified as an external volume.

Considerations for using iSCSI

Before configuring a system that uses iSCSI, review the following considerations. For details about iSCSI, see the *Provisioning Guide* for your storage system. For other considerations when using Universal Volume Manager, see Planning considerations for external storage systems on page 31.

Considerations for external paths

- When adding an external path to a path group, make sure that it uses the same protocol as the other paths in the group. External paths for Fibre Channel and iSCSI cannot exist in the same path group.
- (VSP Gx00 models and VSP Fx00 models) VSP Gx00 models with firmware version 83-03-0*x* or earlier, and VSP Fx00 models with firmware version 83-04-0*x* or earlier do not support login redirection of iSCSI, so disable this function in external storage systems.
- If iSCSI is used for an external path, set Blocked Path Monitoring to at least 40 seconds (default). If you set a lower value, the external path might be blocked due to network delays, including the spanning tree functionality of a switch.
  In addition, if external volumes are accessed from a host, set the command timeout period of the host to a value greater than the value of Blocked Path Monitoring. Otherwise, commands from the host might time out when the external storage system is turned off or a failure occurs.
- After adding an iSCSI path, execute the login test for the iSCSI target to check if you can log in. If there is an iSCSI path from which you cannot log in to the iSCSI target, attempts to connect to the path are made, and the

load to storage systems or networks may become high. If this happens, external volumes might not be recognized.
- For an iSCSI path from which you cannot log in to the target, edit the iSCSI target or check settings of the external storage system to make sure you can log in. Alternatively, remove the iSCSI path.

Considerations for data paths
- When replacing Fibre Channel or iSCSI data paths, first remove any external paths that use the data paths to be replaced.
- Use the same protocol for data paths between a host and a storage system, or between storage systems.
- When Fibre Channel is used in a data path between a host and a storage system, and iSCSI is used for a data path between storage systems, different protocols are used in the data path. In this case, set a value which is equal to or greater than the timeout period for the command between storage systems as the timeout period of the command between the host and the storage system.

Considerations for ports
- When you change parameter settings for an iSCSI port, the iSCSI connection is temporarily disconnected, and then reconnected. Therefore, you should change parameter settings when the I/O load is low to reduce impact on the system.
- When you change settings for an iSCSI port connected to a host, log information might be output to the host. However, this does not indicate a failure. In a system that monitors system logs, if an alert is issued, change the iSCSI port settings, and then check if the host is reconnected.
- For the iSCSI port connecting to storage systems or to the host, set Delayed ACK to Disable.
  If Delayed ACK is set to the default value Enable, the host might take a long time to recognize external volumes. For example, 2,048 volumes might take 8 minutes.
- In the **Edit Ports** window, Selective ACK is set to Enable by default. Do not change this setting.
- In an environment in which a delay occurs in a line between storage systems, such as long-distance connections, we recommend trying various sizes, and then setting an optimal window size of iSCSI ports in storage systems at the primary and secondary sites. The maximum value you can set is 1,024 KB. Note that the default window size is 64 KB.
- In Universal Volume Manager, an external path connection is established for each iSCSI target of an external storage system. The maximum

number of iSCSI external paths for each port is 512. However, we recommend you set no more than 127 external paths for each port.

- iSCSI ports do not support the fragmentation (splitting packets) functionality. If the maximum transfer unit (MTU) of a switch is smaller than the MTU of the iSCSI port, packets are lost and communication might not be performed correctly. To avoid this problem, set the switch MTU to a value equal to or greater than the iSCSI port MTU. Note that the iSCSI port MTU must be at least 1500.
  In a WAN environment in which the MTU value is smaller than 1500, fragmented data cannot be sent or received. In such environment, set a smaller value for the maximum segment size (MSS) of the WAN router according to the WAN environment, and then connect the iSCSI port. Alternatively, use iSCSI in an environment in which the MTU value is 1500 or higher. For details about MTU values for the switch and how to set them, see the documentation for the switch.
- To use Universal Volume Manager on iSCSI ports for which the virtual port mode is enabled, you must use CCI. Additionally, you must use CCI to enable the virtual port mode. Do not set external paths from multiple virtual ports associated with a single iSCSI port of the local storage system to the same iSCSI port of an external storage system. We recommend that you use different iSCSI ports for paths to external storage systems and their alternate paths.
- (VSP Gx00 models and VSP Fx00 models) A single port can be used for connections to hosts (target attribute) and storage systems (initiator attribute). However, to minimize the influence to the system if a failure occurs either in a host or storage system, we recommend that you connect ports for hosts and storage systems to separate CHBs.

Notes on network settings

- We recommend that you disable the spanning tree setting on the port of a switch connecting to an iSCSI port. If you enable the spanning tree functionality of a switch, packets might not be looped in the network when the link is up or down. If this happens, the packets might be blocked for approximately 30 seconds. If you must enable the spanning tree settings, enable the port fast functionality of the switch.
- In a network path between storage systems, if you use a line whose transfer speed is slower than the iSCSI port, packets are lost and the line quality is degraded. To avoid this problem, configure the system so that the transfer speed for iSCSI ports and lines is the same.
- The delay in the line between storage systems varies depending on the system environment. Therefore, validate the system first, and then check the optimum window size settings of iSCSI ports. If the influence of the

line delay is unacceptable, consider using devices for optimizing or accelerating the WAN speed.

- If you use iSCSI, packets are sent or received using TCP/IP. Therefore, the number of packets might exceed the capacity of the communication line, or packets might be resent. As a result, performance might be greatly affected. Therefore, in critical systems that rely on performance, use Fibre Channel.
- If the external storage system is in the HUS 100 series, the number of iSCSI targets you can search for is limited. If the iSCSI target name is 47 characters (default), you can search up to 170 iSCSI targets.

Additional considerations for VSP G1000 and G1500, and VSP F1500

Application performance considerations

When you use external storage, you should consider carefully those factors that could affect application performance. Keep in mind that the mainframe Transaction Processing Facility (TPF) does not support external storage.

The following factors can affect application performance:

- For the same physical resources, Internal storage typically provides faster response times than external storage.
- External volumes must satisfy the performance characteristics and requirements for any applications that use them.
  For example, SATA storage does not provide the performance requirements needed for OLTP applications.

Mainframe volumes

When you map mainframe external volumes, there are many requirements and considerations to keep in mind.

Note the following requirements and considerations for mapping mainframe external volumes:

- Make sure that mainframe external volumes on a mainframe operating system consist of at least one LDEV before mapping.
- When multiple LDEVs exist in an external volume and numerous I/Os are made to them, read/write commands might timeout. When the commands timeout, the SIM (21d2xx) is reported.
- Set the MIH (missing interrupt handler) timer to 45 seconds (which is the recommended value) for mainframe external volumes on a mainframe operating system.

- Pre-existing mainframe volumes on an external storage system cannot be directly connected to the local storage system as external volumes.

You can prepare mainframe external volumes for mapping using one of the following methods:

- Zero-format the external volumes on the external system, map the volumes to the local storage system, then perform the Write to Control Blocks operation using Virtual LVI or Virtual LUN on the local system side.
- Map the external volumes to the local storage system and then format the mapped volumes on the local storage system using Virtual LVI or Virtual LUN.
  After the mapping operation completes, the status of the mapped volume is Blockade; however, after the Write to Control Blocks operation completes or the mapped volume is formatted on the local system, the mainframe host can access the new mainframe volume through the FICON channels of the local storage system.

Note: A good reason to format from the local system side is that if you format the mapped volume from the external system, existing data is deleted and there are no options for retaining it. For information on formatting and the Write to Control Blocks operations, see the *Provisioning Guide for Open Systems*.

Open systems volumes

When you map OPEN systems external volumes, there are many requirements and considerations to keep in mind.

Note the following requirements and considerations for mapping OPEN systems external volumes:

- OPEN systems external volumes do not require reformatting.
  However, if you need to initialize the data area for the volume, format the volume using the Virtual LUN function. See the *Provisioning Guide for Open Systems* for instructions.
- OPEN-V emulation provides the most efficient use of storage and the best performance. Also, emulation types other than OPEN-V might not retain existing data after being mapped.

Capacity requirements for volumes

The capacity of an external volume is carved into LDEVs when mapped to the local system as an internal volume. You must be able to calculate the capacity that the internal volume will have.

Note the following information regarding internal and external volume capacity:

- The LDEV size in the internal volume varies according to the external system's emulation type.

- An external volume whose capacity is less than the minimum LDEV capacity cannot be used.
- An external volume with a capacity that is less than the base LDEV capacity for the emulation type can be used; this causes a custom-sized volume (CV) to be automatically created in the local system during mapping.
  - A custom volume in the local system has a minimum capacity, called minimum LDEV capacity.
  - Base LDEV capacity must be equal to or greater than the minimum LDEV capacity.

    The following figure illustrates minimum and base LDEV capacities.

    Minimum LDEV capacity and Base LDEV capacity are calculated with the following formulas.

```
Minimum LDEV Capacity = Minimum Data Area Capacity
+ Control Information Area Capacity

Base LDEV Capacity = Base Data Area Capacity
+ Control Information Area Capacity
```

    For mainframe systems volumes, other than 3390-A and 3390-V, capacities for the expanded control information area and the adjustment area are also necessary. For details, see Formula for calculating capacity for 3390-A and 3390-V mainframe volumes on page 50.

    If the external volume capacity is less than the minimum LDEV capacity, you cannot specify the emulation type.

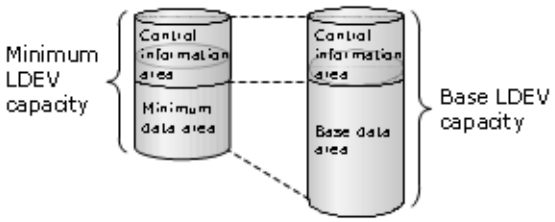


Figure 1 Idea of LDEV capacity

- If you map an external volume that has a capacity that is higher than the base LDEV capacity for the emulation type, multiple LDEVs are created. The resulting LDEVs have the base LDEV capacity.
- When using VLL, you can create a maximum of 2,048 CVs.
  (VLL is not supported for the OPEN-L emulation type.)
- For emulation types other than OPEN-V, usable capacity in the internal volume is the capacity of the external volume minus control information area capacity.
- Data that exceeds the maximum capacity cannot be accessed.
- If you use a virtual volume for which Data Direct Mapping is enabled, you can map an external volume with more than 4 TB without changing its capacity as a virtual volume.

For details about mapping using virtual volumes for which Data Direct Mapping is enabled, see the *Provisioning Guide for Open Systems*.

LDEV capacities per emulation type

The following table shows LDEV capacities for each emulation type in units of blocks and cylinders. The number of cylinders in this section is calculated as: 1 cylinder = 1,740 blocks.

Emulation Type		Minimum Data Area Capacity		Base Area Capacity		Control Information Area Capacity	
		Blocks	Cylinders	Blocks	Cylinders	Blocks	Cylinders
Volume for open systems	OPEN-3	72,000	-	4,806,720	-	11,520	-
	OPEN-8	72,000	-	14,351,040	-	338,880	-
	OPEN-9	72,000	-	14,423,040	-	338,880	-
	OPEN-E	72,000	-	28,452,960	-	27,360	-
	OPEN-K	72,000	-	3,661,920	-	12,960	-
	OPEN-L	71,192,160	-	71,192,160	-	10,080	-
	OPEN-V	96,000[a]	-	8,589,934,592[b]	-	0	-
Volume for mainframe systems	3390-1	87,000	50	1,936,620	1,113	8,700	5
	3390-2	87,000	50	3,873,240	2,226	10,440	6
	3390-3	87,000	50	5,809,860	3,339	10,440	6
	3390-9	87,000	50	17,429,580	10,017	43,500	25
	3390-L	87,000	50	57,002,400	32,760	40,020	23
	3390-M	87,000	50	114,004,800	65,520	92,220	53
	3390-A[c]	1,936,620	1,113	457,042,320	262,668	12,180	7
	3390-V	87,000	50	1,944,902,400	1,117,760	0	0
Intermediate volume	3390-3A -3B -3C	87,000	50	5,809,860	3,339	10,440	6
	3390-9A -9B -9C	87,000	50	17,429,580	10,017	43,500	25
	3390-LA -LB -LC	87,000	50	57,002,400	32,760	40,020	23
	3390-MA -MB -MC	87,000	50	114,004,800	65,520	92,220	53
Notes:							

Emulation Type	Minimum Data Area Capacity		Base Area Capacity		Control Information Area Capacity	
	Blocks	Cylinders	Blocks	Cylinders	Blocks	Cylinders

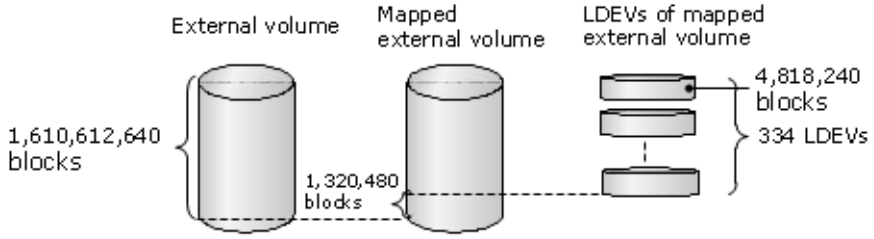
a. If mapping an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled: 16,777,216 blocks

b. If mapping an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled: 549,755,813,888 blocks

c. For 3390-A, a control information area is required for every 1,113 cylinders.

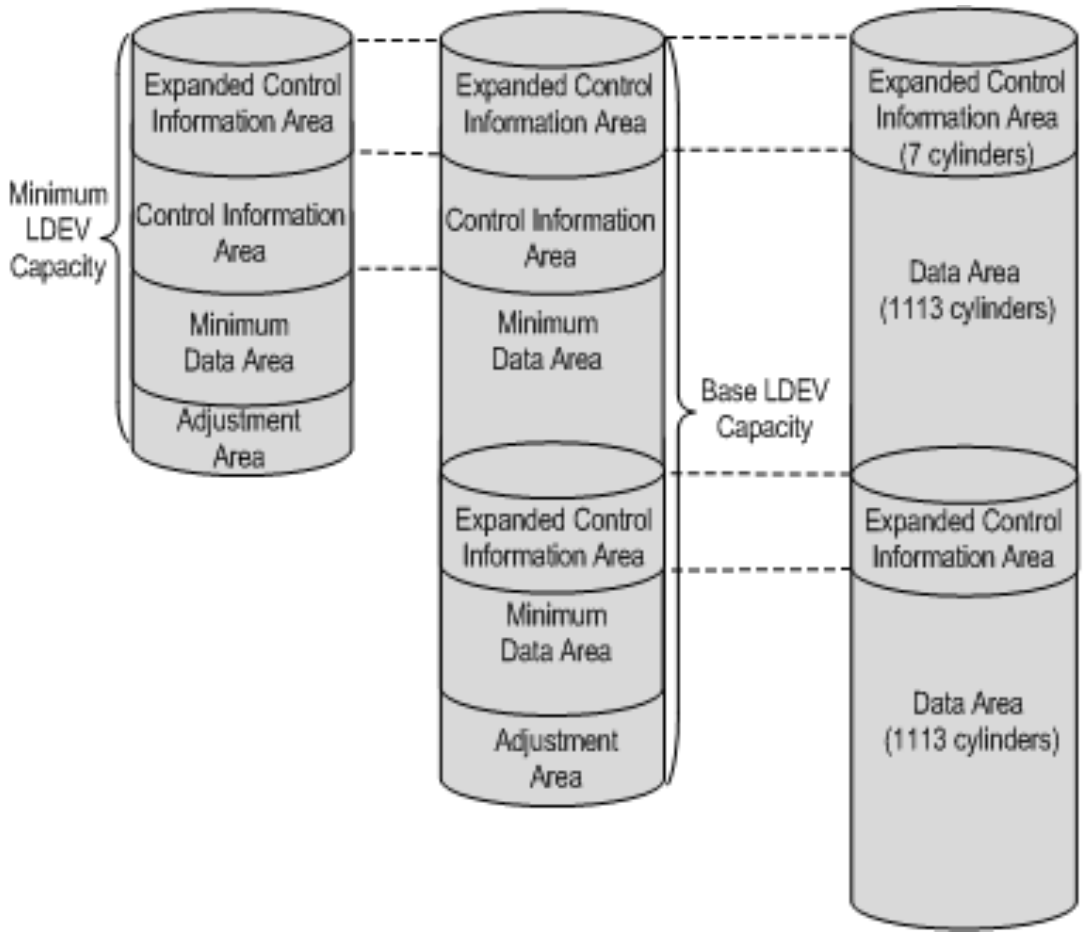
Example: Determining capacity for OPEN-3 volume

The following figure illustrates capacity for an external volume with OPEN-3 emulation type. The capacity is 1,610,612,640 blocks. You can create 334 LDEVs from the base LDEV capacity of 4,818,240 blocks (Base Data Area plus Control Information Area) using the data for OPEN-3 in LDEV capacities per emulation type on page 49. This process creates free space of 1,320,480 blocks of the mapped external volume. You can create LDEVs in free space using VLL.



Formula for calculating capacity for 3390-A and 3390-V mainframe volumes

For 3390-A and 3390-V mainframe volumes, an expanded control information area of 7 cylinders (12,180 blocks) is required for every 1,113 cylinders (1,936,620 blocks). The area total includes the minimum or base data area and the control information area. Because you must be able to divide the entire LDEV capacity by 77,952 blocks, you must include an adjustment area in the LDEV capacity.



Formula for calculating necessary LDEV capacities (in blocks)

ceil: rounding up the first decimal place to the nearest integer

```
Minimum LDEV capacity = ceil({ceil((Minimum data area capacity \
+ Control information area capacity) / 1,936,620) × 12,180 \
+ (Minimum data area capacity \
+ Control information area capacity)} / 77,952) × 77,952
```

```
LDEV capacity = ceil({ceil((Base data area capacity \
+ Control information area capacity) / 1,936,620) × 12,180 \
+ (Base data area capacity \
+ Control information area capacity)} / 77,952) × 77,952
```

Minimum LDEV capacity and Base LDEV capacity for mainframe systems

Emulation type	Minimum LDEV capacity (blocks)	Base LDEV capacity (blocks)
3390-1	155,904	2,026,752
3390-2	155,904	3,975,552

Emulation type	Minimum LDEV capacity (blocks)	Base LDEV capacity (blocks)
3390-3	155,904	5,924,352
3390-9	155,904	17,617,152
3390-L	155,904	57,450,624
3390-M	233,856	114,823,296

Adjusting volume capacities for pairs

Mapped external volumes can be used for replication. All VSP G1000 and G1500, and VSP F1500 replication software requires that the secondary volume (S-VOL) of a pair have the same capacity as the primary volume (P-VOL).

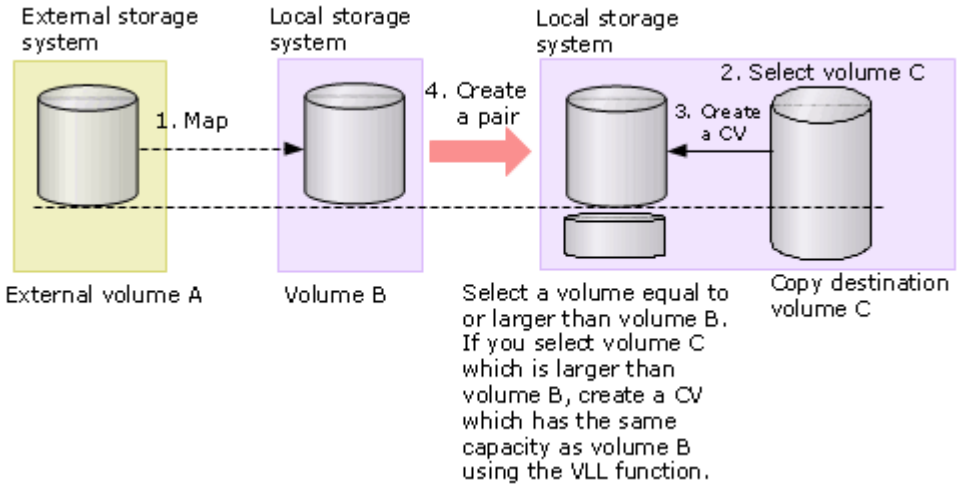
If you need to adjust the capacity of the VSP G1000, VSP G1500, or VSP F1500 volume or the external volume before creating the pair, proceed as shown in Decreasing the size of the VSP G1000, VSP G1500, or VSP F1500 S-VOL on page 52 and Decreasing the size of the external volume S-VOL on page 53.

Decreasing the size of the VSP G1000, VSP G1500, or VSP F1500 S-VOL

When the VSP G1000, VSP G1500, or VSP F1500 volume S-VOL is larger than the mapped external volume P-VOL, you must adjust the capacity of the VSP G1000, VSP G1500, or VSP F1500 volume.

Procedure

1. Map the external volume with emulation type OPEN-V.
2. Make sure the VSP G1000, VSP G1500, or VSP F1500 volume's emulation type is OPEN-V.
3. Decrease the size of the VSP G1000, VSP G1500, or VSP F1500 S-VOL by creating a custom volume (CV) using Virtual LVI/LUN (VLL), as shown in the following figure.



Base the CV capacity on Blocks, which displays in the **Capacity** column on the **LDEV Information** dialog box in Device Manager - Storage Navigator. See the *Provisioning Guide for Open Systems* and the *Provisioning Guide for Mainframe Systems* for instructions on creating CVs.

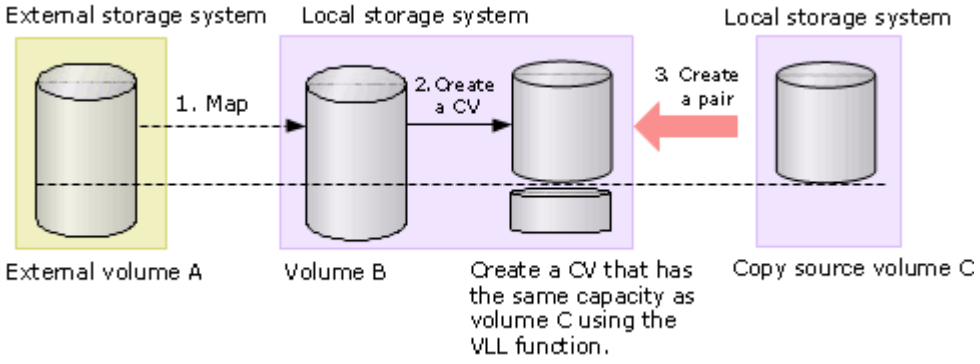
4. Create the pair.

Decreasing the size of the external volume S-VOL

When the mapped external volume S-VOL is larger than the VSP G1000, VSP G1500, or VSP F1500 P-VOL, you must adjust the capacity of the external volume.

Procedure

1. Map the external volume with the same emulation type as the VSP G1000, VSP G1500, or VSP F1500 primary volume.
2. After mapping, check the new internal volume's capacity. If it is larger than the VSP G1000, VSP G1500, or VSP F1500 P-VOL, decrease the size by creating a CV that is the same size as the VSP G1000, VSP G1500, or VSP F1500 P-VOL using Virtual LVI/LUN (VLL) (see the following figure).

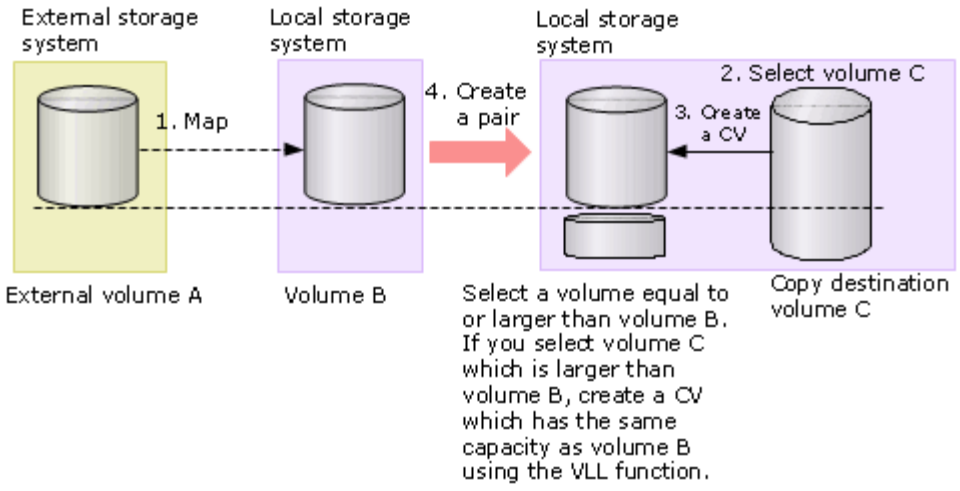


3. Create the pair.

Copying external storage system data

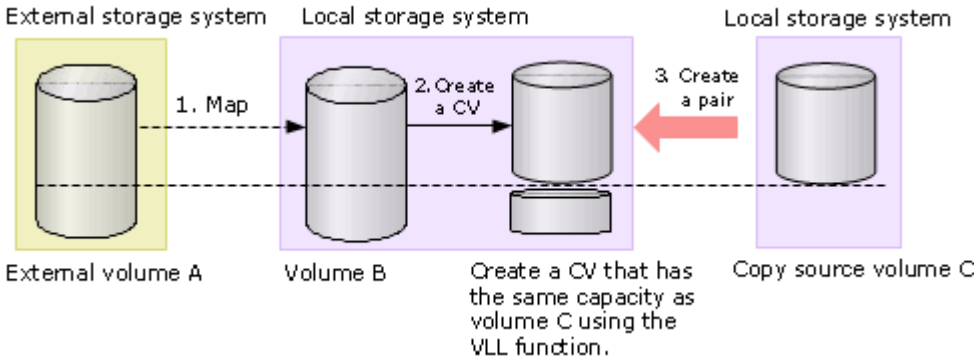
You can use copy pairs to copy data from an external storage system to the local storage system. External volumes can be set up as either a P-VOL or S-VOL.

Using an external volume as a P-VOL to copy data



1. Use Universal Volume Manager to map the external volume (A) to an internal volume (B) of the local storage system. You will use volume (B) as the P-VOL of a copy pair.
2. Check the capacity of internal volume (B) to which external volume (A) is mapped, and select a copy destination volume (C) that has the same or greater capacity than volume (B). You will use copy destination volume (C) as the S-VOL of the copy pair.
3. If the copy destination volume (C) is bigger than volume (B), use the VLL function to create a CV that has the same capacity as volume (B). Create the CV using the block value displayed in the Mapped Volumes tab in the selected external path group window.
4. Create the copy pair using volume (B) as the P-VOL and volume (C) as the S-VOL. This configuration makes a copy of external volume (A).

Using an external volume as an S-VOL to copy data



- Use Universal Volume Manager to map the external volume (A) to an internal volume (B) of the local storage system. You will use volume (B) as the S-VOL of a copy pair.
- Check the capacity of internal volume (B) to which external volume (A) is mapped. If the capacity of internal volume (B) is different than the copy source volume (C), use the VLL function to create a CV that has the same capacity as the copy source volume (C).
- Create the copy pair using copy source volume (C) as the P-VOL and volume (B) as the S-VOL. This configuration makes a copy of the source volume on external volume (A).

3

Supported software for external volumes

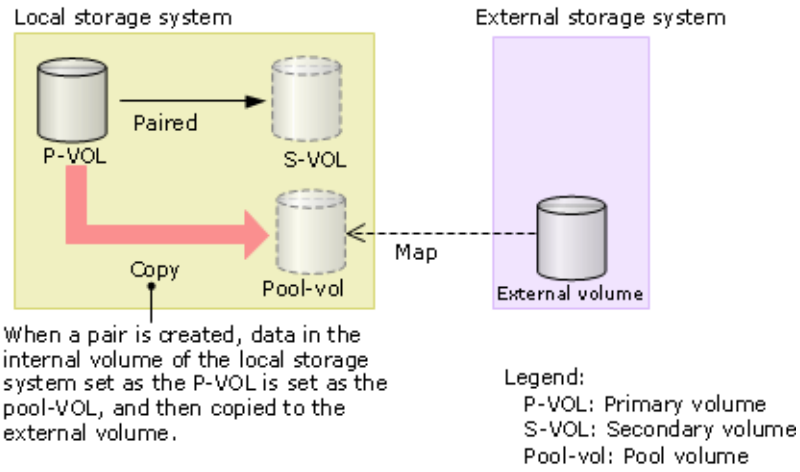
You can use Hitachi Virtual Storage Platform G200, G400, G600, G800, Hitachi Virtual Storage Platform F400, F600, F800,orHitachi Virtual Storage Platform G1000 and G1500, and Hitachi Virtual Storage Platform F1500 software products and functionality to manage and manipulate data in your mapped volumes: for example, Virtual LVI/Virtual LUN, TrueCopy, LUN Manager, and so on.

- Thin Image
- Dynamic Provisioning, Dynamic Tiering, active flash, and Thin Image
- Local replication software
- LUN Manager and Configuration File Loader
- Performance Monitor
- Remote replication software
- SNMP Agent
- Cache Residency Manager restrictions (VSP G1000, G1500, and VSP F1500)
- Virtual LVI/LUN
- Global-active device

Thin Image

Mapped volumes can be used in pairs for Thin Image, but internal and external volumes cannot be used together in the same pool and all external volumes in a pool must use the same Cache Mode setting.

After you map and format an external volume, it is ready to use as a pair volume. The following figure shows an example of an external volume used as a Pool-Vol.



Dynamic Provisioning, Dynamic Tiering, active flash, and Thin Image

Mapped external volumes can be used for the following programs:

- On all storage systems
  - Dynamic Provisioning
  - Dynamic Tiering
  - Active flash
  - Thin Image
- On VSP G1000 and G1500, and VSP F1500
  - Dynamic Provisioning for Mainframe
  - Dynamic Tiering for Mainframe
  - Active flash for mainframe

Note the following restrictions:

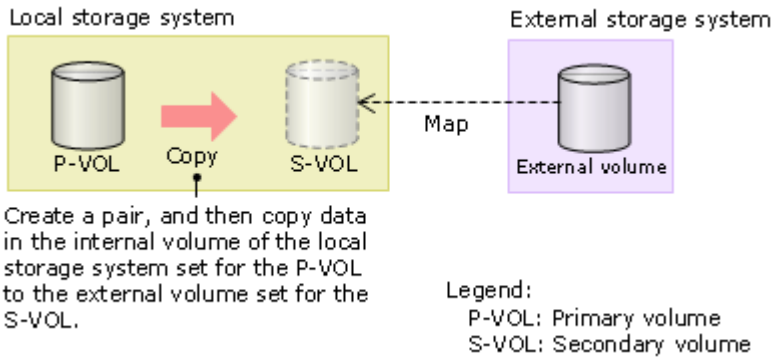
- If you are using a Thin Image pool, all external volumes in the same pool must use the same Cache Mode setting. For more information about this setting, see Cache use and external storage performance on page 34.

- **(VSP G1000, G1500, and VSP F1500):** A mapped volume that is used as a pool volume must use OPEN-V emulation for open systems and 3390-V emulation for mainframe systems.
- **(VSP Gx00 models and VSP Fx00 models):** With Dynamic Tiering, Cache Mode must be set to Enabled.
- **(VSP Gx00 models and VSP Fx00 models):** Mapped external volumes can be used as quorum disks for global-active device, but not pair volumes.

Local replication software

Mapped volumes can be used in pairs for ShadowImage for Mainframe (VSP G1000, G1500, and VSP F1500) and ShadowImage. After you map and format an external volume, the volume can be used as a pair volume.

The following figure shows an example of an external volume used as an S-VOL.



LUN Manager and Configuration File Loader

If you specify the emulation type for open systems when mapping external volumes, use LUN Manager to set the LU path for the mapped volumes.

Some LUN Manager operations can be performed using spreadsheets and the Configuration File Loader function.

When using external volumes, you can use Configuration File Loader for the following operations:

- Set the LU path definition for an external volume (add, delete, or change LU paths).
- Set an external volume as a command device (add or delete the setting).

However, the following actions are not supported:

- Setting the channel adapter (CHA) or channel board (CHB) mode, host group, WWN, and iSCSI target name for the external port

- If an external volume is mapped through an external port, the port setting operation of the topology is not available.

Performance Monitor

Performance Monitor can be used to display monitoring information for mapped external volumes.

Remote replication software

After external volumes are mapped and formatted, they can be used as a pair volumes for the following remote replication software:

- On all storage systems
  - TrueCopy
  - Universal Replicator
- On VSP G1000 and G1500, and VSP F1500
  - TrueCopy for Mainframe
  - Universal Replicator for Mainframe

The following figures show examples of an external volume used as an S-VOL.

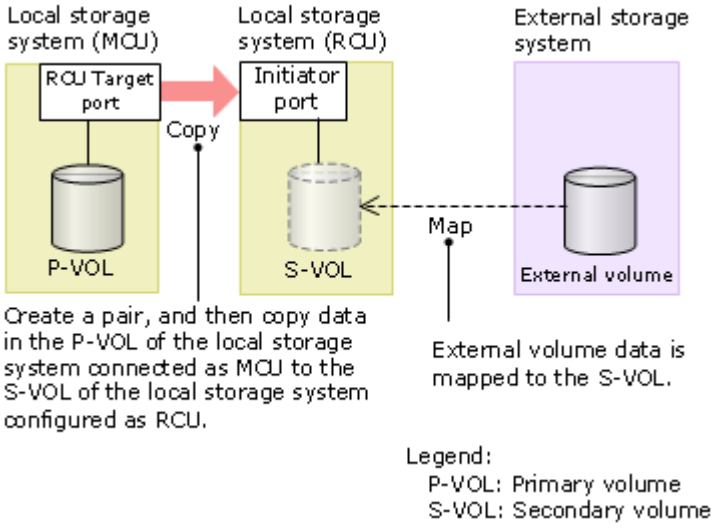


Figure 2 Using a mapped external volume for UR or URz

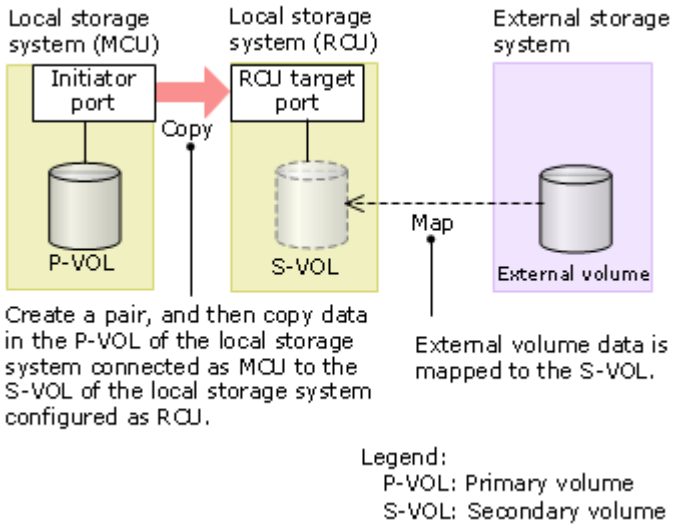


Figure 3 Using a mapped external volume for TC or TCz

SNMP Agent

SNMP Agent can display information about mapped external volumes and external ports.

Cache Residency Manager restrictions (VSP G1000, G1500, and VSP F1500)

The main restrictions for using external volumes with Cache Residency Manager pertain to the use of bind mode.

The following list includes restrictions on the use of external volumes with Cache Residency Manager:

- If you set bind mode, the Cache Residency Manager operation requires a cache of twice as much capacity as the user data area of the mapped volume.
- If the Cache Mode is set to Disable, you cannot specify Bind mode for an external volume. You can specify the Cache Mode setting before, during, or after mapping. For details, see External volume policy settings and functions on page 76.

Virtual LVI/LUN

For Virtual Storage Platform G1000, Virtual Storage Platform G1500, and Virtual Storage Platform F1500 mainframe external volumes, use the Virtual LVI function to perform the Write to Control Blocks operation immediately

after mapping. See the *Provisioning Guide for Mainframe Systems* for information.

If you create LDEVs from an external volume using the Virtual LVI or Virtual LUN function, the Cache Mode setting of the created LDEVs is the same as the Cache Mode setting of the mapped external volume.

Global-active device

Mapped external volumes can be used as pair volumes for global-active device. To adjust volume capacity, see Copying external storage system data on page 54.

4

Setting up external volumes

You set up ports and external paths, map external volumes, and then begin using them with native storage on your storage system. This chapter describes external volume setup procedures and information, including configuring ports and port attributes, mapping external volumes, preparing mapped volumes for use, and using mapped volumes. It also discusses recognizing the local system from the external system.

Workflow for setting up external volumes

You must complete all planning and preparation tasks before setting up Universal Volume Manager.

Before you begin setting up Universal Volume Manager, consult the topics in Planning workflow on page 22 to make sure you have completed all planning tasks.

For VSP G1000 and G1500, and VSP F1500

1. Set up ports on the local and external storage systems. See the following:
   - Setting port attributes on the local system (VSP G1000, G1500, and VSP F1500) on page 65
   - Setting up ports on the external system (VSP G1000, G1500, and VSP F1500) on page 66
2. [Optional] Edit mapping settings before starting the mapping operation. For details, see External volume policy settings and functions on page 76.
   You can also make changes during the mapping operation or accept the default settings.
3. Map each external volume to an internal volume. The following settings are required:
   - Set the emulation type of the external volume to OPEN-V.
   - Set the number of LDEVs per external volume to 1.

   For details, see Mapping an external volume on page 67.
4. After an external volume is successfully mapped, perform the one of the following depending on the emulation type of the volume:
   - For mainframe emulations, format the volume or perform the Write to Control Blocks operation using Virtual LVI. See the *Provisioning Guide for Mainframe Systems*.
   - For OPEN-system emulation, use LUN Manager to define LU paths to hosts. For details, see the *Provisioning Guide for Open Systems*.

For VSP Gx00 models and VSP Fx00 models

1. Set up ports. For details, see Setting up ports (VSP Gx00 models and VSP Fx00 models) on page 67.
2. [Optional] Edit mapping settings before starting the mapping operation. For details, ee External volume policy settings and functions on page 76.
   You can also make changes during the mapping operation or accept the default settings.

3. Map each external volume to an internal volume.
   For details, see Mapping an external volume on page 67.
4. After an external volume is successfully mapped, use LUN Manager to define LU paths to hosts. For details, see the *Provisioning Guide*.

Related references

- Recognizing the local system from the external system on page 74

Setting port attributes on the local system (VSP G1000, G1500, and VSP F1500)

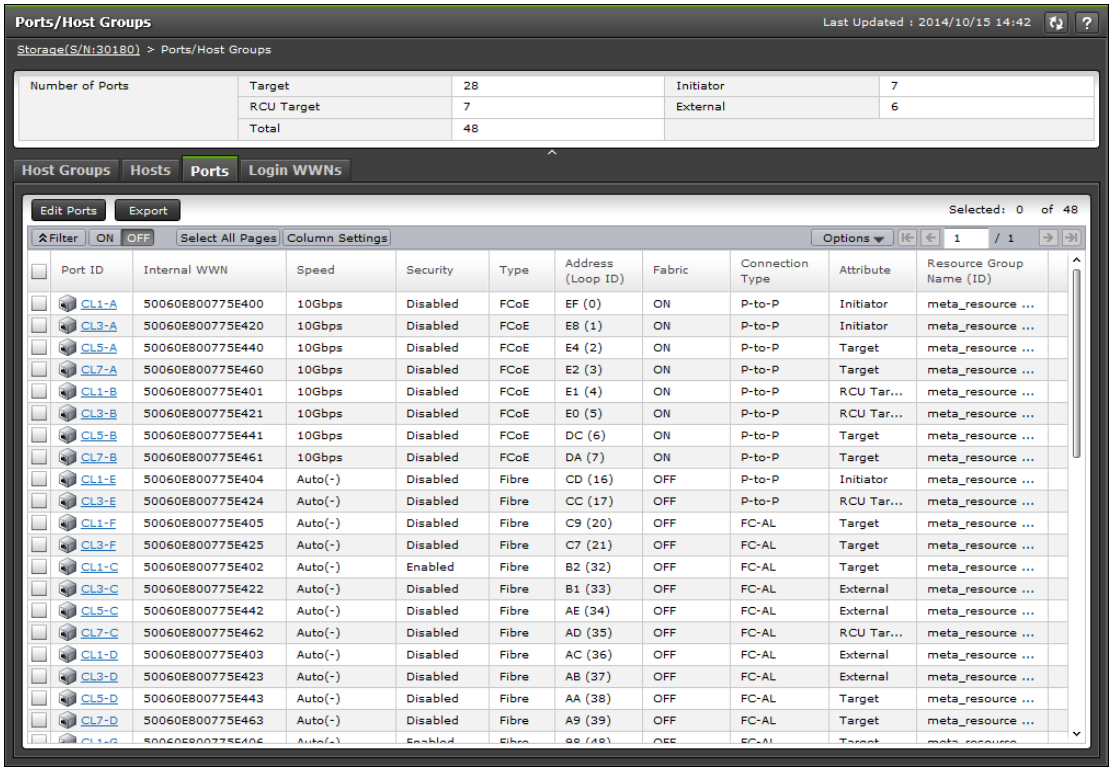
The port attribute of a local storage system connected to an external storage system must be specified as External. For information on setting up ports, see the user guide of your external storage system.

Before you begin

- Before changing the port's attribute, release any LU paths that are assigned to the port.
- Ports that have RCU target and Initiator attributes and that are no longer used for remote copy operations, can be changed to External.
- For more information about setting up the external path, see External paths, path modes, and configurations on page 36.
- For details about the Edit Ports wizard, see the *Provisioning Guide for Open Systems*.
- Storage Administrator (System Resource Management) role

Procedure

1. Open the **Ports/Host Groups/iSCSI Targets** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **Ports/Host Groups/iSCSI Targets**.
2. In the **Ports/Host Groups/iSCSI Targets** window, click the **Ports** tab.
3. Select the desired port, and then click **Edit Ports**.



4. In the **Edit Ports** window, select **External** in the **Port Attribute** box.
5. For help with other settings, see the *Provisioning Guide for Mainframe Systems* or *Provisioning Guide for Open Systems*.
6. When ready, click **Finish**.
7. In the **Confirm** window, review all settings, then either click to accept the task name or enter a new name, and then click **Apply**.

Setting up ports on the external system (VSP G1000, G1500, and VSP F1500)

Make sure the external system ports you use have enough capacity for the read/write workload planned for the external volumes.

See the discussion in External paths on page 36 for more information. Refer to the documentation for the external system for full information.

Procedure

1. Configure the topology settings according to the configuration of the connection (fabric or loop).
2. Set the data transfer speed according to the connection configuration.
3. Set parameters for the ports on the external system as required for connecting with your VSP G1000, VSP G1500, or VSP F1500 system. For

your specific external system, see Supported external storage systems on page 119.

If you do not find your external system in the section, see https://support.hds.com/en_us/interoperability.html to make sure your system is supported and then refer to the documentation for the system's ports.

4. Define LUNs and present them on the port on the external system.

Setting up ports (VSP Gx00 models and VSP Fx00 models)

When you connect external storage systems to a port, information on those storage systems can be viewed from client computers. Multiple external storage systems from different vendors can be connected to the same port. Even if a port connected to external storage systems is in use, you can connect additional external storage systems.

Limitations on mapping an external volume

You must set the port attribute to External port before you can map the external volume as an internal volume. Make sure to check the capacity requirements of the external volume you intend to map as an internal volume.

Following are the limitations on mapping an external volume:

- You cannot access data that is stored in an area that exceeds the maximum capacity of the external volume. For example, if you map 100 GB of an external volume as 70 GB of the internal volume, 30 GB of the external volume cannot be accessed from the local storage system side.
- You cannot map an external volume which does not meet the minimum capacity requirement. For example, you cannot map 10 GB of the external volume as an internal volume with a minimum capacity requirement of 30 GB.
- Volumes for which the T10 PI attribute is enabled cannot be specified as an external volume.

Mapping an external volume

Set the attribute of the port used for Universal Volume Manager to the external port, and then you can map the external volume as an internal volume.

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- Attributes set for the external volume before mapping, such as port security, LUN security, Volume Retention Manager attributes are discarded

when the external volume is mapped. If the original attributes are required, reset them in the local storage system after mapping.
- Volumes for which the T10 PI attribute is enabled cannot be specified as an external volume.
- When the external volume is a command device, it is mapped as a remote command device. For important information about mapping command devices, see Remote command devices on page 143.
- Before you map the external volume, determine whether any application is using the volume. If you find any, stop them before mapping.
  For example, before mapping a command device, make sure CCI commands are not being run.
- **(VSP G1000, G1500, and VSP F1500):** For details about viewing or editing SSIDs, see the Provisioning Guide.

Note: When you create an LDEV at the same time that you map an external volume, you cannot select the following LDEV numbers:
- Numbers already in use.
- Numbers not assigned to the user.
- **(VSP G1000, G1500, and VSP F1500):** Numbers already assigned to another emulation group (which consists of LDEVs that are grouped every 32 LDEV numbers).
- **(VSP G1000, G1500, and VSP F1500):** Model or serial number and LDEV ID or virtual LDEV ID of the storage system and the virtual storage machine do not match in the mainframe volume or the interim volume that you create.

(VSP G1000, G1500, and VSP F1500) For emulation groups, see the Provisioning Guide. To determine whether the LDEV number can be assigned, click the View LDEV IDs button in the **Add External Volumes** window when you map the external volume.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click **Add External Volumes**.
3. In the **Add External Volumes** window, select an existing path group or create a new one.
   To create an external path group, select **By New External Path Group**, click **Create External Path Group**, specify the following, and then click **OK**:
   - **Initial External Path Group ID**: The storage system searches IDs from the initial ID you specify in ascending order and allocates an ID that can be used. The default is 0. Specify a value in the following range:

- VSP G200: 0 to 2,047
- VSP G400, VSP G600, VSP F400, F600: 0 to 4,095
- VSP G800, VSP F800: 0 to 14,079
- VSP G1000, VSP G1500, and VSP F1500: 0 to 63,231

- **External Paths**: If the port or WWN/iSCSI target name you want is not in the **Available External Paths** table, click **Discover External Target Ports**, add ports, and then click **OK**.
- **External Storage System**: Select the desired external storage system.
- **Available External Paths**: Select the desired port IDs, and then click **Add**.
- Set the priority for a path by selecting it, and then clicking **Raise Priority** or **Lower Priority**.

To use an existing external path group, select **By Existing External Path Group**, and then select the desired path group from the **Available External Paths** table.

4. Click **Next**.
5. In the **Discovered External Volumes** table, select the desired external volumes.
6. In **Initial Parity Group ID**, enter an external volume group number and sequential number. You can use the group number to place similar external volumes in a group. For example, you could assign the same external volume group number to volumes used for a copy function.
   - The range is from 1 - 1 to 16384 - 4096.
   - To map an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled, select **Enable** in **Data Direct Mapping**. When you do, **Yes** is automatically selected for **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.
     For details about mapping using virtual volumes for which Data Direct Mapping is enabled, see the Provisioning Guide.
7. Specify **Allow Simultaneous Creation of LDEVs**.
   - To allow the system to automatically create LDEVs in the external volume, select **Yes**. To manually create LDEVs, select **No**.
   - If the external volume is a command device, select **Yes** for both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.
8. Specify **Use External Storage System Configuration**.
   - If you select **Yes**, **Base Emulation Type** is disabled and the emulation type is set based on the LDEV name of the external storage system.

- If you select **No**, **Base Emulation Type** is enabled so you can select the type.
- If you select **Yes** in both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**, one LDEV with the same capacity as the OPEN-V external volume will be created.
- If you select **Disable** in **Data Direct Mapping** and the external volume is larger than 4 TB, one 4 TB LDEV will be created.

9. In **LDEV Name**, enter the prefix character and the initial number.

If you enter a prefix character and an initial number, their combined value can be a maximum of 32 characters, including the initial number (numerical value of 9 digits or less). Note the following numbering rule:

- 1: Total of 9 numbers (1, 2, 3, ...9)
- 08: Total of 92 numbers (08, 09, 10, ...99)
- 23: Total of 77 numbers (23, 24, 25, ...99)
- 098: Total of 902 numbers (098, 099, 100, ...999)

10. Click **Options** (if not already expanded). If you have previously edited mapping settings (policies), you might not want to change the options. However, review the following steps, because some fields in **Options** are affected by the preceding steps.

11. In the expanded **Options** box, for **Initial LDEV ID** enter the initial LDEV ID for the external volume. The local storage system searches from this number in ascending order and allocates the next available ID. You can review used, available, and disabled LDEVS by clicking **View LDEV IDs**.

- For **LDKC**, enter 00.
- For **CU**, enter the CU number. The default is 00. Specify a value in the following range:
  - VSP G200: 00 to 07
  - VSP G400, VSP G600, VSP F400, F600: 00 to 0F
  - VSP G800, VSP F800: 00 to 3F
  - VSP G1000, VSP G1500, and VSP F1500: 00 to FE
- For **DEV**, enter the LDEV ID, which can be from 00 to FF. The default is 00.
- For **Interval**, enter an interval between LDEV IDs, which can be from 0 to 255. The default is 0.

12. (VSP G1000, G1500, and VSP F1500) In **Initial SSID**, enter the SSID, which can be from 0004 to FFFE. The default is 0004.

You can review the current SSIDs by clicking **View SSIDs**.

13. (VSP G1000, G1500, and VSP F1500) In **Base Emulation Type**, select the emulation type of the external volume.

If you selected **Yes** in **Allow Simultaneous Creation of LDEVs** and **No** in **Use External Storage System Configuration**, you must select an emulation type. If you selected **Yes** in both fields, **Base Emulation Type** is greyed out, and OPEN-V is automatically set.

14. In **Number of LDEVs per External Volume**, enter the number of LDEVs to be created when the volume is mapped. This field is greyed out

if you selected **Yes** in **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**, and **1** displays.

(VSP G1000, G1500, and VSP F1500) For details, see Capacity requirements for volumes on page 47.

15. In **Cache Partition**, select the CLPR for accessing the mapped external volume.

> **Note:** For more information about the **Cache Partition**, **Cache Mode**, and **Inflow Control** settings, see External volume policy settings and functions on page 76.

16. In **Cache Mode**, select **Enable** to propagate write data asynchronously from cache to the external storage system. Select **Disable** to propagate data synchronously.
    - (VSP G1000, G1500, and VSP F1500) If you specify **Disable**, the Cache Residency Manager bind mode cannot be set.
    - When the external volume is a command device, **Cache Mode** for the remote command device is automatically set to **Disable** regardless of your setting.
    - Data that is not written by the host (for example, data written by pair operation) is asynchronously destaged to the external storage system regardless of the **Cache Mode** setting.
17. In **Inflow Control**, select **Enable** to limit or prevent write data from being written to cache memory when the write operation to the external volume cannot be performed. Select **Disable** to allow write data to be written to cache.
18. In **MP Blade ID** or **MP Unit ID**, select the MP blade or unit for the external volume, making sure to assign them so that work is evenly distributed across the available processors.

    To automatically assign an MP blade or unit, select **Auto** (the default). If **Auto** is not available, the MP blade or unit with the lowest number is selected by default. Otherwise, select one of the following values:

    - VSP Gx00 models, VSP Fx00 models: MPU-10, MPU-11, MPU-20, or MPU-21

    - VSP G1000, VSP G1500, and VSP F1500: MPB0 to MPB7
19. Click **Add**.
20. If you need to change settings for an added volume, select it in the **Selected External Volumes** table, click **Change Settings**, make necessary changes, and then click **OK**.
21. To add LUN paths, click **Next** in the **Add External Volumes** window. For details, see the Provisioning Guide.
22. Click **Finish** when ready.
23. In the **Confirm** window, review all settings, and then accept the task name or enter one.

When you select the external volume and click **LDEV Detail**, the **External LDEV Properties** window is displayed for you to review the LDEV information.

24. In the **Confirm** window, click **Apply**.

Related references

- Add External Volumes window on page 168
- Create External Path Group window on page 203
- Change Settings window on page 206
- View External LUN Properties window on page 207
- External LDEV Properties window on page 215
- Discovery Result Detail window on page 216
- Requirements on page 145

Preparing mapped volumes for use

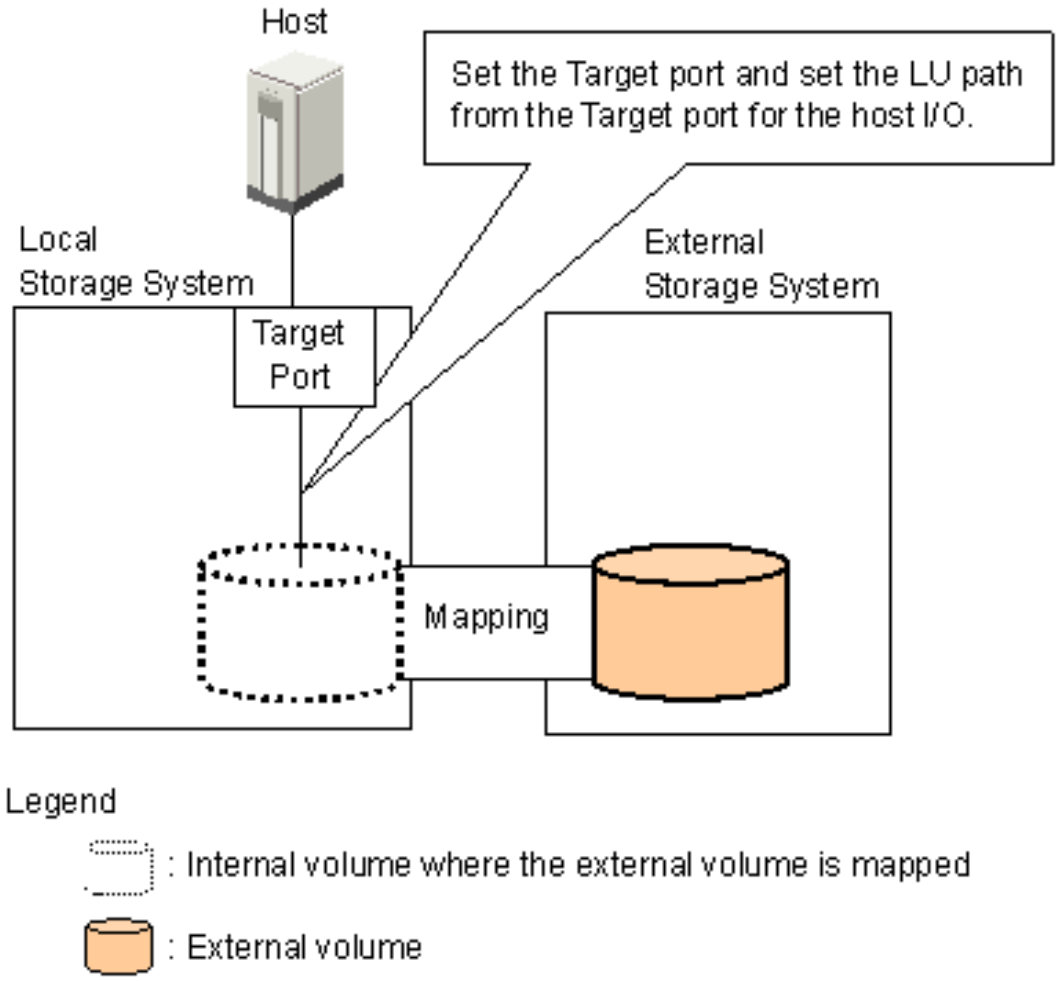
After external volumes are mapped to the local storage system, you must prepare the volumes for use.

Before you begin

- You must have the Storage Administrator (Provisioning) role.

Procedure

1. (VSP G1000, G1500, and VSP F1500) Depending on the emulation type, perform one of the following:
   - For mainframe emulation, the status of the mapped volume becomes **Blockade** after mapping. Format the volume using Virtual LVI to change to a normal status.
     For zero-formatted external volumes, use Virtual LVI to perform the **Write to Control Blocks** operation to restore the volume. Even if you formatted the volume from the external storage side after recovering the mapped volume, you must perform the **Write to Control Blocks** operation of the VLL feature after the formatting. For instructions, see the *Provisioning Guide for Mainframe Systems*.
   - For open-system emulation, the status of the mapped volume automatically becomes **Normal**. If you need to initialize the data area of the mapped volume, format the volume using Virtual LUN.
2. (VSP Gx00 models and VSP Fx00 models) The status of the mapped volume automatically becomes **Normal**. If you need to initialize the data area of the mapped volume, format the volume using Virtual LUN.
3. For each mapped volume (regardless of the emulation type), set an LU path from a target port to the internal volume, as shown in the following figure.
   The LU path enables host I/O to the mapped volume.



Using mapped volumes

After external volumes are mapped and ready for use, you can perform the operations supported by Universal Volume Manager. Review supported software products and operations in Supported software for external volumes on page 57.

Note: Access mapped external volumes only from the local storage system. Do not access them from hosts connected to the external storage systems.

In addition, do not use external storage system functions, including copy functions, to access mapped external volumes.

Recognizing the local system from the external system

Though the local and external systems are connected, the external system might not recognize the local system. You can make the external system recognize the local system by performing the Discover External Target Ports operation. If the path mapping operation does not finish after 15 minutes, though, the external system might not be able to recognize the local system. See Adding an external path to an existing path group on page 83 for instructions.

5

Monitoring and maintenance

To maintain your system, you must know about monitoring, editing, and maintenance for external volumes, paths, and systems.

- ☐ Monitoring external volumes and paths
- ☐ External volume policy settings and functions
- ☐ Editing mapping policies for external volumes
- ☐ Changing the MP blade or unit of an external volume
- ☐ Changing path mode to ALUA mode (Enable or Disable)
- ☐ Changing I/O mode for external storage systems
- ☐ Changing the port settings of an external storage system
- ☐ Path maintenance
- ☐ Disconnecting external systems and volumes
- ☐ Deleting an external volume mapping
- ☐ Reconnecting external systems and volumes
- ☐ Requirements for external storage system maintenance
- ☐ Changing the WWNs/iSCSI target names of the external storage system without deleting the external volume mapping
- ☐ Powering off and on storage systems

Monitoring external volumes and paths

You can view system details about mapped external volumes, the ports used, and the external paths.

Before you begin

- You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select one or more external volumes, and then select **View External LUN Properties**.

Related references

- View External LUN Properties window on page 207

External volume policy settings and functions

When you map an external volume to an internal volume, mapping policies are used. To change the mapping policies, you need to edit the default mapping settings. You can change default mapping settings without affecting the settings in previously mapped volumes.

To reset the values for previously mapped volumes, in the local storage system, go to the **Edit External Volumes** window and change the settings volume by volume .

- Base Emulation Type (VSP G1000, G1500, and VSP F1500): Specify OPEN-V to use existing data in an external volume from VSP G1000, VSP G1500, and VSP F1500.
  If you use an emulation type other than OPEN-V, the volume requires a specific area for management data. This results in a volume capacity after mapping that is less than the actual external volume capacity. For more information about calculating the capacity of external volumes, see Capacity requirements for volumes on page 47.
- Cache Mode: I/O to and from the local storage system always uses cache. Write operations are always backed up in duplex cache. The Cache Mode setting specifies whether write data from the host is written to the external volume asynchronously (Enable) or synchronously (Disable).

- Enable: After receiving the data into the local system's cache memory, the system signals the host that the I/O operation has completed, and then asynchronously destages the data to the external volume.
- Disable (default): After synchronously writing the data to the external volume, the local system signals the host that an I/O operation has completed.

For additional information, see Cache use and external storage performance on page 34.

- **Cache Partition:** Cache memory can be partitioned by using Virtual Partition Manager to configure a cache logical partition (CLPR) for the mapped volumes. Cache logical partitions are often used to limit cache-use by accessing slower external storage volumes.
  We strongly recommend that you place external storage array groups in a CLPR other than CLPR0. For details about CLPR, see *Hitachi Virtual Partition Manager User Guide*.
- **Inflow Control:** When the write operation to the external volume cannot be completed, Inflow Control specifies whether the write operation to cache memory is limited (Enable) or continued (Disable).
  - Enable: The write operation to cache is limited and I/O from the host is not accepted. Limiting the write operation prevents the accumulation of data that cannot destage to cache memory.
  - Disable (default): I/O sent from the host during the retry operation is written to cache memory. When write operations to the external volume are again possible, data in cache memory is destaged to the external volume.
- **Use ALUA as Path Mode:** In the local storage system, you can select whether ALUA mode is used as the path mode. If ALUA is supported in the profile information of the external storage, Enable is used by default. Otherwise, Disable is used. For information on ALUA mode, see Supported external system path mode for external volumes on page 38.
- **Load Balance Mode:** Select Depends on the selected external volume(s), Normal Round-robin, Extended Round-robin, or Disable as a Load Balance Mode for the external storage system. By default, Normal Round-robin (recommended) is set. However, when the product name of the storage system is displayed as (generic), Depends on the selected external volume(s) is used by default.
  If Single is set as the Path Mode or Disable is set for Use ALUA as Path Mode, Load Balance Mode cannot be specified.
  - **Depends on the selected external volume(s):** If Enable is set for ALUA Settable on the external volume, Normal Round-robin is set for Load Balance Mode automatically. If Disable is set for ALUA Settable, Disable is set for Load Balance Mode automatically.
  - **Normal Round-robin:** I/O is distributed to several paths on which I/O operation is enabled for the external storage system.

    - **Extended Round-robin:** I/O is distributed to several paths on which I/O operation is enabled for the external storage system. For sequential I/O, the external volume is divided into sections at regular intervals. In this case, the same path is used for I/O within the same section which reduces the frequency of I/O distribution.
    - **Disable:** As in Single mode, I/O operation is performed using the path that has the highest priority of all paths on which I/O operation is enabled for the external storage system.
- **CLPR:** Specify CLPR when accessing a mapped volume if cache memory is split in Virtual Partition Manager. For detailed information, refer to the *Hitachi Virtual Partition Manager User Guide*.

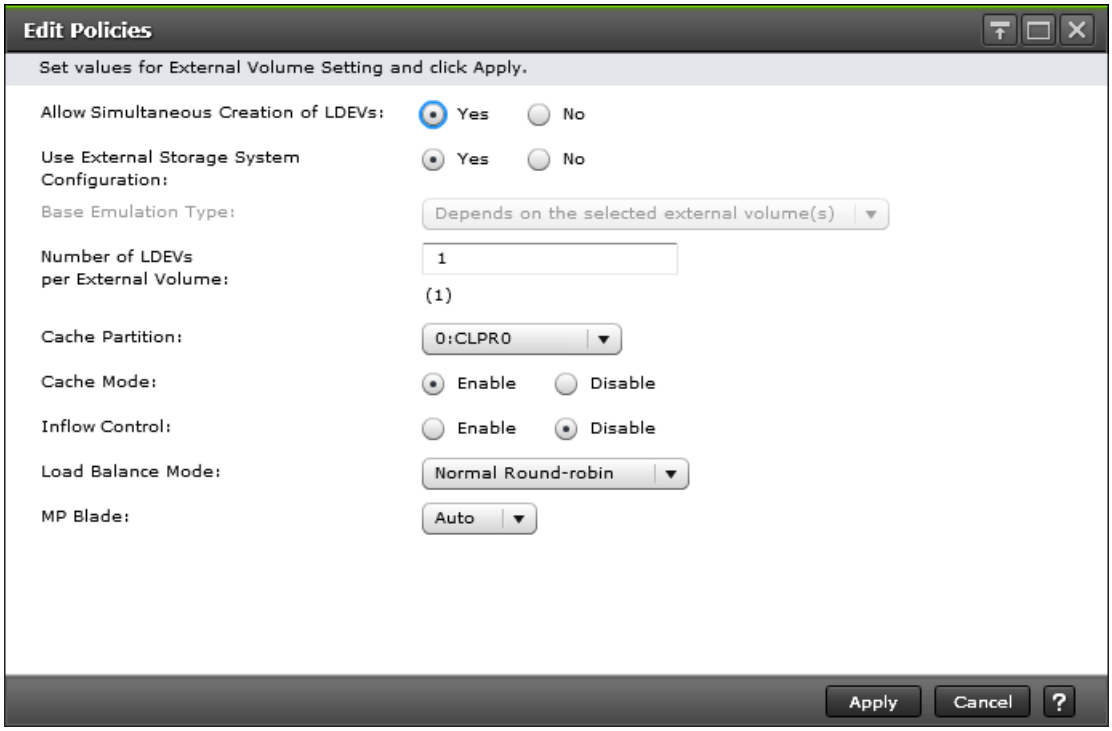
Editing mapping policies for external volumes

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
    a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
    b. Click **External Storage**.
2. In the **External Storage** window, click the **External Paths** tab.
3. On the **External Paths** tab, select a path group.
4. Click **More Actions** and select **Edit Policies**.
5. In the **Edit Policies** window, make whatever changes are required to the external volume settings.
6. Click **Apply**.



Note: You can also edit **Cache Mode** and **Inflow Control** for individual external volumes. In Device Manager - Storage Navigator, select an external volume in the **Mapped Volumes** tab, and then click **Edit External Volumes**.

Related references

- Edit Policies window on page 178

Changing the MP blade or unit of an external volume

Before you begin

- You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.

4. On the **Mapped Volumes** tab, select one or more external volumes, and then select **More Actions >Assign MP Blade** or **Assign MP Unit**.
5. In the **Assign MP Blade** or **Assign MP Unit** window, select the desired MP blade or unit.

   The current setting for the external volume is displayed, unless you have selected multiple external volumes with different values. Then the field is blank.

   The choices you see are dependent on the configuration of the device. They range from **MPB0** to **MPB7** (VSP G1000, G1500, and VSP F1500).

   Note: MP blade or unit assignment should be set to evenly distribute work across all the available processors.

   Selecting **Auto** allows the system to assign the blade or unit.
6. Click **Finish**.
7. In the **Confirm** window, review the settings, accept the task name or enter a new one, and then click **Apply**.

Changing path mode to ALUA mode (Enable or Disable)

You can select whether ALUA mode is used as the path mode. See Supported external system path mode for external volumes on page 38.

Before you begin

- The external storage system must support ALUA. If Enable is set for ALUA Settable on the external volume, Enable is set for Use ALUA as Path Mode automatically. If Disable is set for ALUA Settable, Disable is set for Use ALUA as Path Mode automatically.
- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select **Enable** or **Disable** as the **Use ALUA as Path Mode** property.
6. Click **Finish** to display the **Confirm** window.

7. Confirm the settings and enter the task name in the **Task Name** box.
8. In the **Confirm** window, click **Apply**.

Changing I/O mode for external storage systems

With Load Balance Mode settings, you can change the I/O mode for external storage systems for each of the external volumes.

For more information, see Supported external system path mode for external volumes on page 38.

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select the **Load Balance Mode** property, and then click **Extended Round-robin**, **Normal Round-robin**, or **Disable**.
6. Click **Finish** to display the **Confirm** window.
7. Confirm the settings and enter the task name in the **Task Name** box.
8. In the **Confirm** window, click **Apply**.

Changing the port settings of an external storage system

You can change the port settings of an external system.

For Fibre Channel ports, use the **Edit External WWNs** window. For iSCSI ports, use the **Edit External iSCSI Targets** window.

However, note the following:

- If the current setting is error-free, it is best to continue using it.
- For an external volume with normal I/O, set I/O Timeout from 5 - 15 seconds.
- Use the external system's recommended values for other port settings.
- If you are going to change several parameters for the same external WWN or the same external iSCSI target, ensure that a task is completed before

you perform the next task. If you perform a new task before the prior task is completed, the prior task might not be applied.

Before you begin

- You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Paths** tab, select a port, and then open the window for editing port settings.
   - For a Fibre Channel port, click **Edit External WWNs**.
   - For an iSCSI port, click **More Actions > Edit External iSCSI Targets**.
3. In the **Edit External WWNs** or **Edit External iSCSI Targets** window, change the desired settings.

   Note: The current values for the external WWN display unless you have selected multiple paths with different values. Then the fields are blank.

4. Click **Finish**.
5. In the **Confirm** window, review settings, accept the task name or enter a one, and then click **Apply**.

Path maintenance

You can add external paths to a path group, change a path's priority, disconnect and reconnect paths (which must be performed before removing or replacing paths), remove or replace a path, or replace all paths.

The following topics provide instructions.

- Adding an external path to an existing path group on page 83
- Changing external path priority on page 85
- Disconnecting an external path on page 86
- Reconnecting an external path on page 88
- Removing or replacing an external path on page 89
- Replacing all external paths on page 90

Adding an external path to an existing path group

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.
4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, select an external path or paths from the **Available External Paths** list and click **Add**.
   If the **External Storage System** or the **External WWN** that you want is not available in the dialog box, click **Discover External Target Ports** and add the port that connects to the WWN.
6. To change the priority of external paths, click **Raise Priority** or **Lower Priority** in the **Selected External Paths** list.
7. Click **Finish**.
8. In the **Confirm** window, review settings, accept the task name or enter a new one, and then click **Apply**.

Related references

- Edit External Path Configuration window on page 184
- Discover External Target Ports window on page 202

Adding an iSCSI path

Before you begin

You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab, and then click **Add iSCSI Paths**.
3. Click **Discover iSCSI Targets**.
   The **Discover iSCSI Targets** window displays.

4. For **Local Port ID**, select the port connected to the external storage system of the local storage system.
5. For **Remote IP Address**, enter the IP address of the external storage system port.
6. For **Remote TCP Port Number**, enter the TCP Port Number of the external storage system port (1 to 65535).
7. Click **Add**.

   The targets that you entered will be added to the **Discovery List** table. You can add up to eight targets.
8. Click **OK**.

   The **Add iSCSI Paths** window displays.
9. Select the iSCSI path to be added from the **Available iSCSI Paths** table.
10. For **Authentication Method**, select **CHAP** or **None**.

    For either authentication method, select one of the following options for **Mutual CHAP**:
    - **Enable**: Authentication is bidirectional
    - **Disable**: Authentication is unidirectional

    If you select **CHAP** and enable mutual CHAP, you must specify a user name and secret. If you disable mutual CHAP, the user name and secret are optional.
11. Click **Add**.

    The selected iSCSI path will be added to the **Selected iSCSI Paths** table.

    Up to 4,096 iSCSI paths can be added including those paths that were already added.
12. Click **Finish**.
13. In the **Confirm** window, check settings, enter a task name, and then click **Apply**.

    Tip: To display the **Tasks** window automatically, select **Go to tasks window for status** then click **Apply**.
14. Check the result in the **Tasks** window. You can suspend or cancel the task if the task is not executed.

Editing an iSCSI target

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- Make sure that I/O operations are not being performed on the host.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab, and then click **Edit iSCSI Targets**.
3. For **Authentication Method**, select **CHAP** or **None**.

   For either authentication method, select one of the following options for **Mutual CHAP**:
   - **Enable**: Authentication is bidirectional
   - **Disable**: Authentication is unidirectional

   If you select **CHAP** and enable mutual CHAP, you must specify a user name and secret. If you disable mutual CHAP, the user name and secret are optional.
4. Click **Finish**.
5. In the **Confirm** window, check settings, enter a task name, and then click **Apply**.

   Tip: To display the **Tasks** window automatically, select **Go to tasks window for status** then click **Apply**.

6. Check the result in the **Tasks** window. You can suspend or cancel the task if the task is not executed.

Changing external path priority

You can change the priority of your primary and alternate external paths, moving them higher or lower depending on your requirements. See External paths on page 36 for more information on path priorities for Single and Multi mode.

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.

4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, in the **Selected External Paths** list, select the desired path and click **Raise Priority** or **Lower Priority**.
6. Repeat the previous step to continue moving the path higher or lower. Move other paths as needed.
7. Click **Finish**.
8. In the **Confirm** window, review settings, accept the new task name or enter a new one, and then click **Apply**.

Related references

- Edit External Path Configuration window on page 184

Executing a login test for an iSCSI target

Before you begin

- You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab.
3. Select the iSCSI path for which you want to execute a login test, then click **Test Login iSCSI Target**.

Disconnecting an external path

You can disconnect all external paths connected either to a port on the local system or to a WWN on an external system. Disconnecting paths affects the external volumes mapped using the port.

An external path is disconnected for the following reasons:

- Before removing a path
- To replace a path or switch
- To perform maintenance on a path
- To perform maintenance on the external system or volume

Before you begin

- When you disconnect a path, make certain that alternate paths are available for mapped external volumes using the path.
- You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.

a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
b. Click **External Storage**.

2. Click the **External Paths** tab.
3. On the **External Paths** tab, select a path group.
4. Click **Disconnect External Paths**.
5. In the **Disconnect External Paths** window, select one of the following:
   - For Fibre Channel ports, select either **By Ports** or **By External WWNs**.
   - For iSCSI ports, select either **By Ports** or **By External Storage Ports**.
6. Click **Finish**.
7. In the **Confirm** window, review settings, accept or enter a new task name, and then click **Apply**.

Related references

- Edit External Path Configuration window on page 184

Deleting an iSCSI path

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- The specified iSCSI path must not be used as an external path by Universal Volume Manager.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab.
3. Select the iSCSI path that you want to delete, and then click **Delete iSCSI Paths**.
4. Check settings, enter a task name, and then click **Apply**.

Tip: To display the **Tasks** window automatically, select **Go to tasks window for status** then click **Apply**.

5. Check the result in the **Tasks** window. You can suspend or cancel the task if the task is not executed.

Reconnecting an external path

You can reconnect an external path that was disconnected. You reconnect paths either to a port on the local system or to a WWN on the external system. When you reconnect, original path settings are restored.

Before you begin

- Make sure the path is in a status that can be restored.
- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. Click the **External Paths** tab.
3. On the **External Paths** tab, select a path group.
4. Click **Reconnect External Paths**.
5. In the **Reconnect External Paths** window, select one of the following:
   - For Fibre Channel ports, select either **By Ports** or **By External WWNs**.
   - For iSCSI ports, select either **By Ports** or **By External Storage Ports**.
6. Click **Finish**.
7. In the **Confirm** window, review settings, accept the task name or enter a one, and then click **Apply**.

Related references

- Reconnect External Paths window on page 199

Changing the cache mode setting of the external volume

You can change the cache mode of the external volume in the Edit External Volumes window.

If the system cannot communicate with external volumes, the Inflow Control setting specifies whether the write operation to cache is limited (Enable) or continued (Disable). Disable is set by default. You can change the setting in the **Edit External Volumes** window. If you are using a Thin Image pool, all external volumes in the same pool must use the same Cache Mode setting.

Before you begin

- Storage Administrator (Provisioning) role
- Before changing the cache mode of the external volume, review each item listed in the following table.

Item to Review	Description
Cache Residency Manager and cache mode (VSP G1000, G1500, and VSP F1500)	When the bind mode is set, you cannot change the cache mode from Enable to Disable. To change the cache mode to Disable, cancel the setting for Cache Residency Manager or change the cache residency mode to the priority mode.
Cache mode and pool volumes	When a volume is registered to a pool as a pool volume, the cache mode setting should be the same among all the pool volumes in the pool.
Cache mode and remote command devices	When the volume is a remote command device, you cannot change the cache mode from Disable to Enable.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external storage system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select the **Inflow Control** property, and then click **Enable** or **Disable**.
6. Click **Finish** to display the **Confirm** window.
7. Confirm the settings and enter the task name in the **Task Name** box.
8. In the **Confirm** window, click **Apply**.

Related concepts

- Supported external system path mode for external volumes on page 38

Related references

- Edit External Volumes window on page 180

Removing or replacing an external path

You can remove a path so it is no longer available to the external volume. You remove a path to replace it with another external path or to perform maintenance on the physical link.

Note: If all external paths are not removed before detaching a channel adaptor, the channel adaptor cannot be detached.

Before you begin

- Before removing a path, make sure it is disconnected. See Disconnecting an external path on page 86 for instructions.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.
4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, in the **Selected External Paths** list, select the path to be removed, and then click **Remove**.
6. Click **Finish**.
7. In the **Confirm** window, review settings, accept or enter a new task name, and then click **Apply**.

   If you are replacing the path, see Adding an external path to an existing path group on page 83.

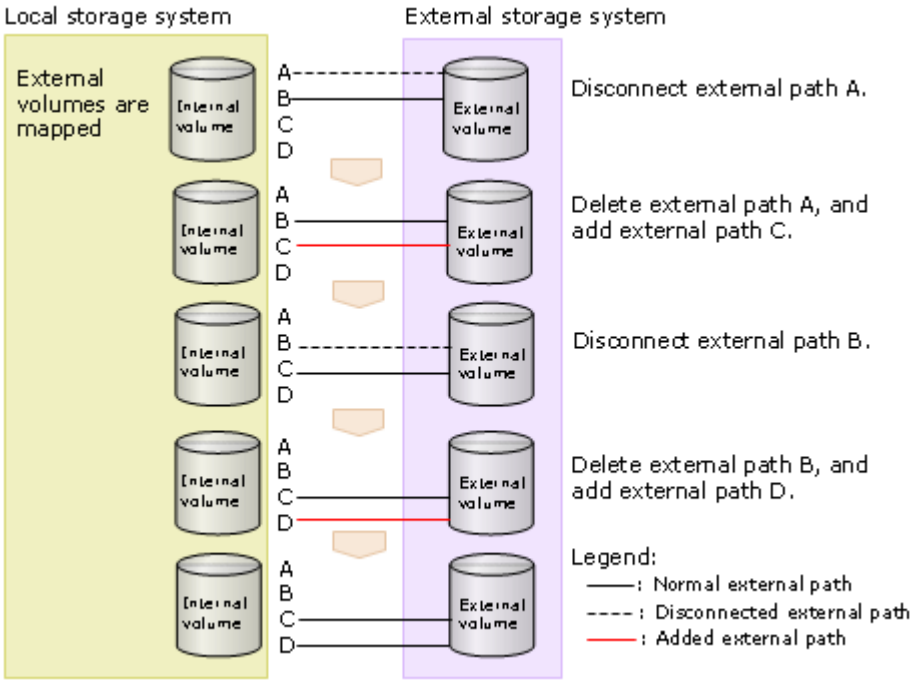
Related references

- Edit External Path Configuration window on page 184

Replacing all external paths

You can replace the primary and alternate paths used by an external volume. Doing this requires one path to remain in Normal status at all times.

The following figure shows one path used by an external volume remaining in a Normal status at all times.



Procedure

1. Disconnect **external path A**. See Disconnecting an external path on page 86.
2. Disconnect the cable for **external path A**, then remove it. See Removing or replacing an external path on page 89.
3. Make sure the cable for **external path C** is connected, and then add this path to an existing path group. See Adding an external path to an existing path group on page 83.

   When **external path C** status is Normal, then both **external path B** and **external path C** are set, and you can replace the next path.
4. Disconnect **external path B**.
5. Disconnect the cable for **external path B**, then remove it.
6. Make sure the cable for **external path D** is connected, and then add this path to an existing path group.

   When **external path D** status is Normal, then both **external path C** and **external path D** are set. The paths have all been replaced.

Disconnecting external systems and volumes

You can disconnect a single mapped external volume, or all the mapped volumes in an external system. You disconnect all volumes by disconnecting the system itself.

You disconnect a volume or system in order to perform the following operations:

- Turn off the power supply of the local or external storage system
- Delete an external volume's mapping
- Access a mapped external volume or volumes from the external storage system

When you disconnect volumes, they stop accepting host I/O and all data in the cache memory is destaged to the volumes. The mapping settings are also preserved. When the volumes are reconnected, they are assigned the same settings.

When you disconnect an external system, the mapped external volumes in the system are also disconnected. This is the primary method for disconnecting all the mapped volumes in an external system.

Prerequisites for disconnecting external systems

Before disconnecting volumes or systems, processes must be resolved or stopped, as described in the following table.

Activity in the external volume	Required operation
I/O to the external volume from the open system host is in progress.	Stop I/O to the volume and un-mount the volume from the host. Host I/O is forcibly stopped if you disconnect when I/O is in progress.
The external volume is online from the mainframe host. (VSP G1000, G1500, and VSP F1500)	Stop the host I/Os to the volume and perform the Vary Offline operation.
The external volume includes LDEVs used in pair operations with the following copy software products: • ShadowImage • ShadowImage for Mainframe (VSP G1000, G1500, and VSP F1500) • Universal Replicator • Universal Replicator for Mainframe (VSP G1000, G1500, and VSP F1500) • TrueCopy • TrueCopy for Mainframe (VSP G1000, G1500, and VSP F1500) • Thin Image • Global-active device	Delete the pair. You can disconnect without deleting a ShadowImage or ShadowImage for Mainframe pair when pair status is PSUE or Suspend/SUSPER.
The external volume includes LDEVs registered to a Thin Image data pool.	Delete Thin Image data pool.
The external volume includes LDEVs registered to a Dynamic	Perform all of the following operations on DP-VOLs associated with the external volume: • Stop using the DP-VOLs.

Activity in the external volume	Required operation
Provisioning pool volume (DP-VOL).	• Use the Block LDEVs window to block the DP-VOLs. • If the Data Direct Mapping attribute is enabled for the external volume, block only the related DP-VOL. • When a virtual volume for which Compression or Deduplication and Compression is enabled is created from a DP pool, if a failure occurs in the pool-VOL registered in the pool, recover the failure of the pool-VOL. In addition, if a deduplication system data volume is created, block it.
The external volume includes LDEVs for which Volume Migration processing is in progress.	Delete the migration plans.
The external volume is used in a global-active device quorum disk.	Delete the quorum disk settings.

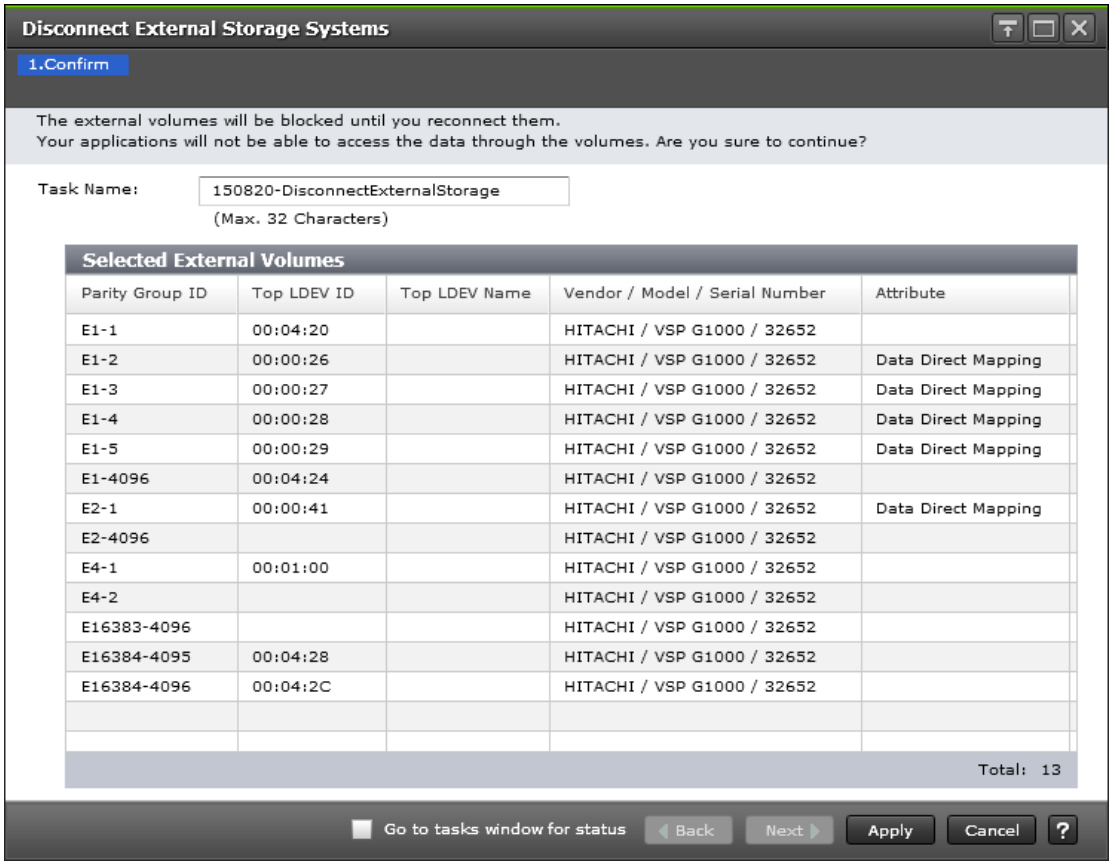
Disconnecting an external storage system, all mapped volumes

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, select a path group.
3. Click **Disconnect External Storage Systems**.
4. In the **Disconnect External Storage Systems** window, review the volumes that will be disconnected, then click **Apply**.



5. In the **Confirm** window, click **Apply** again.

Result

When you finish the procedure, the status of the external volume displays as Cache Destage, even if there is no data left in the cache. You can click Refresh View to update the status. When processing is completed, the status of the volume changes to Disconnect.

Related references

- Disconnect External Storage Systems window on page 211

Disconnecting a single mapped volume

Before disconnecting a mapped volume, review Prerequisites for disconnecting external systems on page 92.

Before you begin

- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.

a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
b. Click **External Storage**.

2. On the **External Storage Systems** tab, click the link for the storage system with the volume to be disconnected.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select the row for the volume you want to disconnect.
5. Click **More Actions** and select **Disconnect External Volumes**.
6. In the **Disconnect External Volumes** window, select the row of the volume to be disconnected, accept the task name or enter a new one, and then click **Apply**.
7. Click **Apply** in the **Confirm** window.

Result

When you finish the procedure, the external volume's status displays as Cache Destage, even if there is no data left in the cache. You can click Refresh View to update the status. When processing is completed, the volume's status changes to Disconnect.

Related references

- Reconnect External Storage Systems window on page 209

Deleting an external volume mapping

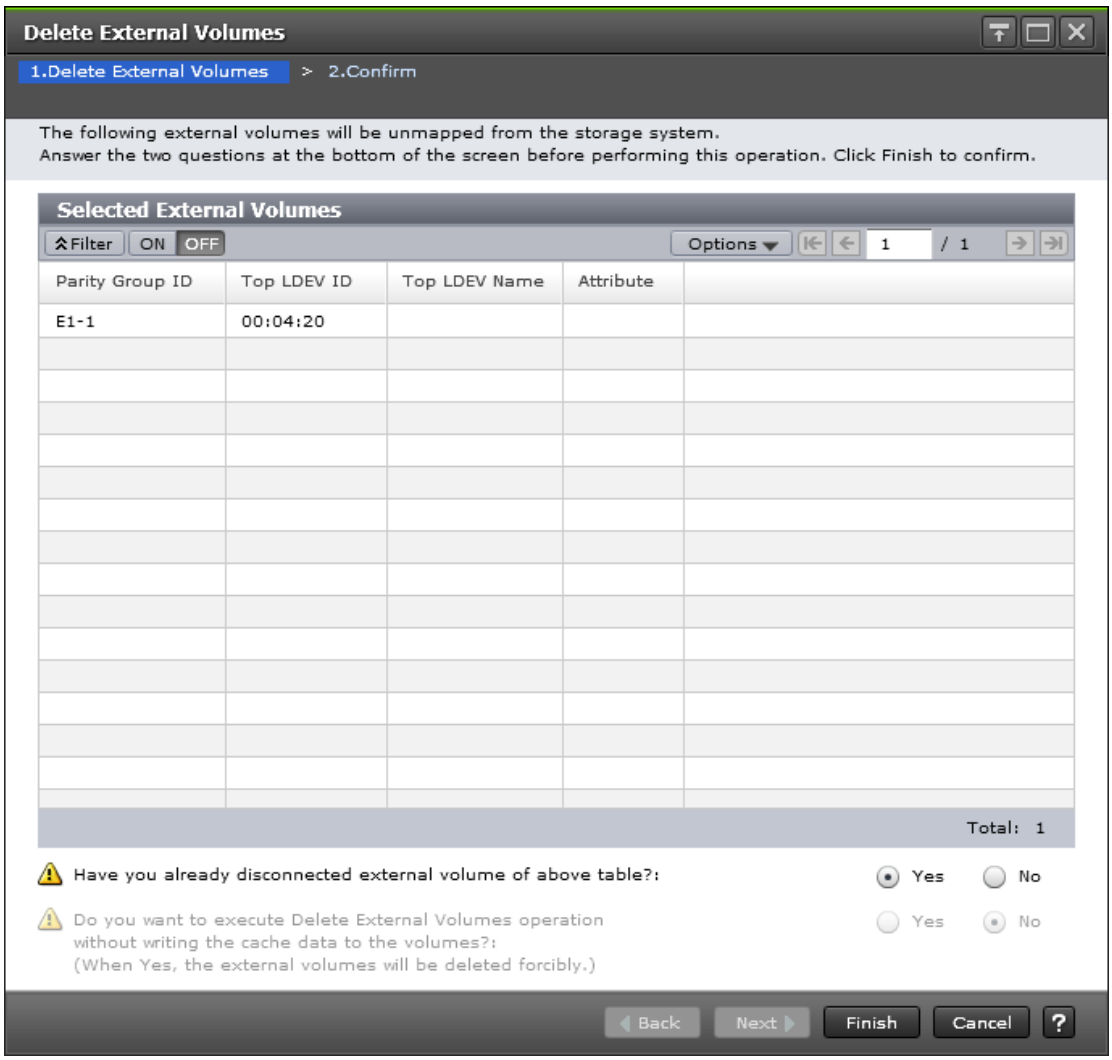
If you no longer want to access data in an external volume, you can delete the mapping. When you do, the data in the external volume is not deleted.

Before you begin

- If you disconnect the external volume or volumes, before you delete them, all the data in the cache memory is written to the external volume. However, you can delete a volume without disconnecting, meaning that data in cache memory is not destaged to the external volume.
- You cannot delete a mapping while the external volume is used in the following:
  - TrueCopy, Universal Replicator, ShadowImage, Thin Image, or global-active device.
  - A reserved volume for ShadowImage or Volume Migration.
  - A pool-VOL
  - A Quorum Disk
- For command devices, stop the application using the external volume as a command device.
- Storage Administrator (Provisioning) role

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select the external volume.
5. Click **More Actions** and select **Delete External Volumes**.
6. In the **Delete External Volumes** window, verify the external volumes you want to delete.



7. For **Have you already disconnected external volume of above table?**, click one of the following:

- **Yes** if you have already disconnected the volumes.
- **No** if you have not disconnected the volumes.

8. If you clicked **No** in the previous step, then, for **Do you want to execute Delete External Volumes operation without writing the cache data to the volumes?**, click **Yes** or **No**.
9. Click **Finish**.
10. In the **Confirm** window, review settings and accept the task name shown or enter a new one. When satisfied click **Apply**.

Related references

- Delete External Volumes window on page 193

Reconnecting external systems and volumes

After you disconnect an external system or volumes, you must reconnect them before you can start using them again.

When you reconnect external systems or volumes, the preserved mapping settings and path statuses are compared to the current statuses. When the statuses and settings match, each volume is mapped, placed in Normal status, and is available for I/O operations. However, if an external volume is not ready to be resumed, the status of the disconnected volume is Blockade. If this problem occurs, see General troubleshooting on page 106.

Reconnecting an external storage system and all mapped volumes

When you reconnect an external system, all mapped volumes in the system are also reconnected. This is the primary method for reconnecting disconnected volumes in an external system.

Before you begin

- You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, select the row for the external system to be reconnected, and then click **Reconnect External Storage Systems**.
3. In the **Reconnect External Storage Systems** window, check the volumes to be reconnected, accept or enter a new task name, and then click **Apply**.
4. In the **Confirm** window, click **Apply** again.

Result

When you finish the procedure, the status for each external volume displays as Checking, then Normal. If the external storage system cannot be reconnected, the status becomes Blockade.

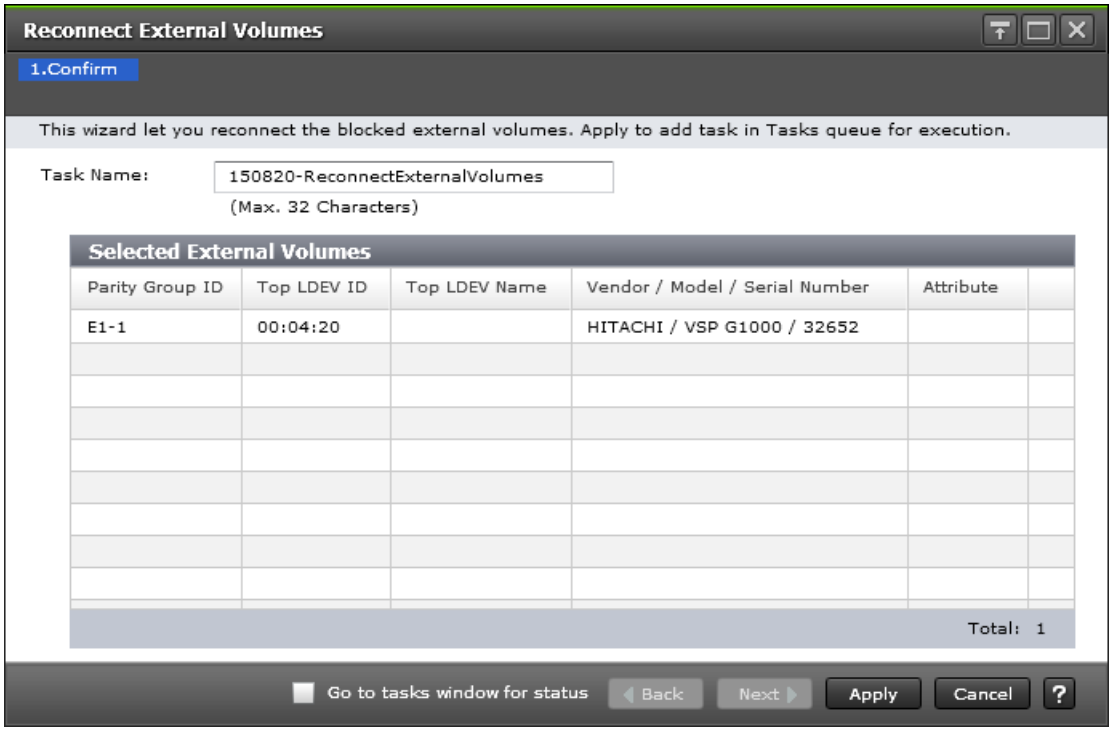
Reconnecting a single mapped volume

Before you begin

- You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Open the **External Storage** window.
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for the storage system with the volume to be reconnected.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select the external volume.
5. Click **More Actions** and select **Reconnect External Volumes**.
6. In the **Reconnect External Volumes** window, select the row of the volume to be reconnected, and then accept or enter a new task name.



7. Click **Apply** in the **Confirm** window.
8. When you finish the procedure, the external volume status displays as **Checking**, and then **Normal**. If the volume cannot be resumed because the mapped settings and the external volume status are not in sync, the status becomes **Blockade**.

Related references

- Reconnect External Volumes window on page 210

Requirements for external storage system maintenance

You must have the Storage Administrator (Provisioning) role. Before making changes to the external system, you must disconnect the external system and delete external volume mapping. After you have completed the changes, you can reconnect the system and remap the external volume.

You must remove and remap the external volume before making any of the following changes to the external system:

- Changing WWNs/iSCSI target names of all target ports that connect to the local storage system
- Changing the serial number of the external system
- Changing LUNs of volumes in the external system
- Reducing the volume capacity of the external volume
- Modifying a host that is directly connected to a external storage system.

To modify the WWNs/iSCSI target names of some target ports connected to the local storage system, you do not need to release volumes mapped to the local storage system.

Changing the WWNs/iSCSI target names of the external storage system without deleting the external volume mapping

Procedure

1. Change the WWN/iSCSI target name of the external storage.
   See the *Provisioning Guide* of your storage system for detailed procedures. Changing the WWN/iSCSI target name blocks the external path that uses the target port with a WWN/iSCSI target name that has been changed.
2. Add an external path between the local storage system and target port with a WWN/iSCSI target name that has been changed.
3. Delete the external path that was blocked in step 1.

Next steps
Before deleting external volume mapping, make sure that the volume has no LU paths and is not part of a copy pair. See Deleting an external volume mapping on page 95 for instructions.

Powering off and on storage systems

This section provides procedures for powering off and on local and external storage systems.

Powering off and on external storage systems

If you power off and on the external storage system when the local storage system is on, the following Universal Volume Manager operation is required.

Disconnect External Storage Systems: Run this command before you perform maintenance on an external storage system or perform a scheduled shutdown. When Disconnect External Storage Systems is selected, the I/O response from hosts of external volumes mapped as a local storage system volumes will stop. Next, data for each external volume is destaged from the cache memory of the local storage system to the external volume.

Tip: The same task can be performed on individual volumes with the Disconnect External Storage Volumes command. External volume mapping can be removed by running Disconnect External Storage Volumes followed by the Delete External Volumes command.

Reconnect External Storage Systems: Run this command to determine whether the defined configuration information of external volumes mapped as local storage system volumes matches the status of the external volumes. If external volumes can be used as mapped volumes, I/O to the external volumes is accepted, and the volumes can be used again.

The Reconnect External Storage Systems command is used to recover from an I/O failure after the Disconnect External Storage Systems command has been run.

If there are any path issues, they must be resolved before you run this command.

Tip: To perform the same task on individual volumes, use the Reconnect External Volumes command.

When you run the Reconnect External Storage Systems or Reconnect External Volumes command, if external volumes can be used, I/O to the external volumes is accepted and the volumes can be used again. If an external volume cannot be used, its status is Blockade.

Related tasks

- Disconnecting external systems and volumes on page 91

- Deleting an external volume mapping on page 95
- Reconnecting external systems and volumes on page 97

Powering off external storage systems (scheduled shutdown)

Before you begin

- You must have the Storage Administrator (Provisioning) role to perform this task.
- For details about the **Block LDEVs** window, see the *Provisioning Guide for Open Systems*.

Procedure

1. Stop read and write I/O operations to the external volume that is mapped as the local storage volume in the external storage system that you want to power off.
2. If the external volume is defined as a DP-VOL in the local storage system, block all DP-VOLs for maintenance. If not, skip the following steps, and go to step 3.
   a. Open the **Pools** window.
      i. Click **Storage Systems**, and then expand the **Storage Systems** tree.
      ii. Click **Pools**.
   b. On the **Pools** tab, click the link for the pool you want to block.
   c. Select the **Virtual Volumes** tab.
   d. Click **Select All Pages**.
   e. On the menu bar, click **Actions**, **Logical Device**, and then **Block LDEVs**.
   f. In the **Block LDEVs** window, confirm the settings and enter the task name in the **Task Name** box.
   g. Click **Apply** in the **Confirm** window.
3. Perform the Disconnect External Storage Volumes command for the external systems you want to power off.
   I/O operations to the external volumes are not allowed, and data in cache memory of the local storage system is written to the external volumes.
4. Perform any other operations required for powering off the external storage system.
5. Power off the external storage system.

Tip: After disconnecting external storage volumes, if you want to use mapped external volumes again as the local storage volumes, you must reconnect the external storage systems.

Reconnecting external storage systems after powering off

After you run the Disconnect External Storage Volumes command, and then power off an external storage system, you cannot access external volumes from the local storage system even if you power on the external storage system again. To access the external storage system again, you must run the Reconnect External Storage Systems command. This process checks whether the defined configuration information of external volumes mapped as local storage volumes matches the status of the external volumes. If external volumes can be used as mapped volumes, I/O operations to the external volumes are accepted, and the volumes can be used again.

Before you begin

- You must have the Storage Administrator (Provisioning) role to perform this task.
- For details about the **Block LDEVs** window, see the *Provisioning Guide for Open Systems*.

Procedure

1. Power on the external storage system.
2. Reconnect the external system.
   For details, see Reconnecting external systems and volumes on page 97.
3. If any external volumes were defined as DP-VOLs in the local storage system, use the steps listed in the following procedure to restore all blocked DP-VOLs.
   a. Open the **Pools** window.
      i. Click **Storage Systems**, and then expand the **Storage Systems** tree.
      ii. Click **Pools**.
   b. On the **Pools** tab, click the link for the pool you want to block.
   c. Select the **Virtual Volumes** tab.
   d. Click **Select All Pages**.
   e. On the menu bar, click **Actions**, **Logical Device**, and then **Restore LDEVs**.
   f. In the **Restore LDEVs** window, confirm the settings and enter the task name in the **Task Name** box.
   g. Click **Apply** in the **Confirm** window.

Powering off and on local storage systems

When you power off the local storage system, data for each external volume is destaged from the cache memory of the local storage system to the external volume.

Powering off local storage systems (scheduled shutdown)

Procedure

1. Stop read and write I/O to the local storage system.
2. Split all pairs that use external volumes.

   For information on pairsplit operations, see the user guide for the relevant software.
3. Confirm that the status of each external volume is **Normal** or **Disconnect**.
4. Perform any other operations required for powering off the external storage system.
5. Turn off the power supply of the local storage system.

Reconnecting local storage systems after powering off

When you disconnect external storage systems, and then power off the local storage system, you cannot access the external volume from the local storage system if you power on the external storage system again. To access the external storage system, you must run the Reconnect External Storage Systems command. This procedure checks whether the defined configuration information of each external volume mapped as a local storage volume matches the status of the external volume. If the external volume can be used as a mapped volume, I/O operations to the external volume are accepted, and the volume can be used again.

When you run the Disconnect External Storage Volumes or Disconnect External Volumes command, and all data stored in the cache memory is written to the external volumes, the external volume status displayed in the window changes to Disconnect.

Procedure

1. Power on the local storage system.
2. Resynchronize all pairs.

   For information on resynchronizing pairs, see the user guide for the relevant software.
3. Start I/O operations to the local storage system.

Powering off and on local and external storage systems

When you power off the local system, data for each external volume in the cache memory of the local system is written to the external volume.

You do not need to disconnect the external system when powering off only the local system. However, if you do disconnect the external system, when you power on the local system again, access is disabled to the external system until you reconnect the external system.

You must temporarily halt Universal Volume Manager operations before powering off external storage systems. When the systems are powered on, you can resume all operations.

Steps in the procedures of this topic must be followed in this order:

1. When you power off the local and external systems, the local system must be turned off first before the external system.
2. When you power on both systems, the external system must be turned on first before the local system.

Powering off local and external storage systems

Procedure

1. Stop read or write I/O operations to the local storage system.
2. Split all pairs that use external volumes.
   For information on pairsplit operations, see the user guide for the relevant software.
3. Confirm that the status of each external volume is **Normal** or **Disconnect**.
4. Power off the local storage system.
   Wait for the local system to completely power off.
5. Power off the external storage system.

Powering on local and external storage systems

Procedure

1. Power on the external storage system.
   Wait for the external storage system to completely power on.
2. Power on the local storage system.
   Wait for the local storage system to completely power on.
3. Resynchronize all pairs.
   For information on resynchronizing pairs, see the user guide for the relevant software.
4. Start read or write I/O operations to the local storage system.

6

Troubleshooting

This chapter describes troubleshooting information.

- Contacting customer support
- General troubleshooting
- Troubleshooting external path status
- Troubleshooting path errors for specific storage systems
- Troubleshooting port and volume discovery problems

Contacting customer support

If you need to contact customer support, provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure
- The content of any error messages displayed on the host systems
- The content of any error messages displayed on Device Manager - Storage Navigator
- The Device Manager - Storage Navigator configuration information. Use the Dump Tool to get this information.
- The service information messages (SIMs), including reference codes and severity levels, displayed by Device Manager - Storage Navigator

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

General troubleshooting

Check the following table for the problem. After resolving an error, retry the operation. If you cannot resolve the issue, contact customer support.

Symptom	Possible causes and troubleshooting steps
Hitachi Device Manager - Storage Navigator cannot access an external volume.	• An error occurred in the switch, or the switch is off. • A cable between the local and external system is not connected properly. • The external volume was deleted in the external system. • An error occurred in the external volume. • The path is changed in the external system. • The port attribute in the local storage system is changed. • Topology information is not properly set.
An external volume cannot be mapped.	• The number of mapped volumes exceeds the maximum number available for the local storage system: - VSP G200: 2,048 - VSP G400, G600, VSP F400, F600: 4,096 - VSP G800, VSP F800: 14,080 - VSP G1000, VSP G1500, and VSP F1500: 0 to 63,231 • There are not enough LDKC:CU:LDEV numbers available for external volume mapping.
An external path is blocked.	**1.** See the preceding problem, "Device Manager - Storage Navigator cannot access the external volume". If the problem persists after correcting any errors, continue to step 2.

Symptom	Possible causes and troubleshooting steps
	2. Confirm that the cables between the local and external systems are connected properly. 3. If the cables are properly connected, disconnect and then reconnect them. After 30 seconds, check the path status.
Action is required for a path status in the **View External LUN Properties** dialog box.	See Troubleshooting external path status on page 108.
The volume in the external system cannot be found even after port discovery or volume discovery was performed.	Follow any instructions given in the error message or messages and then retry the operation. If the problem persists, see Troubleshooting port and volume discovery problems on page 115.
The external volume is blocked.	• All external paths are blocked (paths are not connected). • The external volume is not set to Read/ Write. • The external volume is blocked by an error.
The status of the external volume is Blockade.	When errors occur in all external paths, the local storage system changes the status of the external volume to Blockade. • Reconnect the volume or storage system. • If the volume's status still does not change to Normal, restore the path as described in the preceding problem, "The external path is blocked", and then reconnect the volume again.
The ? sign displays in the LUN ID (Highest Priority) column of the Discovered External Volumes table in the **Add External Volumes** window.	A corresponding external volume was not found for the external path with the highest priority. Look for problems with the connection to the external system that failed during volume discovery. Fix any problems, and perform the operation again.
External volume discovery was not completed because of failure.	Look for problems with the connection to the external system; also verify that the external volume is correctly configured in the external system. Fix any problems, and then perform the operation again.
After reconnecting an external volume or system, 10 minutes have passed but the status has not change from Checking.	Click Refresh on the Device Manager - Storage Navigator main window. If the status remains Checking, perform the reconnect operation again.
After disconnecting an external volume or system, the status does not change.	Click Refresh on the Device Manager - Storage Navigator main window. Note that the time required for write processing from cache to the external volume depends on volume capacity. More time is required for larger volumes. Processing speed is about 20 MB/s. However, the processing speed also depends on the performance and status of the external storage system.
(VSP G1000, G1500, and VSP F1500) A message saying that intervention is required is issued to the mainframe host.	The device status is currently changing. Wait a few minutes, and then check the status again. When the transition of the device status has completed normally, the device can be used immediately. If the device is blocked as a result of the status transition, see General troubleshooting on page 106.

Symptom	Possible causes and troubleshooting steps
(VSP G1000, G1500, and VSP F1500) A message saying that the device is blocked is issued to the mainframe host.	See General troubleshooting on page 106.

Troubleshooting external path status

The following table shows path statuses in the **View External LUN Properties** window. Descriptions and corrective actions you can take are provided.

Also, see Troubleshooting path errors for specific storage systems on page 110. If you cannot resolve the issue, contact customer support.

Status	Description	Corrective action
Unknown	The path status cannot be determined.	Contact customer support.
Blockade	The external port is blocked.	The port is blocked because of microcode or firmware replacement, package replacement, or other factor. Check the status of the local storage system.
External device setting changed	An external system setting has changed. For example, the path definition was deleted, or the external system itself was replaced by another device.	The port of the external system is recognized. See your device manufacturer's documentation to verify that the settings on the volumes in question have not changed.
LDEV size reduced	The external volume capacity was reduced.	Check the external volume capacity. If the LDEV is smaller than expected, delete the external volume, and then remap to it.
Not ready	The reply of the external system was NOTREADY. Either the drive is spinning up or the system is being formatted.	The path cannot be used to access the external system. Check the status of the external system.
Illegal request	The reply of the external system was ILLEGALREQUEST. The command cannot be run on the external system. Data protection might be set on the external system.	The external system port is recognized. Check the external system settings and correct any problems.
Command aborted	The reply of the external system was ABORTEDCOMMAND. An error might have occurred on the external system side.	The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches) and correct any problems.
Busy	The external system is in the BUSY status.	The external system port is recognized. Check whether the external system configuration causes excessive load on the system. If the load is excessive, lower the load.

Status	Description	Corrective action
Response error	The external system is in blocked status caused by an abnormal reply (Response). You might not be able to access the system, or data protection might be set.	The external system port is recognized. Check the settings and status of the external system and fix any problems.
Initiator port	The port attribute of the external system has been changed to "initiator".	Set the port attribute of the external system to "target".
Destage Failed	The writing of data from cache memory to the external volume failed.	Reconnect the external volume or system. When status is Normal, disconnect the volume or system. You might need to try this multiple times.
Unknown port	The port attribute of the external system is unknown.	The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches), and fix any problems. When alternate paths are configured for the external system, the following conditions might cause the unknown port status. If that is the case, verify the path configuration and add the required paths, if any. • The number of paths for external volume group is less than the ones for the external path group. • The path configurations between the external path group and the external volume group are inconsistent.
Cannot detect port	The external path has been removed or the external system port cannot be found. Possible causes are: • The cable is not properly connected. • The topology does not match between the external and target ports. • Because security is set on the port, the external system cannot be recognized from the local system. • If the external system is connected through switches, the switch setting might be incorrect.	If you cannot restore the path after checking the possible causes, contact customer support.
Internal error	A program error occurred, or there is a logical contradiction.	Contact customer support.
Timeout	Processing was retried after an abnormal reply. However, processing stopped because of a timeout.	The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches).
Device check error	An external volume is mapped, but you cannot access the volume in the external system.	Check the status of the volume in the external system and take any necessary corrective action.

Status	Description	Corrective action
		Format the volume if it is not formatted.
Medium error	The external volume has become inaccessible.	Check the status of the volume in the external system and take any necessary corrective action. Format the volume if it is not formatted.

Troubleshooting path errors for specific storage systems

The following types of error messages include storage-system-specific recovery information, external device setting changed, illegal request, cannot detect port. If you cannot resolve the issue, contact customer support.

Virtual Storage Platform G200, G400, G600, G800, Virtual Storage Platform F400, F600, F800

Path Status	Description and corrective actions
External device setting changed	• LU path settings might have been changed by using LUN Manager. If this happens, either: - Use LUN Manager to change the settings back to the values used when the volume was mapped - Use Universal Volume Manager software to delete the LU, and then add it again. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as ShadowImage, TrueCopy, Universal Replicator, or global-active device. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. Make sure the cables are connected correctly, and then use LUN Manager to set the ports properly. • LUN security might have been enabled by using LUN Manager. If so, check whether the LUN security setting is correct.

Hitachi Virtual Storage Platform G1000 and G1500, and Hitachi Virtual Storage Platform F1500

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, ShadowImage, Thin Image, or global-active device. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by using LUN Manager. If so, check whether the LUN security setting is correct.

Unified Storage VM, Virtual Storage Platform, and Universal Storage Platform V/VM

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly.

Path Status	Description and corrective actions
	- Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Universal Storage Platform or TagmaStore NSC

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. • The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Lightning 9900 V

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, or ShadowImage.

Path Status	Description and corrective actions
	• The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Lightning 9900

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, or ShadowImage. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Thunder 9500V

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU.

Path Status	Description and corrective actions
	• The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. • The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • The host group LUN security might have been enabled by LUN Management. If so, check whether the LUN security setting is correct.

HUS/AMS/WMS

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. • The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • The host group LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

SVS200

Path Status	Description and corrective actions
External device setting changed	• LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. • The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	• If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as Business Copy XP, Continuous Access XP, Continuous Access XP Journal. • The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Cable connection. Make sure the cable is connected correctly. - Port settings. The topology settings of the external port and the target port might not match. Use LUN Manager to make sure that the ports are set properly. - Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security might have been enabled by LUN Management. If so, check whether the LUN security setting is correct.

Troubleshooting port and volume discovery problems

The following table shows corrective actions you can take for port and volume discovery problems. If you cannot resolve the issue, contact customer support.

Problem	Corrective action
The port on the local storage system and port on the external system are not connected.	Connect the External port of the local system and the external system port.
The cable for the switch is not connected correctly, or the switch's port is blocked.	Connect the cable to the correct port on the switch. Or change the port status to the normal status.
Zoning for the switch is not set appropriately.	Make sure the zoning configuration allows the External port of the local system to communicate with the external system port.
External volume returned RESERVATION CONFLICT.	Release the reserved state of the external volume.
Port security is set on the external system.	Cancel the port security setting or change the security of the external system so that the local system can access the port of the external system.

Problem	Corrective action
No LU is configured on the external system port.	Configure an LU on the port.
External volume capacity is less than the supported capacity for Universal Volume Manager.	Perform one of the following: • Increase the external volume's capacity to be equal or larger than the supported capacity. • Use a security function or delete the LU setting from the external system port so that the local system cannot recognize a volume with insufficient capacity.
The external volume is configured as a management LU.	If a management LU, such as Universal Xport LU, is configured on the external system port, perform one of the following: • Make sure that at least one LU is used for data storage and has a smaller LUN than the management LU's LUN. Also make sure that the data storage LU is set to the port connected to the local system. • Delete the management LU from the port connected to the local system. • Use a security function and configure the access attribute of the management LU to prohibit read and write operations.
Remote command devices of the external system are cascaded.	Perform one of the following: • Change the configuration so that the remote command devices are not cascaded. • Use a security function or delete the LU setting from the port of the connected external system so that the local system cannot recognize the remote command devices.
External system information retrieved by port discovery is not found in the profile information.	Perform one of the following: • Connect an external system supported by Universal Volume Manager. • Contact customer support to ask if the external system is supported by Universal Volume Manager. If the system is supported, install the microcode or firmware version that supports the external system or install the profile information of the external system.
Login to the external system failed.	Perform one of the following: • Make sure that the port status of the external system is Normal. • Register the WWN to the external system to allow login from the local system.
The external volume is not in Normal status, or a failure or error occurred in retrieving information from the external system.	Make sure that the status of the external system or the external volume is Normal.
(VSP G1000, G1500, and VSP F1500) The external system is not connected to the External port on the local system.	Connect the external system to the external port of the local system. If necessary, change the local system port setting to “External”.
(VSP Gx00 models and VSP Fx00 models)	VSP Gx00 models with firmware version 83-03-0*x* or earlier, and VSP Fx00 models with firmware version 83-04-0*x* or earlier do not support login redirection of

Problem	Corrective action
When adding an iSCSI path, the iSCSI port of the external storage system returns "Redirection".	iSCSI, so disable this function in external storage systems.

If none of the actions suggested in the table provide volume discovery, remove the cable connection between the local and external storage systems, and then reconnect the storage systems. After 30 seconds, retry the operation.

Supported external storage systems

This appendix describes the required configuration settings for many of the supported external storage systems.

- Sun StorageTek FlexLine 380
- Sun StorageTek 2540
- Sun StorageTek V2X2
- EMC CLARiiON CX series
- EMC VNX series
- EMC Symmetrix series
- IBM DS3000/DS4000/DS5000 series
- IBM V7000 series
- IBM SVC series
- IBM XIV series
- Fujitsu FibreCAT CX series
- Fujitsu DX60/80/90 S2 and Fujitsu DX400 S2
- SGI IS4600 series
- 3Par T800, F400, V800, V400, 7000, 8000, 10000, and 20000 series
- Settings and considerations for connecting to Linux or Window 2012 servers
- Connecting to storage systems from other vendors
- Storage system with a product name displayed as (generic)

External systems

The storage systems in the following sections can be connected to your storage system as external storage systems.

Note: Not all information on supported systems is provided here. If you do not find your storage system, refer to https://support.hds.com/en_us/interoperability.html for a complete listing.

HUS VM

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.
- If the external storage system uses Data Retention Utility or Open LDEV Guard, set System Option Mode (SOM) 701 to ON on your local storage system.

Hitachi Virtual Storage Platform G200, G400, G600, G800, Hitachi Virtual Storage Platform F400, F600, F800

Use the following settings on the external system:

The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).

Virtual Storage Platform G1000, G1500, and Virtual Storage Platform F1500

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.
- If the external storage system uses Data Retention Utility, set System Option Mode (SOM) 701 to ON on the local storage system.

Virtual Storage Platform

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.
- If the external storage system uses Data Retention Utility or Open LDEV Guard, set System Option Mode (SOM) 701 to ON on your local storage system.

Universal Storage Platform V/VM

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.
- If the external storage system uses Data Retention Utility or Open LDEV Guard, set SOM 701 to ON on your local storage system.

Universal Storage Platform/TagmaStore NSC

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.
- If the external storage system uses Data Retention Utility or Open LDEV Guard, set SOM 701 to ON on your local storage system.

Host mode option for a volume larger than 2 TB

If a volume's capacity is more than 2 TB, host mode option No. 24 must be enabled before mapping it as an external volume. For instructions, see the *LUN Manager User's Guide* for the Universal Storage Platform / TagmaStore NSC storage system.

Lightning 9900 V

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.

Lightning 9900

Use the following settings on the external system:

- The port's host mode must be set to PC Server (0C).
- The port attribute must be set to Target port or RCU target port.

Thunder 9500V

The following versions are recommended. If you use an earlier version, the SATA drive information might not display correctly.

- For Thunder 9530V, Thunder 9520V, Thunder 9570V: version 0658 or later
- For Thunder 9580V, Thunder 9585V: version 1658 or later

The following table shows the system parameters that must be specified for ports on the Thunder 9500V storage system.

Window Names	Parameters	Parameter Settings
System Startup Settings	Start Attribute	
	Single Mode	Use when the Thunder 9500V is in a one-controller configuration.
	Dual Active Mode	Use when the Thunder 9500V is in a two-controller configuration. Be sure to specify that Data Share Mode will be used.
	Hot Stand-By Mode	Do not specify this parameter.
Common 1	Delay Planned Shutdown	Optional
OPTION 1	SCSI Fibre Channel Common Options	Optional
OPTION 2	SCSI Fibre Channel Common Options	Optional
Data Striping	Operation if the processor failure occurs	Reset of occurred
Inquiry Setting	Command Queuing Mode	ON
	Vendor ID	HITACHI (default)
	Product ID	DF600F (default)
	ROM Microprogram Version	Optional
	RAM Microprogram Version	Optional
	WEB Title	Optional
Port Type	Reset/LIP Mode	
	Reset/LIP Mode (Signal)	Optional
	Reset/LIP Mode (Process)	Optional
	LIP Reset Mode	Optional
Controller Option	RS232C Error Information Outflow Mode	Optional
	Write and verify mode	ON
Host Connection Mode	Host Connection Mode 1	Standard Mode
	Host Connection Mode 2	HISUP Mode (do not specify any other parameter).

Identifying the 9500 V model using the serial number

You can identify the storage system model from the serial number displayed in the Vendor / Model / Serial Number column in the External Storage System tab.

The following table shows the relationship between the number in the Serial Number column and the storage system model.

Displayed Serial Number	Model
D600XXXX	9570V, 9520V
D60JXXXX	9530V
D60HXXXX	9580V, 9585V
Note: In serial numbers, "X" is an arbitrary number or character.	

Identifying the controller using the port WWN

You can identify the controller (controller 0 or controller 1) from the WWN of the port.

The following table describes the relationship between the port WWN and the controller.

Model	Controller	WWN of Port
9570V 9530V 9520V	Controller 0	XXXXXXXXXXXXXXX0 XXXXXXXXXXXXXXX1
	Controller 1	XXXXXXXXXXXXXXX2 XXXXXXXXXXXXXXX3
9580V 9585V	Controller 0	XXXXXXXXXXXXXXX0 XXXXXXXXXXXXXXX1 XXXXXXXXXXXXXXX2 XXXXXXXXXXXXXXX3
	Controller 1	XXXXXXXXXXXXXXX4 XXXXXXXXXXXXXXX5 XXXXXXXXXXXXXXX6 XXXXXXXXXXXXXXX7
Note: In WWNs, "X" is an arbitrary number or character. The ports in the same physical storage system have the identical value.		

HUS/AMS/WMS

The table below shows the system parameters that must be specified for ports on HUS, AMS, and WMS storage systems when used with Universal Volume Manager. You can specify or omit any other parameters.

Also, ensure the following two settings using Storage Navigator Modular or Storage Navigator Modular2:

- Set the data transfer speed of the external port to a fixed value other than Auto.
- Set the data transfer speed of the target port of the HUS/AMS/WMS storage system to a fixed value consistent with the data transfer speed of the external port.

Window Names	Parameters	Parameter Settings
Boot Options	Start Attribute	
	Single Mode	Specify when HUS/AMS/WMS is in a one-controller configuration.
	Dual Active Mode	Specify when HUS/AMS/WMS is a two-controller configuration.
	Delay Planned Shutdown	Optional
	Drive blocking mode	Optional
	Vendor ID	HITACHI (default-do not change)
	Product ID	DF600F (default-do not change)
	ROM Microprogram Version	Optional
	RAM Microprogram Version	Optional
System Parameter	Option	Optional
	Operation if the processor failure occurs	Reset of occurred.
	WEB Title	Optional
	Write and verify mode	For AMS 1000, AMS 500, AMS 200, or WMS 100: ON For HUS 150, HUS 130, HUS 110, AMS 2500, AMS 2300, AMS 2100, or AMS 2010: OFF
Port Options	Port Option	Optional
Host Connection Mode	HUS/AMS: Common Setting WMS: Host Connection Mode 1	Select Standard Mode.
	HUS/AMS: Additional Setting WMS: Host Connection Mode 2	Do not specify any parameters. For AMS 1000, AMS 500, AMS 200, or WMS 100: Do not specify HISUP OFF mode.

Identifying the HUS/AMS/WMS model using the serial number

When the external storage system is HUS, AMS, or WMS, you can identify the storage system model from the serial number displayed in the Serial Number column in the **Volume Operation** window.

The following table describes the relationship between the number in the Serial Number column and the storage system model.

Storage System	Displayed Serial Number	Model
HUS	95XXXXXX	HUS 150
	93XXXXXX	HUS 130
	91XXXXXX	HUS 110
AMS	87XXXXXX	AMS 2500
	85XXXXXX	AMS 2300
	83XXXXXX	AMS 2100, AMS 2010
	77XXXXXX	AMS 1000
	75XXXXXX	AMS 500
	73XXXXXX	AMS 200
WMS	71XXXXXX	WMS 100
In serial numbers, "X" is an arbitrary number or character.		

When the model of HUS/AMS/WMS storage system is changed, the Serial Number is changed as well. If the HUS/AMS/WMS storage system is used as an external storage system, the mapped external volume might be blocked. To correct this problem, you can delete the mapping of the external volume and remap it to use the blocked external volume. See Requirements for external storage system maintenance on page 99 for detailed information on remapping.

Identifying the controller using the port WWN (HUS/AMS/WMS)

When the external storage system is HUS, AMS, or WMS, you can identify the controller (controller 0 or controller 1) from the port WWN.

The following table describes the relationship between the port WWN and the controller.

Model	Controller	WWN of Port
AMS 200	Controller 0	XXXXXXXXXXXXXXX0
WMS 100	Controller 1	XXXXXXXXXXXXXXX1
AMS 2100	Controller 0	XXXXXXXXXXXXXXX0
AMS 2010		XXXXXXXXXXXXXXX1
AMS 500	Controller 1	XXXXXXXXXXXXXXX2

Model	Controller	WWN of Port
		XXXXXXXXXXXXXXX3
HUS 110	Controller 0	XXXXXXXXXXXXXXX0
HUS 130		XXXXXXXXXXXXXXX1
AMS 2300		XXXXXXXXXXXXXXX2
AMS 1000		XXXXXXXXXXXXXXX3
	Controller 1	XXXXXXXXXXXXXXX4
		XXXXXXXXXXXXXXX5
		XXXXXXXXXXXXXXX6
		XXXXXXXXXXXXXXX7
HUS 150	Controller 0	XXXXXXXXXXXXXXX0
AMS 2500		XXXXXXXXXXXXXXX1
		XXXXXXXXXXXXXXX2
		XXXXXXXXXXXXXXX3
		XXXXXXXXXXXXXXX4
		XXXXXXXXXXXXXXX5
		XXXXXXXXXXXXXXX6
		XXXXXXXXXXXXXXX7
	Controller 1	XXXXXXXXXXXXXXX8
		XXXXXXXXXXXXXXX9
		XXXXXXXXXXXXXXXA
		XXXXXXXXXXXXXXXB
		XXXXXXXXXXXXXXXC
		XXXXXXXXXXXXXXXD
		XXXXXXXXXXXXXXXE
		XXXXXXXXXXXXXXXF
Note: In WWNs, "X" is an arbitrary number or character. The ports in a physical storage system have the identical value.		

When the model of HUS/AMS/WMS storage system is changed, the WWN of the port is changed as well. If the HUS/AMS/WMS storage system is used as an external storage system, the mapped external path might be blocked. To correct this problem, you can delete the mapping of the external path and remap it to use the blocked external path. See Requirements for external storage system maintenance on page 99 for detailed information on remapping.

Identifying logical volumes using Volume Properties

The Volume Properties value is the internal LUN number of the LUNS from the AMS/WMS.

Caution on using the power savings option

When an HUS 150, HUS 130, HUS 110, AMS 2500, AMS 2300, AMS 2100, or AMS 2010 storage system is connected as an external system with the Power Savings option is enabled, do not access external volumes from a host if the external volumes are spinning down. This prevents the external volume status from changing to Blockade.

If external volume status changes to Blockade, the volume is automatically restored in several hours. You can also manually restore the external volumes by reconnecting the external volume.

HUS and AMS 2000 series guidelines

- If a failure occurs in an HUS or AMS 2000 series system, responses from local storage systems to the HUS or AMS 2000 series system might be delayed. To prevent requests from external storage systems from timing out, configure the local storage systems as follows:
  - Set the I/O timeout value of the local storage system to 35 seconds.
  - Set the timeout value of the external storage system to *(I/O-timeout-value* x 2) + *margin*. For example:
    (35 seconds x 2) + 10 seconds = 80 seconds
- Avoid unnecessary load to the external storage system. Path mode between storage systems is Multi mode. Therefore, when many external paths and mapping volumes are mapped, the load to the external system is high, and some commands from a host to the local storage system or from the local storage system to an external system might time out. To keep the proper load, the following settings are recommended:
  - Specify two external paths. Set the paths to the ports of each controller of the AMS 2000 series system.
  - Set the queue to 500 or fewer commands issued at the same time from a AMS 2000 series system. The formula to calculate the number of queue commands per system is as follows.
    number-of-queues x *number-of-external-paths* x *number-of-concurrent-external-volume-commands* < 500
    For more information about command queue settings, see Changing the port settings of an external storage system on page 81.
- When using external volumes for replication, the copy operation needs to be distributed to two or more RAID groups.
  There is an upper bound to the number of pairs that can be used for initial copy or resynchronization. Therefore, the copy operation might focus on a specific RAID group according to the order of the operation when it is performed to two or more external volumes.

If the copy operation focuses on a specific RAID group, then the AMS 2000 drive could bottleneck.

SVS200 storage system

Use the following settings on the external system:

- The port must be set to the host group for the Windows hosts (host mode 0C: Windows, host mode 2C: Windows Extension).
- The port attribute must be set to Target port or RCU target port.

EVA storage systems

Use the following settings on the external system:

- The port must be configured as a target attached to a Windows host.
- EVA storage systems with microcode version 4.000 or later can be connected as an external storage system.

Set EVA system parameters in the following table. For parameters not shown, refer to the EVA system documentation for connection parameters.

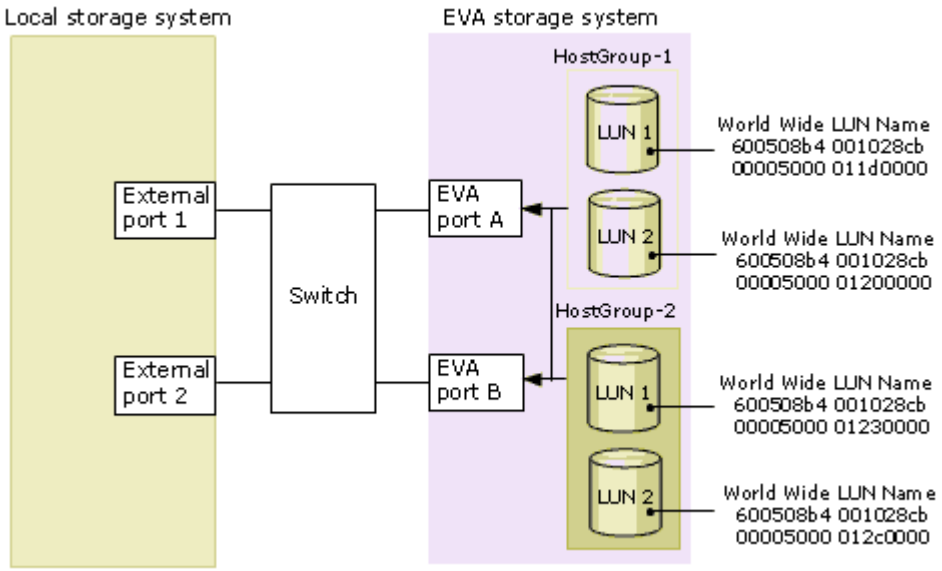
Parameter		Parameter Setting
Add a Host	Host OS	Windows

The WWN of each port on the local storage system that is connected to an EVA storage system must be registered with the EVA system. See EVA storage system documentation for details on registering WWNs.

Identifying logical volumes using Device ID

With an EVA external storage system, LUNs appear as Volume Properties in Device Manager - Storage Navigator windows.

If you search for the logical volumes by specifying the WWN for EVA Port A as illustrated in the following figure, logical volumes LUN 1 and LUN 2 are found for each of HostGroup-1 and HostGroup-2.



In this case, two different logical volumes with the same name (LUN 1 and LUN 2) are found that can be connected from EVA Port A. But you cannot determine which LUN 1 and LUN 2 belong to HostGroup-1 or HostGroup-2 only by Volume Properties.

However, in Device Manager - Storage Navigator, you can identify the logical volumes referring to Device ID. The first 32 characters of Device ID indicate the World Wide LUN Name. Identify the logical volume of the EVA storage system by this World Wide LUN Name.

Sun StorEdge 6120/6320

System Option Mode for connecting Sun StorEdge 6120/6320

When you connect Sun StorEdge 6120/6320 as an external storage system, you must set SOM 725 of the local storage system to ON. If SOM 725 is not set to ON, the external storage system might be blocked when performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

For more information about using SOM 725, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

System option parameters for connecting Sun StorEdge 6120/6320

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to the Sun StorEdge 6120/6320 system documentation.

On your local storage system, set system option mode 725 to ON for support of Sun online maintenance operation.

Parameter	Parameter Setting
port host	SUN

Sun StorageTek FlexLine 380

System Option Mode for connecting Sun StorageTek FlexLine 380

When you connect Sun StorageTek FlexLine 380 as an external storage system, you must set SOM 725 of the local storage system to ON. If SOM 725 is not set to ON, the external storage system might be blocked when performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

For more information about using SOM 725, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

System option parameters for connecting Sun StorageTek FlexLine 380

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to the Sun StorageTek FlexLine 380 documentation.

Parameter	Parameter Setting
host type	Windows Non-clustered (DMP Support)

Sun StorageTek 2540

System Option Mode for connecting Sun StorageTek 2540

When you connect Sun StorageTek 2540 as an external storage system, you must set SOM 725 of the local storage system to ON. If SOM 725 is not set to ON, the external storage system might be blocked when performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

For more information about using SOM 725, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

System option parameters for connecting Sun StorageTek 2540

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to Sun StorageTek 2540 documentation.

Parameter	Parameter Setting
host type	Windows 2K non Clustered DMP

Sun StorageTek V2X2

The port must be configured as a target attached to a Windows host.

Important: Use only one external path when you mapping external volumes. Do not add alternate paths after you finish mapping external volumes.

EMC CLARiiON CX series

The port must be configured as a target attached to a Windows host.

System option modes for connecting EMC CLARiiON CX series

When you connect an EMC CLARiiON CX series as an external storage system, you must enable SOM 725 on the local storage system. If SOM 725 is not enabled, the external storage system might be blocked when performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

If the status becomes Not Ready (that is, the external storage system cannot be accessed), mapped external volumes might be blocked. When restoring a mapped external volume that is blocked, you can select either manual or automatic restore. However, if SOM 1021 is enabled on the local storage system, mapped external volumes that are blocked are restored automatically.

When you attempt to restore a blocked external volume to normal status, if the external storage system has a problem (for example, a failure), the mapped external volume might change immediately back to blocked status because automatic restoration is not possible.

For more information about using SOM 725 and SOM 1021, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

System parameters for connecting EMC CLARiiON CX series

When you connect an EMC CLARiiON CX series as an external storage system, set the system parameters according to the following table.

Parameter	Setting
Initiator Type	CLARiiON Open
Failover Mode	2
ArrayCommPath	Disabled

For system parameters not shown in the table, see the EMC CLARiiON CX series documentation.

Note:
- Volumes created with Individual Disk Units (JBOD disks) of EMC CLARiiON CX series are not supported.
- (VSP Gx00 models and VSP Fx00 models) Volumes created with RAID 0 are not supported.
- For each port in the EMC CLARiiON CX side, make sure to define LUN 0 (VSP Gx00 models and VSP Fx00 models) or the LU number (VSP G1000, G1500, and VSP F1500).

EMC VNX series

System option modes for connecting EMC VNX series

When you connect an EMC VNX series as an external storage system, you must enable SOM 725 on the local storage system. If SOM 725 is not enabled, the external storage system might be blocked when performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

If the status becomes Not Ready (that is, the external storage system cannot be accessed), mapped external volumes might be blocked. When restoring a mapped external volume that is blocked, you can select either manual or automatic restore. However, if SOM 1021 is enabled on the local storage system, mapped external volumes that are blocked are restored automatically.

When you attempt to restore a blocked external volume to normal status, if the external storage system has a problem (for example, a failure), the mapped external volume might change immediately back to blocked status because automatic restoration is not possible.

For more information about using SOM 725 and SOM 1021, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

System parameters for connecting EMC VNX series

When you connect an EMC VNX series as an external storage system, set the system parameters of the EMC VNX series according to the following table:

Parameter	Setting
Initiator Type	CLARiiON Open
Failover Mode	2
ArrayCommPath	Disable

For system parameters not shown in the table, see the EMC VNX series documentation.

Note:

- Volumes created with Individual Disk Units (JBOD disks) of EMC CLARiiON CX series are not supported.
- (VSP Gx00 models and VSP Fx00 models) Volumes created with RAID 0 are not supported.
- For each port in the EMC CLARiiON CX side, make sure to define LUN 0 (VSP Gx00 models and VSP Fx00 models) or the LU number (VSP G1000, G1500, and VSP F1500).

EMC Symmetrix series

Initiator Group and Host Group Flag settings should be configured to virtualize Dell (EMC) VMAX40K.

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to EMC Symmetrix series documentation.

Parameter*	Parameter Setting	
	Override Checked?	Enable Checked?
SCSI_3(SC3) flag	Yes	Yes
SCSI_Support1(OS2007)	Yes	No
SPC2_Protocol_Version(SPC2) flag	Yes	No
* The Consistent LUNs parameter should also be checked.		

On your local storage system, system option mode 745 needs to be ON.

IBM® DS3000/DS4000/DS5000 series

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to IBM® DS3000/DS4000/DS5000 series documentation.

Parameter	Parameter Setting
host type	When alternate paths are connected to different clusters on the DS3000/DS4000/DS5000 series side: Linux

IBM® V7000 series

Set system parameters according to the following table. For connection parameters not shown, refer to the IBM® V7000 series documentation.

Parameter	Parameter setting
host type	generic

The model name of the IBM® V7000 series is displayed as "SVC" on the Device Manager - Storage Navigator window.

IBM® SVC series

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to IBM® SVC series documentation.

Parameter	Parameter Setting
host type	generic

IBM® XIV series

The port must be configured as a target attached to a Windows host.

Device serial number differs between IBM® XIV series and the local storage system, as shown in the following table.

Display in the local storage system		Display in IBM® XIV	
Item	**Type**	**Item**	**Type**
First 2 digits of Serial Number	Decimal value	First 2 digits of (System) Serial number	Decimal value
Last 5 digits of Serial Number	Hexadecimal value	Last 5 digits of (System) Serial number	Decimal value
Volume Properties	Hexadecimal value	Device serial number	Decimal value

Fujitsu FibreCAT CX series

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to Fujitsu FibreCAT CX series documentation.

Parameter	Parameter Setting
Initiator Type	CLARiiON Open
Failover Mode	2

Volumes created with the RAID0 level or Individual Disk Units (JBOD disks) of Fujitsu FibreCAT CX series are not supported.

System option mode for connecting Fujitsu FibreCAT CX series

When you connect the Fujitsu FibreCAT CX series as an external storage system, you must set SOM 725 of the local storage system to ON. If SOM 725 is not set to ON, the external storage system might be blocked when a maintenance task such as rebooting the controller of the external storage system is performed before the firmware update.

For more information about using SOM 725, log on to the Hitachi Data Systems Support Connect: https://knowledge.hds.com/Documents.

Fujitsu DX60/80/90 S2 and Fujitsu DX400 S2

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to Fujitsu DX60/80/90 S2 or Fujitsu DX 400 S2 documentation.

Parameter	Parameter Setting
Inquiry VPD ID Type in Setup Host Response screen	Type1 + Type3
Load Balance Response in Setup Host Response screen	Busy

SGI IS4600 series

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following table. For connection parameters not shown, refer to SGI IS4600 series documentation.

Parameter	Parameter Setting
host type	When alternate paths are connected to different clusters on the SGI IS4600 series side: Linux

3Par T800, F400, V800, V400, 7000, 8000, 10000, and 20000 series

The port must be configured as a target attached to a Windows host.

Set system parameters according to the following tables. For connection parameters not shown, refer to the documentation for your model.

Series	Host mode setting
3Par T800 and F400	generic-legacy or generic
3Par V800, V400, 7000, 8000, 10000, and 20000	generic-legacy

The volumes in which Dynamic optimization or Adaptive optimization is applied must not be used as external volumes. Otherwise, the performance of the external volume might possibly be degraded and the operation cannot be guaranteed.

Settings and considerations for connecting to Linux or Window 2012 servers

Considerations for connecting to Linux Servers

When connecting to Linux servers via iSCSI, please note:

- You need to change the product ID of LU#0 defined as an iSCSI target to "VIRTUAL_DISK".
  - **Command example for setting change (TID=1)**

```
tgtadm --tid 1 --lun 0 --op update --mode logicalunit --
params
vendor_id=IET,product_id=VIRTUAL-DISK
```

- Do not use external volumes beyond their usage as a Quorum disk for global-active device operations.
- LU#0 is a controller. Therefore, mapping LU#0 is not possible.

Considerations for connecting to Windows Server 2012

When connecting to Windows Server 2012 via iSCSI, do not use external volumes beyond their usage as a Quorum disk for global-active device operations.

Connecting to storage systems from other vendors

If connecting another vendor's storage system as an external storage system, a port needs to be configured as a target port connected to a Windows host. For detailed information, please contact the third party vendor.

Storage system with a product name displayed as (generic)

The generic Universal Volume Manager profile provides support for connecting external storage systems that are attached using Fibre Channel, without testing them individually. It will automatically support storage systems that conform to a subset of the standard SCSI Primary Commands. (If you need further information, contact customer support). A representative of customer support can perform a step-wise process to install and connect external storage. These steps (defined below) follow a standard process to ensure that no obvious problems exist in the virtualization.

Support conditions when product name displays as (generic)

When an external storage system is connected to your storage system and is supported with the generic UVM profile, the following support conditions exist.

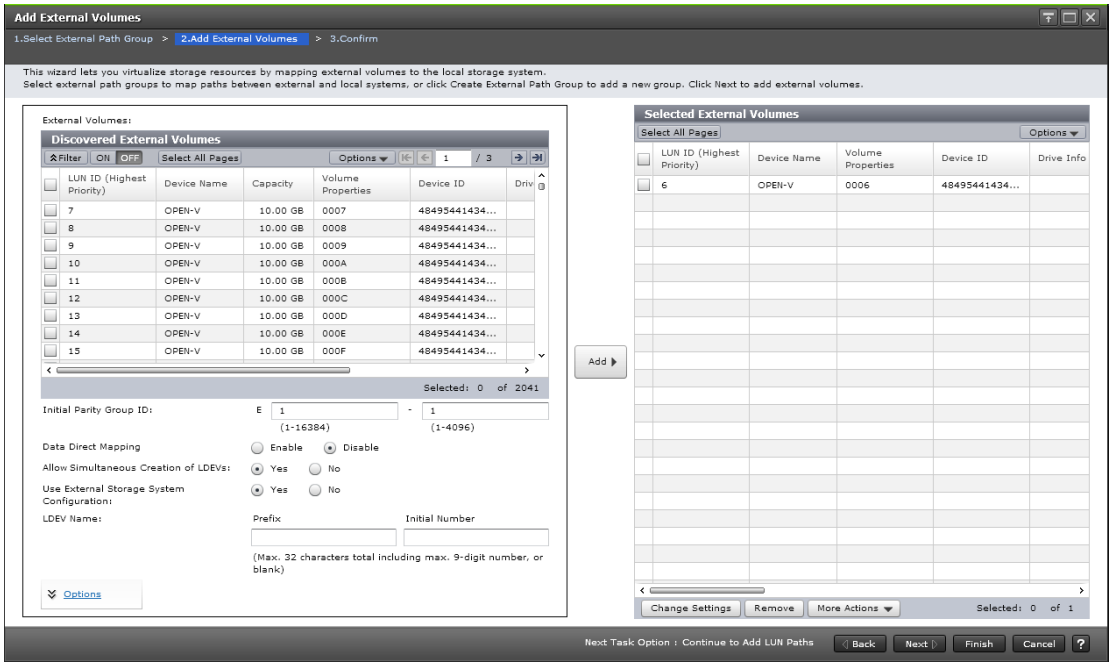
- Vendor name that corresponds to the external storage system is displayed.
- Product name is displayed as (generic).

Note: If multiple generic storage systems of the same vendor are connected, they are displayed as a single storage system. As a result, if Disconnect External Storage Systems or Reconnect External Storage Systems is run for generic storage systems, all the generic storage system volumes are disconnected or reconnected. For disconnecting or reconnecting a particular generic storage system volume, the best practice is to run the command in the external volume unit rather than the external storage system unit.

- Serial number is not displayed.
- Volume Properties (device information). LUN assigned to the path with the highest priority is displayed.
- Path Mode and Load Balance Mode. Load Balance Mode is set to Disable by default. Three Path Mode settings are available:
  1. Normal Round-robin (For Multi Path)
  2. Extended Round-robin (For Multi Path)
  3. Disable (For Single Path and ALUA)

  By default, Load Balance Mode is set to Disable for the generic UVM profile. As a result, UVM uses Single Mode (Active/Passive). If the attached external storage supports Multi pathing (Active/Active), the Load Balance Mode setting must be changed to Extended Round-robin or Normal Round-robin.

The Load Balance Mode can be changed in the Add External Volumes window of Device Manager - Storage Navigator.



Note: If you need a profile that models your specific storage system, contact customer support. HDS will gather the required information and might provide the requested profile in a microcode update. Upgrading to the new microcode will allow the Universal Volume Manager to display the vendor name, product name, serial number, and path mode of the external volumes.

Virtualization support requirements

- The external storage system conforms to SCSI Primary commands (SPC-3).
- Inquiry page 0x83 contains device identifier 2h (EUI-64-based) or 3h (NAA).
- The alternate path mode is not Active/Standby. (Active/Standby is a Single Mode much like Active/Passive, but it does not failover automatically.)
- A profile specific to the storage system does not exist.
- A special device driver or path manager is not required to control the external storage system.
- All other restrictions referenced in this guide apply to virtualization specifications.

Suggested virtualization procedure

Note: The collection of information is optional but recommended. If you attach a new branded storage system, a local customer support representative should collect the required data. After reviewing the data, they will add the External Storage Model to a listing of supported models. The customer support representative might also provide a profile that models your specific storage system. You have the option of continuing to use the external storage system or waiting for your customized profile. If the required data is not provided, support might be limited until the data is acquired.

Procedure

1. Set up external ports on the local storage system.
2. Connect the external storage FC s to the external ports of the local storage system.
3. Virtualize at least four LUNs from the external storage.
   - If virtualization fails, contact customer support.
4. Connect two FC ports of the local storage system to two HBAs of the server.
5. Provision the ELUNs mapped to the LUNs (step 3) on the ES to the UVM FC ports.
6. Run an I/O generator to the virtualized LUNs. IOMETER or VDBENCH can be used.

a. Delete the external path of the highest priority during the I/O.
b. Add the external path as the highest priority during the I/O.

7. Stop the I/O.

B

Remote command devices

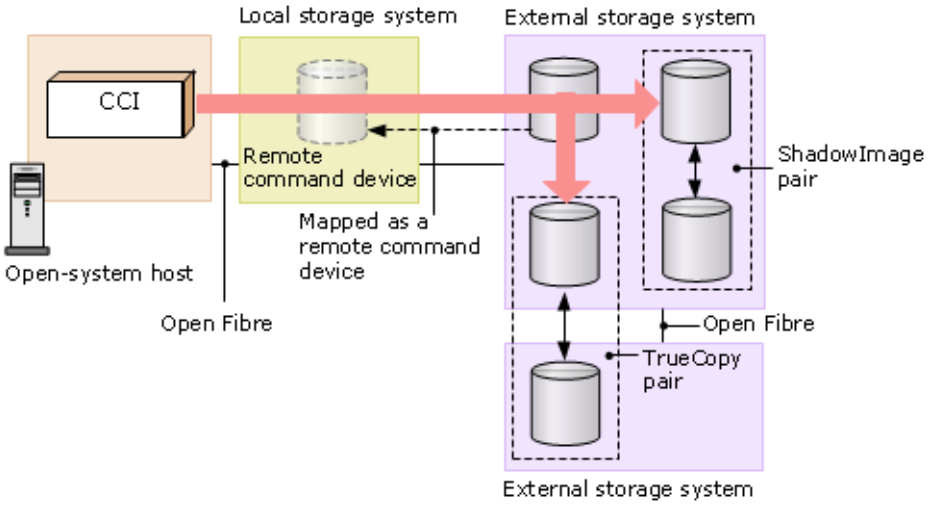
This appendix describes information for mapping to command devices in external storage systems.

Overview of remote command devices

You can map to a volume used as a command device in an external system. From the local system, the mapped command device volume becomes a remote command device.

A license for Universal Volume Manager is not required for a remote command device mapping operation.

From a host connected to the local storage system, you can issue ShadowImage, TrueCopy, or other commands from Command Control Interface (CCI) to the remote command device. The commands are relayed from the remote command device to the external storage system where they are run for pairs such as those for ShadowImage and TrueCopy. This process is outlined in the following figure.



Storage systems supported for remote command devices

You can map command devices in the following external storage systems as a remote command device in the local storage system:

- VSP G200, G400, G600, G800, VSP F400, F600, F800
- VSP G1000, G1500
- VSP F1500
- Unified Storage VM
- Virtual Storage Platform
- Universal Storage Platform V
- Universal Storage Platform VM
- SANRISE Universal Storage Platform
- SANRISE Network Storage Controller
- Unified Storage

- Adaptable Modular Storage
- Workgroup Modular Storage
- SANRISE9900V series
- SANRISE9500V series
- TagmaStore Universal Storage Platform
- TagmaStore Network Storage Controller
- Lightning 9900V series
- Thunder 9500V series
- Virtual Storage Platform VX7
- VP9500
- H24000
- H20000
- SANRISE H12000
- SANRISE H10000
- SANRISE H1024/H128
- XP7 Storage
- P9500
- XP24000
- XP20000
- XP12000
- XP10000
- XP1024/XP128

Requirements

The following table shows requirements for mapping a command device as a remote command device.

Item	Requirement
(VSP G1000, G1500, and VSP F1500) Emulation type	OPEN-V
Number of LDEVs in an external volume	1
Cache mode	Disable
Minimum capacity	96,000 Blocks (about 47 MB)
Maximum capacity	4 TB
Maximum number of the available CCI instances per remote command device	16 However, the maximum number of available CCI instances might be less, depending on the number of paths between the local storage system and an external storage system.

Restrictions and other information

Before mapping a command device as a remote command device, note the following information.

- The remote command device cannot be identified by port discovery or volume discovery process that takes place during the mapping operation.
- When an external storage system (A) has a remote command device (B) (that is, when a command device in another external storage system (C) is mapped to this external storage system (A)), make sure that the remote command device (B) does not have the smallest LUN on the port in the external storage system (A).
- You cannot send I/O to the remote command device.
- You cannot receive I/O from the remote command device.
- You cannot set command device disable on the remote command device.
- You cannot set command device security on the remote command device.
- Do not set the command device security on the external storage system side for the command device that is mapped as a remote command device.
- You cannot create CVs using the VLL function in the remote command device.
- (VSP G1000, G1500, and VSP F1500) Cache Residency Manager is not available on the remote command device.
- Command device information reported to the local host by the remote command device includes the following:
  - Serial number
  - Vendor
  - Device name. The name displayed for many individual storage system is listed in Supported external system path mode for external volumes on page 38.
- Errors can occur when operations are performed on the remote command device, even though the status of the remote command device is normal. In this case, check the status of the command device on the external storage system where the error actually exists.

Remote command device information

To map a command device, select a command device that can be mapped and follow the procedure in Mapping an external volume on page 67.

After the remote command device is mapped, the device appears in the Device Name column of the **Mapped Volumes** window as follows:

Storage system	Information displayed in Device Name column
VSP G200, G400, G600, G800, VSP F400, F600, F800 VSP G1000, G1500, VSP F1500 Virtual Storage Platform Unified Storage VM Universal Storage Platform V Universal Storage Platform VM SANRISE Universal Storage Platform SANRISE Network Storage Controller SANRISE9900V series TagmaStore Universal Storage Platform TagmaStore Network Storage Controller Lightning 9900V series Virtual Storage Platform VX7 VP9500 H24000 H20000 SANRISE H12000 SANRISE H10000 SANRISE H1024/H128 XP7 Storage XP24000 P9500 XP24000 XP20000 XP12000 XP10000 XP1024/XP128	Format: "Emulation Type" + "-CM" Example: OPEN V-CM
Unified Storage Adaptable Modular Storage Workgroup Modular Storage SANRISE9500V series	DF600F-CM

Storage system	Information displayed in Device Name column
Thunder 9500V series	

C

Command Control Interface command reference

You can use Command Control Interface (CCI) commands to perform some of the actions that you can perform in Device Manager - Storage Navigator.

- Device Manager - Storage Navigator actions and CCI commands

Device Manager - Storage Navigator actions and CCI commands

The following table lists actions that you can perform for external volumes in Device Manager - Storage Navigator and the corresponding CCI commands.

Device Manager - Storage Navigator action	CCI command
Add External Volumes	`raidcom add external_grp`
Delete External Volumes	`raidcom delete external_grp`
Disconnect External Storage Systems	`raidcom disconnect external_grp`
Reconnect External Storage Systems	`raidcom check_ext_storage external_grp`
Edit External Volumes	`raidcom modify external_grp`
Assign MP Blade or Unit	`raidcom modify external_grp`
Disconnect External Volumes	`raidcom disconnect external_grp`
Reconnect External Volumes	`raidcom check_ext_storage external_grp`
Disconnect External Paths	`raidcom disconnect path`
Reconnect External Paths	`raidcom check_ext_storage path`
Edit External Path Configuration	`raidcom add path` `raidcom delete path`

D

Universal Volume Manager GUI reference

This appendix describes Device Manager - Storage Navigator windows, dialog boxes, and fields related to Universal Volume Manager.

- Change Settings window
- View External LUN Properties window
- Reconnect External Storage Systems window
- Reconnect External Volumes window
- Disconnect External Storage Systems window
- Disconnect External Volumes window
- Assign MP Blade ID or MP Unit ID wizard
- External LDEV Properties window
- Discovery Result Detail window
- Add iSCSI Paths wizard
- Delete iSCSI Paths window
- Edit iSCSI Targets wizard
- Discover iSCSI Targets window

External Storage window

Use this window to view external storage systems.

You can perform these operations from the window:

- Mapping an external volume on page 67
- Editing mapping policies for external volumes on page 78
- Disconnecting an external path on page 86
- Reconnecting an external path on page 88

Information areas in this window:

- Summary on page 153
- External Storage Systems tab on page 153
- External Paths tab on page 155
- iSCSI Paths tab on page 156

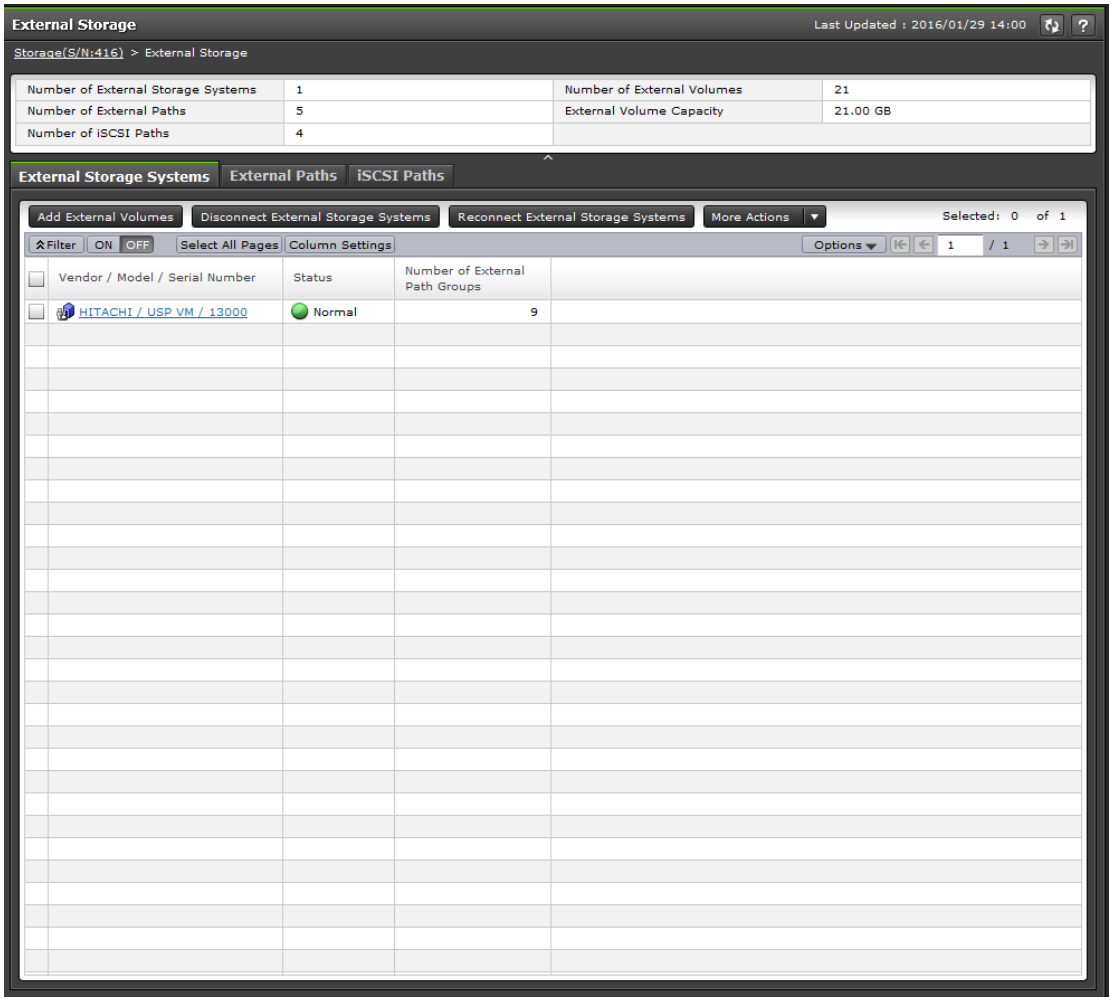
Summary

Displays summary information for external storage.

Item	Description
Number of External Storage Systems	Number of external storage systems in which mapped external volumes reside.
Number of External Paths	Number of external paths.
Number of iSCSI Paths	Number of iSCSI paths of the local storage system set for connection to external storage systems.
Number of External Volumes	Number of mapped external volumes.
External Volume Capacity	Total capacity of mapped external volumes.

External Storage Systems tab

Displays the external storage systems in which mapped external volumes reside.

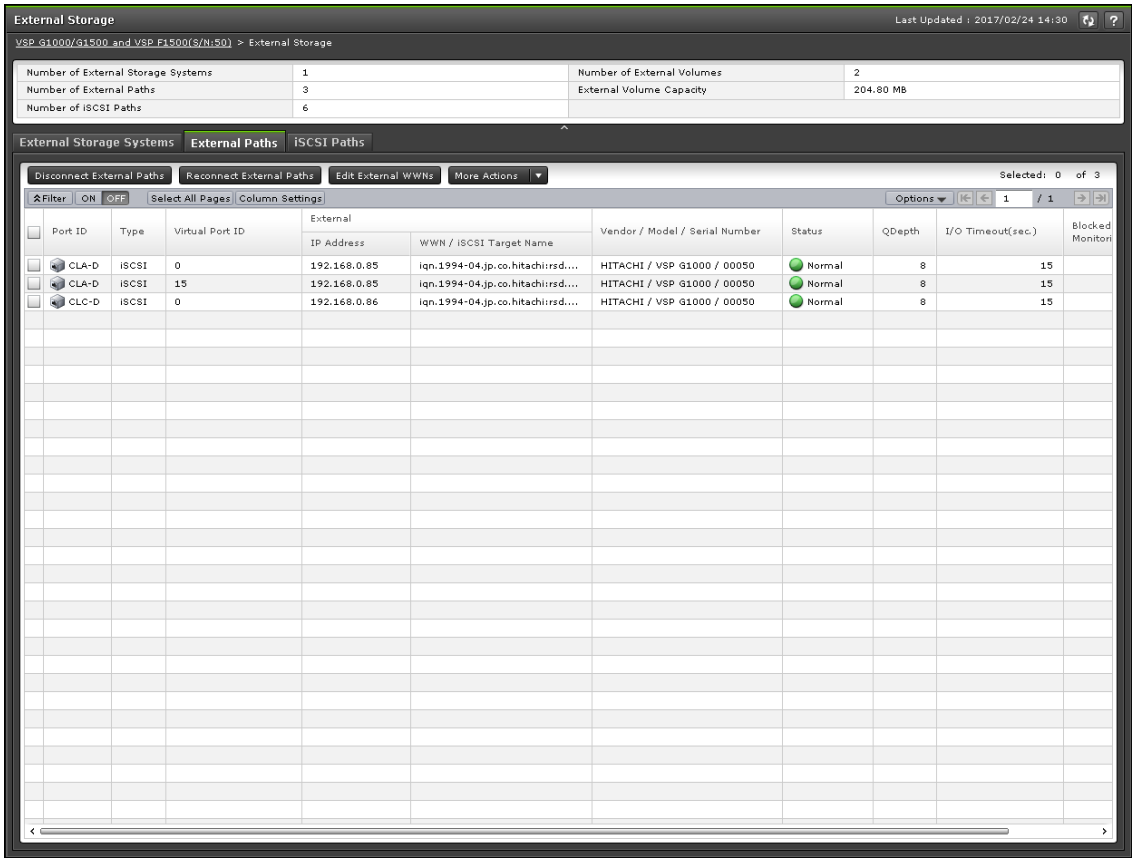


Item	Description
Vendor / Model / Serial Number	Identifying information for the selected external storage system. When the link is clicked, more information for the system is shown.
Status	Any of the following statuses can display for the external system. • Normal: There are no problems, the system is usable. • Disconnect: The external system or one of its mapped volumes has been intentionally disconnected. • Checking: The system is checking the mapping path status. • Unknown: The status of the mapping path is not known. • Cache Destage: Writing of data from cache memory to the volume is in progress. • Warning: There are mapping paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The mapping path is blocked. • Destage Failed: The writing of data from cache memory to the volume failed.

Item	Description
Number of External Path Groups	Number of external path groups in the external system.
Add External Volumes	When clicked, launches the **Add External Volumes** window.
Disconnect External Storage Systems	When clicked, launches the **Disconnect External Storage Systems** window.
Reconnect External Storage Systems	When clicked, launches the **Reconnect External Storage Systems** window.
Edit Policies*	When clicked, launches the **Edit Policies** window.
Export*	When clicked, allows you to save table information to a file.
Notes: * Appears when you click More Actions.	

External Paths tab

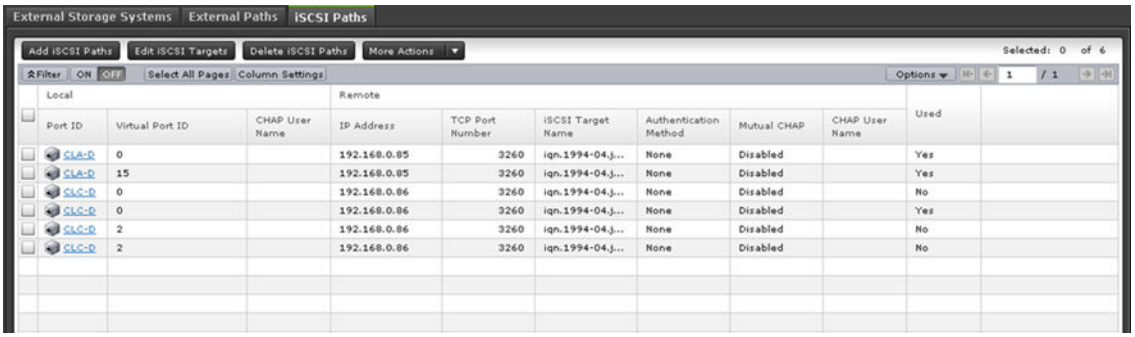
Displays the paths connecting mapped external volumes in the external system to your storage system.



Item	Description
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port. • TCP Port Number[1]: Displays the target TCP port number when the port type is an iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.
Vendor / Model / Serial Number	Identifying information for the external system.
Status	Status of external paths. • Normal: There are no problems, the system is usable. • Disconnect: The path has been intentionally disconnected. • Checking: The system is checking the external path status. • Unknown: The status of the external path is not known. • Warning: There are external paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The external path is blocked.
QDepth	Number of Read/Write commands that can be queued to the external volume. 8 is set by default. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout(sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Blocked Path Monitoring (sec.)	Time that will elapse from the time that a path goes down to the time when the external volume is blocked. 10 seconds is the default.
Disconnect External Paths	When clicked, launches the **Disconnect External Paths** window.
Reconnect External Paths	When clicked, launches the **Reconnect External Paths** window.
Edit External WWNs	When clicked, launches the **Edit External WWNs** window.
Edit External iSCSI Targets[2]	When clicked, launches the **Edit External iSCSI Targets** window.
Edit Policies[2]	When clicked, launches the **Edit Policies** window.
Export[2]	When clicked, allows you to save table information to a file.

1. Does not appear by default. To display the item, change the settings in the **Column Settings** window. See the *System Administrator Guide* for the details of the window.
2. Appears when you click More Actions.

iSCSI Paths tab



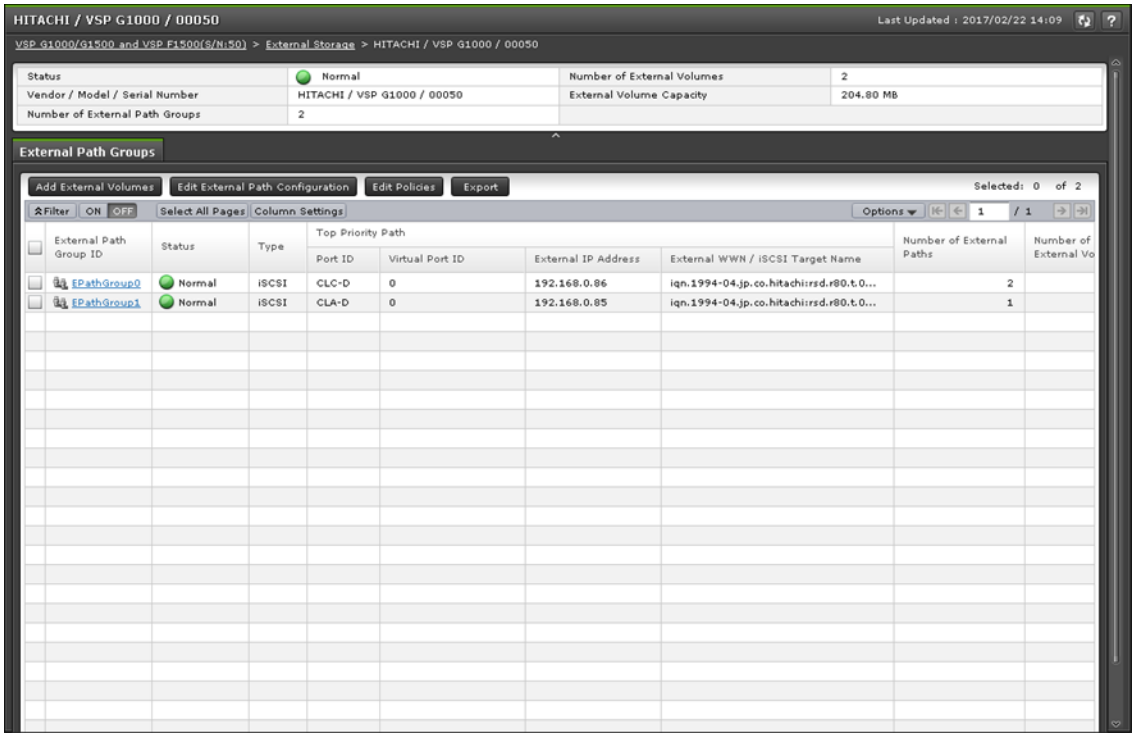
Item	Description
Add iSCSI Paths button	Displays **Add iSCSI Paths** window.
Edit iSCSI Targets button	Displays **Edit iSCSI Targets** window.
Delete iSCSI Paths button	Displays **Delete iSCSI Paths** window.
Test Login iSCSI Target*	Executes login test for the iSCSI target.
Export*	Displays the window to save table information to a file.
Local	Displays the local storage system port information. • Port ID: Displays the port ID. • Virtual Port ID: Displays the virtual port ID. • CHAP User Name: Displays the CHAP user name, if specified.
Remote	Displays the remote storage system port information. • IP Address: Displays the IP address. • TCP Port Number: Displays the TCP port number. • iSCSI Target Name: Displays the iSCSI target name. • Authentication Method: Displays the method for authentication. • Mutual CHAP: Displays the mutual CHAP setting. • CHAP User Name: Displays the CHAP user name, if specified.
Used	Displays whether volume is mapped as an external volume. • Yes: Used as an external path. • No: Not used as an external path.
Notes: * Appears when you click More Actions.	

Selected external storage system window

Use this window to view information about the selected external storage system.

You can perform these operations from the window:

- Mapping an external volume on page 67
- Adding an external path to an existing path group on page 83
- Changing external path priority on page 85
- Removing or replacing an external path on page 89
- External volume policy settings and functions on page 76
- Export table information to a file.



Summary

Displays summary information about the selected external storage.

Item	Description
Status	Status of external storage systems. • Normal: There are no problems, the system is usable. • Disconnect: The external system or one of its mapped volumes has been intentionally disconnected. • Checking: The system is checking the mapping path status. • Unknown: The status of the mapping path is not known. • Cache Destage: Writing of data from cache memory to the volume is in progress. • Warning: There are mapping paths whose status is not normal. You can check their status in the **View External LUN Properties** window.

Item	Description
	• Blockade: The mapping path is blocked. • Destage Failed: The writing of data from cache memory to the volume failed.
Vendor / Model / Serial Number	Identifying information for the external system.
Number of External Path Groups	Number of external path groups in the external system.
Number of External Volumes	Number of mapped external volumes.
External Volume Capacity	Total capacity of mapped external volumes.

External Path Groups tab

Displays the external path groups in which external paths are grouped.

Item	Description
External Path Group ID	Name of the external path group. When the link is clicked, the list of the group's external paths displays.
Status	Status of external path groups. • Normal: There are no problems, the path group is usable. • Disconnect: The path group has been intentionally disconnected. • Checking: The system is checking the mapping path status. • Unknown: The status of the mapping path is not known. • Cache Destage: The writing of data from cache memory to the external volume is in progress. • Warning: There are mapping paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The mapping path is blocked. • Destage Failed: The writing of data from cache memory to the volume is failed.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port • Mixed: Configuration with Fibre Channel and iSCSI ports
Top Priority Path	Displays the external path that has the highest priority. • Port ID: Displays the external port of the local storage system. • Virtual Port ID: Displays the virtual port of the local storage system when the port type is iSCSI. • External IP Address : For iSCSI ports, displays the target port IP address. • External TCP Port Number*: For iSCSI ports, displays the target TCP port number. • External WWN / iSCSI Target Name: - For Fibre Channel ports, displays the WWN of the target port. - For iSCSI ports, displays the iSCSI target name.
Number of External Paths	Number of external paths in the path group.

Item	Description
Number of External Volumes	Number of external volumes using the external path group.
Add External Volumes	When clicked, launches the **Add External Volumes** window.
Edit External Path Configuration	When clicked, launches the Edit External Path Configuration window.
Edit Policies	When clicked, launches the **Edit Policies** window.
Export	When clicked, allows you to save table information to a file.
Notes: * Does not appear by default. To display the item, change the settings in the **Column Settings** window. For details, see the *System Administrator Guide*.	

Selected external path group window

Use this window to view the mapped external volumes using the external path, and view the external paths in the path group.

You can perform these operations from the window.

- Mapping an external volume on page 67
- Edit Cache Mode and Inflow Control settings for individual mapped volumes (see Editing mapping policies for external volumes on page 78)
- View path status and external LUN information (see the Status description in the External Storage Systems tab section.)
- Deleting an external volume mapping on page 95
- Disconnecting a single mapped volume on page 94
- Reconnecting a single mapped volume on page 98
- Changing the MP blade or unit of an external volume on page 79
- External volume policy settings and functions on page 76
- Export table information to a file (see the Export button description in the External Storage Systems tab section.)

Summary

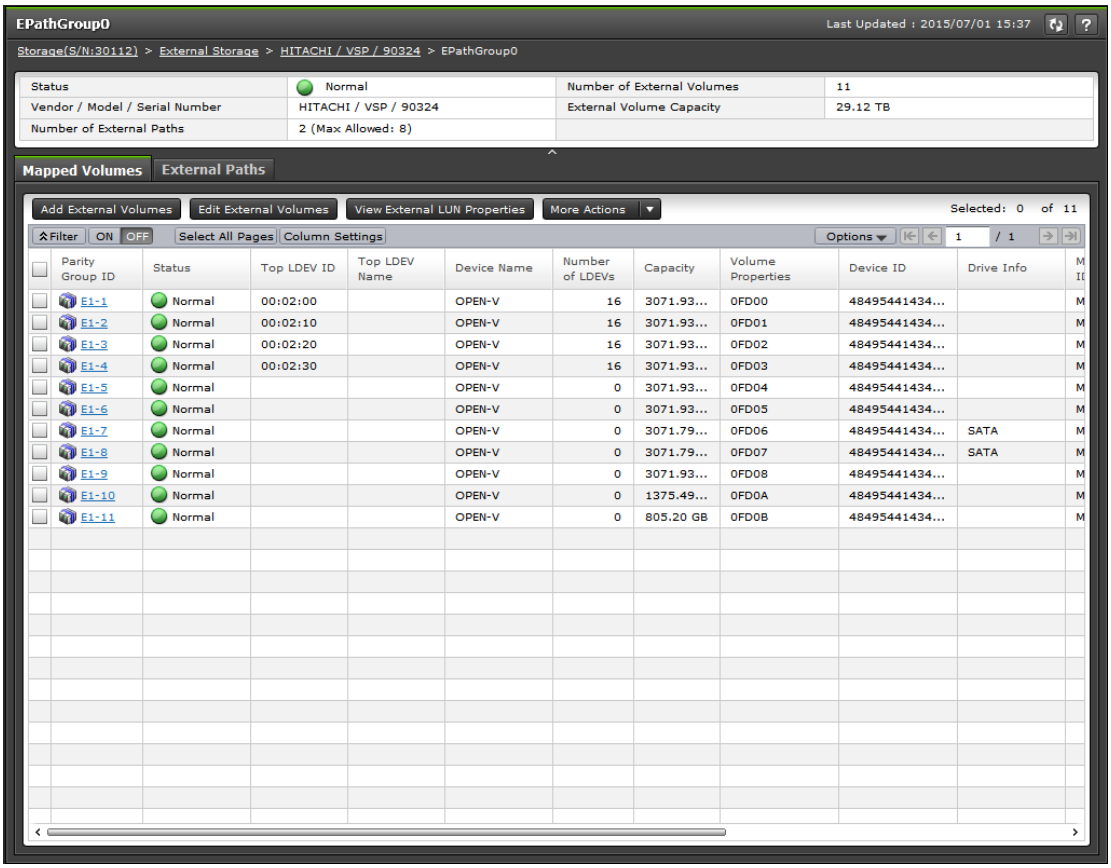
Displays summary information about the selected external path group.

Item	Description
Status	Status of path groups. • Normal: There are no problems, the path group is usable. • Disconnect: The path group has been intentionally disconnected. • Checking: The system is checking the mapping path status. • Unknown: The status of the mapping path is not known. • Cache Destage: The writing of data from cache memory to the external volume is in progress.

Item	Description
	• Warning: There are mapping paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The mapping path is blocked. • Destage Failed: The writing of data from cache memory to the volume is failed.
Vendor / Model / Serial Number	Identifying information for the external system.
Number of External Paths	Number of external paths in the external path group.
Number of External Volumes	Number of mapped external volumes using the external path group.
External Volume Capacity	Total capacity of mapped external volumes using the path group.

Mapped Volumes tab

Displays the external volumes mapped to your storage system using the selected path group.



Item	Description
Parity Group ID	Displays parity group numbers for the mapped external volumes. When the link is clicked, a list of LDEVs in the mapped volume and parity group displays. When the link is clicked, a list of LDEVs in the mapped volume and parity group displays.
Status	Status of the external volume • Normal: There are no problems, the volume is usable. • Disconnect: The external system or one of its mapped volumes has been intentionally disconnected. • Checking: The system is checking the mapping path status • Unknown: The status of the mapping path is not known. • Cache Destage: Writing of data from cache memory to the volume is in progress. • Warning: There are mapping paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The mapping path is blocked. • Destage Failed: The writing of data from cache memory to the volume failed.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Device Name	Product ID of Standard Inquiry. This is the name defined by the standard body that controls SCSI. This name varies according to the storage system vendor. For example, for some enterprise storage systems, this field displays the emulation type.
Number of LDEVs	Number of LDEVs created in the external volume.
Capacity	Capacity of the external volume.
Volume Properties	Identification number of the external volume. The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.
Device ID	Identification number of the external volume.
Drive Info	Information about the external volume's drive type. SATA displays when the external volume is a SATA drive of following storage systems. • Virtual Storage Platform • Universal Storage Platform V/VM • HUS/AMS/WMS • SMS • Thunder 9500V SSD displays when the external volume is the SSD of following storage systems. • VSP Gx00 models, VSP Fx00 models • VSP G1000 and G1500, and VSP F1500 • HUS VM Storage Platform • Virtual Storage Platform • Universal Storage Platform V/VM
MP Blade ID or MP Unit ID	ID of the MP blade or unit allocated to the external volume.

Item	Description
Path Mode	Path mode for the external volume's external path. • Single: Ordinarily, only one external path is used even if alternate paths are set. Alternate paths are available in case of failure. • Multi: Multiple paths are used at the same time. • ALUA: Like Multi, all paths are used; however, they are not used when connected to ports in Passive status. See External paths on page 36 for more information.
Path Mode on Profile[1]	Displays the path mode on the profile information of the external storage system. • Single: Ordinarily, only one external path is used even if alternate paths are set. • Multi: When alternate paths are set, external paths from several ports are used simultaneously with load balancing.
ALUA Settable[1]	Displays whether ALUA can be set as the Path Mode in the external storage system. • Enable: Enables ALUA Mode. • Disable: Disables ALUA Mode.
ALUA Permitted[1]	Displays whether ALUA can be set as the Path Mode in the local storage system. • Enable: ALUA Mode is used. Disable: ALUA Mode is not used.
Load Balance Mode	Displays I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance.
Cache Mode	Write data from the host to the external system is propagated synchronously (Disable) or asynchronously (Enable). When nondisruptive migration is specified as the Attribute, the cache modes are displayed. • Through: Transfers write and read requests from the host to the external storage system. The local system's cache is not used. • Write Sync: Reflects write data from the host to the external storage system synchronously. If read or write is performed while data is being written to the external storage system, the read or write operation waits until the ongoing write operation is completed. • Check Condition (VSP Gx00 models and VSP Fx00 models): Indicates that write or read commands from the host were rejected. • Pending (VSP Gx00 models and VSP Fx00 models): Holds write and read commands from the host. While cache mode operations are in progress, status is reported for cache mode changes. • (Changing): Transition to the displayed cache mode is in progress.

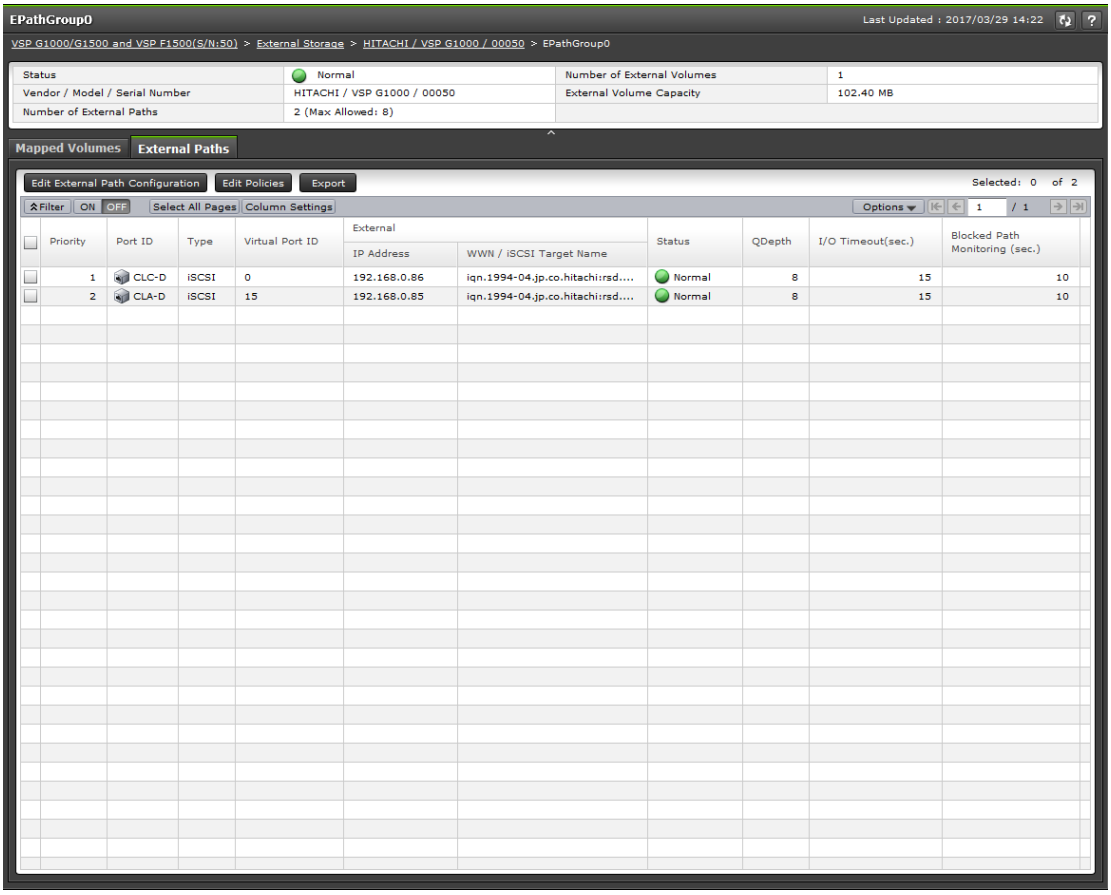
Item	Description
	• (Error): Transition to the displayed cache mode has failed and maintenance work is required.
Inflow Control	Write operation to cache memory is limited (Enable) or continued (Disable) when the write operation to the external volume cannot be performed.
Attribute	Displays the attribute of the parity group. • Nondisruptive migration: Parity group that has the nondisruptive migration attribute • A blank displays if no attribute is set.
Data Direct Mapped LDEV[1]	Displays the LDEV ID of the mapped DP-VOL. • If the Data Direct Mapping attribute is disabled, a hyphen is displayed. • If a V-VOL that has the Data Direct Mapping attribute is not set to the pool that has the Data Direct Mapping attribute, a blank is displayed. When clicked, launches the **LDEV Properties** window.
Add External Volumes	Displays the Add External Volumes window.
Edit External Volumes	Displays the Edit External Volumes window.
View External LUN Properties	View external system LUN information for the external volume, as well as external and mapping path information in the **Displays the View External LUN Properties** window.
Delete External Volumes[2]	When clicked, launches the **Delete External Volumes** window.
Disconnect External Volumes[2]	When clicked, launches the **Disconnect External Volumes** window.
Reconnect External Volumes[2]	When clicked, launches the **Reconnect External Volumes** window.
Assign MP Blade (VSP G1000, G1500, and VSP F1500)[2]	When clicked, launches the **Assign MP Blade** window.
Assign MP Unit (VSP Gx00 models and VSP Fx00 models)[2]	When clicked, launches the **Assign MP Unit** window.
Edit Policies[2]	When clicked, launches the **Edit Policies** window.
Export[2]	When clicked, allows you to save table information to a file.

Notes:

1. Does not appear by default. To display the item, change the setting in the **Column Settings** window of the table option. See the *System Administrator Guide* for the details of the window.
2. Appears when you click More Actions.
3. (VSP Gx00 models and VSP Fx00 models) If an MP unit is blocked due to a failure, the processing to be performed by the MP unit where the failure occurred is taken over by another MP unit. See Selected external path group window on page 160.

External Paths tab

Displays the external paths within the selected path group.



Item	Description
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
External WWN (VSP G1000, G1500, and VSP F1500)	Displays the WWN of the external storage system. The external WWN shows the target port.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port. • TCP Port Number*: Displays the target TCP port number when the port type is an iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.
Status	Status of external paths. • Normal: There are no problems, the system is usable. • Disconnect: The path has been intentionally disconnected.

Item	Description
	• Checking: The system is checking the external path status. • Unknown: The status of the external path is not known. • Warning: There are external paths whose status is not normal. You can check their status in the **View External LUN Properties** window. • Blockade: The external path is blocked.
QDepth	Number of Read/Write commands that can be queued to the external volume. 8 is set by default. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout(sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Blocked Path Monitoring (sec.)	Time that will elapse from the time that a path goes down to the time when the external volume is blocked. 10 seconds is the default.
Edit External Path Configuration	When clicked, launches the **Edit External Path Configuration** window.
Edit Policies	When clicked, launches the **Edit Policies** window.
Export	When clicked, allows you to save table information to a file.
Notes: * Does not appear by default. To display the item, change the settings in the **Column Settings** window. See the *System Administrator Guide* for the details of the window.	

Add External Volumes wizard

Use this wizard to connect external volumes to your storage systems.

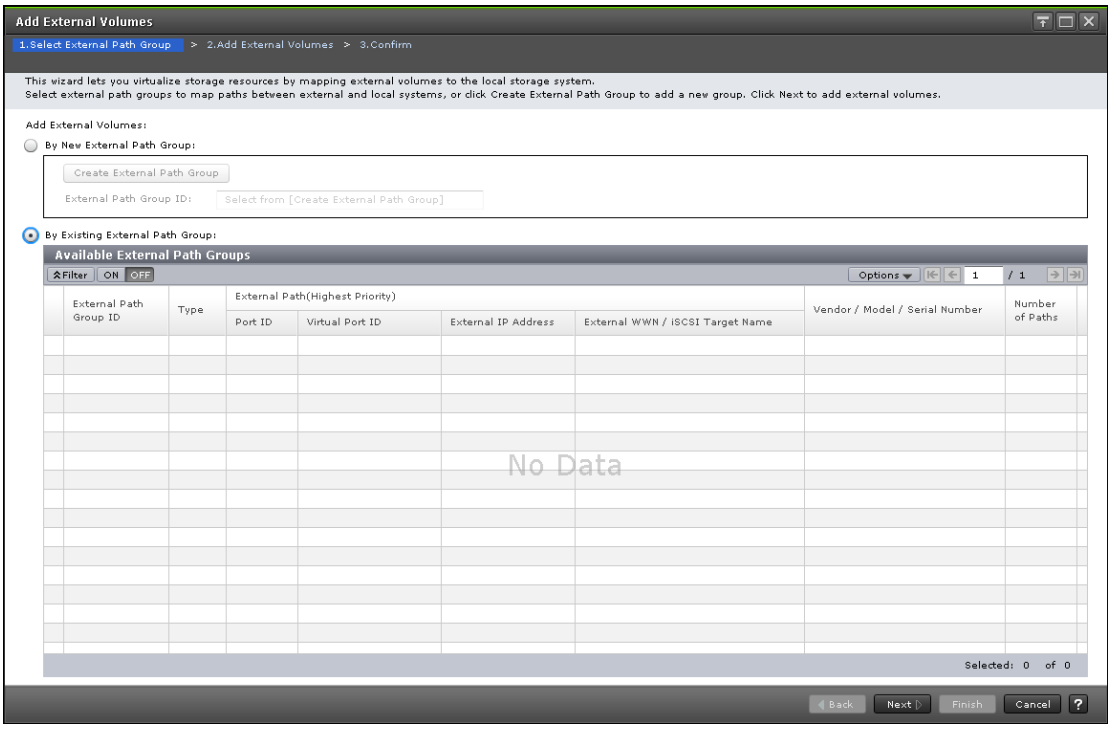
See Mapping an external volume on page 67 for instructions.

Each window in the wizard is identified below the wizard title. The windows are:

- Select External Path Group window on page 166
- Add External Volumes window on page 168
- Add External Volumes confirmation window on page 175

Select External Path Group window

Part of the Add External Volumes wizard, use this window to select and set parameters for an external path group.



Item	Description
By New External Path Group	Option for setting up a new external path group.
Create External Path Group	When clicked, launches the **Create External Path Group** window.
External Path Group ID	Number to identify the new external path group. Blank by default. Specify a value in the following range: • VSP G200: 0 to 2,047 • VSP G400, G600, VSP F400, F600: 0 to 4,095 • VSP G800, VSP F800: 0 to 14,079 • VSP G1000, VSP G1500, or VSP F1500: 0 to 63,231
By Existing External Path Group	Option for using an existing external path group.

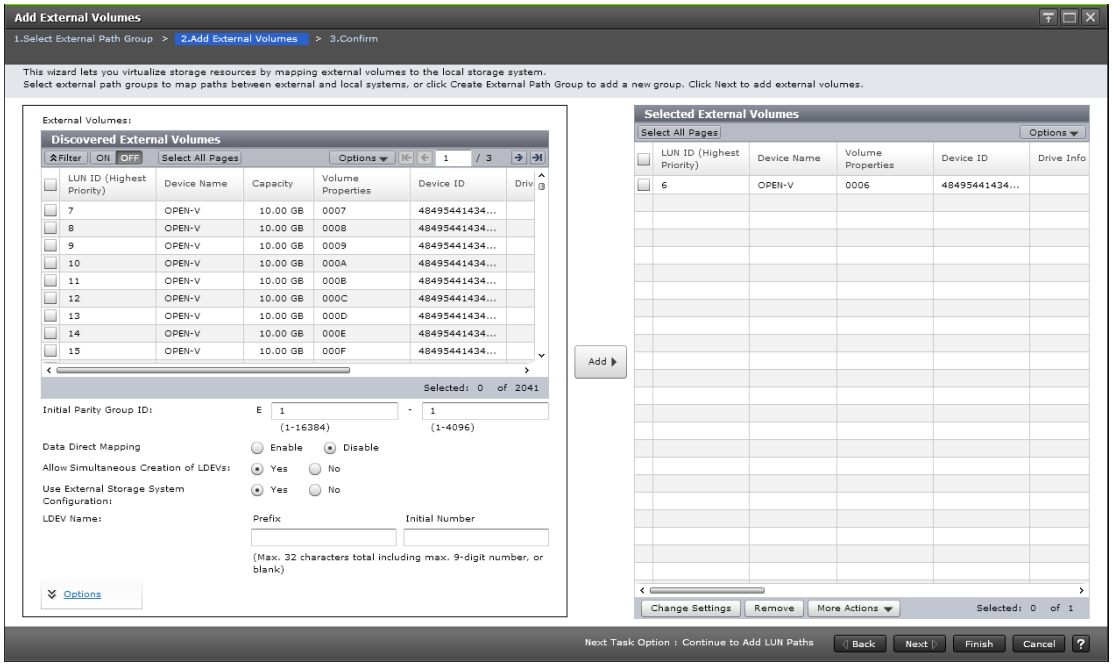
Available External Path Groups table

Item	Description
External Path Group ID	Name of the external path group.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port • Mixed: Configuration with Fibre Channel port and iSCSI port
External Path (Highest Priority)	Displays the external path that has the highest priority.

Item	Description
	• Port ID: Displays the external port of the local storage system. • Virtual Port ID: Displays the virtual port of the local storage system when the port type is iSCSI. • External IP Address : For iSCSI ports, displays the target port IP address. • External TCP Port Number*: For iSCSI ports, displays the target TCP port number. • External WWN / iSCSI Target Name: - For Fibre Channel ports, displays the WWN of the target port. - For iSCSI ports, displays the iSCSI target name.
Vendor / Model / Serial Number	Identifying information for the external system.
Number of Paths	Number of external paths in the path group.
Notes: * Does not appear by default. To display the item, change the settings in the **Column Settings** window. For details, see the *System Administrator Guide*.	

Add External Volumes window

Part of the Add External Volumes wizard, use this window to display discovered external volumes and to make related selections.



Discovered External Volumes

Item	Description
LUN ID(Highest Priority)	The external LUN with the highest priority. "?" indicates that an external volume is not found. In this case, confirm the connection with the external system, and then perform the operation again.
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some enterprise storagesystems, this field displays emulation type.
Capacity	External volume capacity.
Volume Properties	Identification number of the external volume. The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.
Device ID	Identification number of the external volume.
Drive Info	Information about the external volume's drive type. SATA displays when the external volume is a SATA drive of following storage systems. • Virtual Storage Platform • Universal Storage Platform V/VM • HUS/AMS/WMS • SMS • Thunder 9500V SSD displays when the external volume is the SSD of following storage systems. • VSP Gx00 models, VSP Fx00 models • VSP G1000 and G1500, VSP F1500 • HUS VM Storage Platform • Virtual Storage Platform • Universal Storage Platform V/VM
Path Mode	Displays operation mode of the external path. • Single: Ordinarily, only one external path is used even if alternate paths are set, In Single mode, alternate paths are used only in case of maintenance work failure. • Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing.
ALUA Settable	Displays whether ALUA can be set as the Path Mode in the external storage system. • Enable: Enables ALUA Mode. • Disable: Disables ALUA Mode.
Discovery Result	Displays one of the following: • Normal • An error code When clicked, the link displays the Discovery Result Detail window with details of the search.
Initial Parity Group ID	An external volume group number and sequence number. Values range from 1 - 1 (default) to 16384 - 4096.

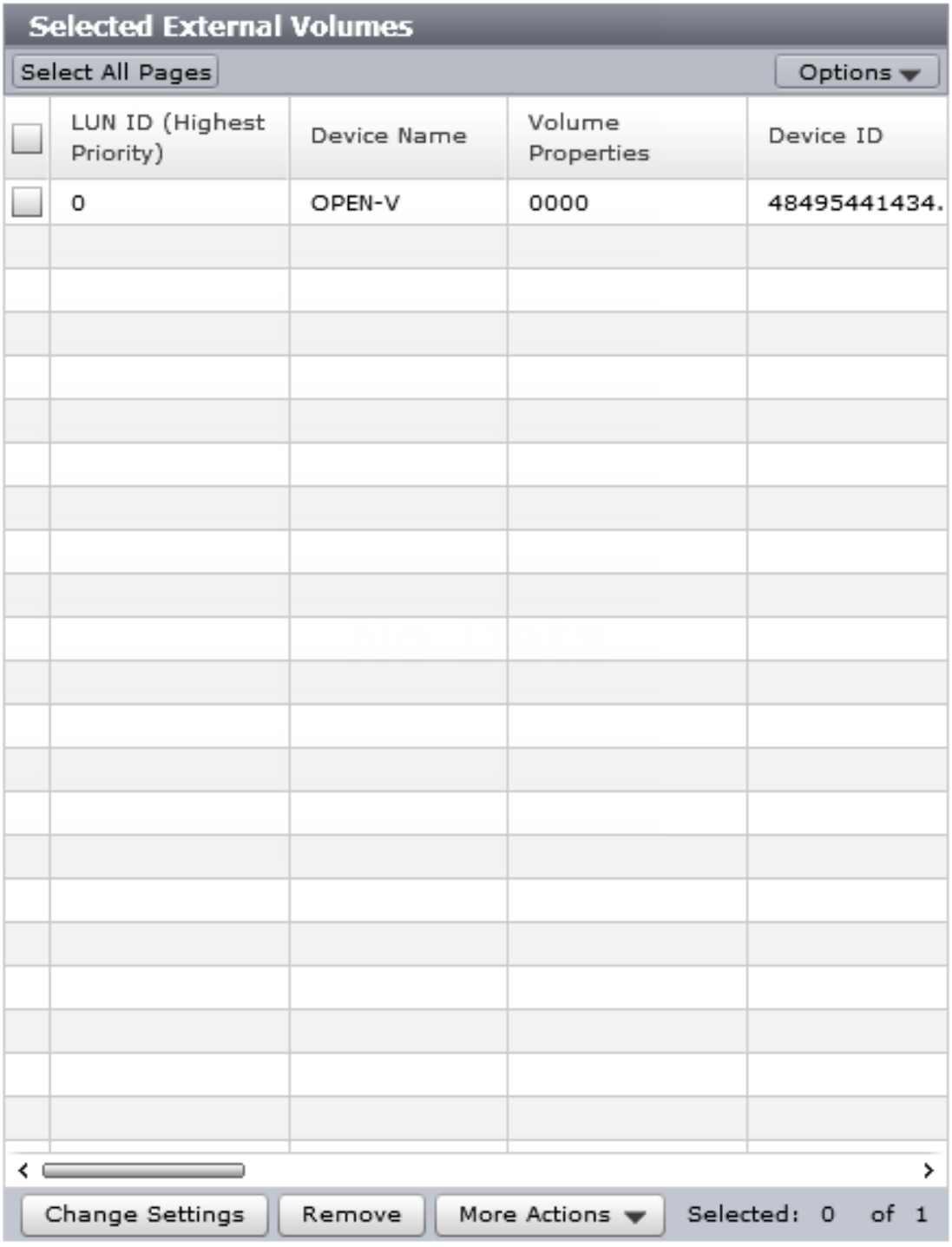
Item	Description
Data Direct Mapping	Specify whether to enable the Data Direct Mapping attribute. • Enable: Enables the Data Direct Mapping attribute. • Disable: Disables the Data Direct Mapping attribute (Default).
Allow Simultaneous Creation of LDEVs	LDEVs are automatically created in the external volume when Yes is selected. If No is selected, you must create LDEVs manually. By default, the value set in the **Edit Policies** window is set. If Enable is specified for Data Direct Mapping, Yes is selected automatically.
Use External Storage System Configuration	If Yes is specified in "Allow Simultaneous Creation of LDEVs", the external volume's configuration for the LDEVs is used when Yes is selected. If No is selected, you must configure LDEVs manually. By default, Yes is selected. If Enable is specified for Data Direct Mapping, Yes is selected automatically.
LDEV Name	Requires a prefix character and initial number, 32 characters maximum (including the initial number). Numbering rule for Initial Number: • 1: Total of 9 numbers (1, 2, 3, ...9) • 08: Total of 92 numbers (08, 09, 10, ...99) • 23: Total of 77 numbers (23, 24, 25, ...99) • 098: Total of 902 numbers (098, 099, 100, ...999)
Options	Optional default settings for the external volume. Options can be affected by values entered in previous fields.
Initial LDEV ID	The storage system searches from this number in ascending order and allocates the next available LDEV ID to the external volume.
LDKC	LDKC number. 00 can be set for the value.
CU	CU number. Possible values for each model: • VSP G200: 00 to 07 • VSP G400, G600, VSP F400, F600: 00 to 0F • VSP G800, VSP F800: 00 to 3F • VSP G1000, VSP G1500, VSP F1500: 00 to FE Default is 00.
DEV	LDEV identifier. Value between 00 and FF can be set. Default is 00.
Interval	Interval between the LDEV IDs can be selected. The specified interval will be kept and the LDEV ID will be set to each LDEV in external volume. From 0 (default) to 255.
View LDEV IDs	Shows used, available, and disabled LDEV IDs.
Initial SSID (VSP G1000, G1500, and VSP F1500)	SSID number. Range can be from 0004 (default) to FFFE.
View SSID (VSP G1000, G1500, and VSP F1500)	Shows current SSIDs. For information on the **Edit SSIDs** window, see the *Provisioning Guide for Open Systems* or the *Provisioning Guide for Mainframe Systems*.

Item	Description
Base Emulation Type (VSP G1000, G1500, and VSP F1500)	External system's emulation type. All supported emulation types except OPEN-L can be specified. See External volume policy settings and functions on page 76 for more information.
Number of LDEVs per External Volume	Maximum number of LDEVs to be created in the external volume when the volume is mapped. Depends on base emulation type and the capacity of the external volume. If Enable is specified for Data Direct Mapping, 1 is selected automatically.
Cache Partition	CLPR for accessing the external volume. The range can be from CLPR0 to CLPR31. The default is the value set in the **Edit Policies** window. See External volume policy settings and functions on page 76 for more information.
Cache Mode	• Enable: Write data from the host is propagated asynchronously • Disable: Write data from the host is propagated synchronously (VSP G1000, G1500, and VSP F1500) Except the data written directly by the host, data (such as written by ShadowImage) will be propagated asynchronously regardless of the Cache Mode settings. If set to Disable, bind mode is not specified with Cache Residency Manager. The default is the value set in the **Edit Policies** window. See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed. • Disable: Allows write data to be written to cache when the write operation cannot be performed. See External volume policy settings and functions on page 76 for more information.
Use ALUA as Path Mode	Select whether ALUA is used as the Path Mode. The default is Enable if ALUA mode can be set as the Path Mode. Otherwise, the default is Disable. • Enable: Enables ALUA mode. • Disable: Disables ALUA mode. (VSP G1000, G1500, and VSP F1500) If the product name of an external storage system is displayed as (generic), the selected external volume or volumes is used by default.
Load Balance Mode	Select I/O load balance system for external storage system. • Depends on the selected external volume(s): If Enable is set for ALUA Settable on the external volume, Normal Round-robin is set for Load Balance Mode automatically. If Disable is set for ALUA Settable, Disable is set for Load Balance Mode automatically. • Normal Round-robin: Performs load balance in round-robin system.

Item	Description
	• Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance. The default is the value set in the Edit Policies window. If the product name of an external storage system is displayed as (generic), Depends on the selected external volume(s) is used by default. This item cannot be selected when the path mode of the external volume is Single or Disable is selected for Use ALUA as Path Mode.
MP Blade (VSP G1000, G1500, and VSP F1500)	MP blade for the external volume. • Range is from MPB0 to MPB7. • Auto (default): Blade is automatically selected by the system. • If Auto cannot be selected, the blade with lowest number is used.
MP Unit ID (VSP Gx00 models and VSP Fx00 models)	MP unit ID for the external volume. • You can select MPU-10, MPU-11, MPU-20 or MPU-21. • Auto (default): Unit is automatically selected by the system. • If Auto cannot be selected, the unit with lowest number is used.
Add	When clicked, moves selected volumes to the Selected External Volumes list.

Selected External Volumes

Displays selected external volumes.

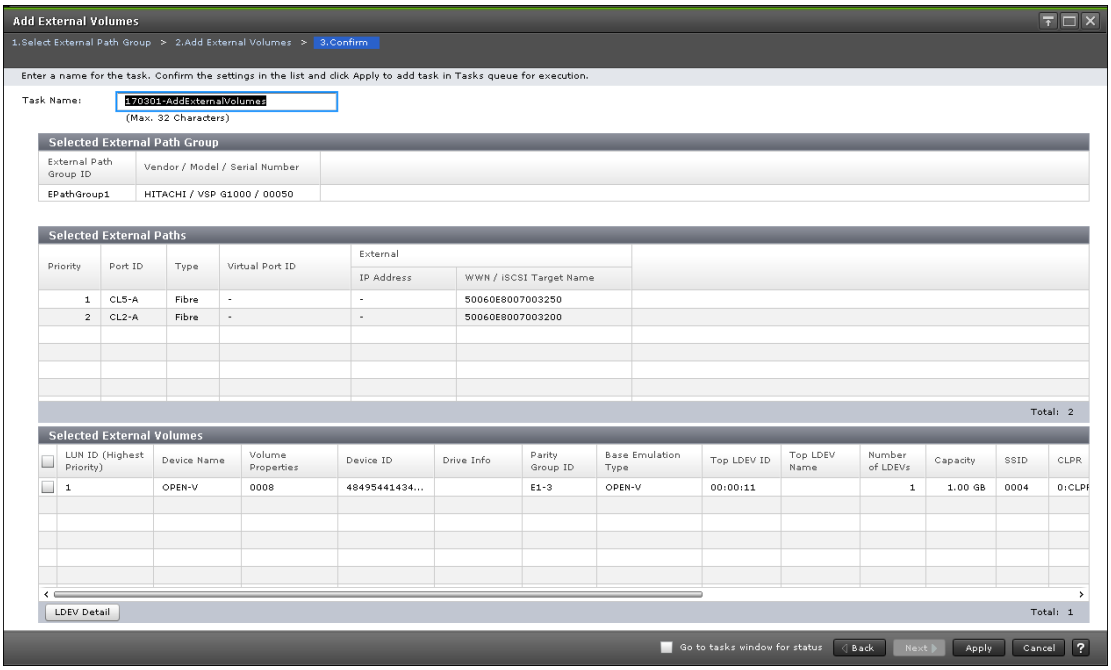


Item	Description
LUN ID(Highest Priority)	External volume's LUN with the highest priority.
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For

Item	Description
	some enterprise storage systems, this field displays emulation type.
Volume Properties	Identification number of the external volume. The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.
Device ID	External volume's identification number.
Drive Info	Information about the external volume's drive type. SATA displays when the external volume is a SATA drive of following storage systems. • Virtual Storage Platform • Universal Storage Platform V/VM • HUS/AMS/WMS • SMS • Thunder 9500V SSD displays when the external volume is the SSD of following storage systems. • VSP Gx00 models, VSP Fx00 models • VSP G1000, VSP G1500, VSP F1500 • HUS VM Storage Platform • Virtual Storage Platform • Universal Storage Platform V/VM
Parity Group ID	Parity group numbers.
Base Emulation Type (VSP G1000, G1500, and VSP F1500)	External volume's emulation type.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Number of LDEVs	External volume's number of LDEVs.
Capacity	External volume's capacity.
SSID (VSP G1000, G1500, and VSP F1500)	SSIDs.
CLPR	CLPR used for accessing to the mapped external volume.
Cache Mode	• Enable: Write data from the host is propagated asynchronously • Disable: Write data from the host is propagated synchronously See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed. • Disable: Allows write data to be written to cache when the write operation cannot be performed. See External volume policy settings and functions on page 76 for more information.
Path Mode	Displays operation mode of the external path.

Item	Description
	• Single: Ordinarily, only one external path is used even if alternate paths are set, In Single mode, alternate paths are used only in case of maintenance work failure. • Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. • ALUA: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths connected to ports in Passive status are not used.
ALUA Permitted	Displays whether ALUA can be set as the Path Mode in the local storage system. • Enable: ALUA Mode is used. • Disable: ALUA Mode is not used.
Load Balance Mode	Displays I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance.
MP Blade ID or MP Unit ID	ID of the MP blade or unit of the external volume.
Attribute	Attribute of the external volume.
Change Settings	When clicked, the Change Setting dialog box opens.
Remove	When clicked, removes external volumes from the Selected External Volumes table.
Edit SSIDs* (VSP G1000, G1500, and VSP F1500)	When clicked, the **Edit SSIDs** window opens and you can change the SSID of the selected external volume. For information on the **Edit SSIDs** window, see the *Provisioning Guide for Open Systems* or the *Provisioning Guide for Mainframe Systems*.
Path Detail*	When clicked, the **External LUN Properties** window opens and you can review the path details of the selected external volume.
LDEV Detail*	When clicked, the **External LDEV Properties** window opens and you can review the details of the LDEV to be created from the selected external volume.
Notes: * Appears when you click More Actions.	

Add External Volumes confirmation window



Item	Description
Task Name	Identifies the operation within the system when Apply is clicked. Allows you to track the status of the operation.
External Path Group ID	Name of the external path group.
Vendor / Model / Serial Number	Identifying information for the external system.
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.
LUN ID(Highest Priority)	The LUN which is connected to the external path with the highest priority.
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some enterprise storage systems, this field displays emulation type.
Capacity (VSP G1000, G1500, and VSP F1500)	External volume capacity.

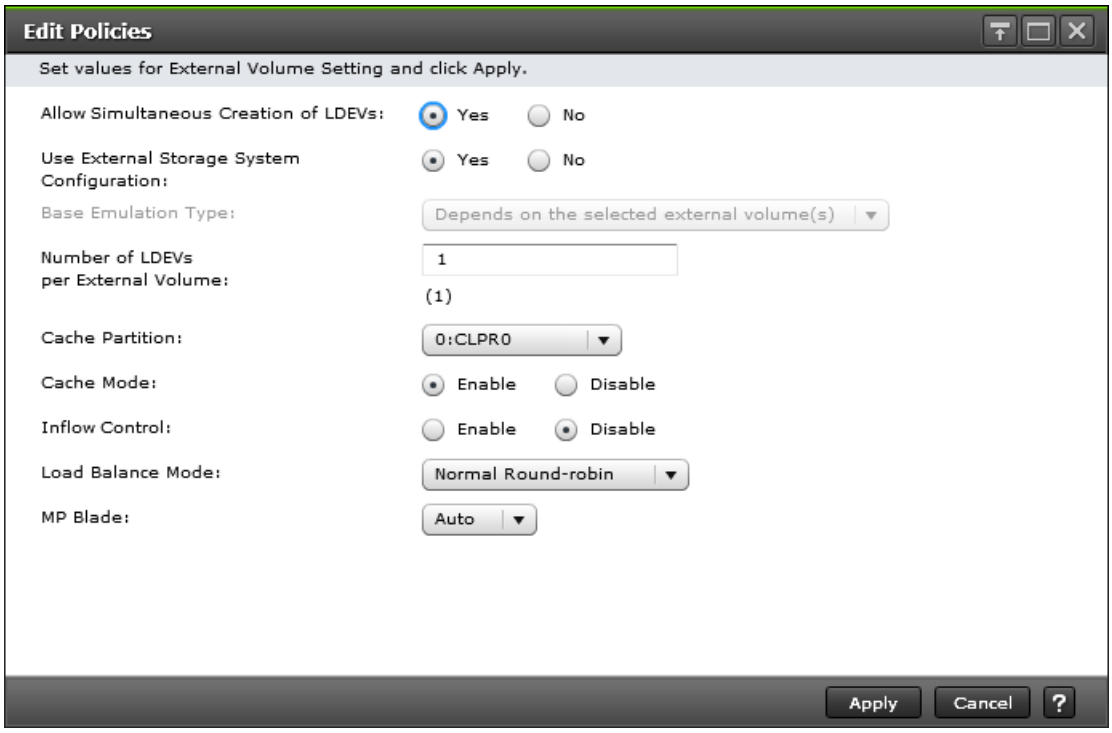
Item	Description
Volume Properties	Identification number of the external volume. The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.
Device ID	Identification number of the external volume.
Drive Info	Information about the external volume's drive type. SATA displays when the external volume is a SATA drive of following storage systems. • Virtual Storage Platform • Universal Storage Platform V/VM • HUS/AMS/WMS • SMS • Thunder 9500V SSD displays when the external volume is the SSD of following storage systems. • VSP Gx00 models, VSP Fx00 models • VSP G1000, VSP G1500, VSP F1500 • HUS VM Storage Platform • Virtual Storage Platform • Universal Storage Platform V/VM
Parity Group ID	Parity group numbers.
Base Emulation Type (VSP G1000, G1500, and VSP F1500)	External volume's emulation type.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Number of LDEVs	External volume's number of LDEVs.
Capacity	External volume capacity.
SSID (VSP G1000, G1500, and VSP F1500)	SSIDs.
CLPR	CLPR used for accessing to the mapped external volume.
Cache Mode	• Enable: Write data from the host is propagated asynchronously • Disable: Write data from the host is propagated synchronously See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed. • Disable: Allows write data to be written to cache when the write operation cannot be performed. See External volume policy settings and functions on page 76 for more information.
Path Mode	Displays operation mode of the external path.

Item	Description
	• Single: Ordinarily, only one external port is used even if alternate paths are set. In Single mode, alternate paths are used only in case of maintenance work failure. • Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. • ALUA: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths connected to ports in Passive status are not used.
ALUA Permitted	Displays whether ALUA can be set as the Path Mode in the local storage system. • Enable: ALUA Mode is used. • Disable: ALUA Mode is not used.
Load Balance Mode	Displays I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance.
MP Blade ID or MP Unit ID	IDs of the external volume's MP blade or unit.
Attribute	External volume's attribute.
LDEV Detail	Displays the **External LDEV Properties** window and you can review the details of the selected external volume.

Note: Information in this **Confirm** window assumes only a single task is performed. If multiple tasks are performed, the window displays all configuration items. For information on these items, return to the configuration window by clicking Back and refer to the topic on each configuration window by clicking Help.

Edit Policies window

Use this window to change settings for mapped external volumes.



Item	Description
Allow Simultaneous Creation of LDEVs	If Yes is specified, LDEVs are automatically created in the external volume. If No is selected, you must create LDEVs manually.
Use External Storage System Configuration	If Yes is specified in "Allow Simultaneous Creation of LDEVs", the external volume's configuration for the LDEVs is used when Yes is selected. If No is selected, you must configure LDEVs manually.
Base Emulation Type (VSP G1000, G1500, and VSP F1500)	External system's emulation type. All supported emulation types except OPEN-L can be specified. See External volume policy settings and functions on page 76 for more information.
Number of LDEVs per External Volume	Number of LDEVs to be created in the local system when the volume is mapped. Depends on the base emulation type (VSP G1000, G1500, and VSP F1500) or capacity of the external volume (VSP Gx00 models and VSP Fx00 models).
Cache Partition	CLPR for accessing the external volume.
Cache Mode	• Enable: Write data from the host is propagated asynchronously • Disable: Write data from the host is propagated synchronously See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed.

Item	Description
	• Disable: Allows write data to be written to cache when the write operation cannot be performed.
Load Balance Mode	Select I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance. The default is Normal Round-robin.
MP Blade (VSP G1000, G1500, and VSP F1500)	MP blade for the external volume. • Range is from MPB0 to MPB7. • Auto (default): The blade is automatically selected by the system. • If Auto cannot be selected, the blade with the lowest number is the default.
MP Unit ID (VSP Gx00 models and VSP Fx00 models)	MP unit ID for the external volume. • You can select MPU-10, MPU-11, MPU-20 or MPU-21. • Auto (default): The unit is automatically selected by the system. • If Auto cannot be selected, the unit with the lowest number is the default.

Related concepts

- External volume policy settings and functions on page 76

Related tasks

- Editing mapping policies for external volumes on page 78

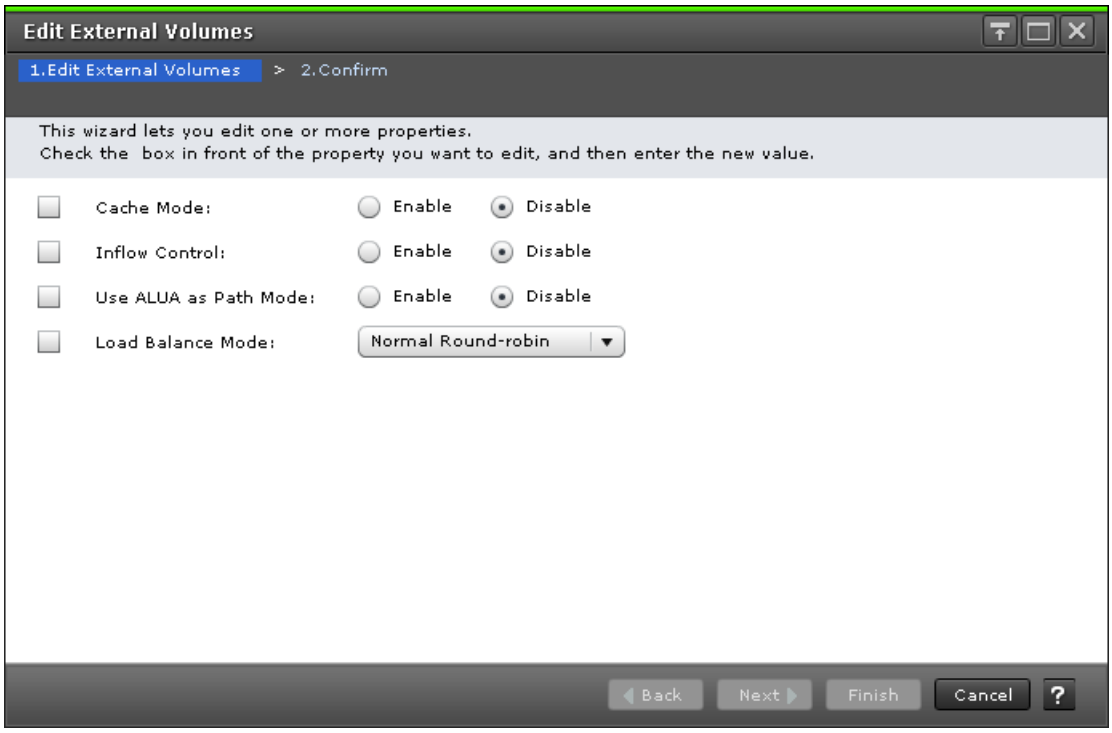
Edit External Volumes wizard

Use this wizard to change settings for a mapped external volume.

The windows in the wizard are:

- Edit External Volumes window on page 180
- Edit External Volumes confirmation window on page 182

Edit External Volumes window



Item	Description
Cache Mode	• Enable: Write data from the host is propagated asynchronously. • Disable: Write data from the host is propagated synchronously. See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed. • Disable: Allows write data to be written to cache when the write operation cannot be performed.
Use ALUA as Path Mode	Select whether ALUA is used as the Path Mode. • Enable: Enables ALUA mode. • Disable: Disables ALUA mode. The value that is set for the selected external volume is used as the default. If two or more external volumes with different values are selected, the item is placed in non-selected status. If the ALUA mode cannot be set for the selected external volume, Enable cannot be selected.
Load Balance Mode	Select I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O.

Item	Description
	• Disable: Performs I/O operation with a single path, without load balance. The value that is set for the selected external volume is used as the default. If two or more external volumes with different values are selected, the item is placed in non-selected status.

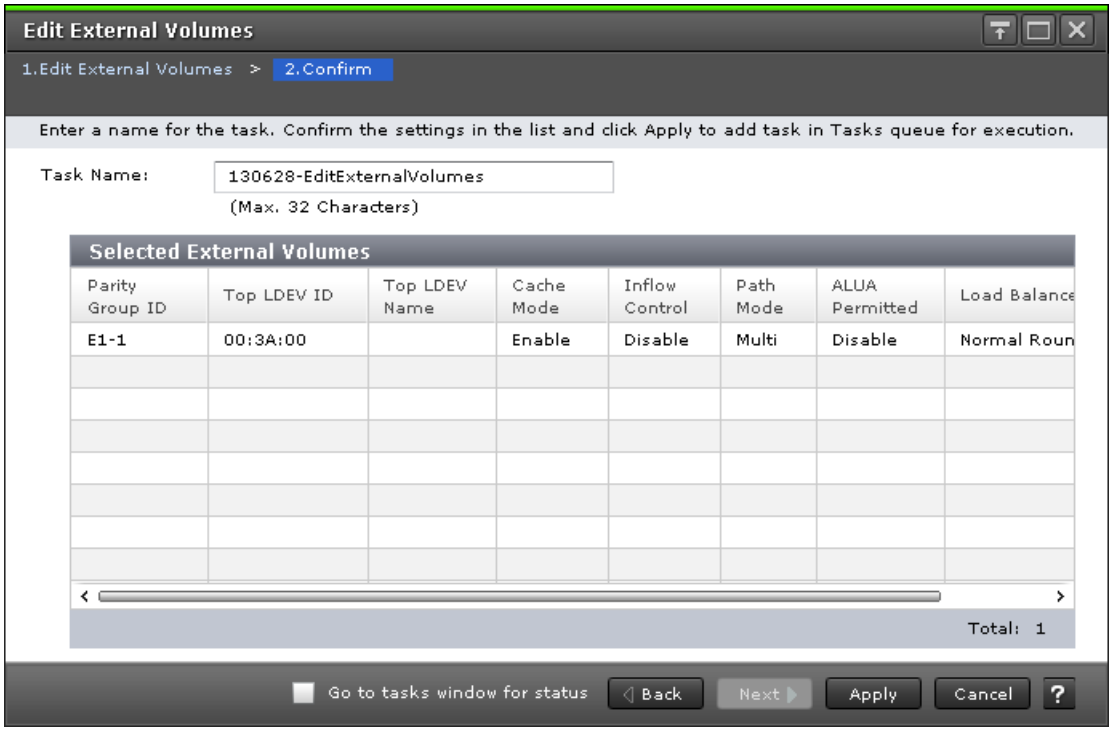
Related concepts

- External volume policy settings and functions on page 76

Related tasks

- Editing mapping policies for external volumes on page 78

Edit External Volumes confirmation window



Item	Description
Parity Group ID	Displays parity group numbers.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Cache Mode	• Enable: Write data from the host is propagated asynchronously

Item	Description
	• Disable: Write data from the host is propagated synchronously When nondisruptive migration is specified as the Attribute, the cache modes are displayed. • Through: Transfers write and read requests from the host to the external storage system. The local system's cache is not used. • Write Sync: Reflects write data from the host to the external storage system synchronously. If read or write is performed while data is being written to the external storage system, the read or write operation waits until the ongoing write operation is completed. • Check Condition (VSP Gx00 models and VSP Fx00 models): Indicates that write or read commands from the host were rejected. • Pending (VSP Gx00 models and VSP Fx00 models): Holds write and read commands from the host. While cache mode operations are in progress, status is reported for cache mode changes. • (Changing): Transition to the displayed cache mode is in progress. • (Error): Transition to the displayed cache mode has failed and maintenance work is required. See Cache use and external storage performance on page 34 for more information.
Inflow Control	• Enable: Limits or prevents write data from being written to cache memory when the write operation cannot be performed. • Disable: Allows write data to be written to cache when the write operation cannot be performed.
Path Mode	Displays the external path of the external volume. • Single: One external path is used, with alternate paths available in case of failure. • Multi: Multiple paths are used at the same time. • ALUA: Like Multi, all paths are used; however, they are not used when connected to ports in Passive status. For more information, see External paths on page 36.
ALUA Permitted	Displays whether ALUA can be set as the Path Mode in the local storage system. • Enable: ALUA Mode is used. • Disable: ALUA Mode is not used.
Load Balance Mode	Displays I/O load balance system for external storage system. • Normal Round-robin: Performs load balance in round-robin system. • Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. • Disable: Performs I/O operation with a single path, without load balance.

Related concepts

- External volume policy settings and functions on page 76

Related tasks

- Editing mapping policies for external volumes on page 78

Edit External Path Configuration wizard

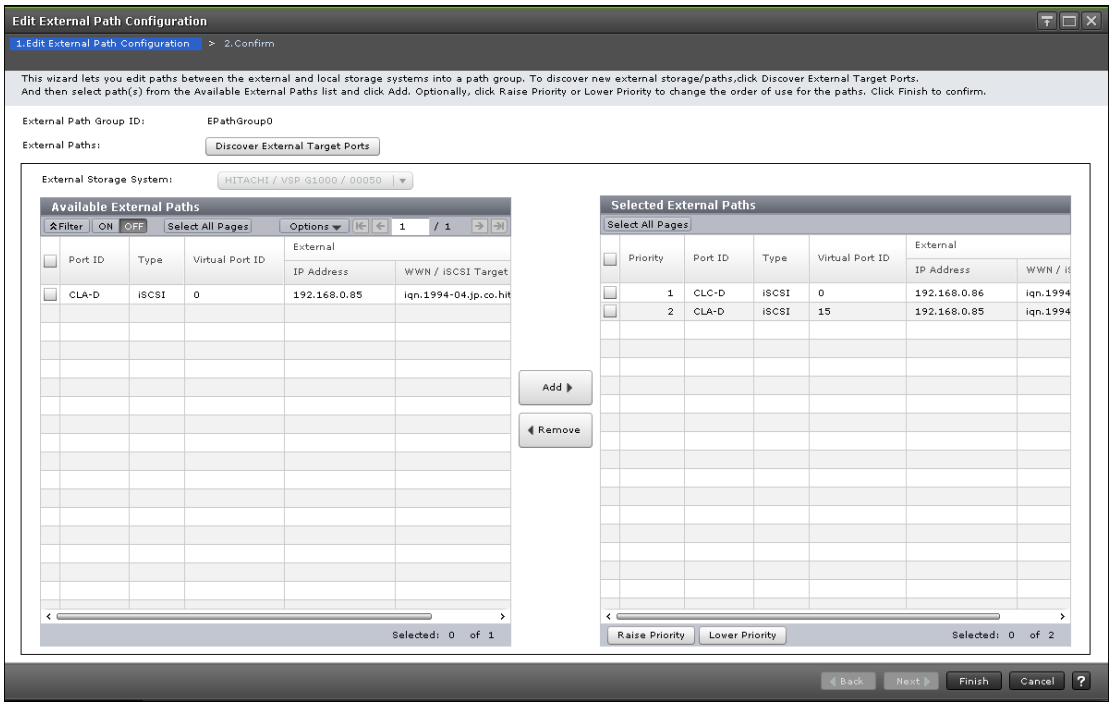
Use this wizard to add and remove external paths to a path group, and to raise and lower path priority.

See Adding an external path to an existing path group on page 83 for instructions.

The windows in the wizard are:

- Edit External Path Configuration window on page 184
- Edit External Path Configuration confirmation window on page 187

Edit External Path Configuration window

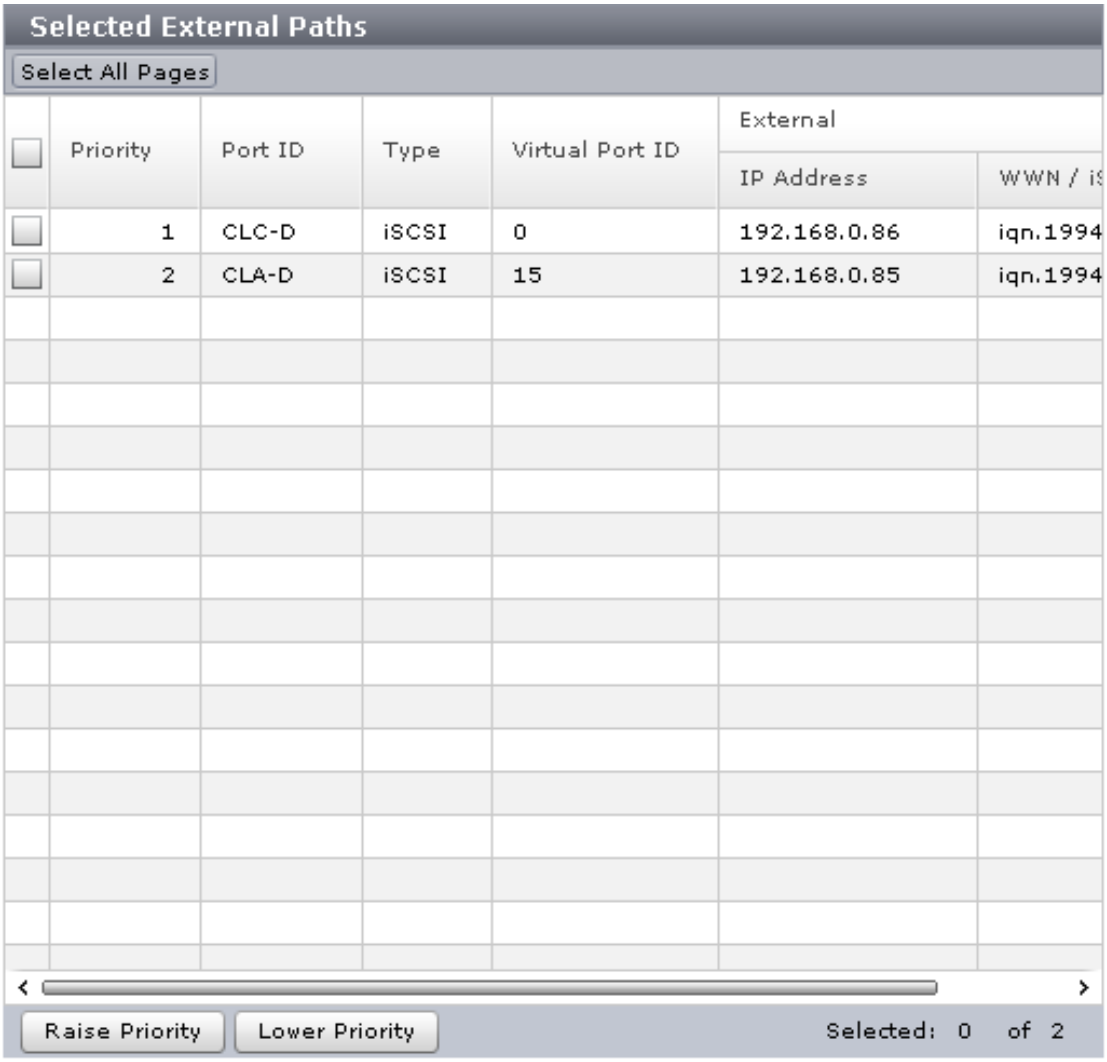


Only the external paths that are connected with the port assigned to the user are displayed.

Item	Description
External Path Group ID	Name of the external path group.
External Paths	External path information.

Item	Description
Discover External Target Ports	When clicked, opens the Discover External Target Ports window, which lists available external ports.
External Storage System	The external system selected (greyed out). If no system was selected, allows you to select the system from a list.
Available External Paths	
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.
Add	When clicked, moves the selected paths to the Selected External Paths list.
Remove	When clicked, removes the selected paths from the Selected External Paths.

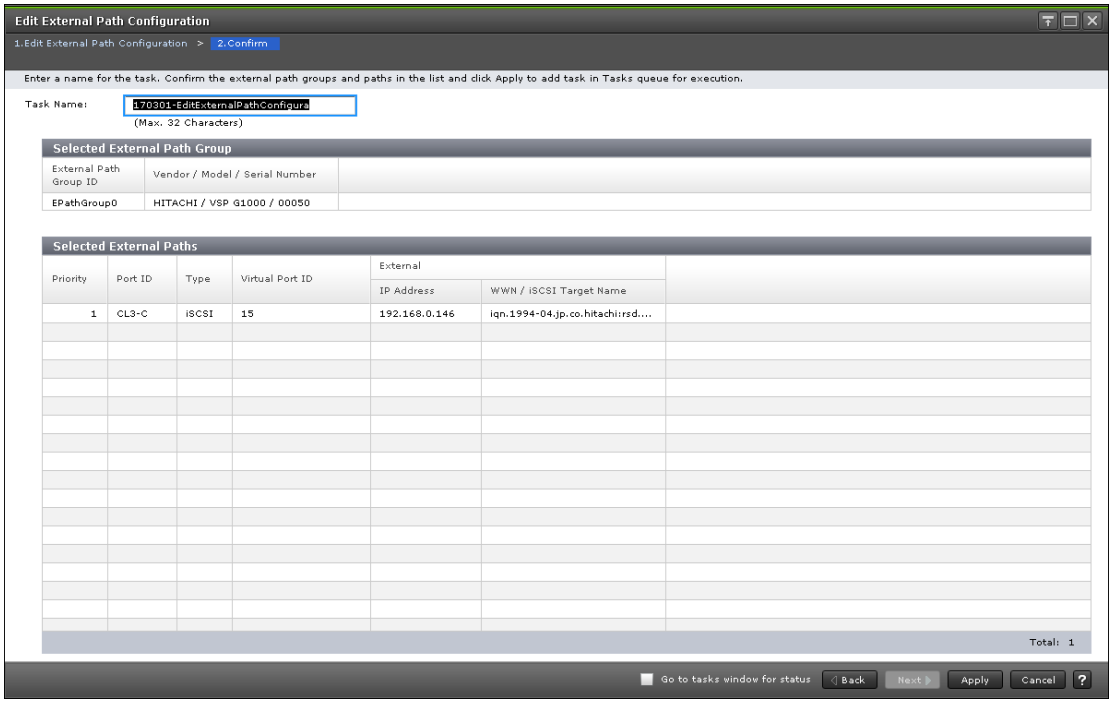
Selected External Paths



Item	Description
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.

Item	Description
Raise Priority	Raise the priority of the selected external path.
Lower Priority	Lower the priority of the selected external path.

Edit External Path Configuration confirmation window



Item	Description
Task Name	Identifies the operation within the system when Apply is clicked. Allows you to track the status of the operation.
External Path Group ID	Displays the name of the external path group.
Vendor / Model / Serial Number	Identifying information for the external system.
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about the target port of the external storage system. • IP Address: Displays the target port IP address when the port type is an iSCSI port.

Item	Description
	• WWN / iSCSI Target Name: Displays the WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.

Edit External WWNs wizard

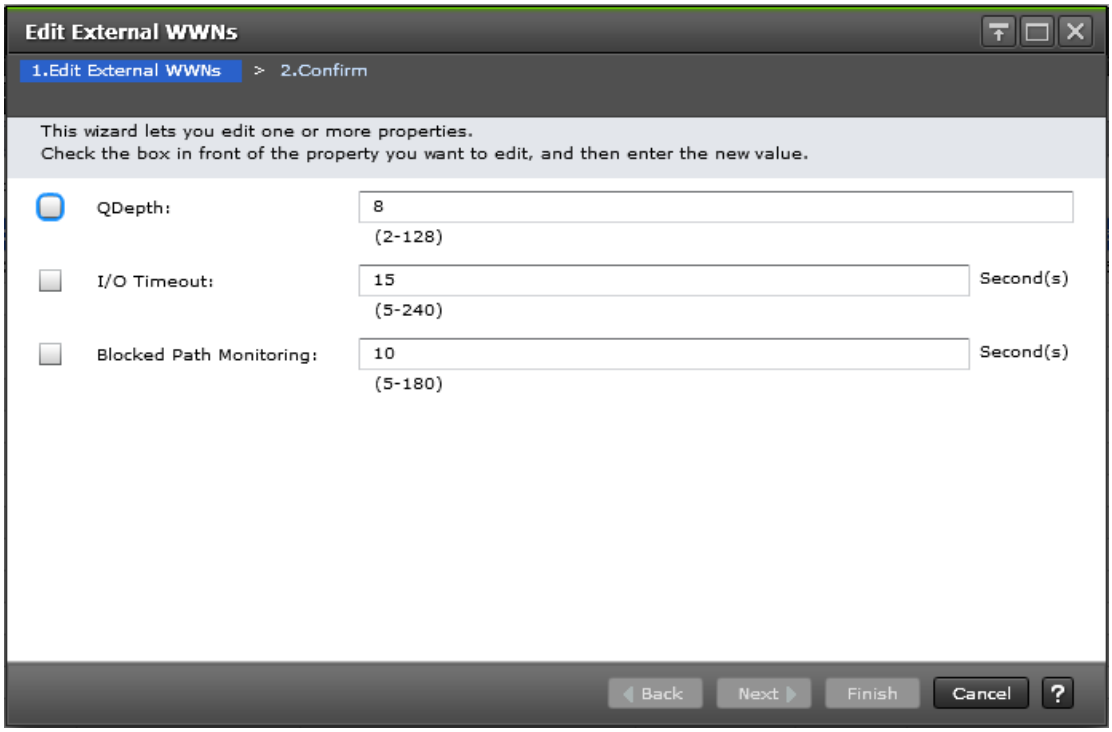
Use this wizard to change the external system's WWN port setting.

See Changing the port settings of an external storage system on page 81 for instructions.

The windows in the wizard are:

- Edit External WWNs window on page 188
- Edit External WWNs confirmation window on page 189

Edit External WWNs window



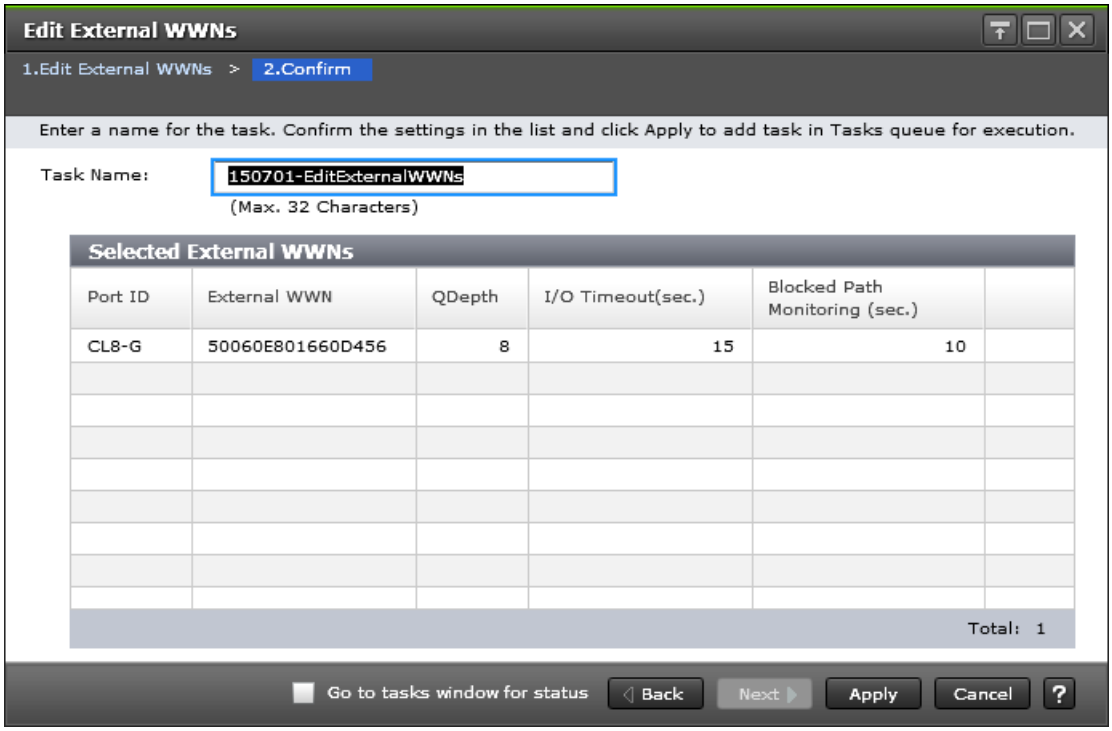
Item	Description
QDepth	Number of Read/Write commands that can be queued to the external volume. The numbers 2 through 128 can be entered.

Item	Description
	When two or more external paths with different values are selected, the field is blank. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout	Number of seconds that should pass before I/O to the external volume times out. The numbers 5 through 240 can be entered. When two or more external paths with different values are selected, the field is blank.
Blocked Path Monitoring	Time that elapses from the time that a path goes down to the time when the external volume is blocked. The numbers 5 through 180 can be entered. When two or more external paths with different values are selected, the field is blank.

Caution: If you want to change multiple parameters for an external WWN more than once, wait until the currently applied task finishes, and then perform the next setting change.

If you make a setting change for the next task before completing the last, the setting will be applied to the next task only. The result might be different from what you expected.

Edit External WWNs confirmation window



Item	Description
Port ID	Displays the external port of the local storage system.
External WWN	Displays the WWN of the external storage system. The external WWN shows the target port.
QDepth	Number of Read/Write commands that can be queued to the external volume. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout(sec.)	Number of seconds that should pass before I/O to the external volume times out.
Blocked Path Monitoring (sec.)	Time that will elapse from the time that a path goes down to the time when the external volume is blocked.

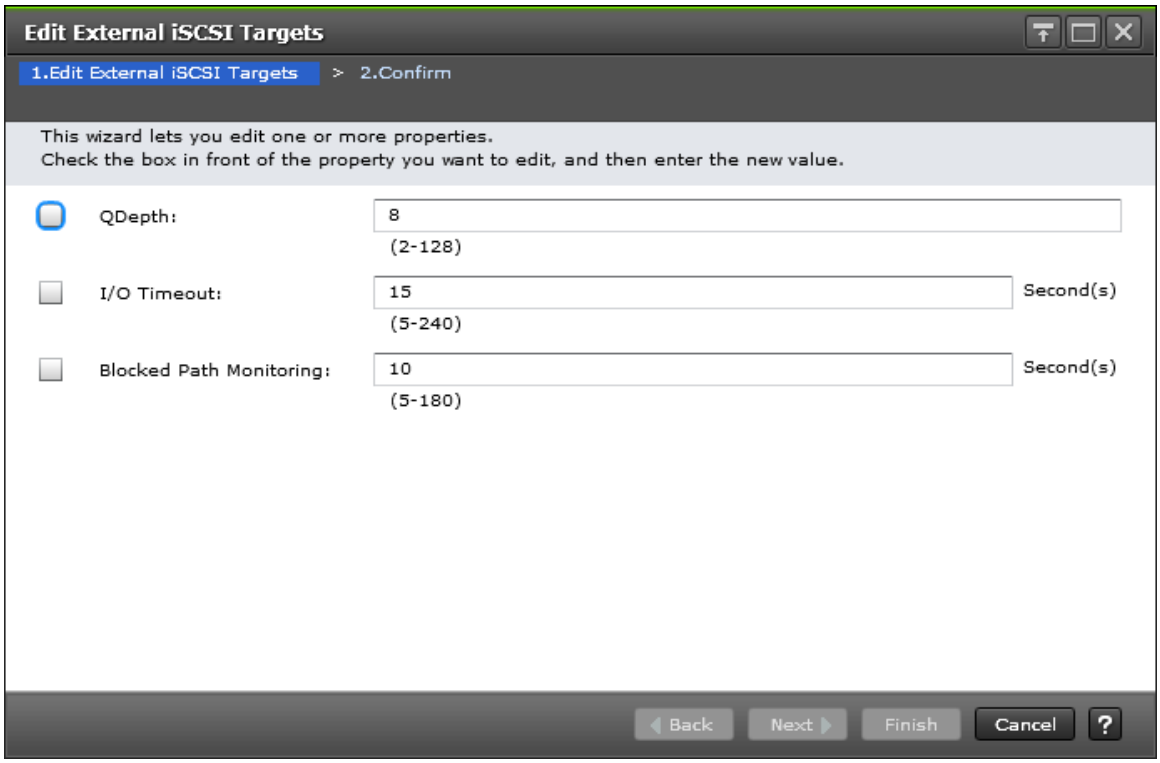
Edit External iSCSI Targets wizard

Use this wizard to change the external iSCSI targets. See Changing the port settings of an external storage system on page 81 for instructions.

The windows in the wizard are:

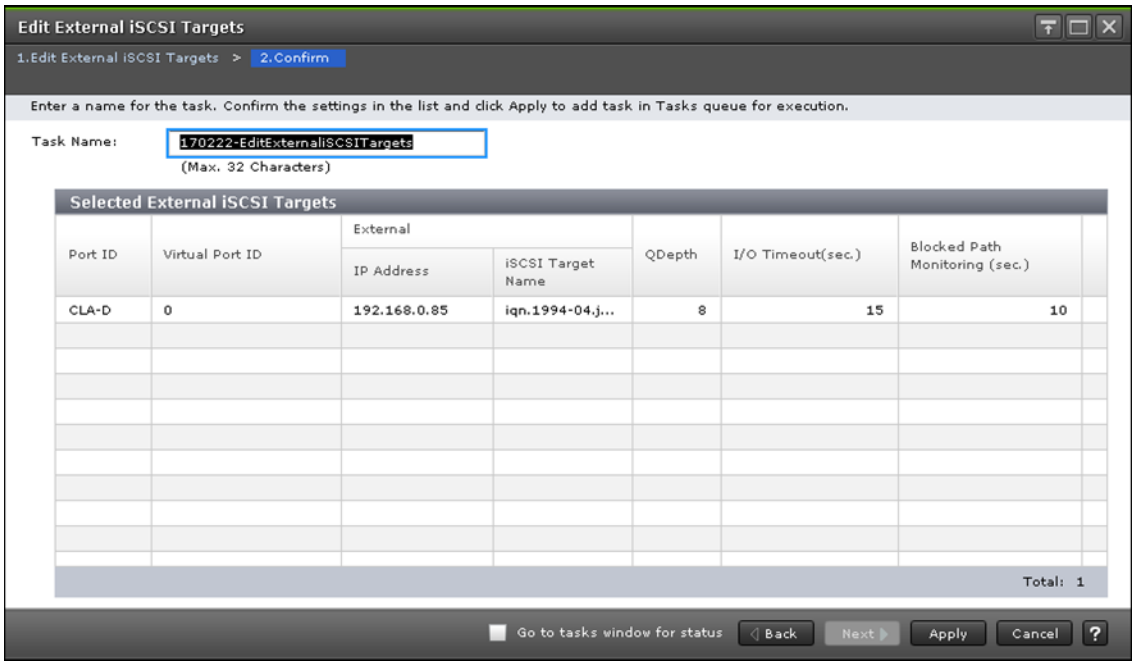
- Edit External iSCSI Targets window on page 190
- Edit External iSCSI Targets confirmation window on page 191

Edit External iSCSI Targets window



Item	Description
QDepth	Number of Read/Write commands that can be queued to the external volume. The numbers 2 through 128 can be entered. When two or more external paths with different values are selected, the field is blank. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout	Number of seconds that should pass before I/O to the external volume times out. The numbers 5 through 240 can be entered. When two or more external paths with different values are selected, the field is blank.
Blocked Path Monitoring	Time that elapses from the time that a path goes down to the time when the external volume is blocked. The numbers 5 through 180 can be entered. When two or more external paths with different values are selected, the field is blank.

Edit External iSCSI Targets confirmation window



Item	Description
Port ID	Displays the port connected to the external storage system for the local storage system.
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the target port information for the external storage system. • IP Address: Displays the IP address of the target port. • iSCSI Target Name: Displays the iSCSI target name of the target port.
QDepth	Number of Read/Write commands that can be queued to the external volume. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout(sec.)	Number of seconds that should pass before I/O to the external volume times out.
Blocked Path Monitoring (sec.)	Time that will elapse from the time that a path goes down to the time when the external volume is blocked.

Delete External Volumes wizard

Use this wizard to delete external volume mapping.

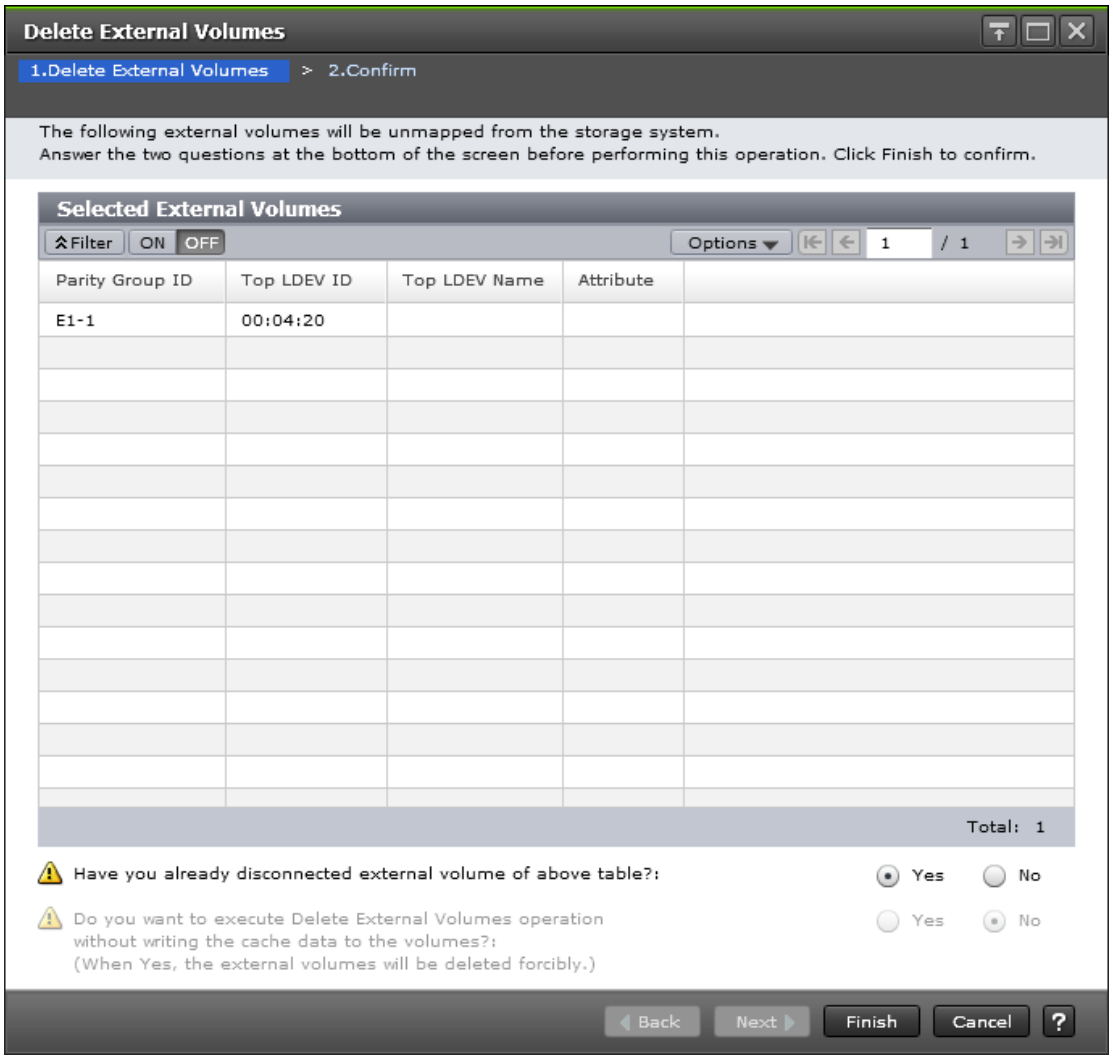
See Deleting an external volume mapping on page 95 for instructions.

The windows in the wizard are:

- Delete External Volumes window on page 193

- Delete External Volumes confirmation window on page 194

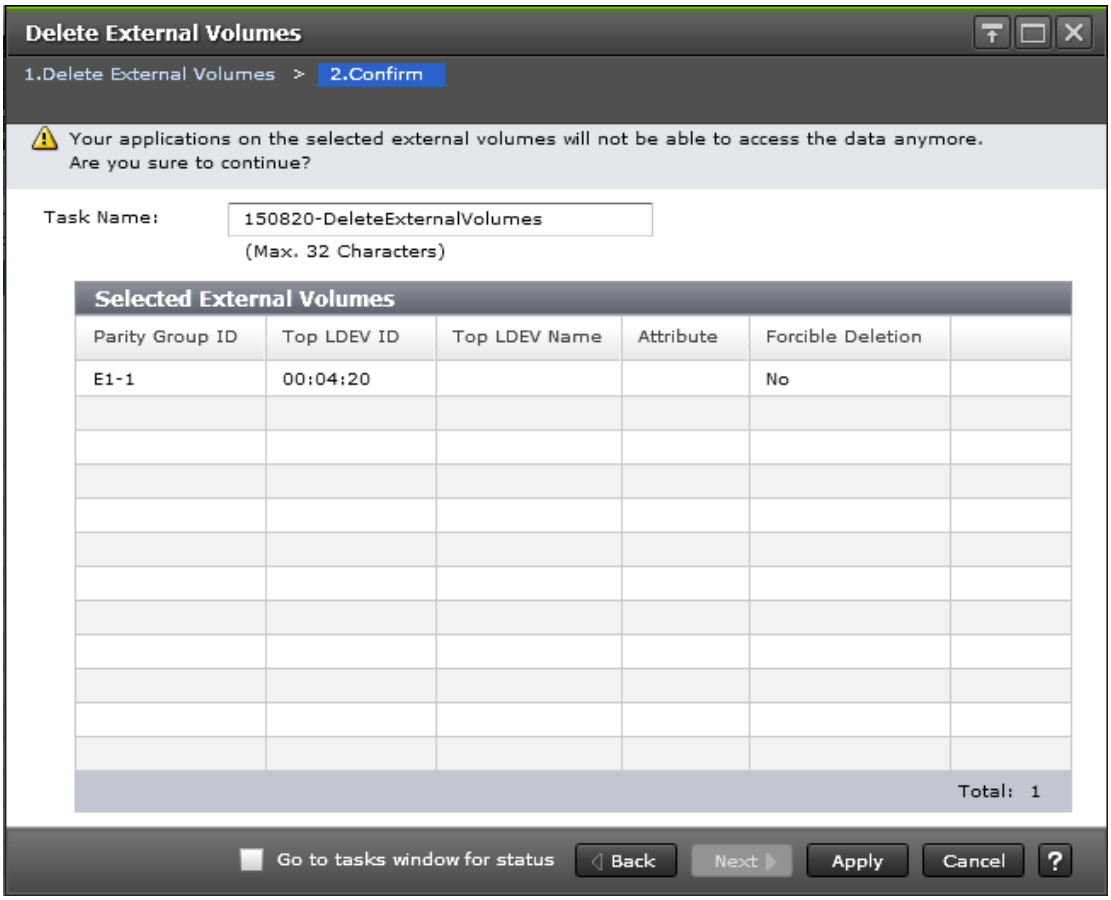
Delete External Volumes window



Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Attribute	External volume's attribute.
Have you already disconnected the external volume of the above table?	• Yes: Select if you have disconnected the external volume you want to delete. This is the default. • No: Select if you have not disconnected the external volume you want to delete.

Item	Description
Do you want to execute the Delete External Volumes operation without writing the cache data to the volumes?	• Yes: For deleting the external volumes without writing the data in cache memory into the volumes. • No: If selected, the operation cannot be completed. This is the default.

Delete External Volumes confirmation window



Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID.
Top LDEV Name	External volume's top LDEV name.
Attribute	External volume's attribute.
Forcible Deletion	Yes: The external volume will be forcibly deleted even if the connection to the external volume has not been disconnected.

Item	Description
	No: The external volume will be deleted after confirming that the connection to the external volume is disconnected.

Disconnect External Paths wizard

Use this wizard to disconnect external paths.

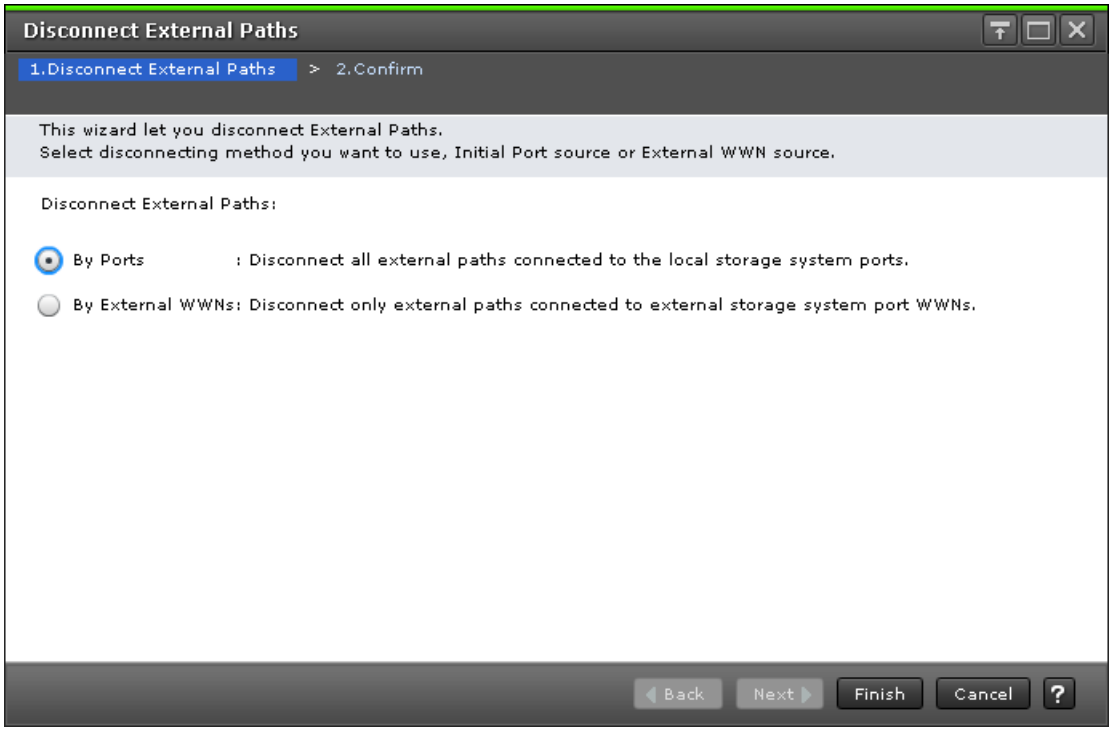
See Disconnecting an external path on page 86 for instructions.

The windows in the wizard are:

- Disconnect External Paths window on page 195
- Disconnect External Paths confirmation window on page 196

Disconnect External Paths window

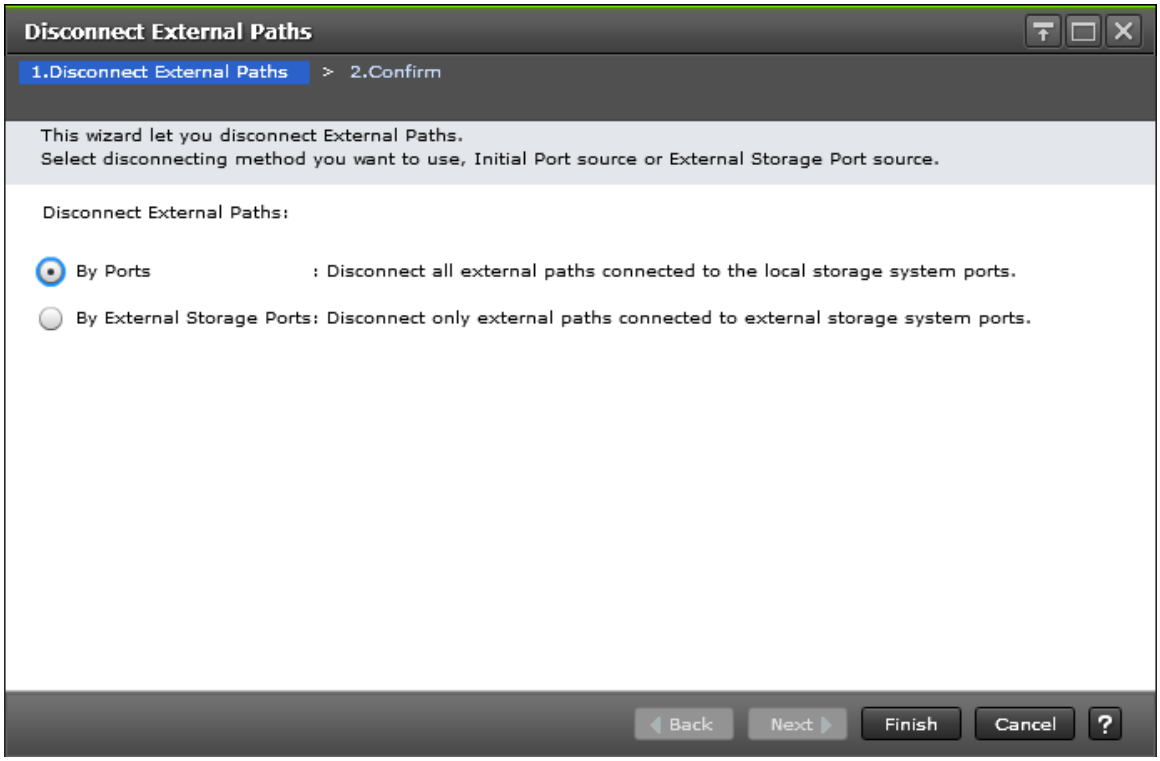
For Fibre Channel ports



Item	Description
Disconnect External Paths	• By Ports (default): Stops use of all the external paths connected to the specified port in the local system.

Item	Description
	• By External WWNs: Stops the use of all the external paths connected to the specified WWNs (ports) in the external system.

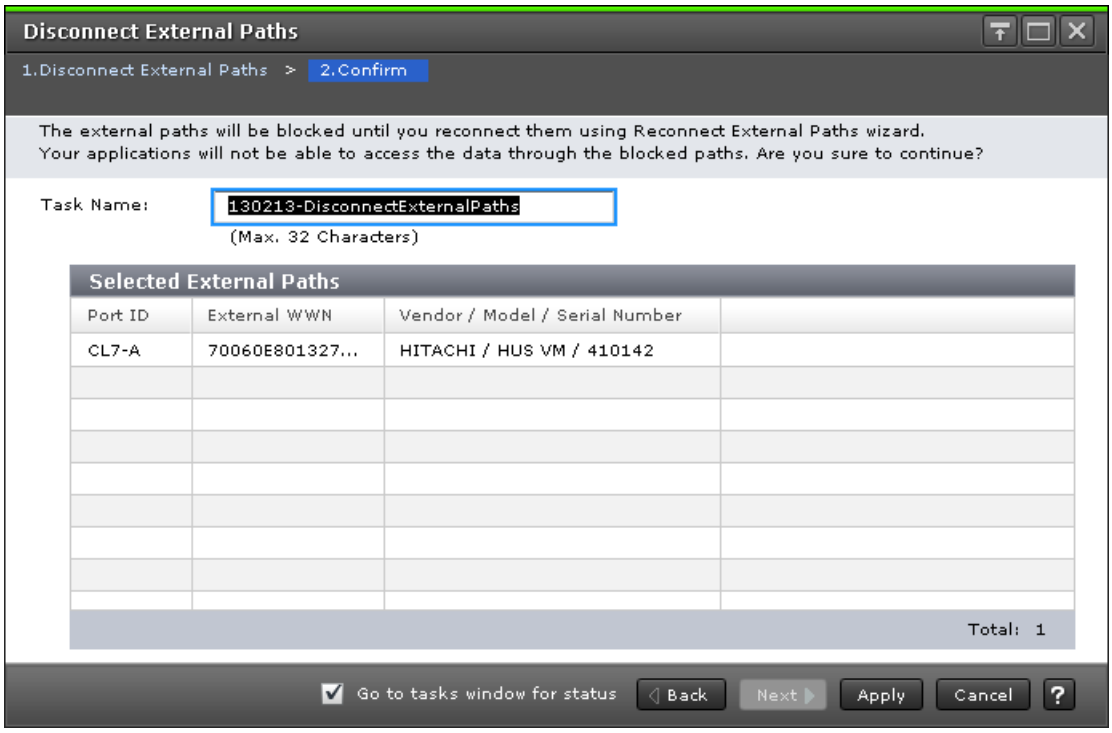
For iSCSI ports



Item	Description
Disconnect External Paths	• By Ports (default): Stops the use of all the external paths connected to the specified port in the local system. • By External Storage Ports: Stops use of all the external paths connected to the external system.

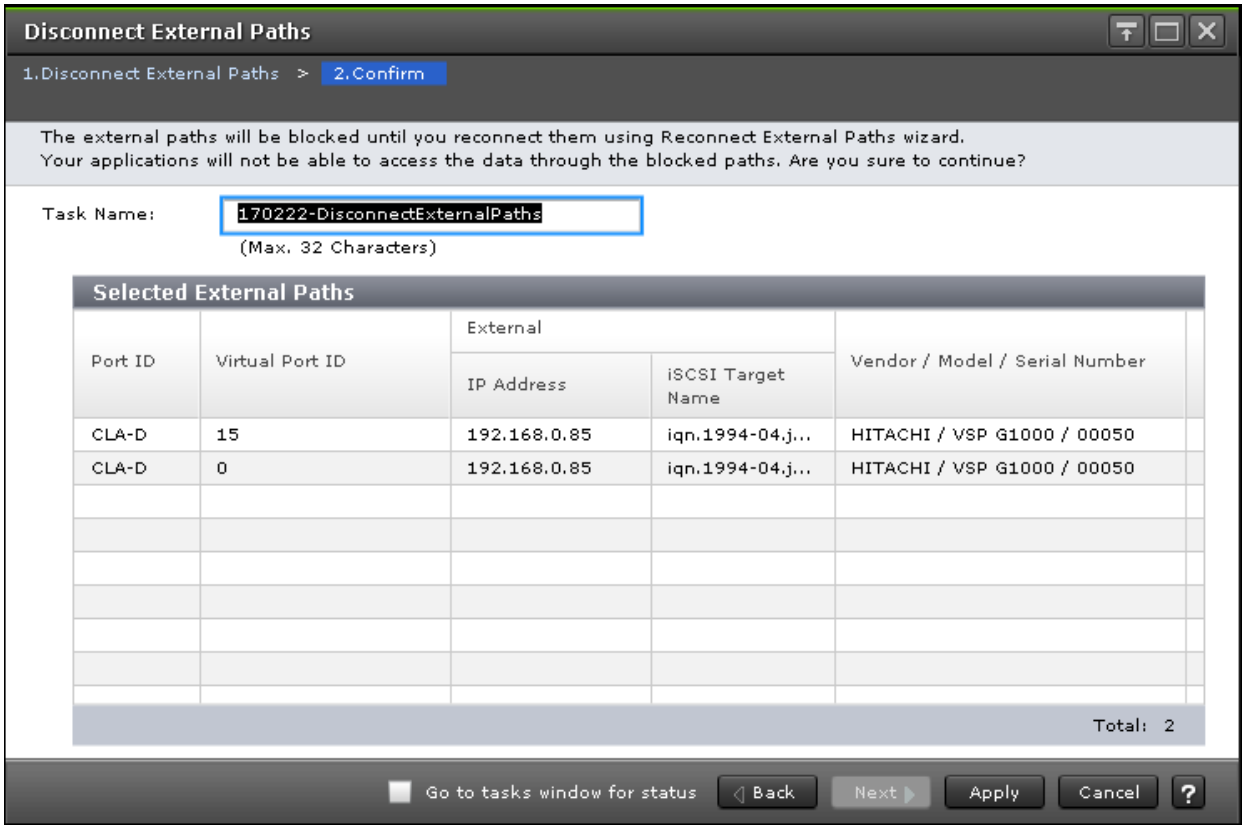
Disconnect External Paths confirmation window

For Fibre Channel ports



Item	Description
Port ID	Displays the external port of the local storage system.
External WWN	Displays the WWN of the external storage system. The external WWN shows the target port.
Vendor / Model / Serial Number	Identifying information for the external system.

For iSCSI ports



Item	Description
Port ID	Displays the external port of the local storage system.
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the target port information for the external storage system. • IP Address: Displays the IP address of the target port. • iSCSI Target Name: Displays the iSCSI target name of the target port.
Vendor / Model / Serial Number	Identifying information for the external system.

Reconnect External Paths wizard

Use this wizard to reconnect external paths.

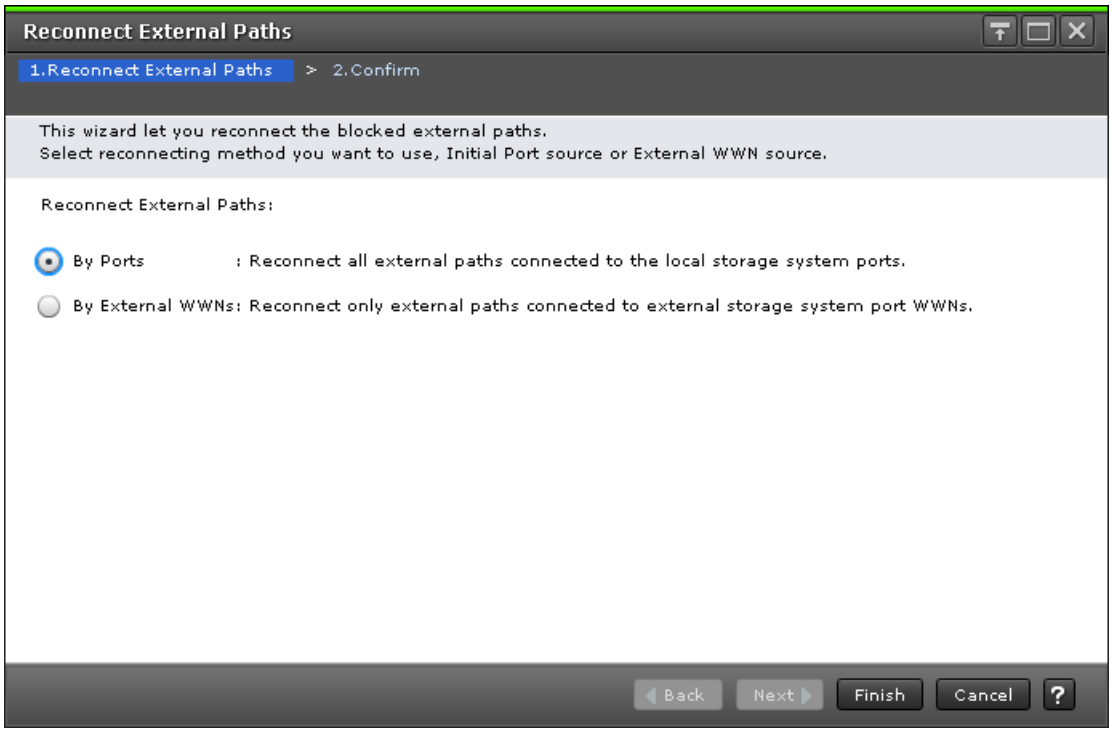
See Reconnecting an external path on page 88 for instructions.

The windows in the wizard are:

- Reconnect External Paths window on page 199
- Reconnect External Paths confirmation window on page 200

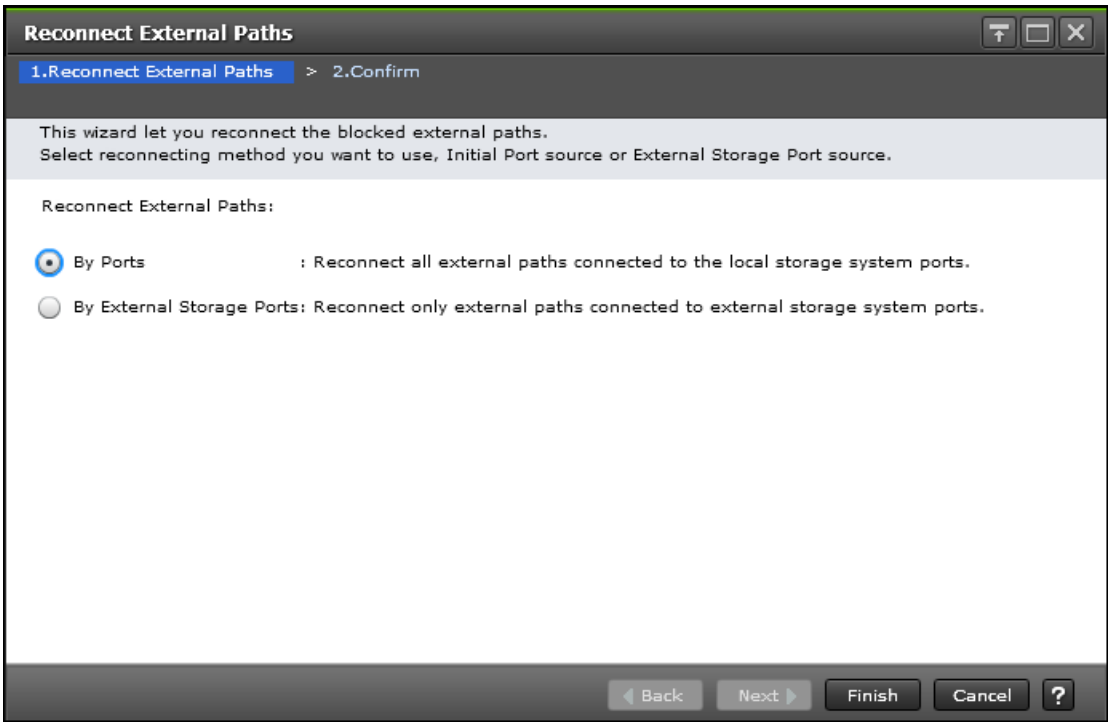
Reconnect External Paths window

For Fibre Channel ports



Item	Description
Reconnect External Paths	• By Ports (default): Reconnects all external paths connected to the specified port in the local system. • By External WWNs : Reconnects all external paths connected to the specified WWNs in the external system.

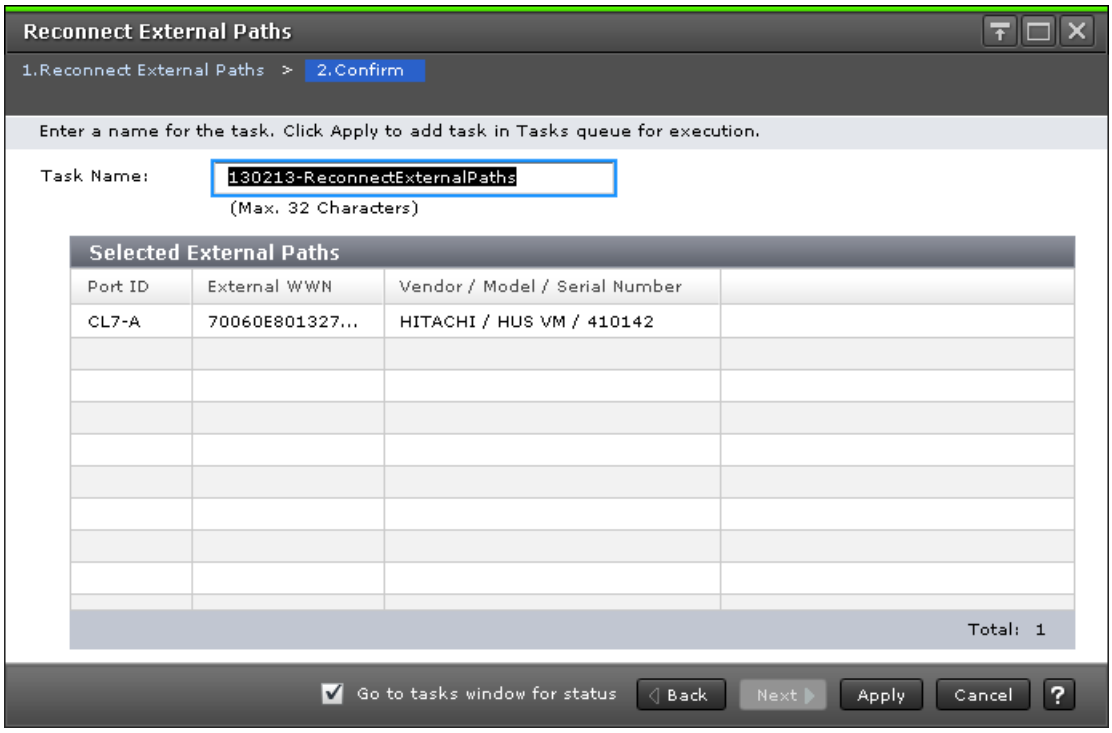
For iSCSI ports



Item	Description
Reconnect External Paths	• By Ports (default): Reconnects all external paths connected to the specified port in the local system. • By External Storage Ports: Reconnects all external paths connected to the specified ports in the external system.

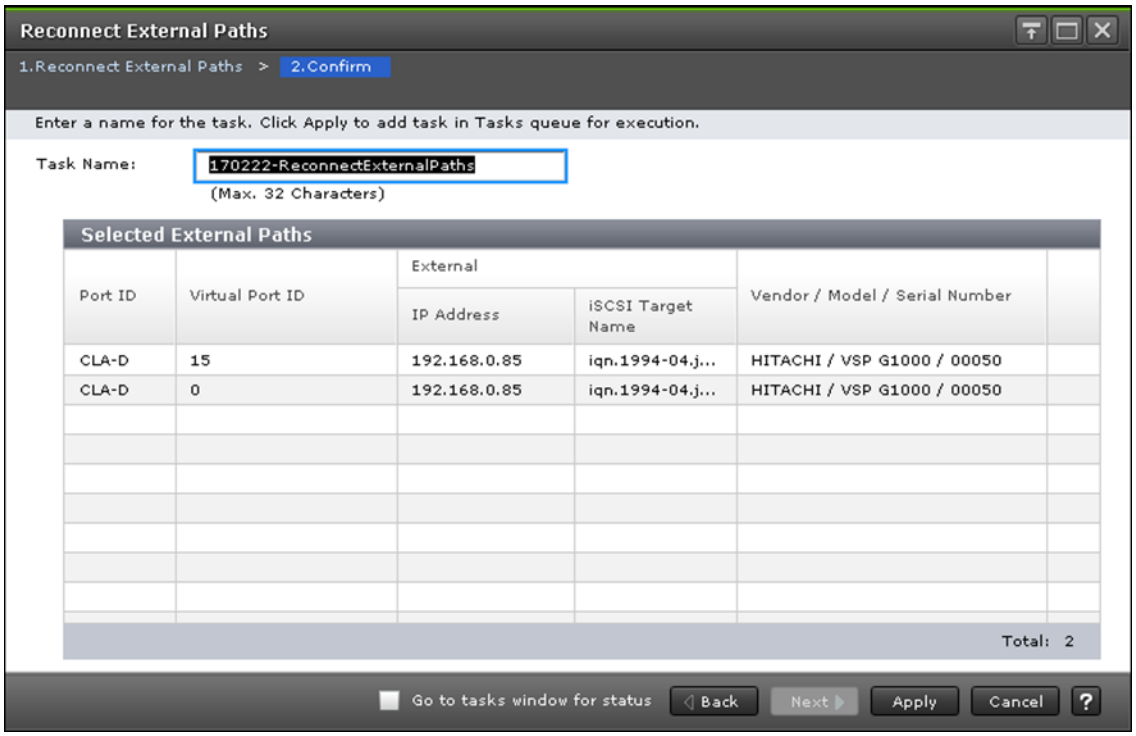
Reconnect External Paths confirmation window

For Fibre Channel ports



Item	Description
Port ID	Displays the external port of the local storage system.
External WWN	Displays the WWN of the external storage system. The external WWN shows the target port.
Vendor / Model / Serial Number	Identifying information for the external system.

For iSCSI ports



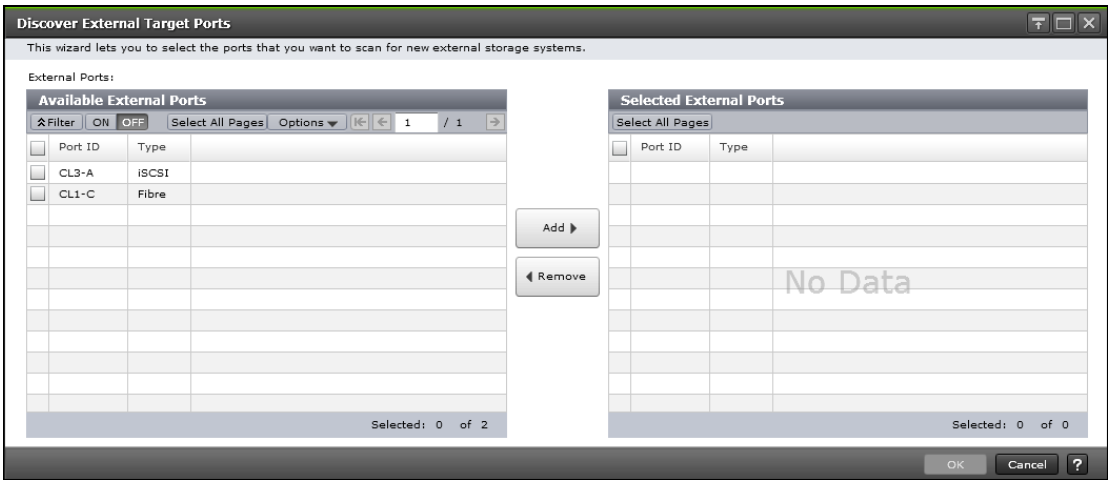
Item	Description
Port ID	Displays the external port of the local storage system.
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the target port information for the external storage system. • IP Address: Displays the IP address of the target port. • iSCSI Target Name: Displays the iSCSI target name of the target port.
Vendor / Model / Serial Number	Identifying information for the external system.

Discover External Target Ports window

Use this window to add or remove external ports for the external path.

This window is used in the following operations:

- Mapping an external volume on page 67
- Adding an external path to an existing path group on page 83



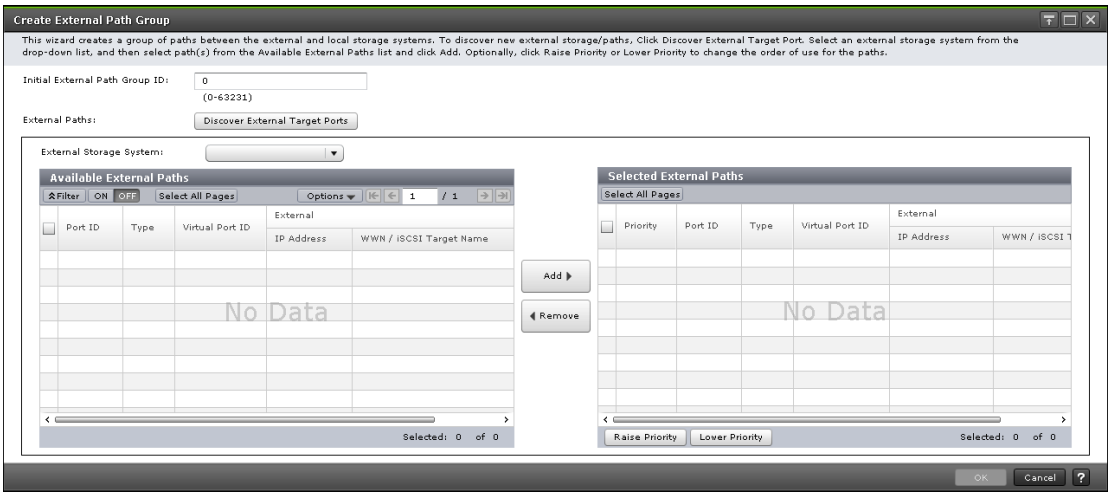
Only external ports assigned to the user display.

Item	Description
Port ID (In the list of available and selected external paths)	Port number in the local system connecting to the external system.
Type (In the list of available and selected external paths)	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Add	When clicked, moves selected paths to the Selected External Ports list.
Remove	When clicked, removes the selected path from the Selected External Ports list.

Create External Path Group window

Use this window to create a new external path group.

This window is used in the operation, Mapping an external volume on page 67.



Only paths with ports assigned to the user can display.

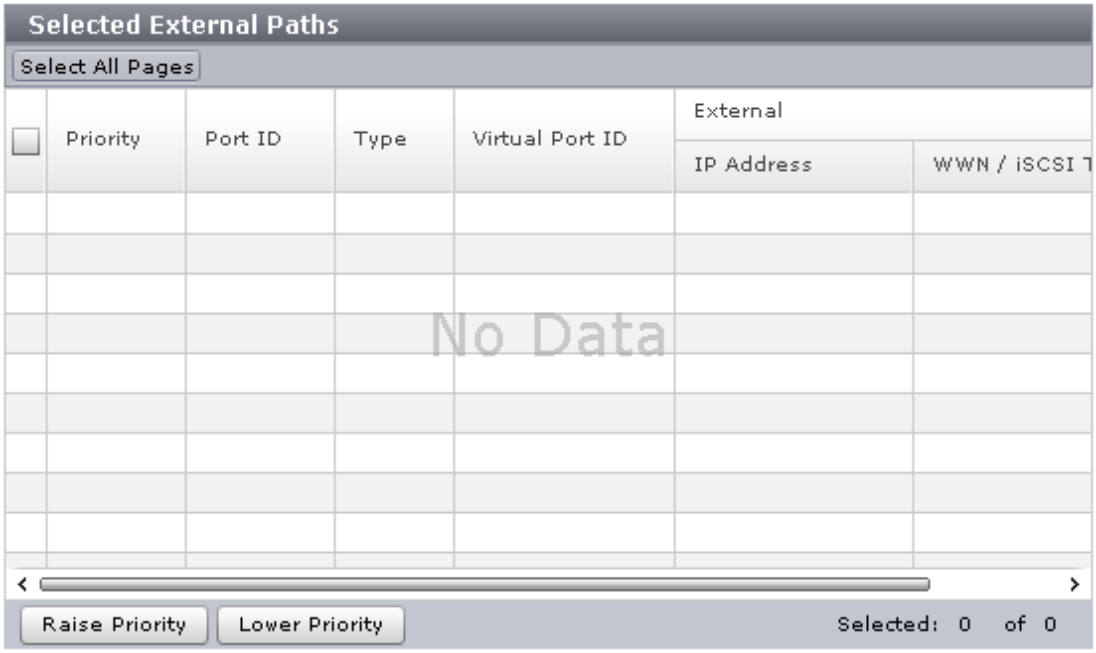
Item	Description
Initial External Path Group ID	An initial ID for the path group. The storage system searches IDs in ascending order from this value and allocates an ID that can be used. Range of values: • VSP G200: 0 to 2,047 • VSP G400, G600, VSP F400, F600: 0 to 4,095 • VSP G800, VSP F800: 0 to 14,079 • VSP G1000, VSP G1500, VSP F1500: 0 to 63,231 The default is 0.
Discover External Target Ports	When clicked, opens the **Discover External Target Ports** window.
External Storage System	The external system selected (greyed out). If no system was selected, allows you to select the system from a list.

Available External Paths

Item	Description
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about external storage system's target port. • IP Address: Displays the target port IP address when port type is iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when port type is Fibre Channel port. If the port type is iSCSI port, iSCSI target name is displayed.

Item	Description
Add	When clicked, moves selected paths to the Selected External Paths list.
Remove	When clicked, removes the selected path from the Selected External Paths list.

Selected External Paths

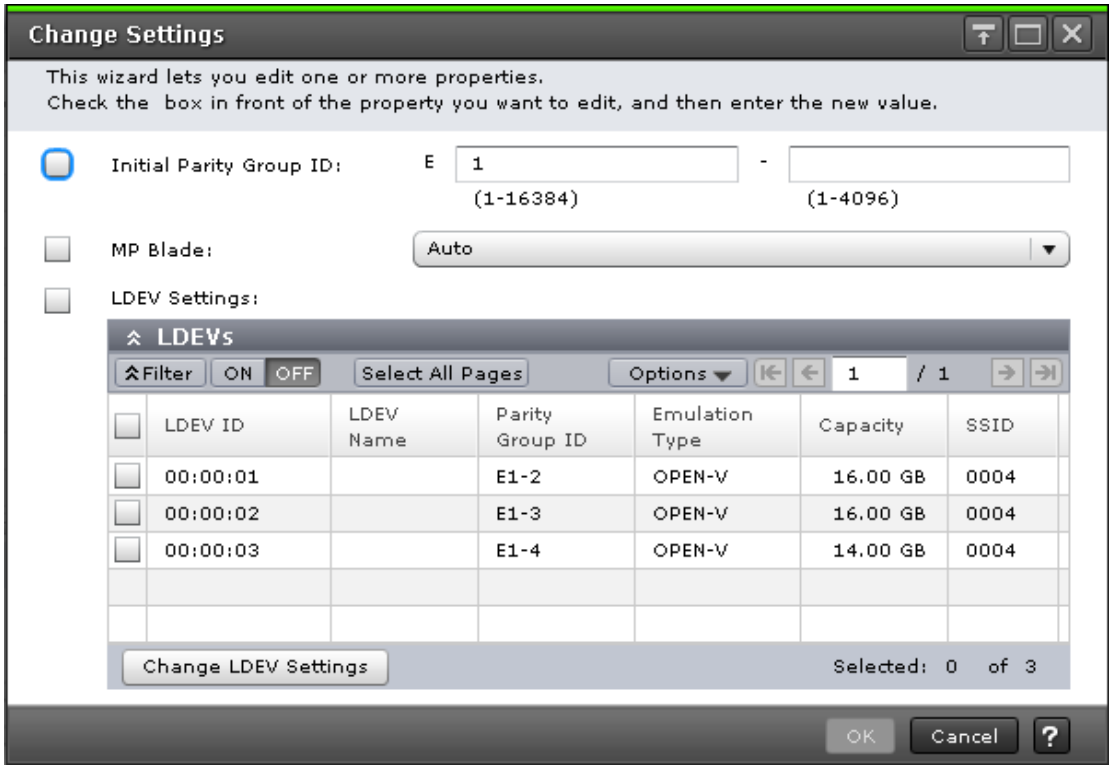


Item	Description
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about external storage system's target port. • IP Address: Displays the target port IP address when port type is iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when port type is Fibre Channel port. If the port type is iSCSI port, iSCSI target name is displayed.
Raise Priority	When clicked, raises the priority of the selected external path.
Lower Priority	When clicked, lowers the priority of the selected external path.

Change Settings window

Use this window to change the settings for selected external volumes.

This window is used in the operation, Mapping an external volume on page 67.

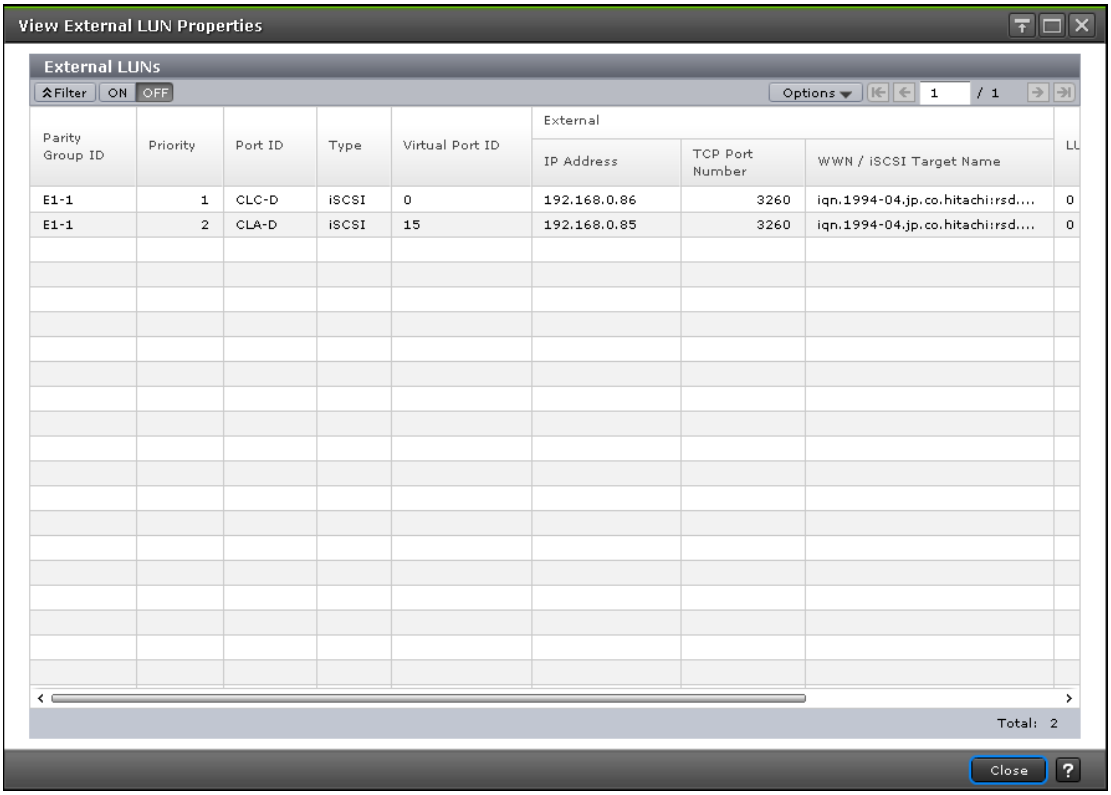


Item	Description
Initial Parity Group ID	An external volume group number and sequence number. Values range from 1 - 1 to 16384 - 4096. The default is the value set on the selected external volume. When two or more volumes with different values are selected, these fields are blank.
MP Blade (VSP G1000, G1500, and VSP F1500)	• Range is from MPB0 to MPB7, but depends on the system configuration. • Auto: You can select Auto when there are more than one MP blades whose auto assignment function is enabled. The default is the value set on the selected external volume. • If Auto cannot be selected, the blade with the lowest number is used. • When two or more volumes with different values are selected, this field is blank.

Item	Description
MP Unit ID (VSP Gx00 models and VSP Fx00 models)	• You can select MPU-10, MPU-11, MPU-20 or MPU-21. • Auto: You can select Auto when there are more than one MP units whose auto assignment function is enabled. The default is the value set on the selected external volume. • If Auto cannot be selected, the unit with the lowest number is used. • When two or more volumes with different values are selected, this field is blank.
LDEV Settings	If changes to LDEV settings are made, box must be checked to proceed.
LDEV ID	LDEV IDs allocated to the external volume.
LDEV Name	LDEV names.
Parity Group ID	Parity group numbers.
Emulation Type (VSP G1000, G1500, and VSP F1500)	LDEV emulation type.
Capacity	LDEV capacity.
SSID (VSP G1000, G1500, and VSP F1500)	SSIDs.
Resource Group Name (ID)	Name and ID of the resource group for the LDEV. ID is enclosed in parentheses.
Virtual Storage Machine	• Model / Serial Number: Model and serial number of the virtual storage machine for the LDEV. • Attribute: Virtual attribute of the LDEV. When the virtual attribute is not set, blank displays.
Change LDEV Settings	When clicked, opens the **Change LDEV Settings** window.

View External LUN Properties window

Use this window to view settings and other details about external LUNs.



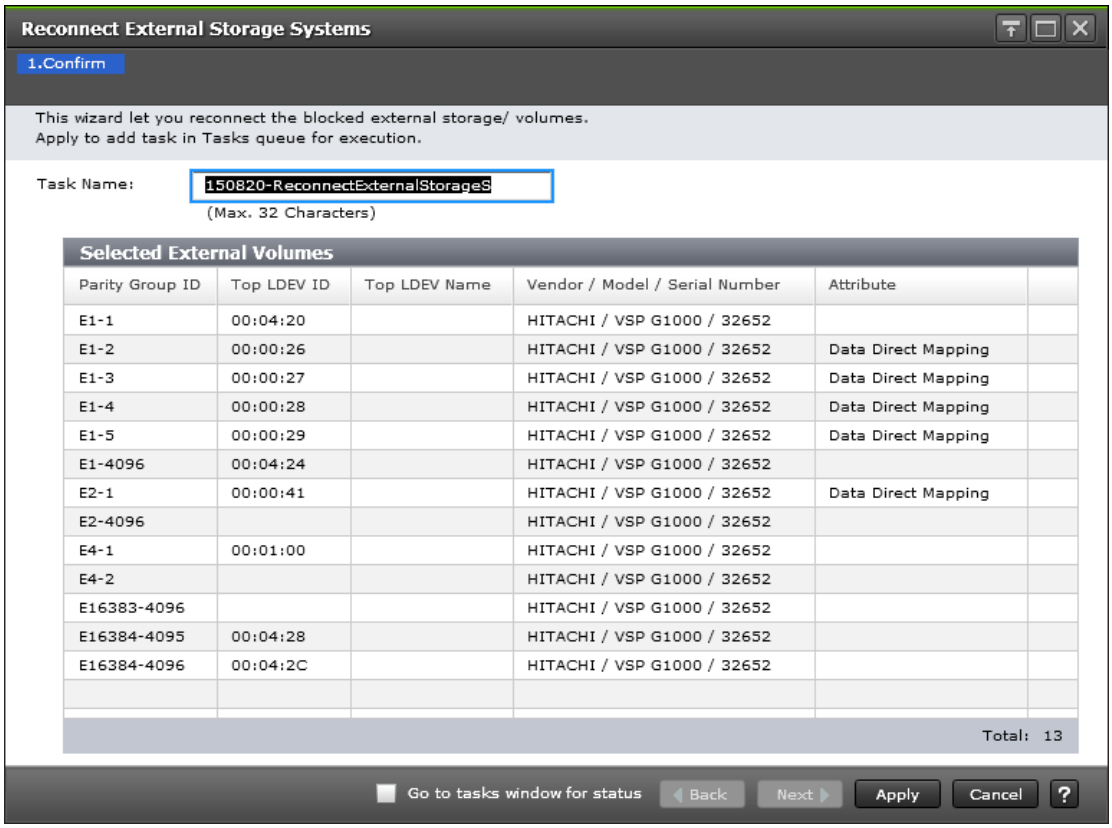
Item	Description
Parity Group ID	Parity group numbers.
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about external storage system's target port. • IP Address: Displays the target port IP address when port type is iSCSI port. • TCP Port Number: Displays the target TCP port number when port type is iSCSI port. • WWN / iSCSI Target Name: Displays the WWN to show the target port when port type is Fibre Channel port. If the port type is iSCSI port, iSCSI target name is displayed.
LUN ID	When the external path is connected to the selected external volume, the LUN ID displays.
Status	Status of external paths. • Unknown: The status of the mapping path is not known. • Checking: The system is checking the mapping path status. • Blockade: The mapping path is blocked. • Normal: There are no problems, the system is usable.

Item	Description
	• Disconnect: The external system or one of its mapped volumes has been intentionally disconnected. • External Device Setting Changed: An external system setting has been changed. For example, the path definition was deleted, or the external system itself was replaced by another device. • LDEV Size Reduced: The external volume's capacity was reduced. • Not Ready: The reply from the external system was NOT READY. • Illegal Request: The reply from the external system was ILLEGAL REQUEST. • Command Aborted: The reply from the external system was ABORTED COMMAND. • Busy: The external system is busy. • LDEV Reserved: The external system is reserved. • Response Error: The external system is blocked because of an abnormal reply. • Initiator Port: The port attribute of the external system has been changed to the initiator port. • Unknown Port: The port attribute of the external system is not known. • Cannot Detect Port: The path has been removed or the external system port cannot be found. • Timeout: Processing was retried because an abnormal reply was returned; however, processing has timed out. • Passive: The external system port is not active. Port status is normal but the port is not used for I/O. • Standby: The external system port is standing by. The port status is normal but cannot receive I/O. • Target Error: Port failures, such as controller blockade, are detected on the external system. • Unavailable: The reply from the external system was Unavailable. The external system demands to change the connected port. Once the status becomes Unavailable, the primary path is changed to an alternate path in Standby status. When the primary path is available, the status changes to Normal. • Backoff: The reply from the external system was Backoff. A temporary error has occurred in the external volume and the path is waiting for recovery. The primary path is not changed to the alternate path immediately. After recovery, the status changes to Normal. • Destage Failed: The writing of data from cache memory to the volume has failed.
Target Port Asymmetric Access State	When the path mode is ALUA, the port state of the external storage system displays. • Active/Optimized: The performance is in a good state. • Active/Non-Optimized: Data can be sent and received, but the performance is inferior to Active/Optimized. A space displays in one of the following cases: • The path mode is other than ALUA. • Mapping of an external volume is not completed.

Reconnect External Storage Systems window

Use this window to reconnect the external storage system.

For details, see Reconnecting external systems and volumes on page 97.

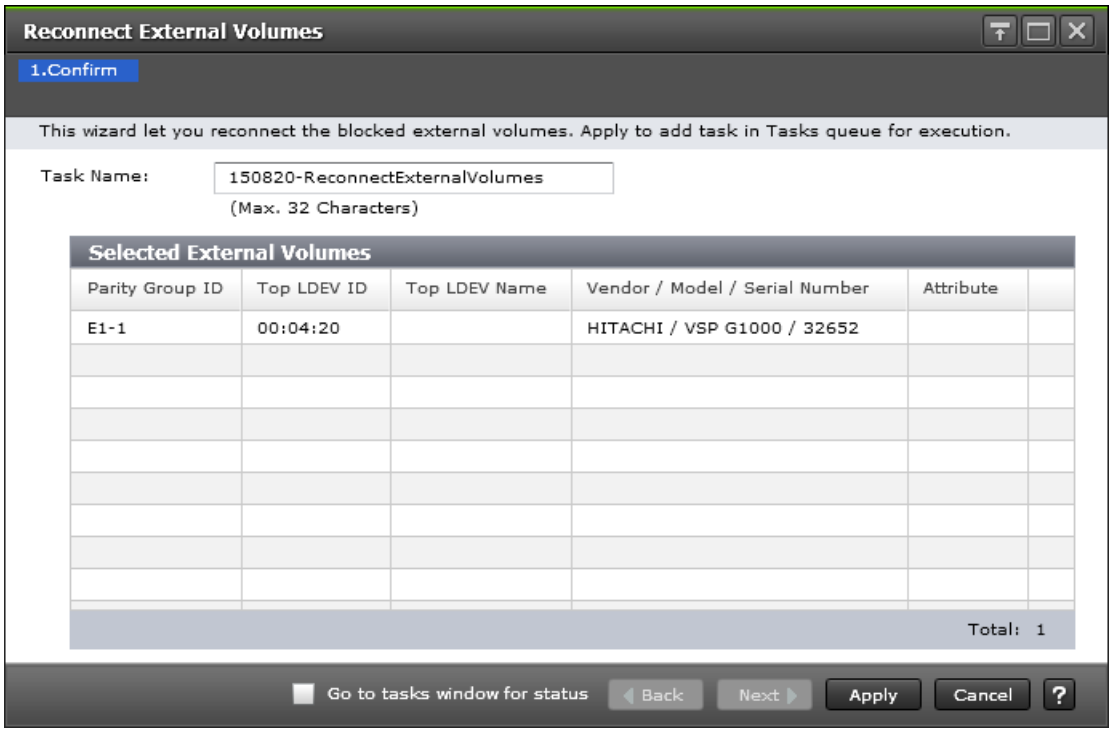


Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external system.
Attribute	External volume's attribute.

Reconnect External Volumes window

Use this window to reconnect the external volume.

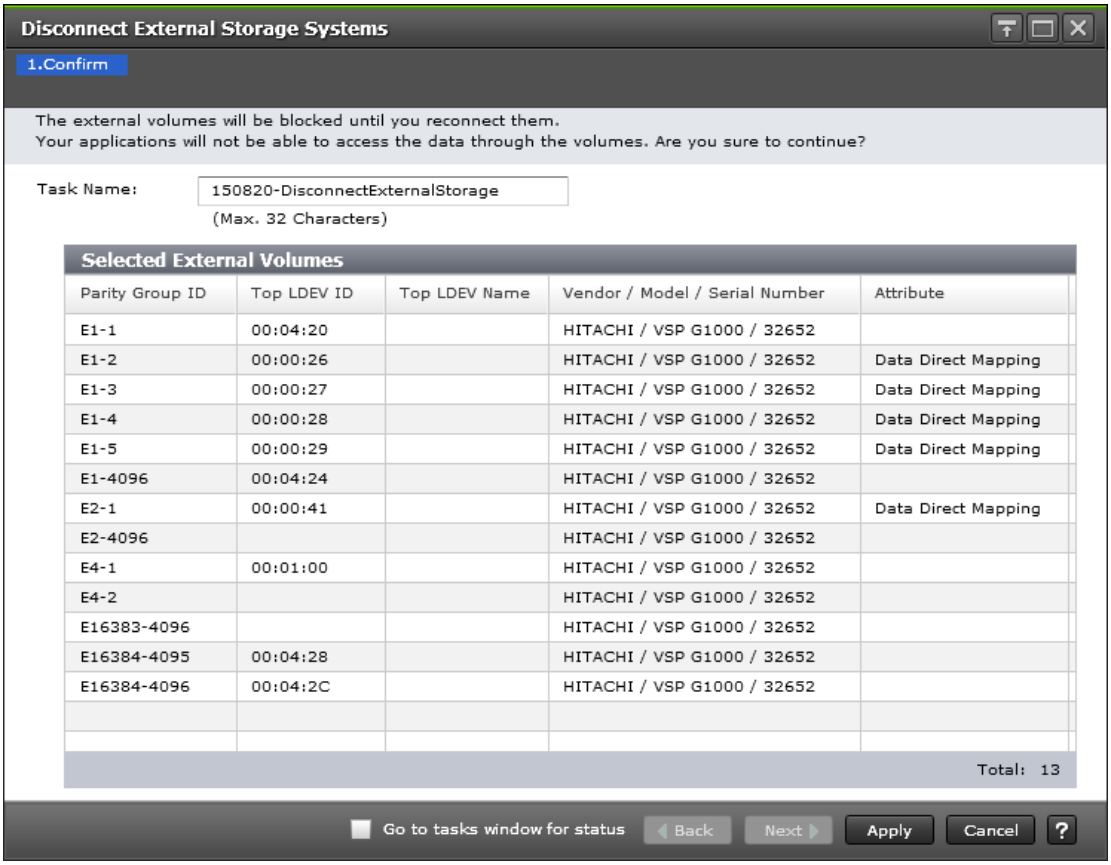
See Reconnecting a single mapped volume on page 98 for instructions.



Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external system.
Attribute	External volume's attribute.

Disconnect External Storage Systems window

Use this window to disconnect the storage system

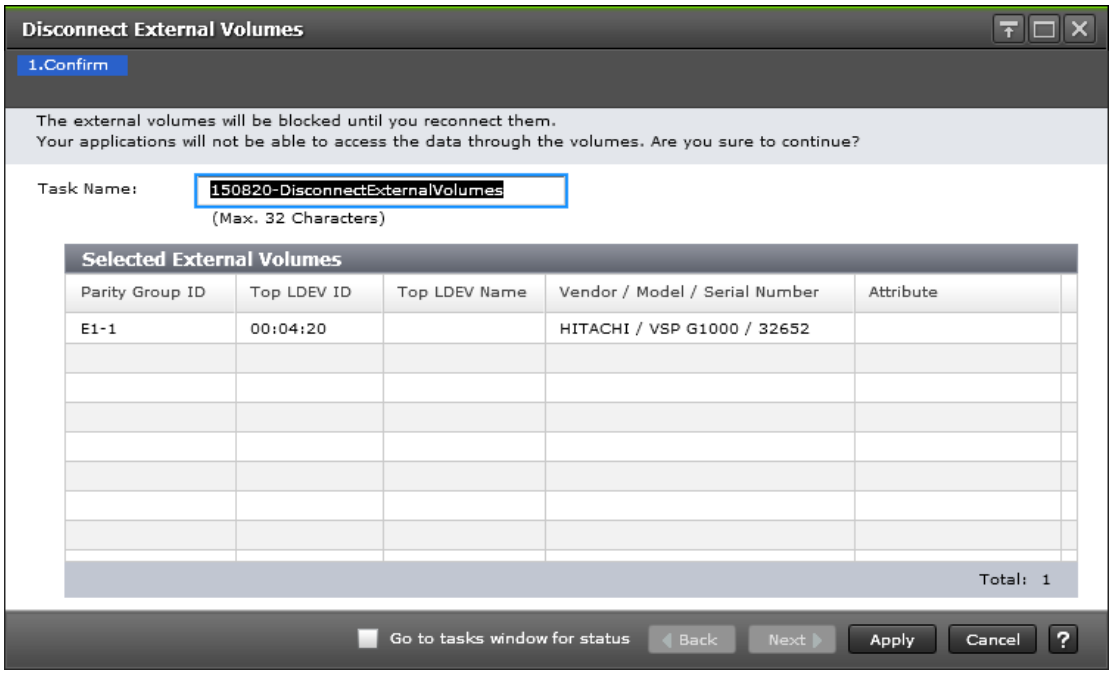


Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external system.
Attribute	External volume's attribute.

Disconnect External Volumes window

Use this window to disconnect an external volume.

See Disconnecting a single mapped volume on page 94 for instructions.



Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external system.
Attribute	External volume's attribute.

Assign MP Blade ID or MP Unit ID wizard

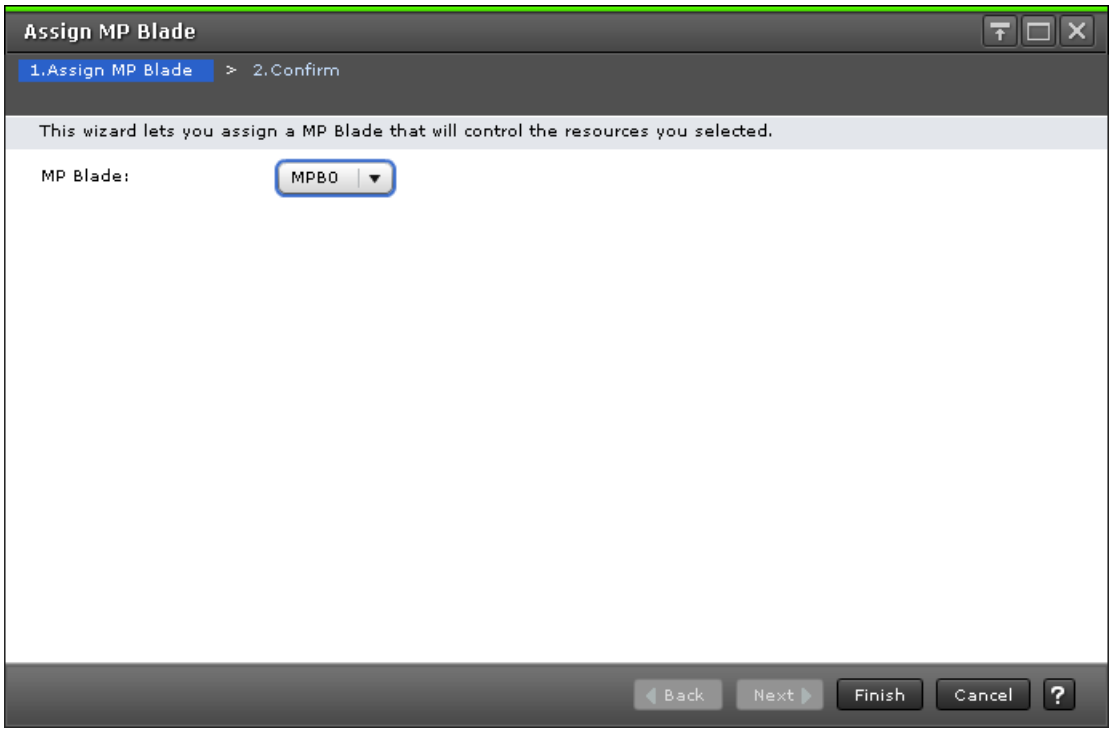
Use this wizard to select an MP blade or unit for the external volume.

See Changing the MP blade or unit of an external volume on page 79 for instructions.

The windows in this wizard are:

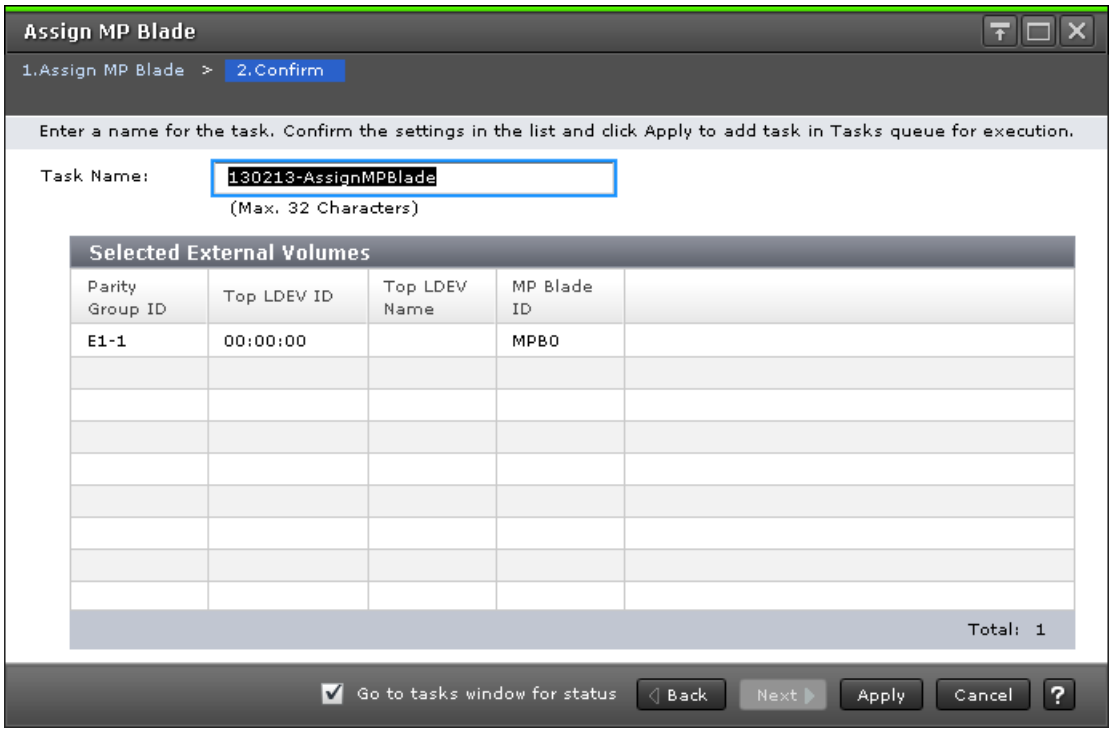
- Assign MP Blade or MP Unit window on page 213
- Assign MP Blade or MP Unit confirmation window on page 214

Assign MP Blade or MP Unit window



Item	Description
MP Blade (VSP G1000, G1500, and VSP F1500)	MP blade for the external volume. • Range is from MPB0 to MPB7. • The default is the value set on the selected external volume. When two or more volumes with different values are selected, blank displays. • Blade with lowest number is used when Auto cannot be selected.
MP Unit ID (VSP Gx00 models and VSP Fx00 models)	MP unit for the external volume. • You can select MPU-10, MPU-11, MPU-20 or MPU-21. • The default is the value set on the selected external volume. When two or more volumes with different values are selected, blank displays.

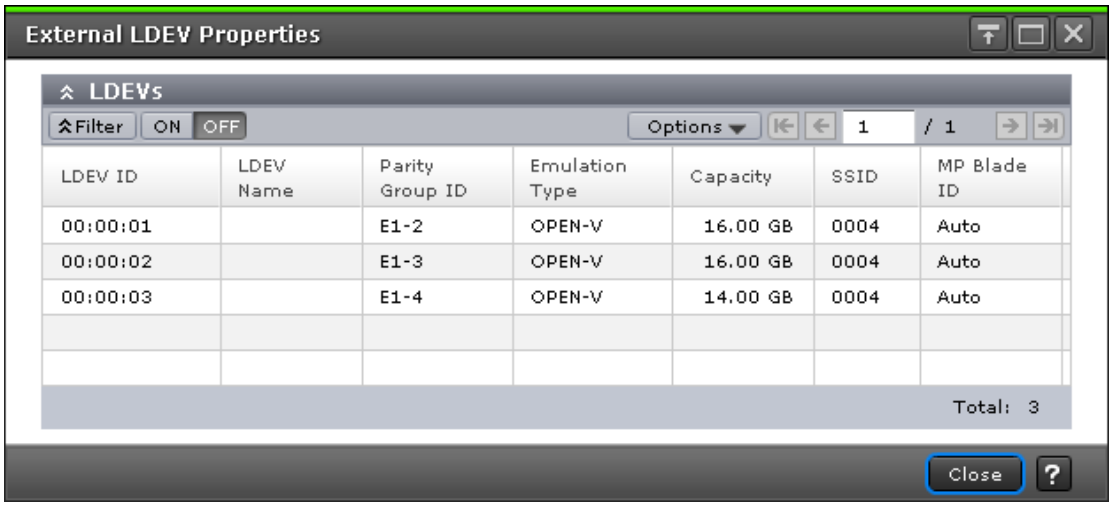
Assign MP Blade or MP Unit confirmation window



Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
MP blade or unit ID	MP blade or unit ID allocated to the external volume.

External LDEV Properties window

Use this window to view settings for external LDEVs.

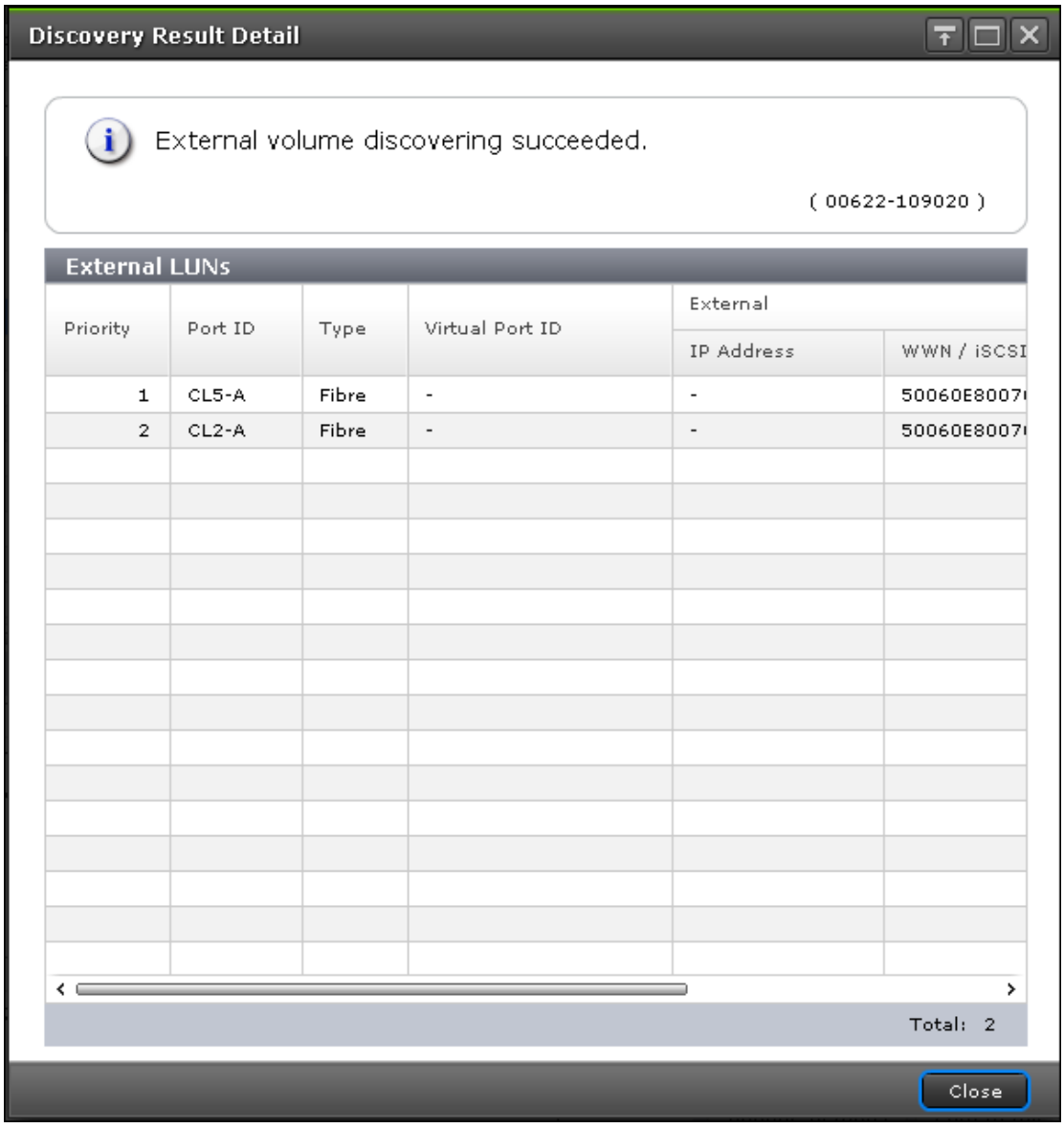


LDEVs table

Item	Description
LDEV ID	LDEV IDs allocated to the external volume.
LDEV Name	LDEV names.
Parity Group ID	Parity group numbers.
Emulation Type (VSP G1000, G1500, and VSP F1500)	LDEV's emulation type.
Capacity	LDEV's capacity.
SSID (VSP G1000, G1500, and VSP F1500)	LDEV's SSIDs.
MP Blade ID or MP Unit ID	MP blade or unit IDs allocated to the LDEV.
Attribute	LDEV's attribute.
Resource Group Name (ID)	Name and ID of the resource group for the LDEV. ID is enclosed in parentheses.
Attribute (VSP G1000, G1500, and VSP F1500)	External volume's attribute.
Virtual Storage Machine	• Model / Serial Number: Model and serial number of the virtual storage machine for the LDEV. • Attribute: Virtual attribute of the LDEV. When the virtual attribute is not set, blank displays.

Discovery Result Detail window

Use this window to view discover result settings and other details.



Item	Description
Priority	Priority of external paths.
Port ID	Displays the external port of the local storage system.
Type	Displays the port type. • Fibre: Fibre Channel port • iSCSI: iSCSI port
Virtual Port ID	Displays the virtual port of the local storage system.
External	Displays the information about external storage system's target port. • IP Address: Displays the target port IP address when port type is iSCSI port.

Item	Description
	• WWN / iSCSI Target Name: Displays the WWN to show the target port when port type is Fibre Channel port. If the port type is iSCSI port, iSCSI target name is displayed.
LUN ID	When the external path is connected to the selected external volume, the LUN ID displays.
Status	Status of external paths. • Unknown: The status of the mapping path is not known. • Normal: There are no problems, the system is usable.

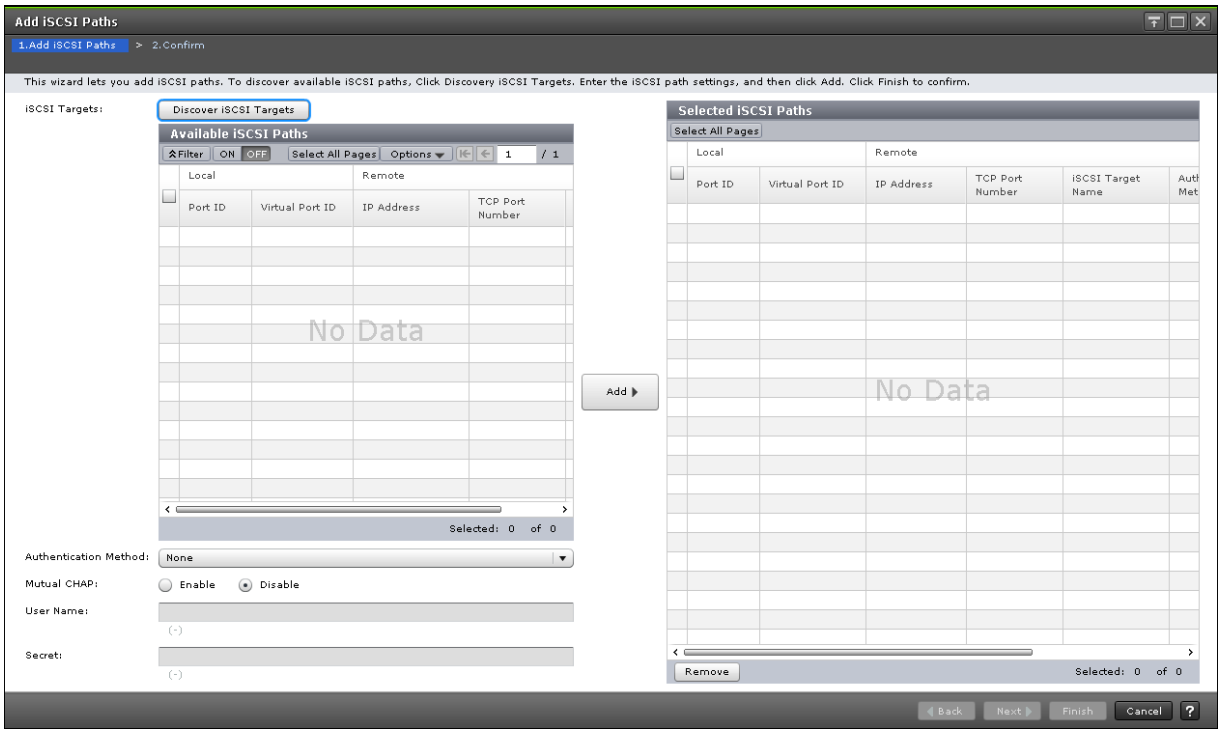
Add iSCSI Paths wizard

Use this wizard to add an iSCSI path for external volumes.

The windows in this wizard are:

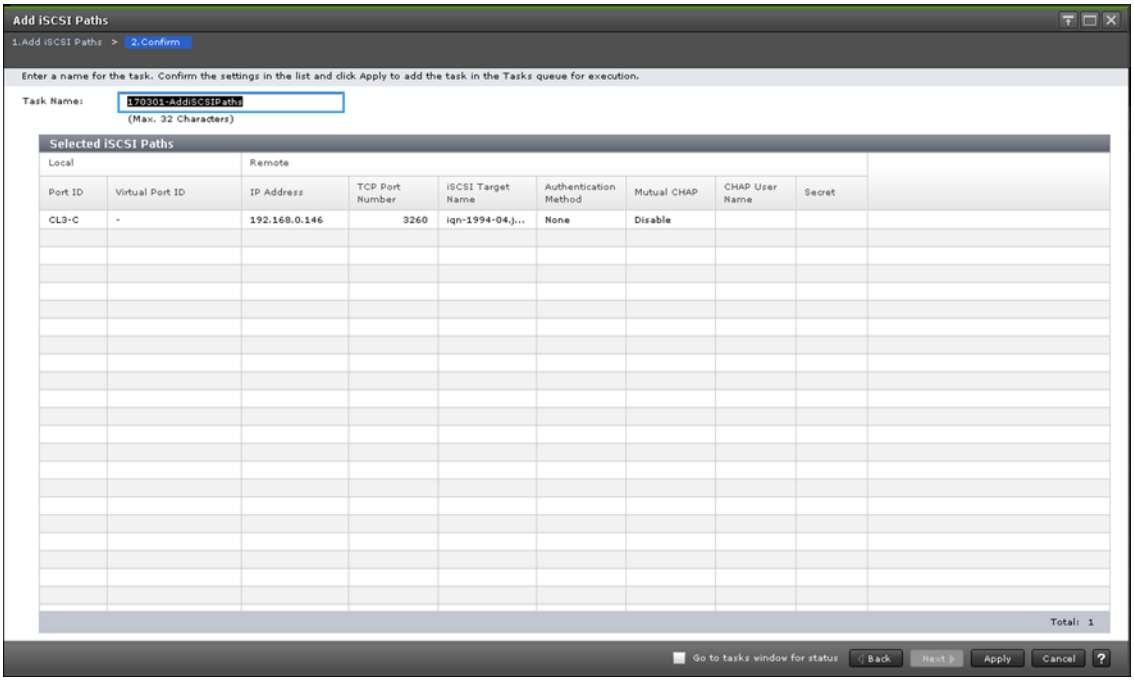
- Add iSCSI Paths window on page 218
- Add iSCSI Paths confirmation window on page 219

Add iSCSI Paths window



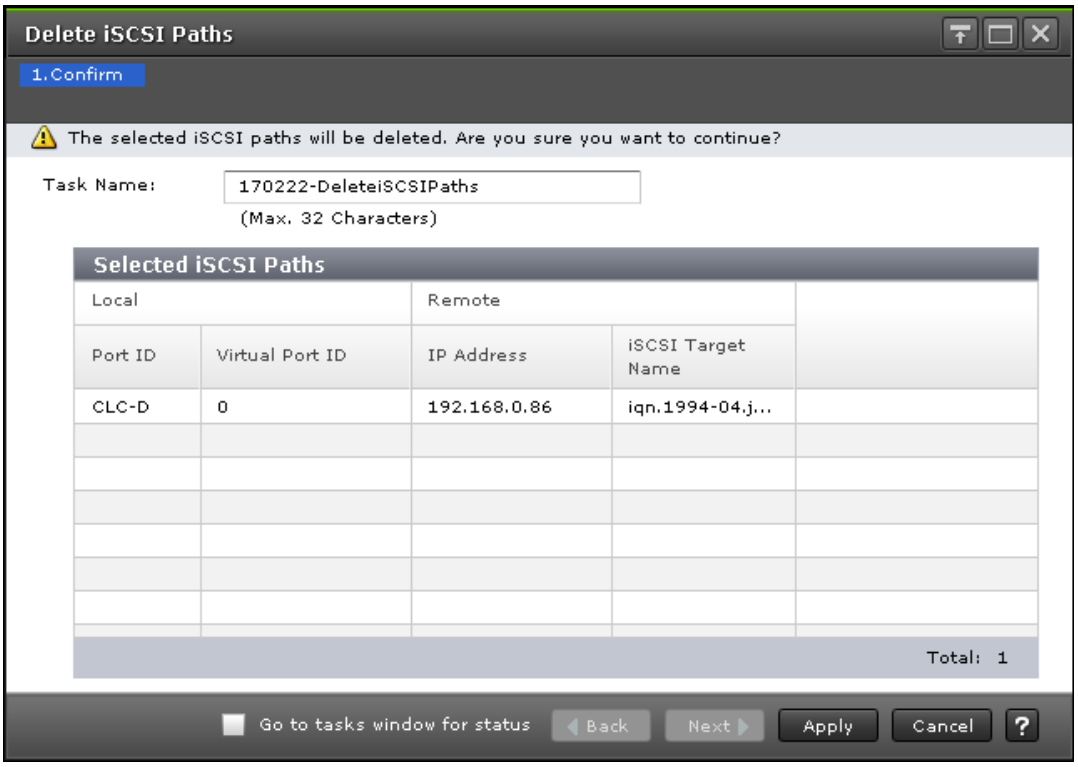
Item	Description
Discover iSCSI Targets button	Displays the **Discover iSCSI Targets** window, where you can edit information about iSCSI paths.
Available iSCSI Paths table: Local	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Available iSCSI Paths table: Remote	Displays the remote storage system port information. • IP Address: Displays the IP address. • TCP Port Number: Displays the TCP port number. • iSCSI Target Name: Displays the iSCSI target name.
Authentication Method	Select the authentication method (CHAP or None).
Mutual CHAP	Specify whether to enable mutual CHAP. • Enable: Authentication is bidirectional. • Disable: Authentication is unidirectional.
User Name	Specify a case-sensitive user name. You can use up to 223 characters. Valid characters: Alphanumeric characters and symbols (. - + @ _ = : / [ ] ~)
Secret	Set the secret for host authentication. You can use between 12 and 32 letters. Valid characters: Alphanumeric characters and symbols (. - + @ _ = : / [ ] ~)
Selected iSCSI Paths table: Local	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Selected iSCSI Paths table: Remote	Displays the remote storage system port information. • IP Address: Displays the IP address. • TCP Port Number: Displays the TCP port number. • iSCSI Target Name: Displays the iSCSI target name. • Authentication Method: Displays the method for authentication. • Mutual CHAP: Displays the mutual CHAP setting. • CHAP User Name: Displays the CHAP user name, if specified.
Add button	Adds the iSCSI path selected in the Available iSCSI Paths table to the Selected iSCSI Paths table.
Remove button	Deletes the iSCSI path selected in the Selected iSCSI Paths table.

Add iSCSI Paths confirmation window



Item	Description
Local	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Remote	Displays the remote storage system port information. • IP Address: Displays the IP address. • TCP Port Number: Displays the TCP port number. • iSCSI Target Name: Displays the iSCSI target name. • Authentication Method: Displays the method for authentication. • Mutual CHAP: Displays the mutual CHAP setting. • CHAP User Name: Displays the CHAP user name, if specified. • Secret: If a secret is set, displays ****** (6 asterisks).

Delete iSCSI Paths window



Item	Description
Local	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Remote	Displays the external storage system port information. • IP Address: Displays the IP address. • iSCSI Target Name: Displays the iSCSI target name.

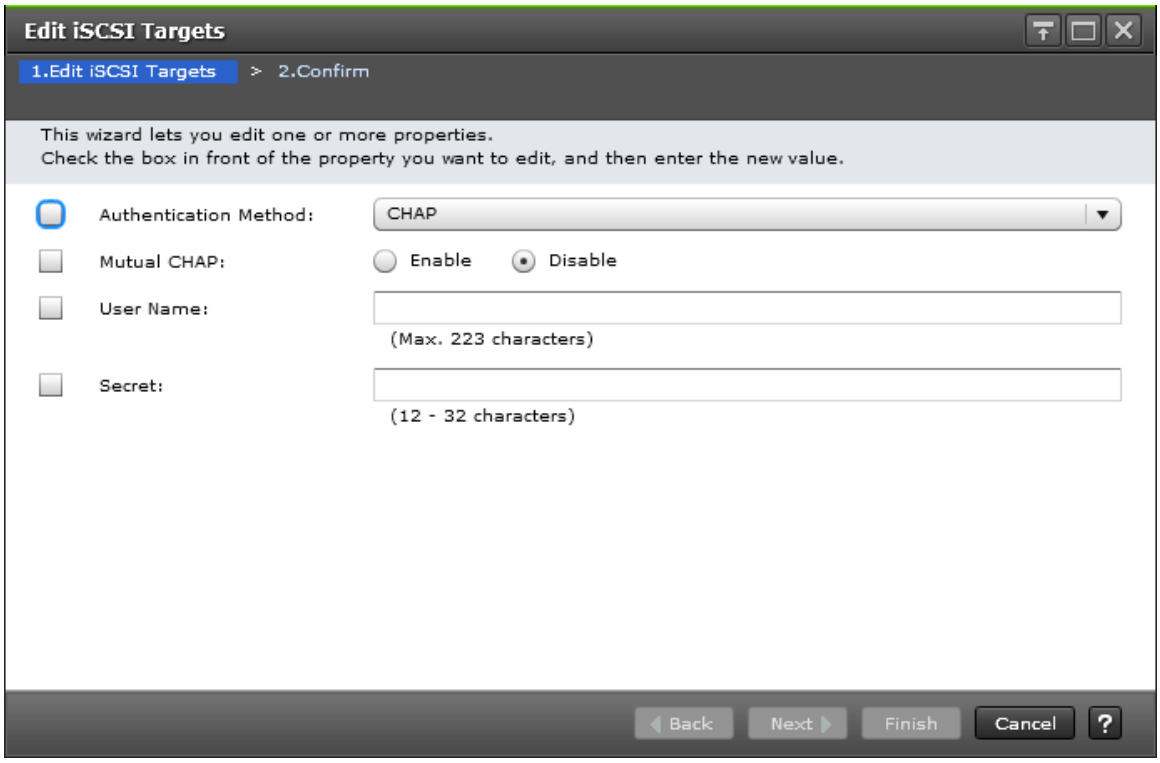
Edit iSCSI Targets wizard

Use this wizard to edit iSCSI targets for the external volume.

The windows in this wizard are:

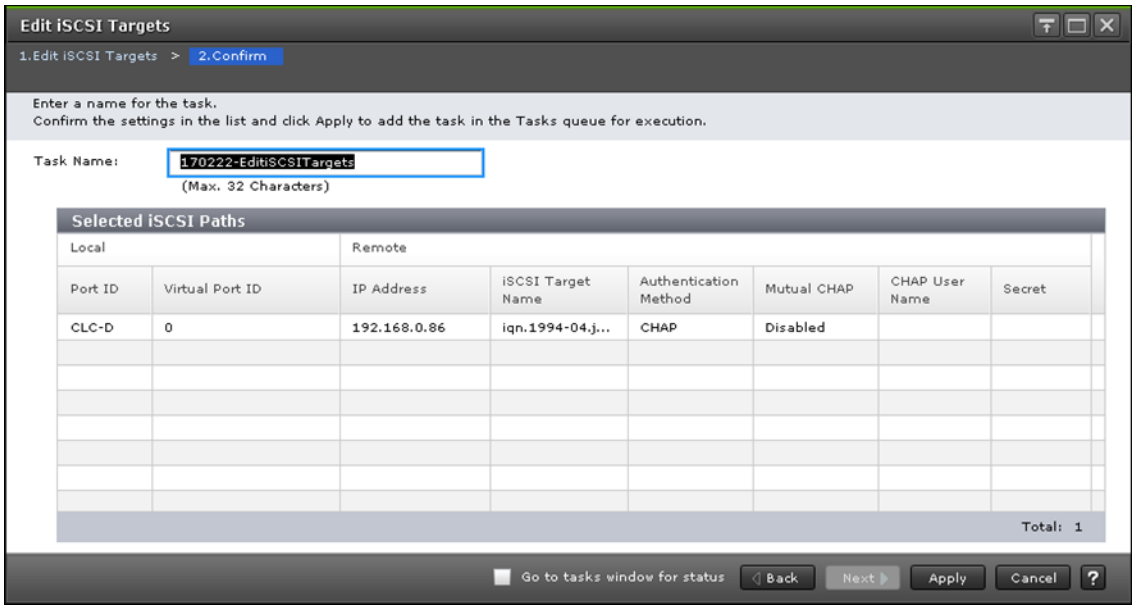
- Edit iSCSI Targets window on page 221
- Edit iSCSI Targets confirmation window on page 222

Edit iSCSI Targets window



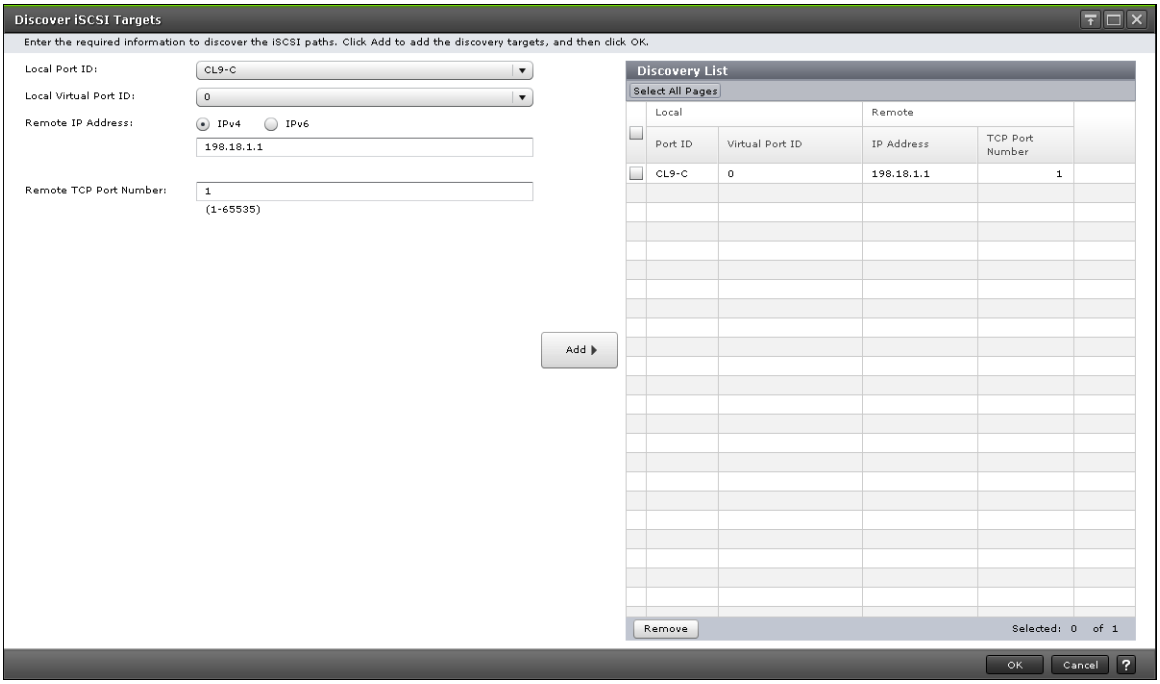
Item	Description
Authentication Method	Select the authentication method (CHAP or None).
Mutual CHAP	Specify whether to enable mutual CHAP. • Enable: Authentication is bidirectional. • Disable: Authentication is unidirectional.
User Name	Specify a case-sensitive user name. You can use up to 223 characters. Usable characters: Alphanumeric characters and symbols (. - + @ _ = : / [ ] ~)
Secret	Set the secret for host authentication. You can use from 12 to 32 characters. Usable characters: Alphanumeric characters and symbols (. - + @ _ = : / [ ] ~)

Edit iSCSI Targets confirmation window



Item	Description
Local	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Remote	Displays the external storage system port information. • IP Address: Displays the IP address. • iSCSI Target Name: Displays the iSCSI target name. • Authentication Method: Displays the method for authentication. • Mutual CHAP: Displays the mutual CHAP setting. • CHAP User Name: Displays the CHAP user name, if specified. • Secret: Displays ****** (6 asterisks) if Secret is set.

Discover iSCSI Targets window



Item	Description
Local Port ID	Select the port connected to external storage system of the local storage system.
Local Virtual Port ID	Select the virtual port of the local storage system.
Remote IP Address	Enter the IP address of the external storage system port. • IPv4: Select if the external storage system supports IPv4. Enter the address in the box. • IPv6: Select if the external storage system supports IPv6. Enter the address in the box.
Remote TCP Port Number	Enter the TCP port number of external storage system port. You can enter from 1 to 65535.
Add button	Adds the entered targets to the Discovery List table. You can add up to 8 targets.
Local – Discovery List table	Displays the local storage system port information. • Port ID: Displays the external port. • Virtual Port ID: Displays the virtual port.
Remote – Discovery List table	Displays the external storage system port information. • IP Address: Displays the IP address. • TCP Port Number: Displays the TCP port number.

Item	Description
Remove button – Discovery List table	Deletes the target selected in the Discovery List table.

Glossary

A

access attribute

The setting on a logical volume that determines whether hosts can read and/or write to the volume.

alternate path

A secondary path (for example, port, target ID, or LUN) to a logical volume, in addition to the primary path, that is used as a backup in case the primary path fails.

ALUA

See *asymmetric logical unit access*.

array

See disk array

B

bind mode

In bind mode the Cache Residency Manager extents are used to hold read and write data for specific extent(s) on volume(s). Data written to the Cache Residency Manager bind area is not destaged to the drives. For bind mode, all targeted read and write data is transferred at host data transfer speed.

blade

A computer module, generally a single circuit board, used mostly in servers.

C

cache logical partition (CLPR)

Consists of virtual cache memory that is set up to be allocated to different hosts in contention for cache memory.

capacity

The amount of data storage space available on a physical storage device, usually measured in bytes (MB, GB, TB, and so on).

CCI

Command Control Interface

CLPR

See *cache logical partition (CLPR)*.

command device

A dedicated logical volume used only by Command Control Interface and Business Continuity Manager to interface with the storage system. Can be shared by several hosts.

custom volume (CV)

A custom-size volume whose size is defined by the user using Virtual LVI/Virtual LUN.

CVS

custom volume size

D

device

A physical or logical unit with a specific function.

device emulation

Indicates the type of logical volume. Mainframe device emulation types provide logical volumes of fixed size, called logical volume images (LVIs), which contain EBCDIC data in CKD format. Typical mainframe device emulation types include 3390-9 and 3390-M. Open-systems device emulation types provide logical volumes of variable size, called logical units (LUs), that contain ASCII data in FBA format. The typical open-systems device emulation type is OPEN-V.

Dynamic Provisioning (HDP)

An approach to managing storage. Instead of "reserving" a fixed amount of storage, it removes capacity from the available pool when data is actually written to disk.

E

emulation

The operation of a storage system to emulate the characteristics of a different storage system. For device emulation, the mainframe host recognizes the logical devices on the storage system as 3390-x devices. For controller emulation, the mainframe host recognizes the control units (CUs) on the storage system as 2105 or 2107 controllers.

The storage system operates the same as the storage system being emulated.

external volume

A logical volume whose data resides on drives that are physically located outside the Hitachi storage system.

H

host group

A group of hosts of the same operating system platform.

host mode

Operational modes that provide enhanced compatibility with supported host platforms. Used with fibre-channel ports on RAID storage systems.

host mode option

Additional options for fibre-channel ports on RAID storage systems. Provide enhanced functionality for host software and middleware.

I

internal volume

A logical volume whose data resides on drives that are physically located within the storage system. See also *external volume*.

L

LDEV

logical device

logical device (LDEV)

An individual logical data volume (on multiple drives in a RAID configuration) in the storage system. An LDEV may or may not contain any data and may or may not be defined to any hosts. Each LDEV has a unique identifier or "address" within the storage system composed of the logical disk controller (LDKC) number, control unit (CU) number, and LDEV number. The LDEV IDs within a storage system do not change.An LDEV formatted for use by mainframe hosts is called a logical volume image (LVI). An LDEV formatted for use by open-system hosts is called a logical unit (LU).

logical partition (LPAR)

A subset of a system's hardware resources that is virtualized as a separate system. For a storage system, logical partitioning can be applied to cache memory and/or storage capacity.

logical unit (LU)

A logical volume that is configured for use by open-systems hosts (for example, OPEN-V).

logical unit (LU) path

The path between an open-systems host and a logical unit.

logical volume (LV)

See *volume*.

LU

See *logical unit (LU)*.

LUN

See logical unit number

LV

logical volume

P

P-VOL

This term is used only in the earlier version of the Device Manager - Storage Navigator GUI (still in use) for the primary volume. See *primary volume*.

pair

Two logical volumes in a replication relationship in which one volume contains original data to be copied and the other volume contains the copy of the original data. The copy operations can be synchronous or asynchronous, and the pair volumes can be located in the same storage system (in-system replication) or in different storage systems (remote replication).

physical device

See *device*.

pool

A set of volumes that are reserved for storing pool volumes (pool-VOL), and used by Thin Image, Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, active flash, or active flash for mainframe data.

A set of volumes that are reserved for storing pool volumes (pool-VOL), and used by Thin Image, Dynamic Provisioning, Dynamic Tiering, or active flash data.

pool volume (pool-VOL)

A logical volume that is reserved for storing snapshot data for Thin Image operations or write data for Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, active flash, or active flash for mainframe.

A logical volume that is reserved for storing snapshot data for Thin Image operations or write data for Dynamic Provisioning, Dynamic Tiering, or active flash.

port attribute

Indicates the type of fibre-channel port: target, RCU target, or initiator.

primary volume (P-VOL)

The volume in a copy pair that contains the original data to be replicated. The data on the P-VOL is duplicated synchronously or asynchronously on the secondary volume (S-VOL).

The following Hitachi products use the term P-VOL: Thin Image, Copy-on-Write Snapshot, ShadowImage, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.

See also *secondary volume*.

R

RAID

redundant array of inexpensive disks

RAID group

A set of RAID disks that have the same capacity and are treated as one group for data storage and recovery. A RAID group contains both user data and parity information. This allows user data to be accessed in the event that one or more of the drives within the RAID group are not available. The RAID level of a RAID group determines the number of data drives and parity drives and how the data is "striped" across the drives. For RAID1, user data is duplicated within the RAID group, so there is no parity data for RAID1 RAID groups.

A RAID group can also be called an array group or a parity group.

RAID level

The type of RAID implementation. RAID levels include RAID0, RAID1, RAID2, RAID3, RAID4, RAID5 and RAID6.

remote control unit (RCU)

A storage system at a secondary or remote site that is configured to receive remote I/Os from one or more storage systems at the primary or main site.

remote copy

See *remote replication*.

S

S-VOL

See *secondary volume* or *source volume*. When used for "secondary volume", "S-VOL" is only seen in the earlier version of the Device Manager - Storage Navigator GUI (still in use).

secondary volume (S-VOL)

The volume in a copy pair that is the copy of the original data on the primary volume (P-VOL). The following Hitachi products use the term "secondary volume": Thin Image, Copy-on-Write Snapshot, ShadowImage, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.

See also *primary volume*.

service information message (SIM)

Messages generated by a RAID storage system when it detects an error or service requirement. SIMs are reported to hosts and displayed on Device Manager - Storage Navigator.

snapshot

A point-in-time virtual copy of a Hitachi Thin Image primary volume (P-VOL). The snapshot is maintained when the P-VOL is updated by storing pre-updated data (snapshot data) in a data pool.

SNMP

See *Simple Network Management Protocol*.

SOM

See *system option mode*.

SSD

solid-state drive. Also called flash drive.

SSID

See *storage subsystem identifier*.

system option mode (SOM)

Additional operational parameters for the RAID storage systems that enable the storage system to be tailored to unique customer operating requirements. SOMs are set on the service processor.

T

target port

A fibre-channel port that is configured to receive and process host I/Os.

U

UR

Hitachi Universal Replicator

URz

Hitachi Universal Replicator software for Mainframe

V

V-VOL

virtual volume

virtual device (VDEV)

A group of logical devices (LDEVs) in a RAID group. A VDEV typically consists of some fixed volumes (FVs) and some free space. The number of fixed volumes is determined by the RAID level and device emulation type.

Virtual LVI/LUN

A custom-size volume whose size is defined by the user using Virtual LVI/LUN. Also called a custom volume (CV).

virtual volume (V-VOL)

A logical volume in a storage system. A V-VOL has no physical storage space.

Thin Image uses V-VOLs as secondary volumes of copy pairs.

In Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, active flash, and active flash for mainframe, V-VOLs are called DP-VOLs.

In Dynamic Provisioning, Dynamic Tiering, and active flash, V-VOLs are called DP-VOLs.

volume (VOL or vol)

A logical device (LDEV), or a set of concatenated LDEVs in the case of LUSE, that has been defined to one or more hosts as a single data storage unit. An open-systems volume is called a logical unit (LU), and a mainframe volume is called a logical volume image (LVI).

W

WWN

worldwide name

Index

Hitachi Data Systems

Corporate Headquarters
2845 Lafayette Street
Santa Clara, California 95050-2639
U.S.A.
www.hds.com

Regional Contact Information

Americas
+1 408 970 1000
info@hds.com

Europe, Middle East, and Africa
+44 (0) 1753 618000
info.emea@hds.com

Asia Pacific
+852 3189 7900
hds.marketing.apac@hds.com

Contact Us
www.hds.com/en-us/contact.html

Hitachi Data Systems

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