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Hitachi Universal Volume Manager User Guide

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Hitachi Data Systems

MK-90RD7033-14

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Preface

This document describes and provides instructions for performing external storage operations using the Universal Volume Manager software on the Hitachi Virtual Storage Platform storage system.

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

This preface includes the following information:

- ☐ Intended audience
- ☐ Product Version
- ☐ Document revision level
- ☐ Changes in this revision
- ☐ Referenced documents
- ☐ Document organization
- ☐ Document conventions
- ☐ Convention for storage capacity values
- ☐ Accessing product documentation
- ☐ Getting help
- ☐ Comments

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and authorized service providers who install, configure, and operate Hitachi Virtual Storage Platform storage system.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The Hitachi Virtual Storage Platform storage system, and you should have read the *Hitachi Virtual Storage Platform User and Reference Guide*
- The Hitachi Storage Navigator software for the Hitachi Virtual Storage Platform, and the *Hitachi Storage Navigator User Guide*.
- The storage systems that are connected to the Hitachi Virtual Storage Platform as external storage.

Product Version

This document revision applies to Hitachi VSP microcode 70-06-2*x* or later.

Document revision level

Revision	Date	Description
-90RD7033-00	October 2010	Initial release
MK-90RD7033-01	December 2010	Supersedes and replaces MK-90RD7033-00
MK-90RD7033-02	April 2011	Supersedes and replaces MK-90RD7033-01
MK-90RD7033-03	August 2011	Supersedes and replaces MK-90RD7033-02
MK-90RD7033-04	November 2011	Supersedes and replaces MK-90RD7033-03
MK-90RD7033-05	February 2012	Supersedes and replaces MK-90RD7033-04
MK-90RD7033-06	June 2012	Supersedes and replaces MK-90RD7033-05
MK-90RD7033-07	August 2012	Supersedes and replaces MK-90RD7033-06
MK-90RD7033-08	November 2012	Supersedes and replaces MK-90RD7033-07
MK-90RD7033-09	January 2013	Supersedes and replaces MK-90RD7033-08
MK-90RD7033-10	July 2013	Supersedes and replaces MK-90RD7033-09
MK-90RD7033-12	April 2014	Supersedes and replaces MK-90RD7033-11
MK-90RD7033-13	August 2015	Supersedes and replaces MK-90RD7033-12
MK-90RD7033-14	March 2016	Supersedes and replaces MK-90RD7033-13

Changes in this revision

- Changed "system" to "mode" and definitions for QDepth. See Changing I/O mode for external storage systems on page 5-5, Editing external WWN settings on page 5-6, External Paths tab on page D-5, External Paths tab on page D-13, Edit External WWNs window on page D-33, and Confirm window on page D-34.
- Added support for Hitachi Virtual Storage Platform G200, G400, G600 as external storage.

Referenced documents

Hitachi Virtual Storage Platform documentation:

- *Command Control Interface User and Reference Guide*, MK-90RD7010
- *Hitachi Copy-on-Write Snapshot User Guide*, MK-90RD7013
- *Hitachi Virtual Storage Platform Performance Guide*, MK-90RD7020
- *Hitachi Virtual Storage Platform Provisioning Guide for Mainframe Systems*, MK-90RD7021
- *Hitachi Virtual Storage Platform Provisioning Guide for Open Systems*, MK-90RD7022
- *Hitachi ShadowImage® for Mainframe User Guide*, MK-90RD7023
- *Hitachi ShadowImage® User Guide*, MK-90RD7024
- *Hitachi Storage Navigator User Guide*, MK-90RD7027
- *Hitachi Storage Navigator Messages*, MK-90RD7028
- *Hitachi TrueCopy® User Guide*, MK-90RD7029
- *Hitachi TrueCopy® for Mainframe User Guide*, MK-90RD7030
- *Hitachi Universal Replicator User Guide*, MK-90RD7031
- *Hitachi Universal Replicator for Mainframe User Guide*, MK-90RD7032
- *Hitachi Virtual Storage Platform User and Reference Guide*, MK-90RD7042

Document organization

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

Chapter	Description
Chapter 1, Chapter 1, Overview on page 1-1	Provides an overview of Universal Volume Manager.
Chapter 2, Chapter 2, Requirements and planning on page 2-1	Provides system requirements and planning information.

Chapter	Description
Chapter 3, Chapter 3, VSP software supported for external volumes on page 3-1	Provides interoperability information.
Chapter 4, Chapter 4, Setting up external volumes on page 4-1	Provides procedures for setting up Universal Volume Manager.
Chapter 5, Chapter 5, Monitoring and maintenance on page 5-1	Provides information and procedures for monitoring and maintaining Universal Volume Manager.
Chapter 6, Chapter 6, Troubleshooting on page 6-1	Provides troubleshooting information.
Appendix A, Appendix A, Supported external storage systems on page A-1	Provides configuration information for connecting external storage systems to the VSP storage system.
Appendix B, Appendix B, Remote command devices on page B-1	Provides information for using remote command devices as command devices.
Appendix C, Appendix C, Command Control Interface command reference on page C-1	Provides CCI commands that correspond to Storage Navigator operations.
Appendix D, Appendix D, Universal Volume Manager GUI reference on page D-1	Describes the Storage Navigator windows and dialog boxes for Universal Volume Manager.

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	Indicates text on a window or dialog box, including window and dialog box names, menus, menu options, buttons, fields, and labels. Example: Click **OK**.
Italic	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy *source-file target-file* ***Note:*** Angled brackets (< >) are also used to indicate variables.
`screen/code`	Indicates text that appears on screen or entered by the user. Example: `# pairdisplay -g oradb`
< > angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: `# pairdisplay -g <group>` ***Note:*** Italic font is also used to indicate variables.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.

Convention	Description
{ } 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	Meaning	Description
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Note	Provides information that is essential to the completion of a task.
	Caution	Warns that failure to take or avoid a specified action can result in adverse conditions or consequences (for example, loss of access to data).
	WARNING	Warns the user of severe conditions, consequences, or both (for example, destructive operations).??Need icon.

Convention 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 KB	1,000 bytes
1 MB	$1,000^2$ bytes
1 GB	$1,000^3$ bytes
1 TB	$1,000^4$ bytes
1 PB	$1,000^5$ bytes
1 EB	$1,000^6$ bytes

Logical storage capacity values (logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 KB	1,024 bytes

Logical capacity unit	Value
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
1 block	512 bytes
1 Cyl	For open systems: • OPEN-V: 960 KB • Other than OPEN-V: 720 KB For mainframe systems: 870 KB

Accessing product documentation

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

Getting help

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week.

If you need technical support, log on to the Hitachi Support Portal for contact information: https://portal.hds.com.

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision 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

With Hitachi Universal Volume Manager, you connect volumes in external storage systems to Hitachi Virtual Storage Platform (VSP) and manage them as if they were one system.

This guide provides information and instructions for planning, set up, maintenance, and troubleshooting the use of external volumes with VSP and its software products.

- Features—multiple systems, common management
- How Universal Volume Manager works
- Typical components

Features—multiple systems, common management

When a system consists of multiple storage systems, a host must usually be connected to all of the systems. When a system administrator configures the connections from the host to volumes, he or she follows different instructions for each of the storage systems.

With Universal Volume Manager, the administrator configures the connection from the host to the VSP storage system, then can manipulate mapped volumes in an external storage system in the same way as volumes in the VSP storage system.

Operations between storage systems can also involve different procedures. But with Universal Volume Manager, you perform them with the same Hitachi software as when you use VSP systems.

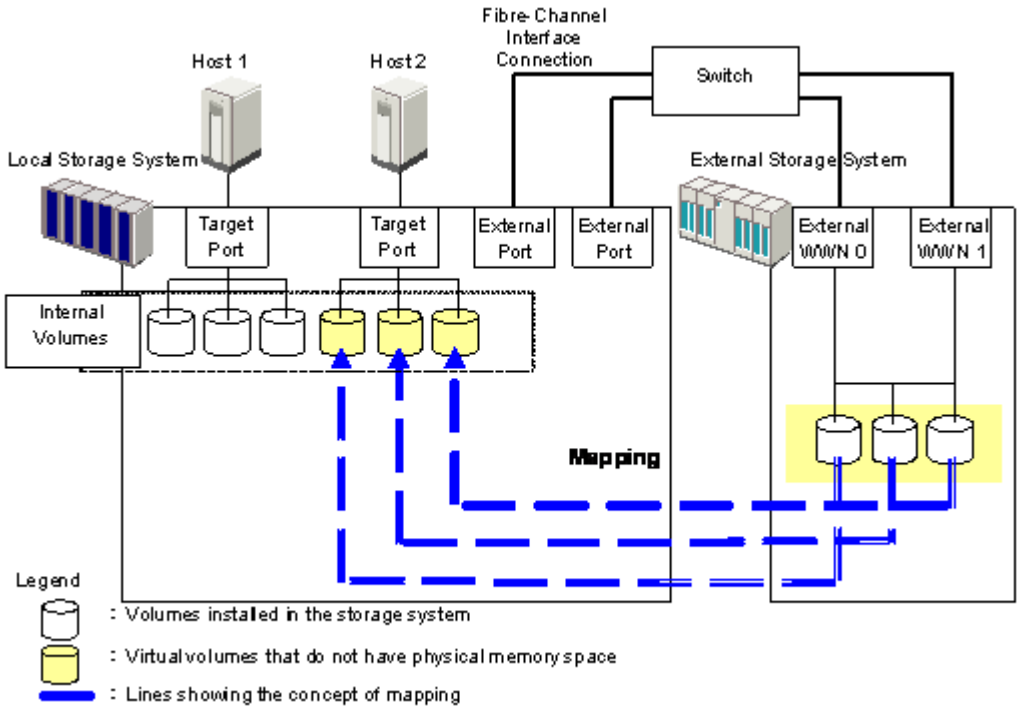
For example, you will use the desired Hitachi replication program for copy operations between VSP and the external systems, including the following:

- Copying data from a volume in VSP to a volume in the external system.
- Copying data from a volume in an external system to a volume in another external system.

How Universal Volume Manager works

A volume in an external storage system becomes an internal volume in VSP when you map to it.

- A local system port must be connected to the external storage system port with a fibre cable. This route between ports is the "external path".
- The external volume is represented in the VSP 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 using the Fibre-Channel interface. An “external port” is an attribute assigned to VSP ports.



Multiple external storage systems can be connected to one external port. You can add an additional external storage system even when the external port is already in use.

Note: Mapped external volumes must be accessed and copied only by hosts that are connected to the VSP, not by hosts connected to the external systems.

Logical devices (LDEVs) are created during or after the mapping operation. If created after mapping, the LDEVs are created in the same way they are when you create normal internal volumes using Virtual LVI/Virtual LUN. As shown in the figure, LDEVs in mapped external volumes are required for use in the local system.

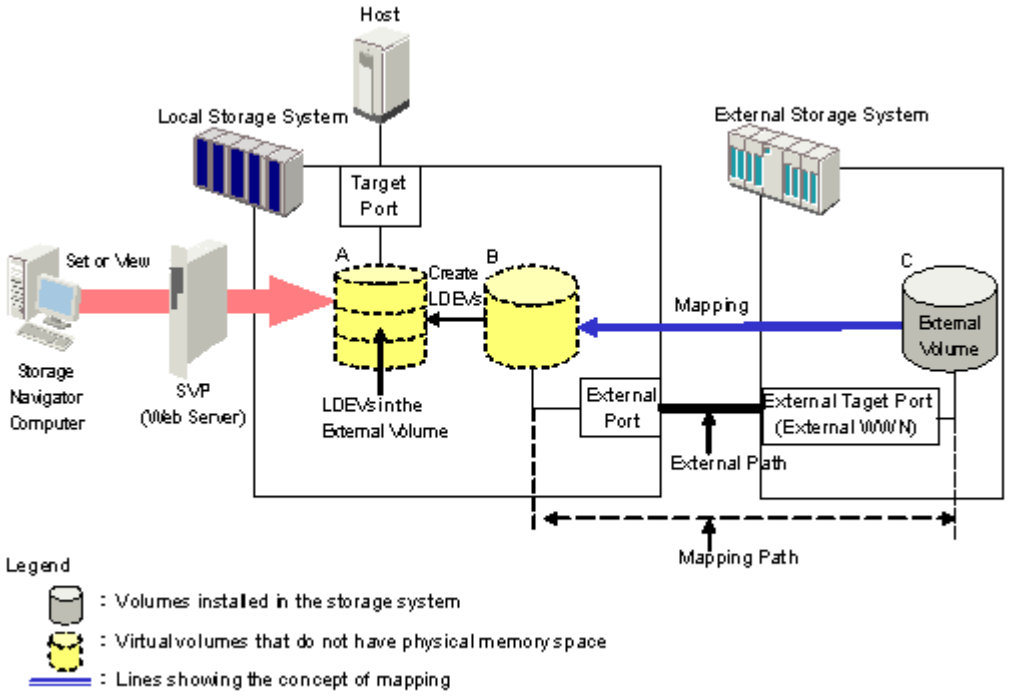
Typical components

Universal Volume Manager consists of the following components:

- A VSP storage system, referred to as the "local storage system"
- Universal Volume Manager license
- An external storage system
- An external volume mapped to the local system. In the local system, the mapped external volume is referred to as an "internal volume", and is a virtual representation of the external volume.
- LDEVs (logical devices).
- Hitachi Storage Navigator, Command Control Interface software, and/or Hitachi Command Line Interface

- External path
- Mapping path

These components are illustrated in the following figure, and discussed in more detail below.



External storage system

VSP can connect to other Hitachi storage systems, original equipment manufacturer (OEM) systems, and other vendors' systems (such as IBM or EMC). Hosts recognize volumes in these other systems as "internal volumes" of the VSP.

External volume

A volume in the external storage system that is mapped to the local storage system.

Internal volume

A volume managed by the local storage system. An internal volume can be a physical volume or the virtual representation of an external volume.

License

Universal Volume Manager is a Hitachi software product requiring installation of a license key. See the *Hitachi Storage Navigator User Guide* for instructions.

Interfaces

You can perform Universal Volume Manager operations using the following interfaces:

- Storage Navigator
- Command Control Interface
- Spreadsheets

Hitachi Storage Navigator

The Hitachi graphical user interface used to manage the VSP system and the connected external storage volumes. Storage Navigator is run from a browser on the user-supplied computer. The operations described in this document are performed using Storage Navigator.

Command Control Interface software (CCI)

CCI provides a command line interface to perform most of the same operations as Storage Navigator. CCI operations are issued directly from the host, and can be automated using scripts. External volumes can be used as remote command devices.

Spreadsheets

With spreadsheets, you can schedule and perform the following Universal Volume Manager operations.

- Map external volumes with multiple or single LDEVs to the local system
- Retrieve information about mapped external volumes
- Retrieve information about external volume groups configured to the local system
- Retrieve information about all SSIDs in the local system
- Disconnect and reconnect an external volume or an external storage system
- Delete external volume mapping
- Move an external volumes from one path group to another existing group or to a new group.

See *System Operations Using Spreadsheets* for complete information.

2

Requirements and planning

This topic describes requirements and planning.

- ☐ Planning workflow
- ☐ System requirements
- ☐ Planning considerations for external storage systems
- ☐ Application performance considerations
- ☐ Planning external volumes
- ☐ Planning external paths and path groups
- ☐ Default mapping settings

Planning workflow

Before mapping an external volume to VSP, review the information in this chapter to make sure that you understand the Universal Volume Manager requirements and implementation procedures.

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

- Review System requirements on page 2-2.
- Ensure that the external system whose volumes you want to map is supported by Universal Volume Manager. See Appendix A, Supported external storage systems on page A-1.
- Ensure the functionality you want is supported for mapped external volumes. See Chapter 3, VSP software supported for external volumes on page 3-1.
- In the external system, select a port and set any necessary parameters. See Setting up ports on the external system on page 4-4.
- In the local system, identify the port that will connect to the external system and make sure it is specified as an "external port". See Setting up ports on the local system on page 4-2.
- Plan data paths from the local to the external system. See Planning external paths and path groups on page 2-13.
- In the external system, prepare volumes for use in the local system. For example, if you plan to use an external volume for replication, make sure it matches the Hitachi replication software's requirements.

  See the following for this and other considerations.

  - Planning external volumes on page 2-5
  - Mainframe volumes on page 2-7
  - Open systems volumes on page 2-8
  - Capacity requirements for volumes on page 2-8
- In the local storage system, configure external volume groups to which you will assign the external volume during the mapping operation. See External volume groups (ExGs) on page 2-8.
- You can change the defaults for some mapping settings before performing the operation. See Editing external volume policies (settings) on page 5-2.

System requirements

Universal Volume Manager (UVM) operations are performed between the local storage system—VSP—and volumes in an external storage system. General requirements for these and all UVM components are described below.

Item	Description
Virtual Storage Platform (VSP)	• Required for the UVM local storage system. • All hardware and microcode levels must be installed.
External storage systems	One is required, multiple external systems are supported per VSP. See Appendix A, Supported external storage systems on page A-1 for related details about each supported external storage system.
UVM license key	Required. See the Hitachi Storage Navigator User Guide for installation and operations instructions.
Other VSP software licenses	As needed. See Chapter 3, VSP software supported for external volumes on page 3-1 for VSP software and functions that can be used with external volumes.
Storage Navigator	Required.
RAID level	External volumes are reported as RAID 1 in the following displays: • VSP internal processing. (A bar (-) displays on the Storage Navigator windows.) • Information about the external storage system that is reported to a higher-level device (OS). Internally, VSP uses RAID 1 cache management for external volumes. The external storage controller is responsible for physical RAID methods.
Ports in external storage system	• Maximum = 1,024 ports can be connected with VSP. • (WWN is used as a port identification number)
No. of mapped ext. vols.	• Maximum = 63,232 • Maximum per port = 4,096 • For Thin Image, Copy-on-Write Snapshot and Dynamic Provisioning: `Number of external volumes + Number of virtual volumes ≤ 63,232`
No. of ext. vol. groups	Maximum = 16,384
No. of vols. registered in ext. vol. group	Maximum = 4,096
No. of mapping paths	• One required • Two or more recommended • Maximum = 8 per external volume
Minimum capacity of an internal volume	The minimum capacity of an internal volume changes depending on the emulation type. See LDEV capacities per emulation type on page 2-9.
Minimum capacity of an ext. vol.	77,760 blocks (about 38 MB). However, when the emulation type is OPEN-V, the minimum capacity is 96,000 blocks (about 47 MB).
Maximum capacity of an ext. vol.	• 59.99TB (128,849,011,200 blocks) • You can use a volume with more than 59.99TB, but you can only access 59.99TB as a mapped external volume.

Item	Description
	• Use Virtual LVI/Virtual LUN to create multiple LDEVs of OPEN-V up to the maximum LDEV size of 3.99 TB each.

Planning considerations for external storage systems

An external storage system's performance 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:

- Host I/O performance (sequential write performance only) to mapped volumes can be improved by setting SOM 872 to ON. For more information, call the Hitachi Data Systems customer support.
- The performance and status of the external system affect read/write performance of the mapped external volume. A heavy load on the external system slows the processing speed of read/write operations. In this case, I/O from a mainframe host may receive a Missing Interrupt error.
- If the host connected to the local storage system issues numerous I/O to be processed by the external storage system, the commands from the host may time out.
- When you execute VSP software commands that result in more I/O processed than the external storage system can handle, the commands could time out and an error may occur.
- When you manipulate an external volume from the host, check the Path Blockade Watch time for the external volume. If the value for this setting is longer than the timeout period of the host command, the host command may time out when the power supply is off or when an error occurs in the external storage system. If host I/O is a significant concern, make sure that the Path Blockade Watch time of the external volume is the same as or shorter than the timeout period of the host command.

Application performance considerations

Performance requirements for an application can be met when using external storage, but note the following considerations in this regard:

- Internal storage typically provides faster response times than external storage when the storage is of the same type.
- Storage used by the application must have the proper performance characteristics.

  For example, SATA type storage does not provide the performance requirements usually needed for an OLTP application.
- The mainframe Transaction Processing Facility (TPF) should not use external storage.

Planning external volumes

External volumes must be set up to match Universal Volume Manager requirements. Note the following:

- You can use pre-existing data in an external volume after it is mapped to the local system, with the following restrictions:
  - Emulation type must be set to OPEN-V when you map the volume.
  - To perform host I/O operations, an LU path from the Target port to the mapped volume must be set.
- An external volume's maximum or minimum available capacity depends on the emulation type you specify when mapping the volume.

  See Capacity requirements for volumes on page 2-8 for more information.
- You cannot access data stored in an external volume beyond the allowed maximum capacity. See "Maximum capacity of an external volume" in System requirements on page 2-2.
- You cannot map an external volume whose capacity is smaller than the minimum capacity required for internal volumes.
- Make sure that a mapped external volume is accessed only from the local VSP 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.
- When an external storage system that uses control unit path ownership is connected to VSP, 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 may affect performance.
- A management LU cannot be used as an external volume.

  A management LU receives commands from an application; 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 VSP.
- 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 VSP.
- 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.

Cache use and external storage performance

Performance for external storage used with VSP is highly dependent on proper cache configuration. The Cache Mode setting, which you specify during the mapping operation, affects external storage performance.

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

- When Enabled is specified, the write-complete response is sent when the write data is in VSP cache.
- When Disabled is specified, the write-complete response is sent when the write data is accepted by the external 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 VSP performance if the I/O rate exceeds the performance capabilities of the external system. If you specify Enabled, you should use the same formula for sizing cache in both the internal and external systems.

A cache partition should be defined when Enabled is used for the Cache Mode setting. A CLPR helps to protect overall VSP performance when the I/O rate tends to exceed the capabilities of the external system.

Cache Mode effects with other Hitachi software

Note the following additional effects regarding the **Cache Mode** setting:

- If you perform the Cache Residency Manager bind mode operation on an external volume, Cache Mode is set to Enabled. In this case, twice as much cache capacity as user data area capacity is required for the operation. (Bind mode is unavailable when UVM Cache Mode is set to Disable.)
- The external volumes in a LUSE must all use the same Cache Mode setting, either Enabled or Disabled.
- The external volumes in a Dynamic Provisioning pool must all use the same Cache Mode setting, either Enabled or Disabled.

- Dynamic Tiering pool volumes require Cache Mode to be set to Enabled.
- 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 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.

Mainframe volumes

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 may 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 system that are accessed by FICON channels cannot be mapped to the local storage system because VSP does not recognize these 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 VSP, then perform the Write to Control Blocks operation using Virtual LVI/Virtual LUN on the local system side.
  - Map the external volumes to VSP, and then format the mapped volumes on the local storage system using the Virtual LVI/Virtual LUN.



Note: The following relates to mapped volumes:

- After the mapping operation, the status of the mapped volume becomes Blockade; however, after the Write to Control Blocks operation is performed or mapped volume is formatted on the local system, the mainframe host can then access the new mainframe volume through the local VSP system's FICON channels.
- If you format the mapped volume from the external system, existing data is deleted and there are no options for retaining it. This is the reason for formatting from the local system side, as mentioned above.

For information on formatting and the Write to Control Blocks operations, see the *Provisioning Guide for Mainframe Systems*.

Open systems volumes

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

- OPEN systems external volumes do not require reformatting because the connection between VSP and the external system is Fibre Channel.

  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 may not retain existing data after being mapped.

External volume groups (ExGs)

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

For example, you may want to assign mapped volumes in the same external system to a specific ExG. Or, you may 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.

Capacity requirements for volumes

An external volume's capacity is carved into LDEVs when mapped to the local system as an internal volume. This topic provides information and instructions for calculating the capacity that the internal volume will have.

Note the following regarding internal/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 can be used whose capacity is less than the base LDEV capacity for the emulation type; 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 equal or be greater than the minimum LDEV capacity.

    The following figure illustrates minimum and base LDEV capacities.

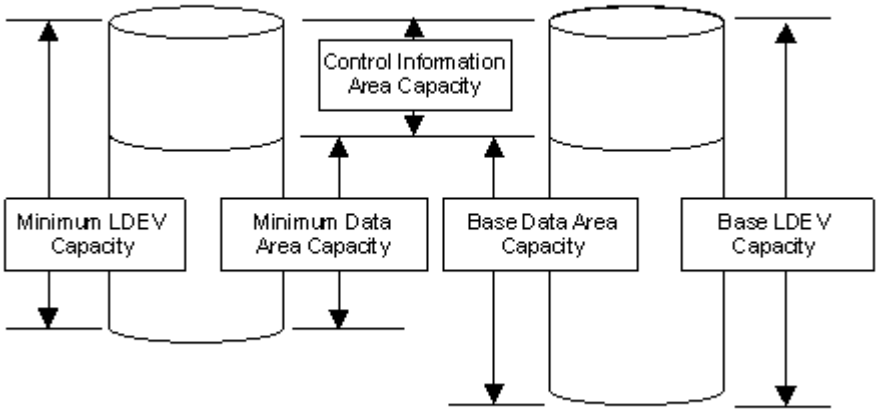


Figure 2-1 Idea of LDEV capacity

- An external volume whose capacity is more than the base LDEV capacity for the emulation type results in multiple LDEVs created when the volume is mapped. These LDEVs will have the base LDEV capacity.
- When using VLL, a maximum 2,048 CVs can be created.
  (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 above the maximum capacity cannot be accessed.

LDEV capacities per emulation type

The following table shows LDEV capacities for each emulation type in units of blocks and cylinders.

Emulation Type	Minimum Data Area Capacity		Base Data Area Capacity		Control Information Area Capacity	
	Blocks	Cylinders	Blocks	Cylinders	Blocks	Cylinders
Mainframe						
3380-3	72,000	50	4,808,160	3,339	10,080	7
3380-3A	72,000	50	4,808,160	3,339	10,080	7
3380-3B	72,000	50	4,808,160	3,339	10,080	7
3380-3C	72,000	50	4,808,160	3,339	10,080	7
3390-3	87,000	50	5,809,860	3,339	10,440	6
3390-3A	87,000	50	5,809,860	3,339	10,440	6
3390-3B	87,000	50	5,809,860	3,339	10,440	6

Emulation Type	Minimum Data Area Capacity		Base Data Area Capacity		Control Information Area Capacity	
	Blocks	Cylinders	Blocks	Cylinders	Blocks	Cylinders
3390-3C	87,000	50	5,809,860	3,339	10,440	6
3390-3R	87,000	50	5,809,860	3,339	10,440	6
3390-9	87,000	50	17,429,580	10,017	43,500	25
3390-9A	87,000	50	17,429,580	10,017	43,500	25
3390-9B	87,000	50	17,429,580	10,017	43,500	25
3390-9C	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-LA	87,000	50	57,002,400	32,760	40,020	23
3390-LB	87,000	50	57,002,400	32,760	40,020	23
3390-LC	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-MA	87,000	50	114,004,800	65,520	92,220	53
3390-MB	87,000	50	114,004,800	65,520	92,220	53
3390-MC	87,000	50	114,004,800	65,520	92,220	53
3390-A	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	-	-
OPEN						
OPEN-3	72,000	-	4,806,720	-	11,520	-
OPEN-8	72,000	-	14,351,040	-	38,880	-
OPEN-9	72,000	-	14,423,040	-	38,880	-
OPEN-E	72,000	-	28,452,960	-	27,360	-
OPEN-L	71,192,160	-	71,192,160	-	10,080	-
OPEN-V	96,000	-	8,589,934,592	-	-	-

- For mainframe emulation types, LDEV capacity is an integer when converted to cylinders.
- For 3380 mainframe volumes, 1 cylinder = 1,440 blocks
- For 3390 mainframe volumes, 1 cylinder = 1,740 blocks
- 3390-A requires a control information area every 1,113 cylinders.
- For OPEN-L, CVs cannot be created. Therefore, the base data area capacity and minimum data area capacity are the same.
- For OPEN-V:

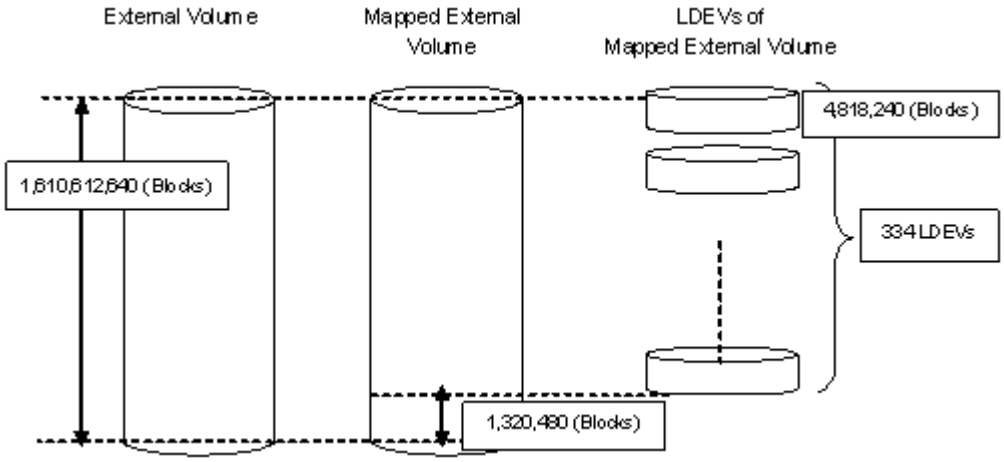
  - The maximum capacity of LDEVs is listed as the base data area capacity.

  - The capacity of the external volume is equal to the capacity of the internal volume, when 4 TB or less. This is because there is no control information area capacity.
- For OPEN emulation types other than OPEN-V, LDEV capacity is divisible by 1,440 blocks.

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. Using the data for OPEN-3 in LDEV capacities per emulation type on page 2-9, 334 LDEVS can be created from the base LDEV capacity of 4,818,240 blocks (Base Data Area plus Control Information Area).

This results in 1,320,480 blocks of the mapped external volume becoming free space. LDEVs can be created in free space using VLL.



Adjusting volume capacities for pairs

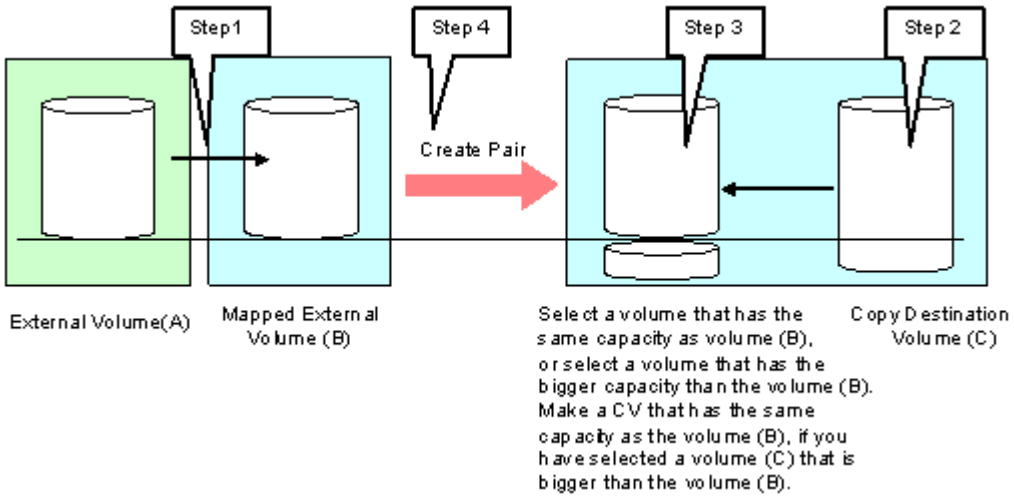
Mapped external volumes can be used for replication. All VSP replication software requires a pair's secondary volume (S-VOL) to have the same capacity as the primary volume (P-VOL).

If you need to adjust the capacity of the VSP volume or the external volume before creating the pair, proceed as shown in the following subtopics.

Decreasing the size of the VSP S-VOL

When the VSP volume S-VOL is larger than the mapped external volume P-VOL, adjust the VSP volume's capacity as follows:

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



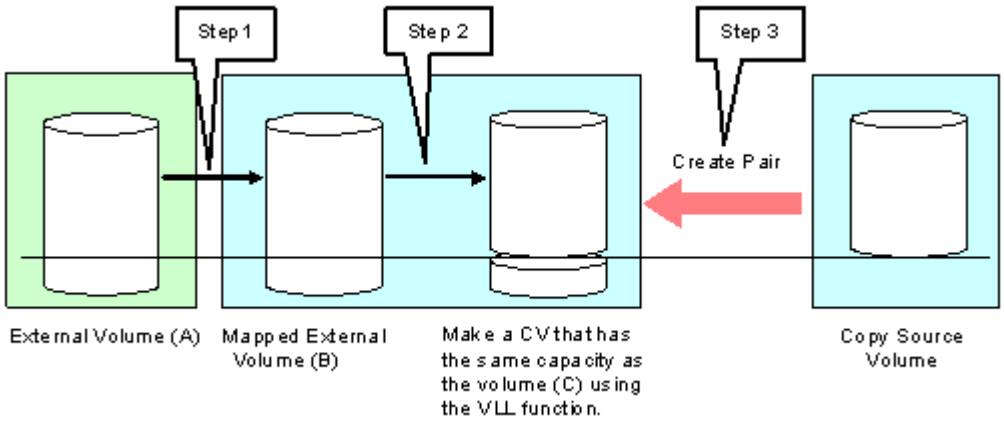
Base the CV capacity on Blocks, which displays in the **Capacity** column on the **LDEV Information** dialog box in Storage Navigator. See the *Provisioning Guide for Open Systems* and the *Provisioning Guide for Mainframe Systems* for instructions on creating CVs.

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 P-VOL, adjust the external volume's capacity as follows:

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



3. Create the pair.

Planning external paths and path groups

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 up ports on the local system on page 4-2
- Setting up ports on the external system on page 4-4

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.

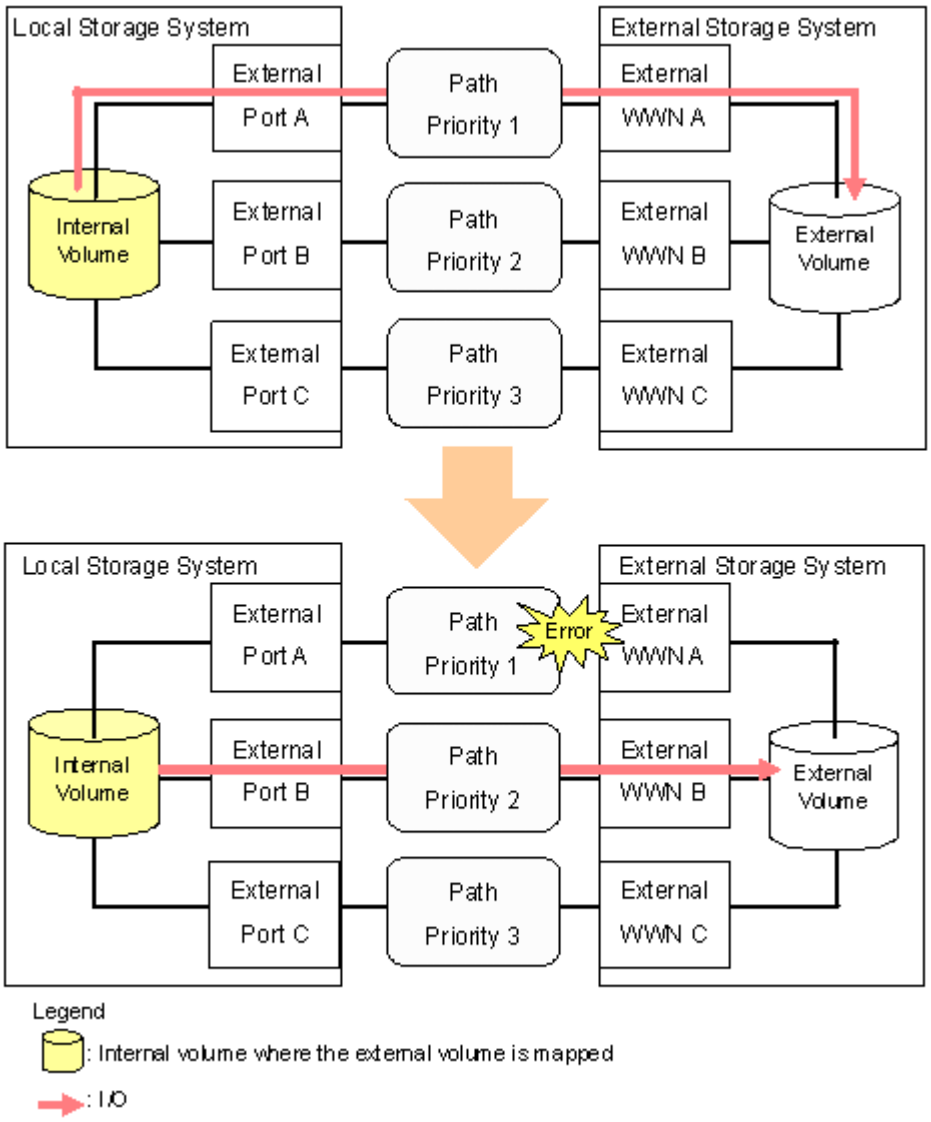
Because workload can spike and cable or switch failures can occur, Hitachi strongly recommends that you set up redundant external paths. A maximum of eight paths can be used per mapped external volume. Multiple paths—redundancy—allows you to perform I/O operations with external volumes regardless of workload and/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 to execute I/O to the external volume. If the primary path cannot be used, it is switched to an alternative path, after a 3-minute period.

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

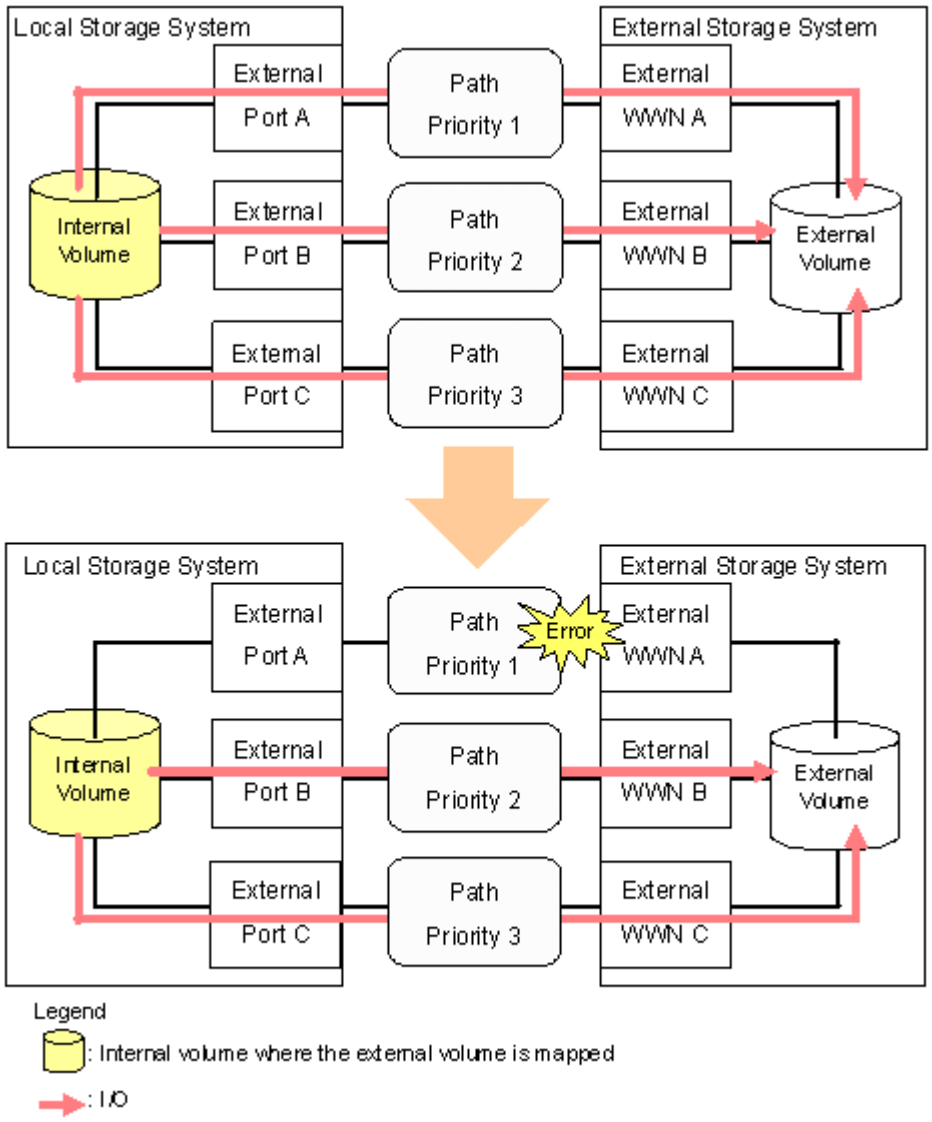


When you restore a path with higher priority than the currently-used path, I/O is switched to the restored path.

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 systems' path mode for external volumes

"Single" or "Multi" path mode displays in 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 APLB mode, all paths that are defined are used. I/O operation for external volumes is performed through load balancing with the use of several paths (round-robin control). External paths connected to ports in Passive status are not used.

Load Balance Mode

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

- **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. This mode is applied to external volumes mapped before 70-04-XX-XX/XX. Specify this if Extended Round-robin may 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. Read speed can be improved 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 may 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 Storage Navigator.

If your system is not shown below, refer to http://www.hds.com/products/storage-systems/specifications/supported-external-storage.html.

Storage System	Reference
Hitachi Virtual Storage Platform G200, G400, G600	• Path Mode: Multi • Displays as "VSP Gx00".
Hitachi Virtual Storage Platform G1000	• Path Mode: Multi • Displays as "VSP G1000".
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".

Storage System	Reference
Hitachi TagmaStore® Universal Storage Platform	• Path Mode: Multi • Displayed "USP".
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	• 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".

Storage System	Reference
HP Virtual Storage Platform VP9500	• Path Mode: Multi • Displays as "P9500".
A/H-6593	• Path Mode: Multi • Displays as "300".
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	• Path Mode: Single • Displays as "EVA".

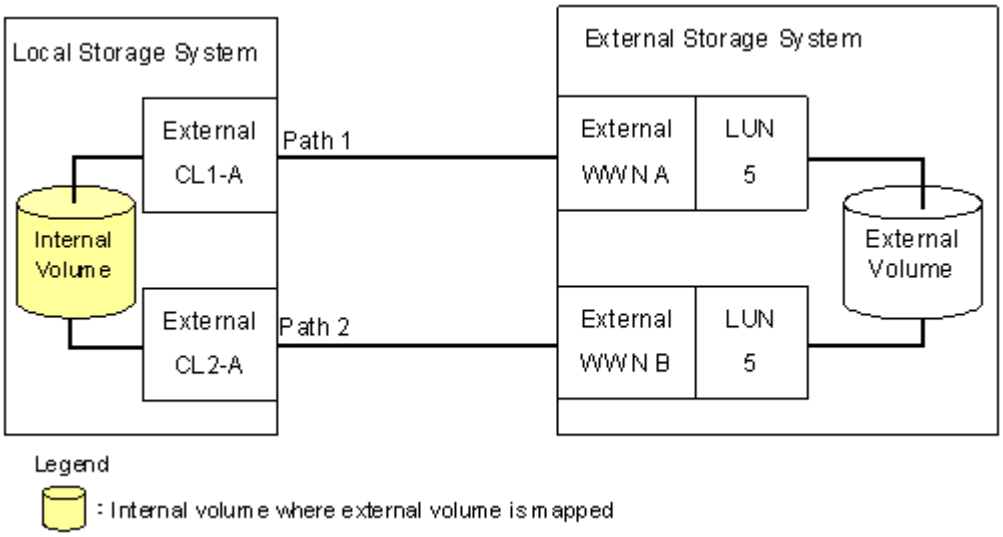
Storage System	Reference
Array 3000/4000/5000/6000/8000	
SVS200	• Path Mode: Multi • Displays as "SVS200".

External path configurations — direct and switch

This topic provides recommendations for setting up direct and switch external path configurations.

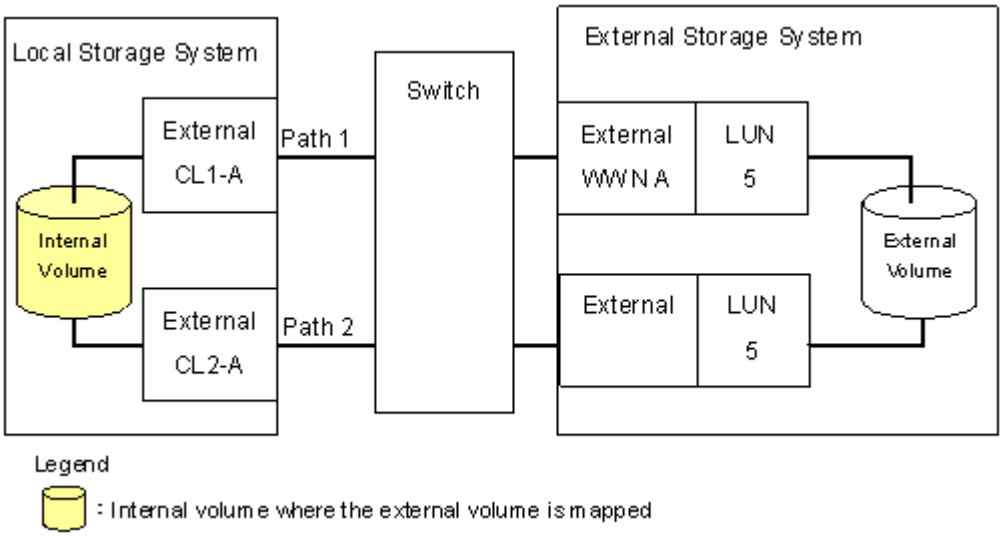
Direct connection

The following figure shows redundant paths in a direct connection configuration. External storage system ports, "WWN A" and "WWN 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.



Default mapping settings

Mapped volumes have default values that you can use or change before (or after) mapping.

See Editing external volume policies (settings) on page 5-2 to review the settings and edit them if desired.

3

VSP software supported for external volumes

You will use VSP 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.

This topic provides requirements and restrictions for the Hitachi software supported with external volumes.

- Cache Residency Manager
- Copy-on-Write Snapshot
- Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, and Thin Image
- Local replication software
- LUN Manager and Configuration File Loader
- LUN Expansion
- Performance Monitor
- Remote replication software
- SNMP Agent
- Virtual LVI/LUN (VLL)

Cache Residency Manager

Review the following when using external volumes with Cache Residency Manager:

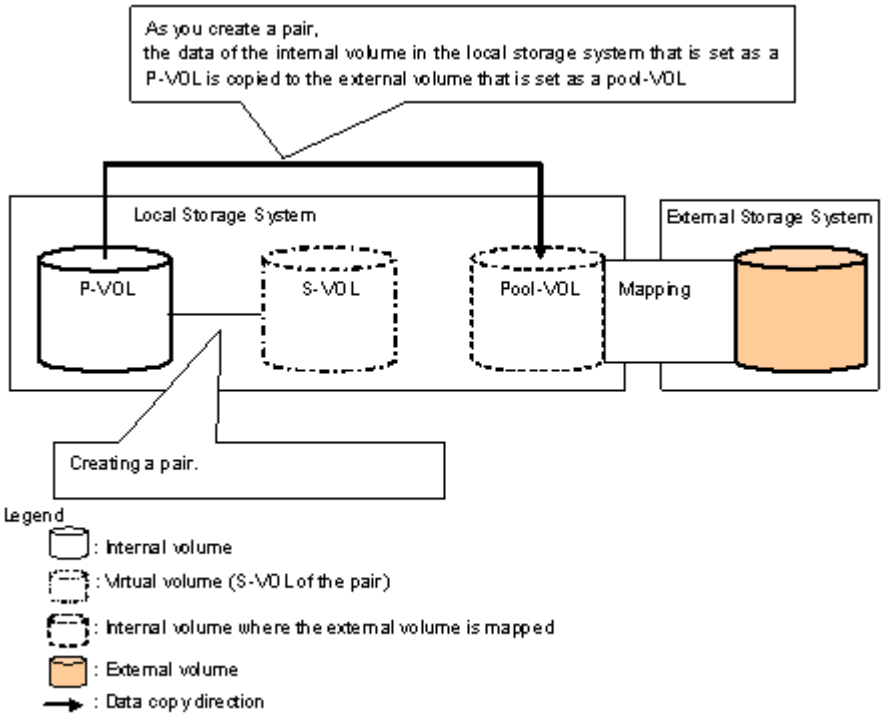
- If you set bind mode, a cache of twice as much capacity as the user data area of the mapped volume is required for the Cache Residency Manager operation.
- Bind mode cannot be specified for an external volume if the **Cache Mode** is set to **Disable** You can specify the **Cache Mode** setting before, during, or after mapping. See Editing external volume policies (settings) on page 5-2 for more information.

Copy-on-Write Snapshot

Mapped volumes can be used in pairs for Copy-on-Write Snapshot, with the following restrictions:

- Both internal and external volumes cannot be used together in the same pool.
- All external volumes in a pool must use the same **Cache Mode** setting.

After mapping and formatting 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 Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, and Thin Image

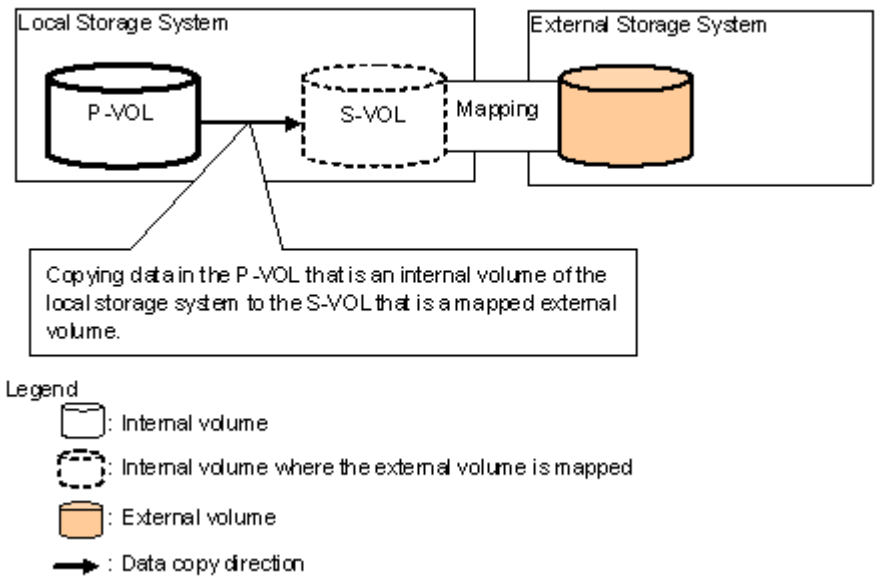
Mapped external volumes can be used as pool volumes for Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe, and Thin Image.

- 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.
- 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 2-6.
- With Dynamic Tiering, the **Cache Mode** setting must be **Enabled**.

Local replication software

Mapped volumes can be used in pairs for ShadowImage and ShadowImage for Mainframe.

After mapping and formatting an external volume, it is ready to use as a pair volume. The following figure shows an example of an external volume used as an S-VOL (R-VOL in an SIz pair).



LUN Manager and Configuration File Loader

Use LUN Manager to set the LU path for the mapped volume with OPEN systems emulation types.

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).
- Setting the channel adapter (CHA) mode, host group, and WWN for the external port is not supported. When an external volume is mapped through an external port, the port setting operation of the topology is not available.

LUN Expansion

External volumes can be used in a LUSE volume with the following restrictions:

- An internal volume in the local storage system and a mapped external volume cannot be combined to form a LUSE volume.
- Only LDEVs from the same external storage system can be used in a LUSE volume. Do not combine LDEVs of multiple external storage systems to create a LUSE volume, otherwise the following occurs:
  - When one external volumes is lower performing than others, it affects the performance of the LUSE volume.
  - If an external volume that is part of a LUSE volume is blocked, the data reliability of the LUSE volume deteriorates because the LUSE volume has both accessible areas and inaccessible areas from a host.
  - If an external volume in a LUSE volume is disconnected or reconnected, all external volumes in the LUSE volume must be disconnected or reconnected at the same time.
- All external volumes in a LUSE volume must use the same **Cache Mode** setting. For more information about this setting, see Cache use and external storage performance on page 2-6.

Performance Monitor

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

Remote replication software

Mapped external volumes can be used with the following remote replication software:

- TrueCopy
- TrueCopy for Mainframe
- Universal Replicator

- Universal Replicator for Mainframe

After mapping and formatting an external volume, it is ready to use as a pair volume. The following figures show examples of an external volume used as an S-VOL (T-VOL in a TCz pair).

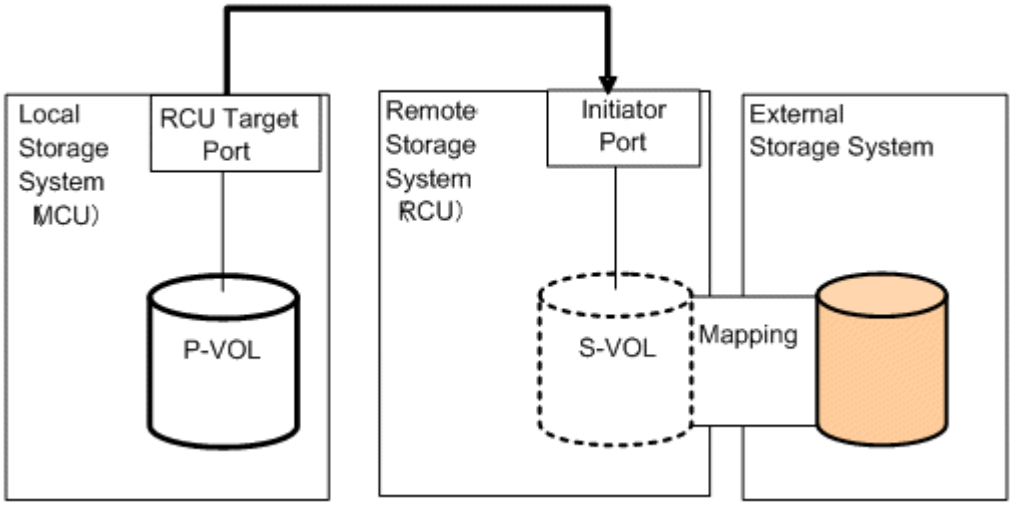


Figure 3-1 UR and URz example using a mapped external volume

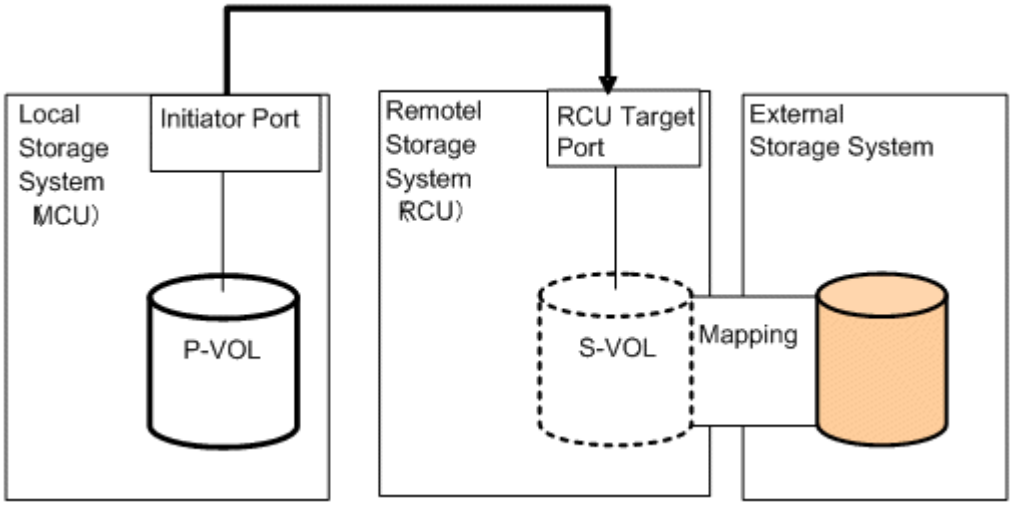


Figure 3-2 TC and TCz example using a mapped external volume

SNMP Agent

Information about both the mapped external volume and the External port can be displayed by SNMP Agent.

Virtual LVI/LUN (VLL)

For mainframe external volumes, use the Virtual LVI function to format or 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 mapped external volume.

4

Setting up external volumes

You set up ports and external paths, map the external volume, then begin using it with native storage on the VSP. This topic provides setup procedures and information.

- Setup workflow
- Setting up ports on the local system
- Setting up ports on the external system
- Mapping an external volume
- Preparing mapped volumes for use
- Using mapped volumes
- Recognizing the local system from the external system

Setup workflow

When you begin setting up Universal Volume Manager, all planning tasks and considerations should be completed. Consult the topics in Planning workflow on page 2-2 to review.

Set up external volumes as follows:

1. Set up ports on the local and external storage systems. See the following:
   - Setting up ports on the local system on page 4-2
   - Setting up ports on the external system on page 4-4
2. To edit certain mapping settings prior to the mapping operation, see Editing external volume policies (settings) on page 5-2. Otherwise, you can make changes during the operation or accept the default settings.
3. Map the external volume to the VSP.
   See Mapping an external volume on page 4-5.
4. When the external volume is successfully mapped, perform the one of the following based on the volume's emulation type:
   - 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, define LU paths to a host using LUN Manager. See the *Provisioning Guide for Open Systems*.

See Also:

Recognizing the local system from the external system on page 4-12.

Setting up ports on the local system

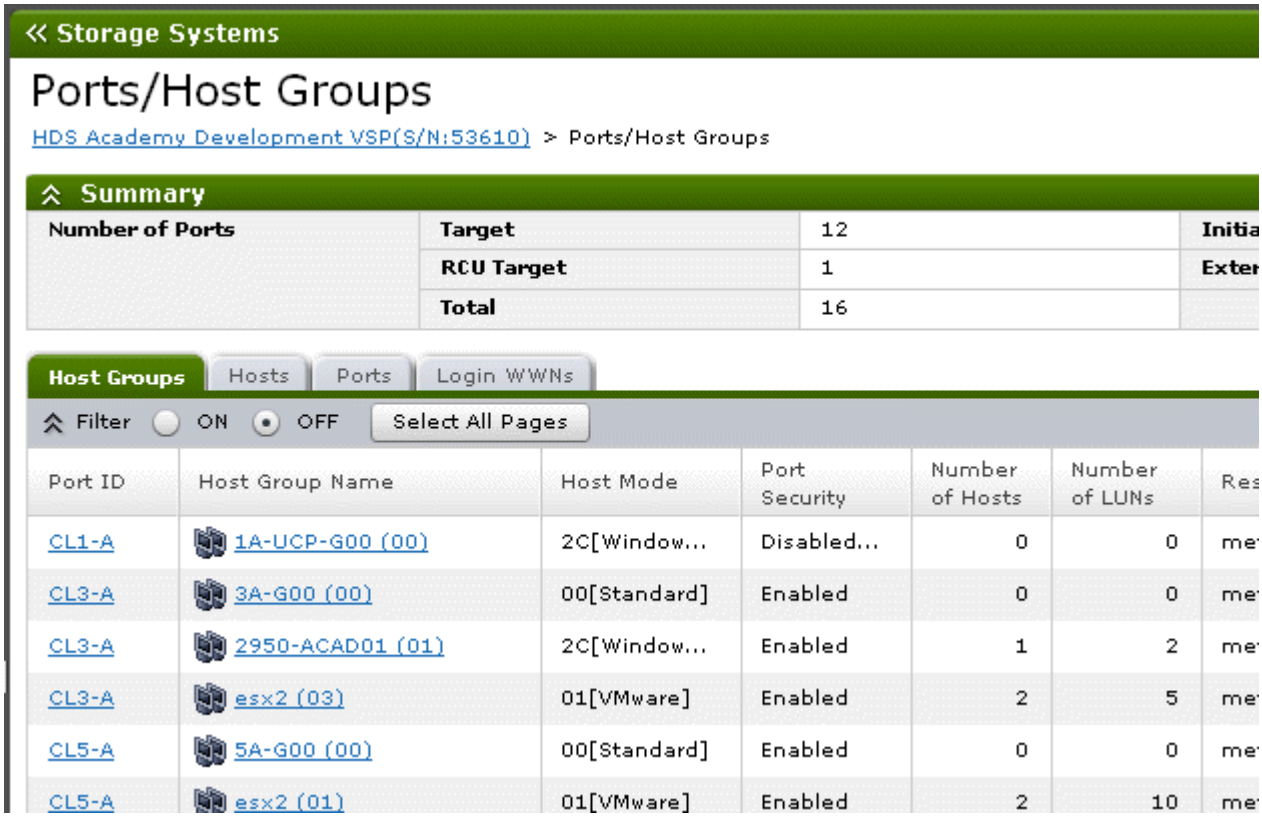
A port on the VSP must connect with the port on the external system via the external path. The VSP port must be specified as an "External" port. This topic provides instructions for changing the Fibre Channel port attribute to "External".

Prerequisites

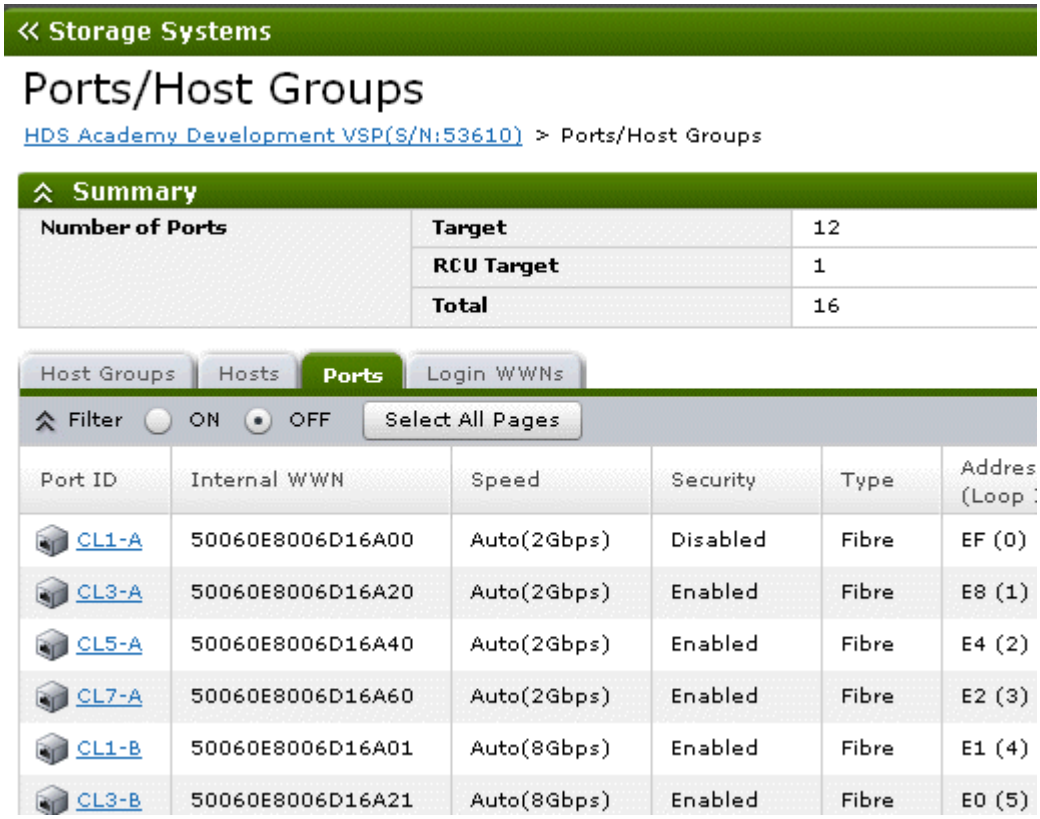
- Before changing the port's attribute, release LU paths that may be assigned to the port.
- Ports with RCU target and Initiator attributes can be changed to External, but ensure that they are no longer used for remote copy.
- For more information about setting up the external path, see Planning external paths and path groups on page 2-13.

To set a port attribute to external

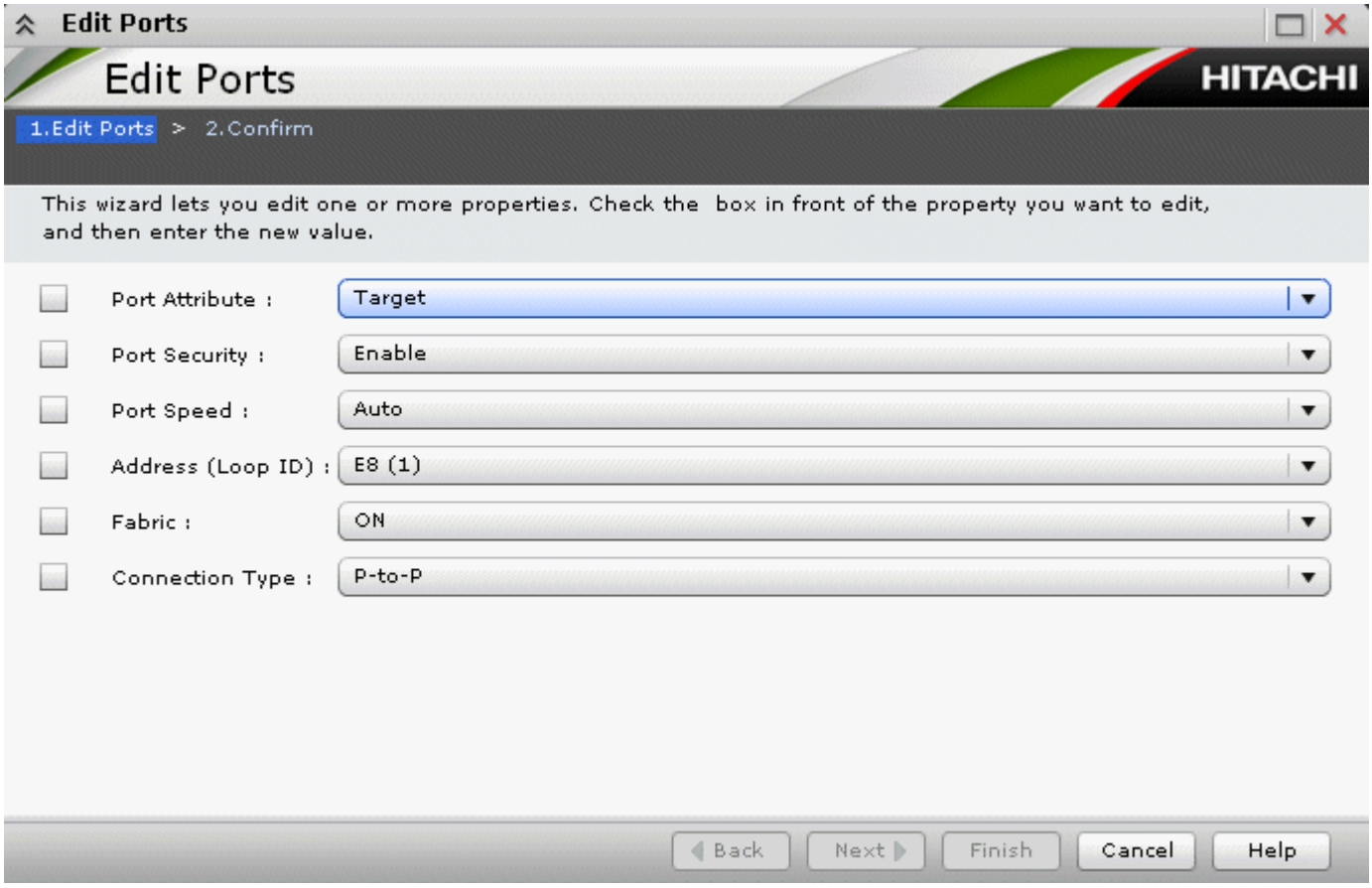
1. In the Storage Navigator **Storage Systems** tree, click the **Ports/Host Groups** link.
2. In the **Ports/Host Groups** window, select the **Ports** tab.



3. On the **Ports** tab, select the desired port row.



4. On the menu bar, click **Actions**, **Ports/Host Groups**, and then **Edit Ports**.
5. On the **Edit Ports** window, select **External** in the **Port Attribute** box.



6. For help with other settings, see the *Provisioning Guide for Mainframe Systems* or *Provisioning Guide for Open Systems*.
7. When ready, click **Finish**.
8. In the **Confirm** window, check all settings, accept or enter a new task name, and then click **Apply**.

Setting up ports on the external system

Make sure the external system ports you use can handle the read and write workload planned for the external volumes. See the discussion in External paths on page 2-13 for more information.

The following are general steps for setting up external-system ports. Refer to the documentation for the external system for full information.

1. Set the topology information 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 VSP. For your specific external system, see Appendix A, Supported external storage systems on page A-1.

   If you do not find your external system in the section, see http://www.hds.com/products/storage-systems/specifications/supported-external-storage.html to make sure your system is supported, then refer to the documentation for the system's ports.
4. Define LUNs and present them on the port on the external system.

Mapping an external volume

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

Prerequisite information

- Attributes set for the external volume before mapping, such as port security, LUN security, Volume Retention Manager attributes, and so on are discarded when the external volume is mapped. If the original attributes are required, reset them in the local storage system after mapping.
- When the external volume is a command device, it is mapped as a remote command device. For important information about mapping command devices, see Appendix B, Remote command devices on page B-1.
- Before you map the external volume, check whether any application is using the volume. If so, stop the application before mapping.

  For example, if mapping a command device, make sure CCI commands are not being executed during the mapping operation.

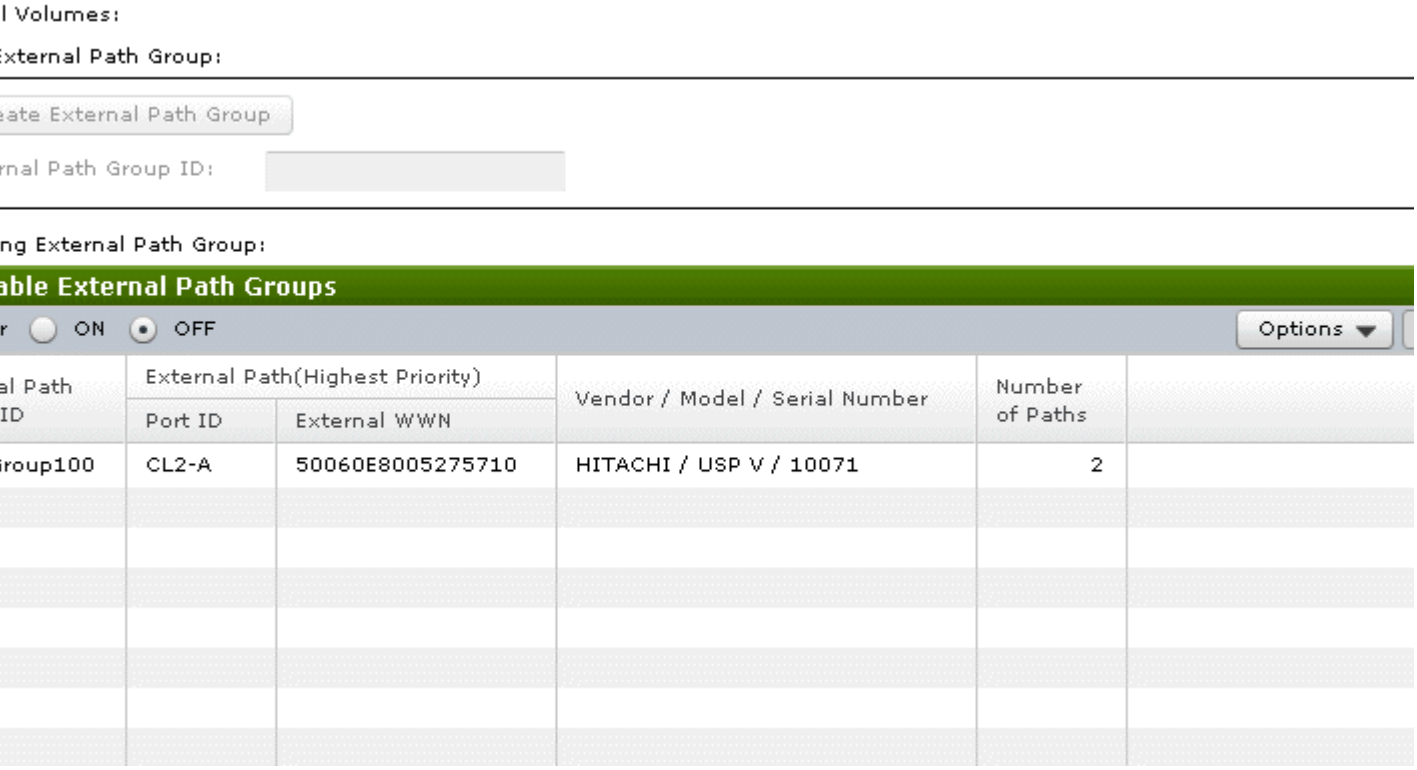
Note: When you create an LDEV at the same time that you map an external volume, you cannot select the following LDEV numbers:

- Numbers already in use.
- Numbers already assigned to another emulation group (grouped every 32 LDEV numbers).
- Numbers not assigned to the user.

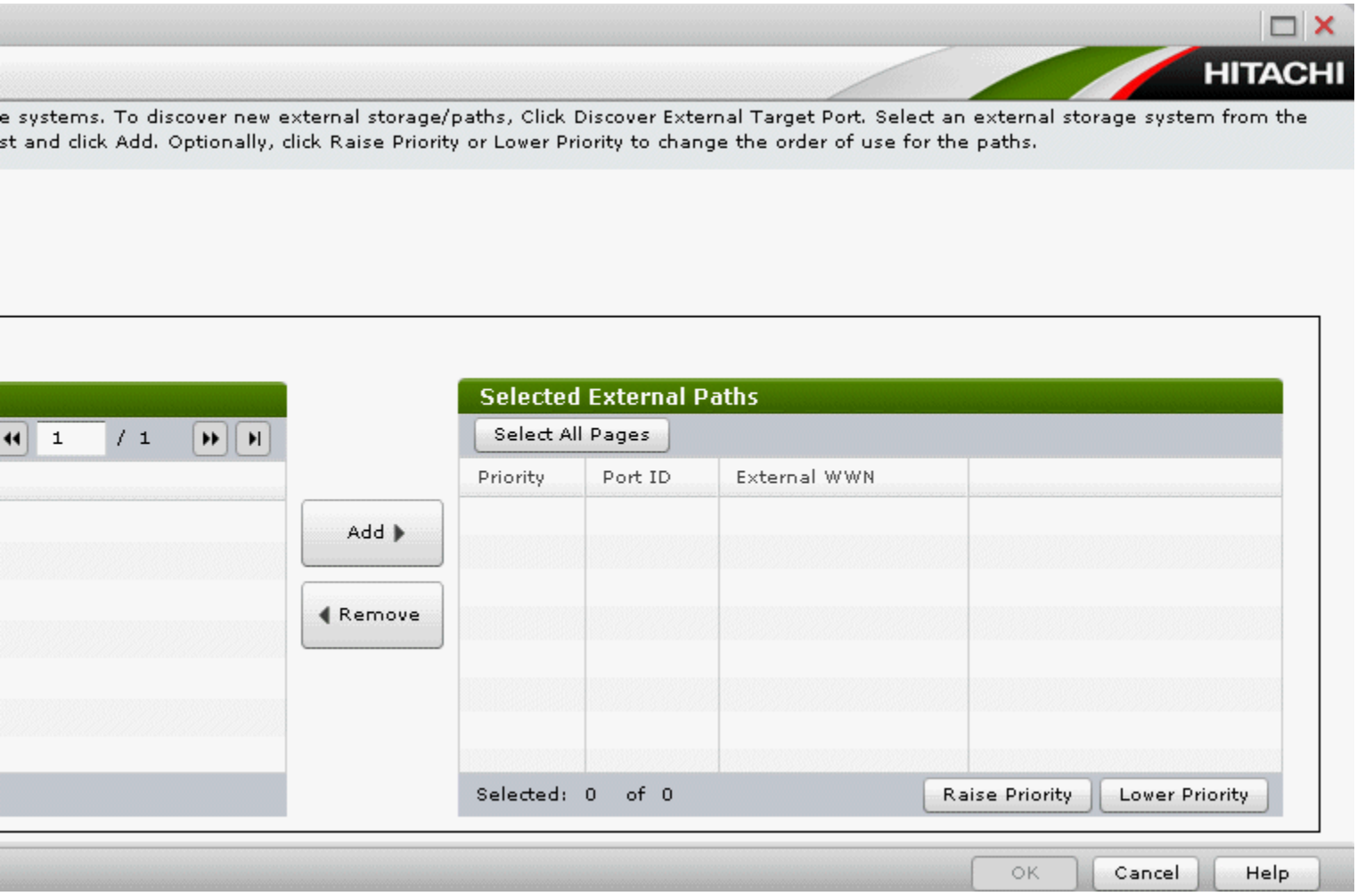
For emulation groups, see *Provisioning Guide for Open Systems* or *Provisioning Guide for Mainframe Systems*. To determine whether the LDEV number can be assigned, click the **View LDEV IDs** button in the **Add External Volumes** window when you map the external volume.

To map an external volume

1. In Storage Navigator, select **Add External Volumes** from the **General Tasks** menu.
2. In the **Add External Volumes** window, add the external volume by clicking either **By New External Path Group** or **By Existing External Path Group**.



- To add the external volume **By New External Path Group**:
  a. Click **Create External Path Group**.
  b. In the **Create External Path Group** window, enter the following:



— **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 range can be from 0 to 63,231. 0 is the default.

— **External Paths**. If you do not see the port or WWN you want in the **Available External Paths** box, click **Discover External Target Ports**. In the new window, select the desired ports and click **Add**, then click **OK**.

— **External Storage System**. If the external system is not selected, scroll down the list and select it.

— **Available External Paths**. Select the desired port IDs and click **Add**, then click **OK**.

c. Set the priority for a path by selecting it and clicking **Raise Priority** or **Lower Priority**.

d. Click **OK**.

- To add the external volume **By Existing External Path Group**:

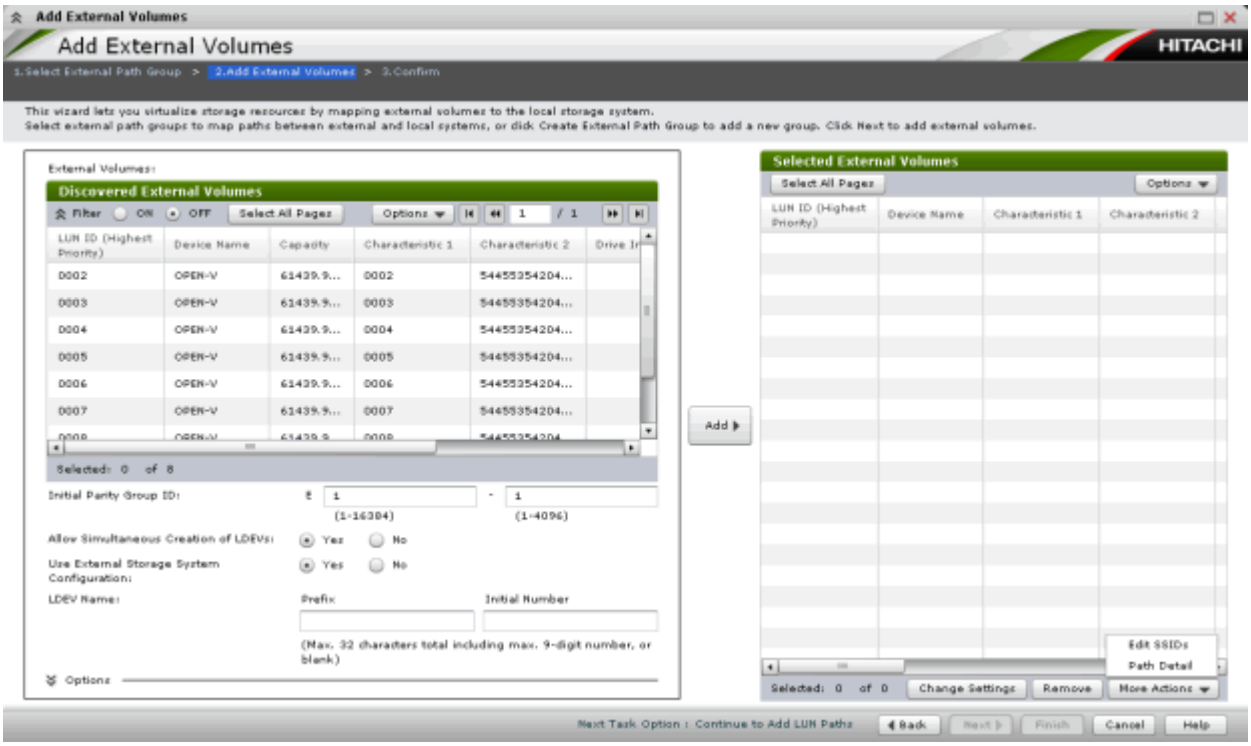
  a. Click **By Existing External Path Group**.

  b. If you have not identified the external storage system that you want to connect the external path to, click the storage system button and select the system.

c. In the **Available External Paths** list, select the desired path group. Path groups consist of the external paths previously set up and prioritized.

d. Click **Next**.

3. In the **Add External Volumes** window's **Discovered External Volumes** box, select the desired external volumes.



4. In **Initial Parity Group ID**, enter an external volume group number and sequential number. A group allows you to place similar external volumes in a group; for example, volumes used for a copy function.

   The range is from 1 - 1 to 16384 - 4096.

5. In **Allow Simultaneous Creation of LDEVs**, select **Yes** to allow the system to automatically create LDEVs in the external volume, otherwise select **No**.

   If the external volume is a command device, select **Yes** in both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.

6. In **Use External Storage System Configuration**, select **Yes** to use the external storage system's configuration when the local system create LDEVs (if **Allow Simultaneous Creation of LDEVs** is also **Yes**). Otherwise, select **No**.

   - If you select **Yes**, an LDEV whose emulation type is OPEN-V and has the same capacity as the external volume is created (maximum capacity of an OPEN-V LDEV is 4 TB).
   - If you select **No**, the **Options** list expands. You must select an **Emulation Type** when you select **No**.

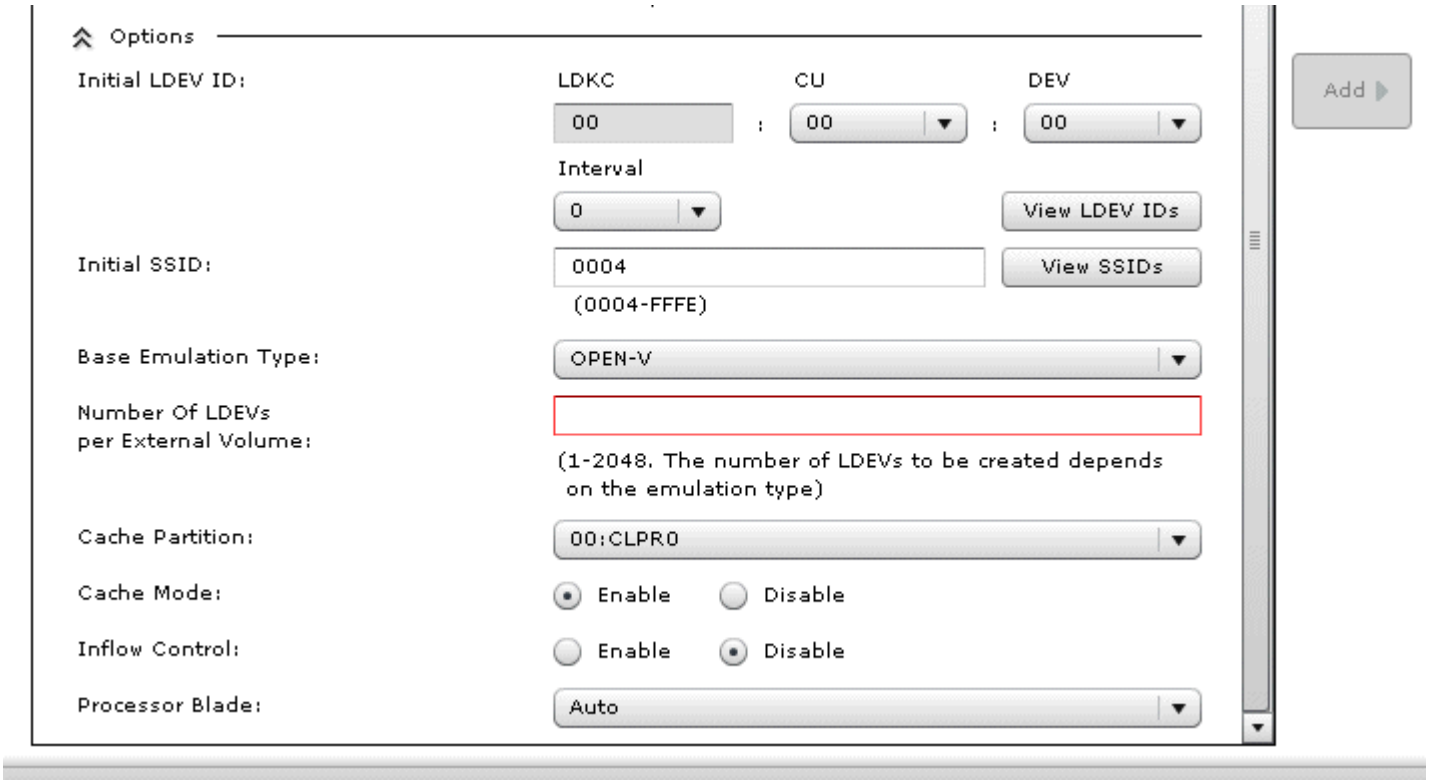
If the external volume is a command device, select **Yes** in both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.

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

   The entire value can be a maximum of 32 characters including the initial number (numerical value of 9 digits or less), or blank. Blank is displayed by default. Note the following numbering rule:

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

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



9. 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, which can from 00 to FE. 00 is the default.
   - For **DEV**, enter the LDEV ID, which can be from 00 to FF. 00 is the default.

- For **Interval**, enter an interval between LDEV IDs, which can be from 0 to 255. 0 is the default.

10. In **Initial SSID**, enter the SSID, which can be from 0004 to FFFE. 0004 is the default.

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

11. 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.

12. 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 (since OPEN-V is the emulation type). See Capacity requirements for volumes on page 2-8 for more information.

13. 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 Editing external volume policies (settings) on page 5-2.

---

14. In **Cache Mode**, click **Enable** to propagate write data asynchronously from cache to the external storage system. Click **Disable** to propagate data synchronously.

    - 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.

15. In **Inflow Control**, click **Enable** to limit or prevent write data from being written to cache memory when the write operation to the external volume cannot be performed. Click **Disable** to allow write data to be written to cache.

16. In **Processor Blade**, select the processor blade for the external volume. Processor blade assignment should evenly distribute work across the available processors.

    The range is from MPB0 to MPB7. The value depends on the configuration of the device.

    Select **Auto** (the default) to cause a processor blade to be automatically assigned by the system. If **Auto** cannot be selected, the processor blade with the lowest number is selected by default.

17. Click **Add**.

18. If you need to change the added volume's settings, in the **Selected External Volumes** list click the volume, click **Change Settings**, make necessary changes, and click **OK**.
19. To to add LUN paths, click **Next** in the **Add External Volumes** window. See the *Provisioning Guide for Open Systems* for information.
20. Click **Finish** when ready.
21. In the **Confirm** window, check all settings, accept or enter a new task name, and then click **Apply**.

Preparing mapped volumes for use

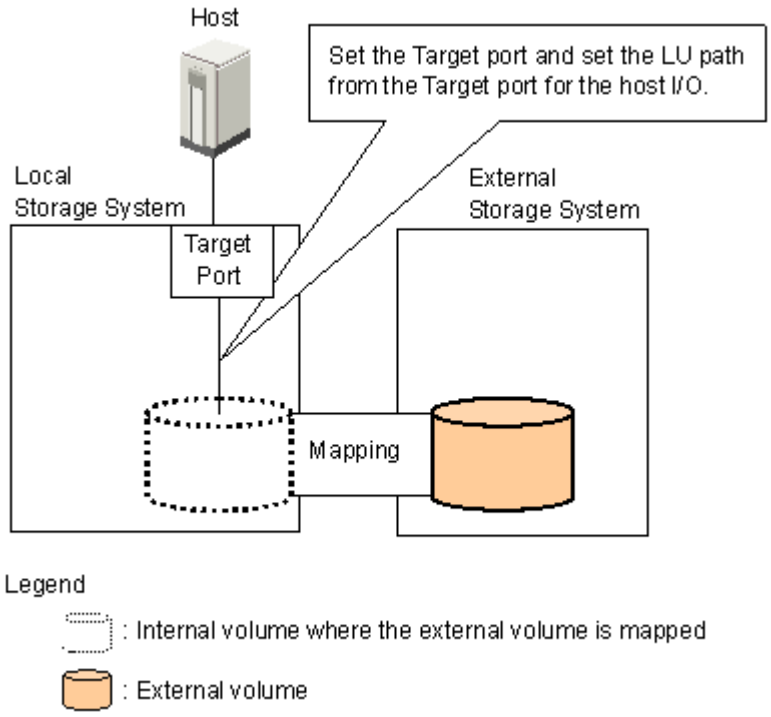
After your external volume is mapped to the local storage system, proceed as follows:

To prepare mapped volumes for use

1. Based on 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. For both emulation types, 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

When 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 Chapter 3, VSP software supported for external volumes on page 3-1.

Note: A mapped external volume can be accessed only from the local system. Do not access the volume from a host connected to the external storage system.
Also, do not use external storage system functions to access the mapped external volume, including copy functions.

Recognizing the local system from the external system

Though the local and external systems are connected, the external system may not recognize the local system. If desired, you can try to make this happen by performing the Discover External Target Ports operation. See Adding an external path to an existing path group on page 5-8 for instructions. If the path does not become mapped after 15 minutes, though, the external system might not be able to recognize the local system.

5

Monitoring and maintenance

This topic provides monitoring, editing, and maintenance instructions for external volumes, paths, and systems.

- ☐ Monitoring external volumes and paths
- ☐ Editing external volume policies (settings)
- ☐ Changing external volume processor blade
- ☐ Changing I/O mode for external storage systems
- ☐ Editing external WWN settings
- ☐ Path maintenance
- ☐ Disconnecting external systems and volumes
- ☐ Reconnecting external systems and volumes
- ☐ Deleting an external volume mapping
- ☐ Powering off and on local, external storage systems

Monitoring external volumes and paths

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

To view mapped external volumes and paths

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. Select an external storage system.
3. Select a path group.
4. Select the **Mapped Volumes** tab.
5. Select an external volume row. Click **View External LUN Properties** at the bottom of the window.

Editing external volume policies (settings)

When you map new external volumes, preset mapping policies are used. You can change default mapping values without affecting settings in previously mapped volumes.

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

The settings and their functions are described in the following bullets. To skip to the procedure, see Editing mapping policies on page 5-3.

- **Base Emulation Type**
  - Specify OPEN-V to use existing data in the external volume from VSP.
  - 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.

    See Capacity requirements for volumes on page 2-8 for more information about capacity and calculating the capacity of your external volume.
- **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**).
  - If **Enable** is specified: 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.
  - When **Disable** is specified (the default): After synchronously writing the data to the external volume, the local system signals the host that an I/O operation has completed.

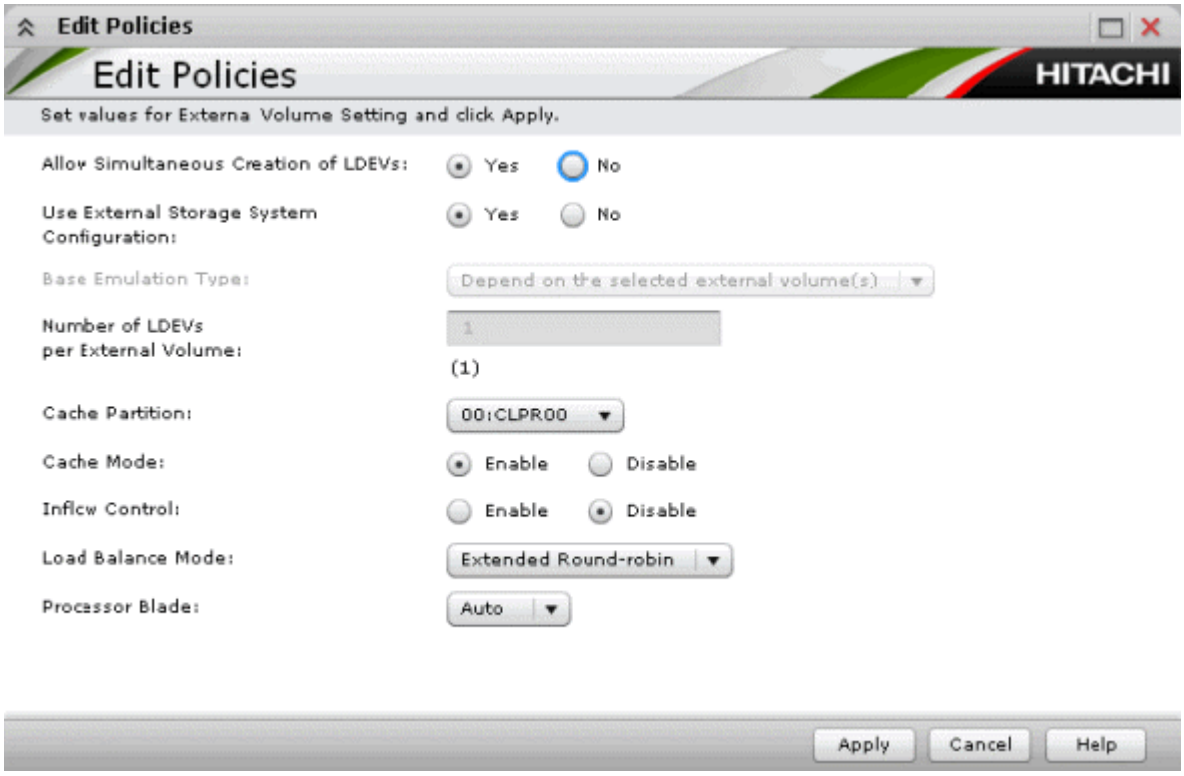
  For further discussion, see Cache use and external storage performance on page 2-6.

- **Cache Partition**. Cache memory can be partitioned 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.

  Hitachi strongly recommends that you place external storage array groups in a CLPR other than CLPR0. See the *Hitachi Virtual Partition Manager User Guide* for detailed information on CLPR.
- **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**).
  - If **Enable** is specified, 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.
  - When **Disable** (the default) is specified, I/O 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 written to the external volume (all data is destaged).
- **Load Balance Mode**. When the Path mode is Multi or APLB, select **Normal Round-robin**, **Extended Round-robin**, or **Disable** as a Load Balance Mode for the external storage system. By default, Normal Round-robin is used. However, when the product name of the storage system is displayed as "generic", **Disable** is used by default.
  - **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.

Editing mapping policies

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the row for an external storage system.
3. At the bottom of the window, click **More Actions > Edit Policies**.
4. In the **Edit Policies** window, use the information in the previous sections to enter new settings.



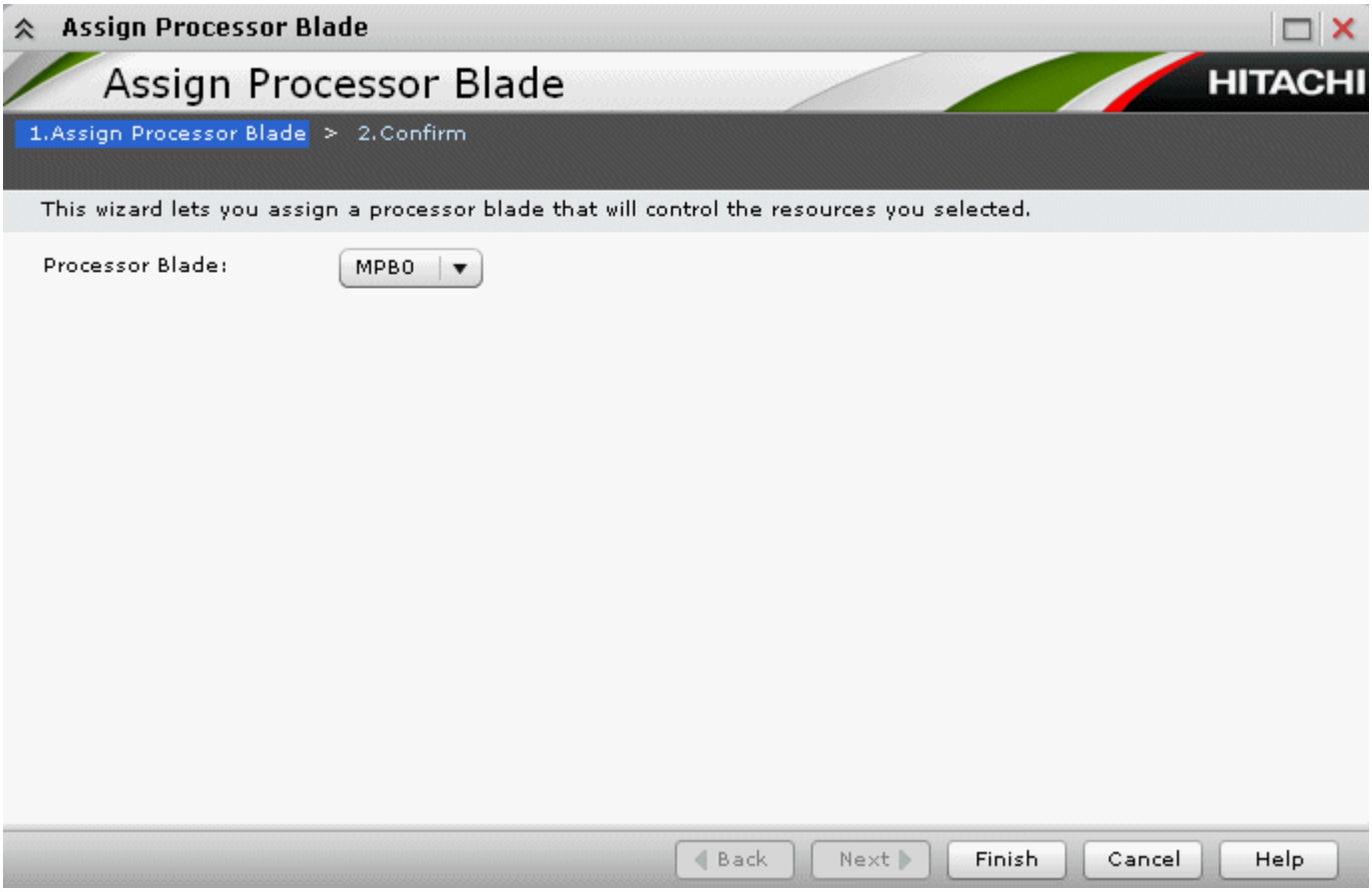
Note: You can also edit **Cache Mode** and **Inflow Control** for individual external volumes. In Storage Navigator, select an external volume in the **Mapped Volumes** tab. Then click **Edit External Volumes**.

5. Click **Apply**.

Changing external volume processor blade

To change the processor blade

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the desired external storage system.
3. In the window for the selected external storage system, select a path group.
4. In the window for the selected path group, select the external volume whose processor blade you want to change.
5. At the bottom of the window, click **More Actions > Assign MP Blade**.
6. In the **Assign Processor Blade** window, select the desired processor blade.



The current setting for the external volume displays, 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**.

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

Selecting **Auto** allows the system to assign the blade.

7. Click **Finish**.
8. In the **Confirm** window, check settings, accept or enter a new task name, and then 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.

This section describes operations to change the Load Balance Mode of external volumes in the Edit External Volumes window. For more information, see Load Balance Mode on page 2-16.

Note: To change the Load Balance Mode, the path mode of the external volume must be either Multi or APLB.

To change the Load Balance Mode for each external volume:

1. Click **External Storages** in the **Storage Systems**.
   The list of available external storage systems appears in the tree.
2. In the tree, select an external storage system.
   The path groups corresponding to the external storage system appear.
3. Select a path group.
4. Select the **Mapped Volumes** tab.
5. Select an external volume.
6. In the menu bar, click **Actions > External Storage > Edit External Volumes**.
   The **Edit External Volumes** window opens.
7. In **Load Balance Mode**, select **Extended Round-robin**, **Normal Round-robin**, or **Disable**.
8. Click **Finish** to display the **Confirm** window displays.
9. Confirm the settings and enter the task name in the **Task Name** box.
10. In the **Confirm** window, click **Apply**.

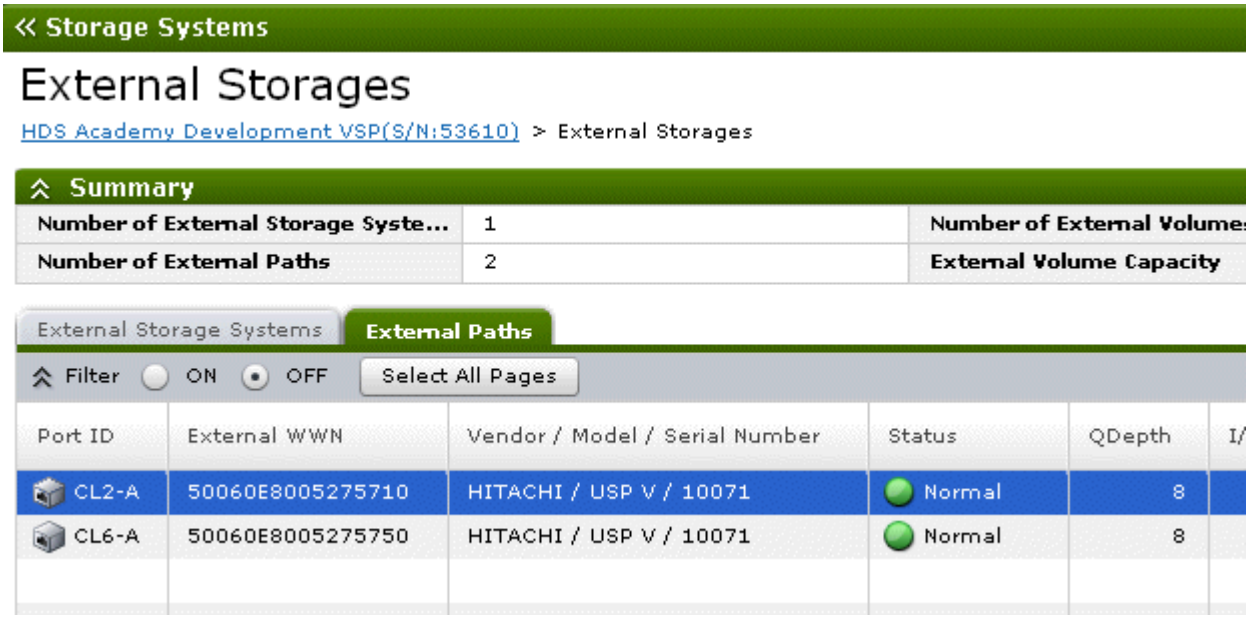
Editing external WWN settings

You can change the external system's WWN port setting. 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.

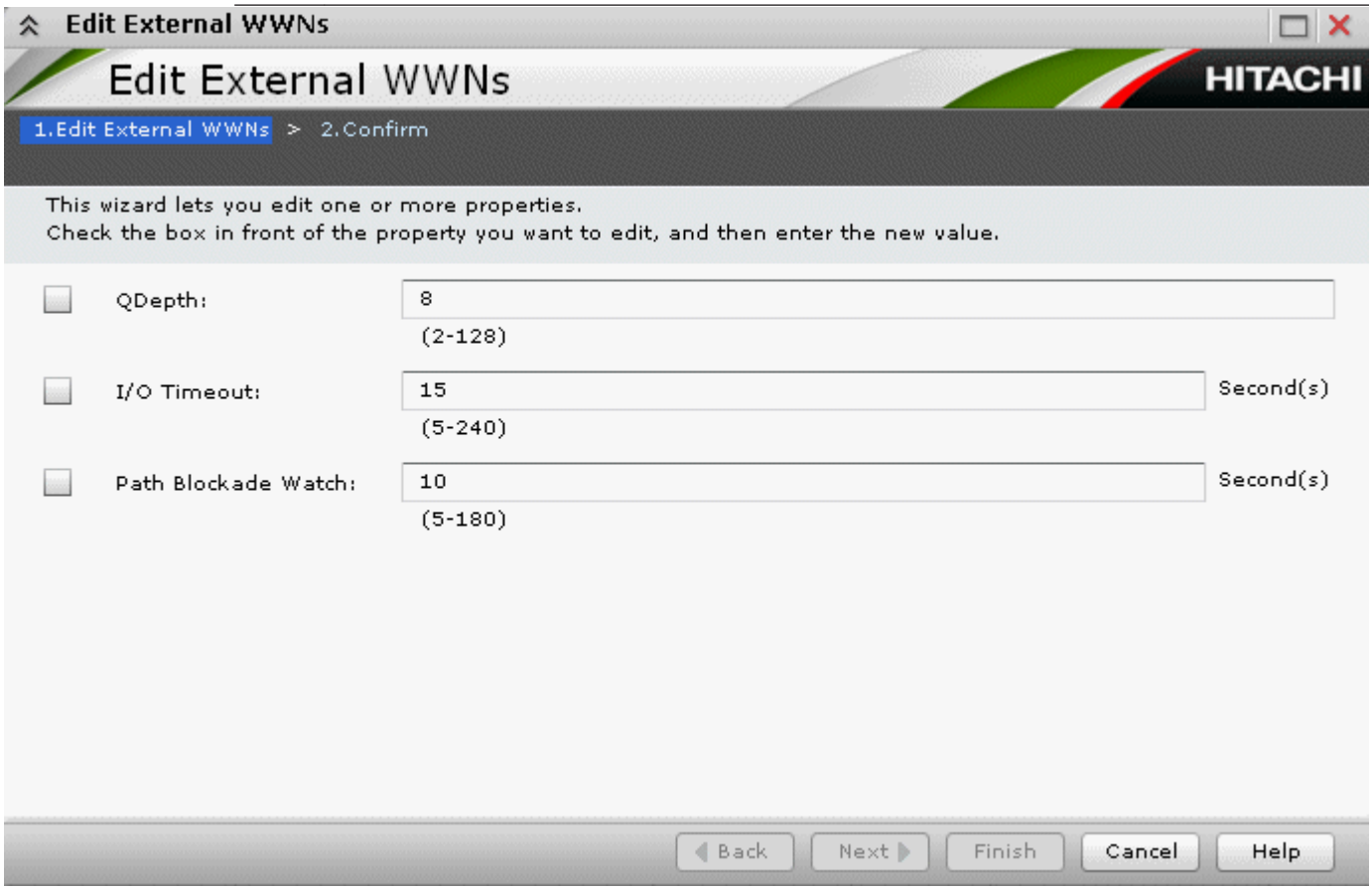
To edit the WWN port setting

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the External Paths tab.
3. In the External Path window, select the row for the external path whose external WWN you want to change.



4. At the bottom of the window, click **Edit External WWNs**.
5. In the **Edit External WWNs** 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.



- 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 external path QDepth values.
- **I/O Timeout**. Enter the number of seconds that should pass before I/O to the external volume times out. The range is 5 to 240 (seconds).
- **Path Blockade Watch**. Enter a time that should elapse from the time when the connection to the external volume goes down to the time when the external volume is blocked. Commands from the host are accepted until Path Blockade Watch passes, then the status of the external volume and all paths to that volume becomes Blockade. The range is from 5 to 180 (seconds).

6. Click **Finish**.
7. In the **Confirm** window, check settings, accept or enter a new task name, 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 5-8
- Changing external path priority on page 5-9
- Disconnecting an external path on page 5-9
- Reconnecting an external path on page 5-10
- Removing, replacing an external path on page 5-12
- Replacing all external paths on page 5-13

Adding an external path to an existing path group

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select an external storage system.
3. In the window for the external system, click the **External Path Groups** tab and then select a path group *row*.
4. Click **Edit External Path Configuration** at the bottom of the window.
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, check settings, accept or enter a new task name, and then click **Apply**.

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 2-13 for more information on path priorities for Single and Multi mode.

To change current path priority

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select an external storage system.
3. In the window for your external system, click the **External Path Groups** tab and then select a path group *row*.
4. Click **Edit External Path Configuration** at the bottom of the window.
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, check settings, accept or enter a new task name, and then click **Apply**.

Disconnecting an external path

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

An external path is disconnected for the following reasons:

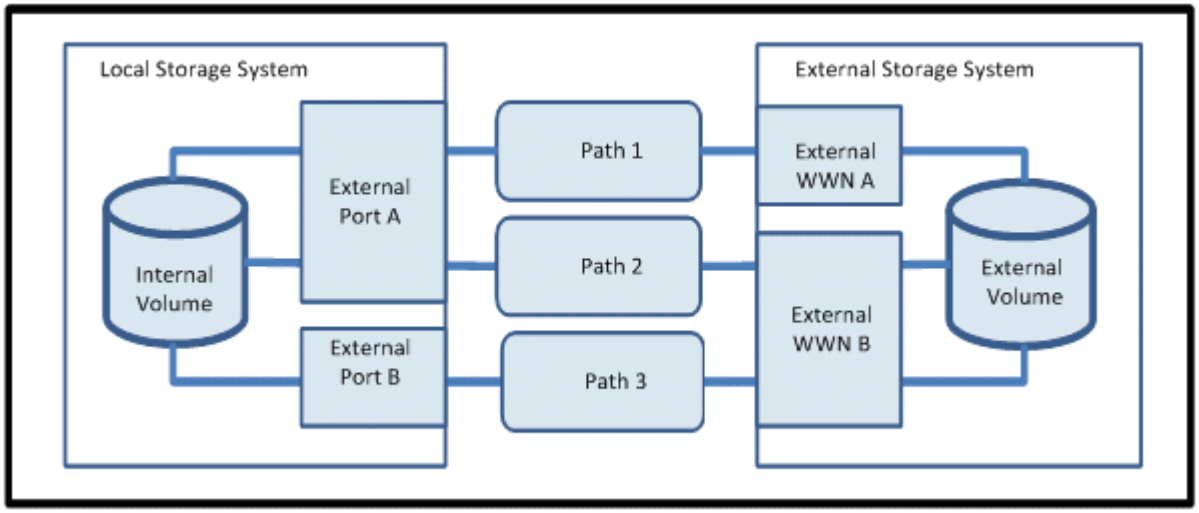
- Before removing a path.
- To replace a path or switch
- To perform maintenance on a path
- To perform maintenance on the external system or volume

Prerequisite information

- When you disconnect a path, make certain that alternate paths are available for mapped external volumes using the path.

To disconnect an external path

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the **External Paths** tab.
3. Select a path group *row*, then click **Disconnect External Paths** at the bottom of the window.
4. In the **Disconnect External Paths** window, select one of the following (illustrated in the figure below:
   - **By Ports** to disconnect all external paths connected to the specified port in the local storage system.
   - **By External WWNs** to disconnect all external paths connected to the specified WWNs (ports) in the external storage system.



5. Click **Finish**.
6. In the **Confirm** window, check settings, accept or enter a new task name, and then click **Apply**.

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 resumed.

Prerequisite information

- Make sure the path is in a status that can be restored.

To reconnect an external path to an external volume

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the **External Paths** tab.
3. Select a path row, then click **Reconnect External Paths** at the bottom of the window.

4. In the **Reconnect External Paths** window, select one of the following:
   - **By Ports** to reconnect all external paths connected to the specified port in the local storage system.
   - **By External WWNs** to reconnect all external paths connected to the specified WWNs (ports) in the external storage system.
5. Click **Finish**.
6. In the **Confirm** window, check settings, accept or enter a new task name, and then click **Apply**.

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.

Prerequisites

Before changing the cache mode of the external volume, check each item listed in the following table.

Item to Check	Description
Cache mode and LUSE volumes	If an external volume is a part of a LUSE volume, the cache mode setting should be the same among all volumes that constitute a LUSE volume.
Cache Residency Manager and cache mode	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.
Nondisruptive Migration Attribute	The cache mode of external volume whose attribute is set to nondisruptive migration cannot be changed.

Changing the cache mode

To change the cache mode setting

1. Click **External Storage** in the **Storage Systems** tree.
   The list of available external storage systems appear in the tree.
2. In the tree, select an external storage system.
   The path groups corresponding to the external storage system appear.
3. Select a path group.
4. Select the **Mapped Volumes** tab.
5. Select an external volume.

6. In the menu bar, click **Actions** >**External Storage > Edit External Volumes**. The **Edit External Volumes** window opens.
7. Select **Enable** or **Disable** in **Cache Mode**.
8. Click **Finish** to display the **Confirm** window.
9. Confirm the settings and enter the task name in the T**ask Name** box.
10. In the **Confirm** window, click **Apply**.

Removing, 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.

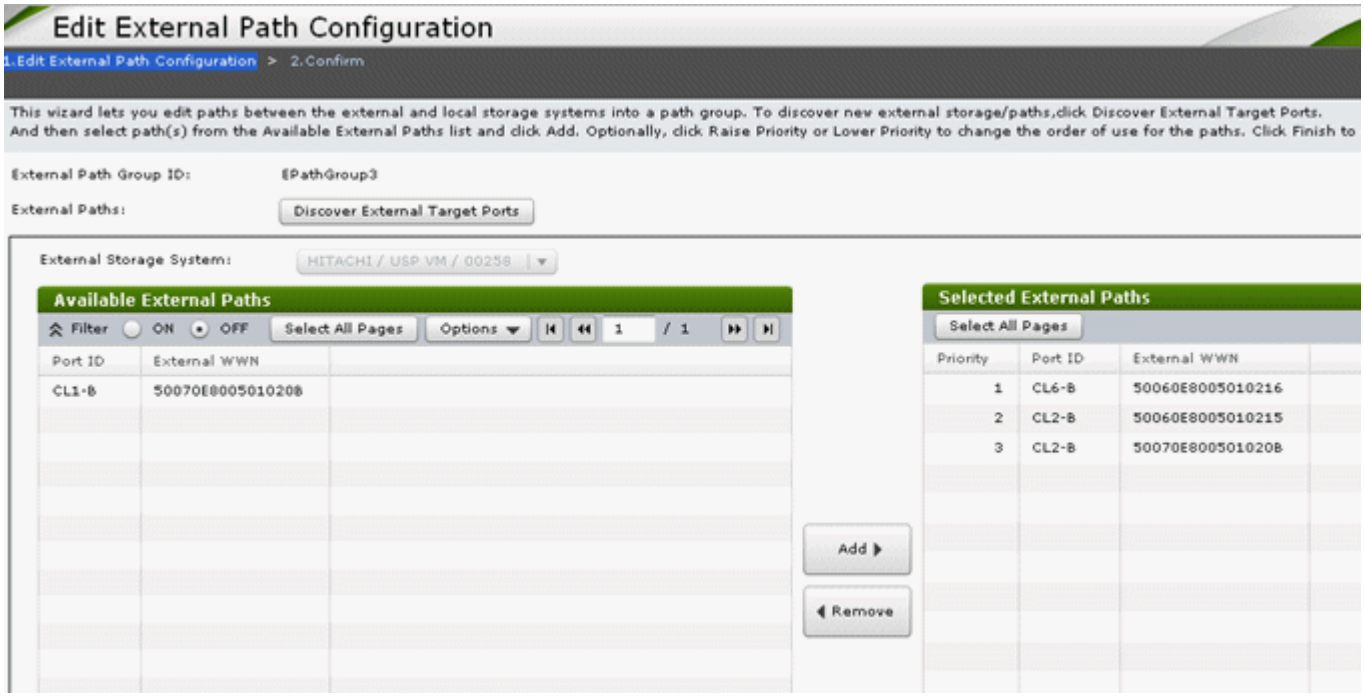
Note: All external paths must be removed before detaching a channel adaptor, otherwise the channel adaptor cannot be detached.

Prerequisite information

- Before removing a path, make sure it is disconnected. See Disconnecting an external path on page 5-9 for instructions.

To remove an external path

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select an external system.
3. In the window for the external system, select a path group *row*.
4. Click **Edit External Path Configuration** at the bottom of the window.
5. In the **Edit External Path Configuration** window, in the **Selected External Paths** list, select the path to be removed and click **Remove**.



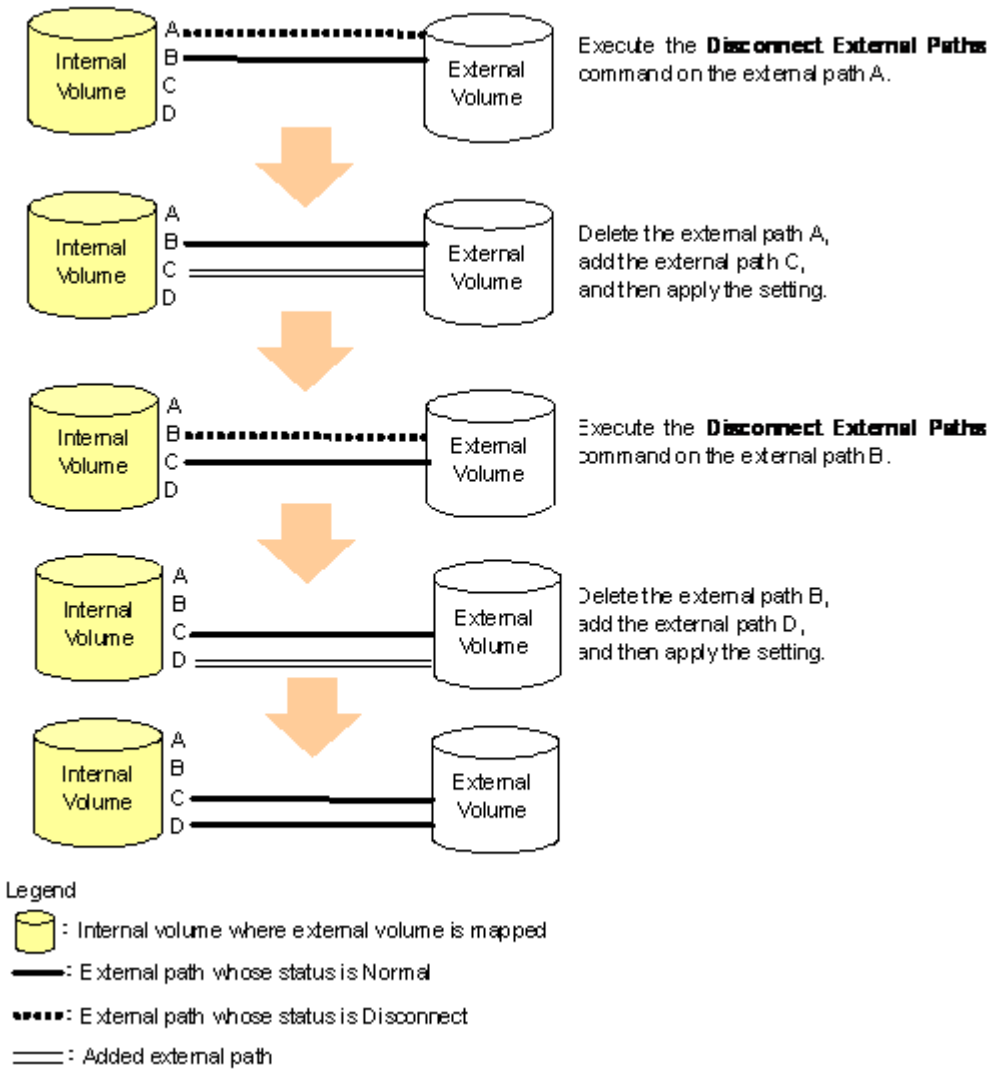
The external path is deleted from the **Selected External Paths** list.

6. Click **Finish**.
7. In the **Confirm** window, check 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 5-8.

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, which is shown in the following figure.



To replace the external paths for an external volume

1. This procedure uses the illustration above.
   Disconnect **external path A**. See Disconnecting an external path on page 5-9.
2. Disconnect the cable for **external path A**, then remove it. See Removing, replacing an external path on page 5-12.
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 5-8.
   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 a volume or volumes, they stop accepting host I/O, and all data in cache is written to the volumes (data is destaged). Also, the mapping settings are preserved. When the volumes are reconnected, they are assigned the same settings.

Prerequisite requirements

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.	Stop the host I/Os to the volume and perform the Vary Offline operation.
The external volume includes LDEVs used in a copy pair*	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 Copy-on-Write Snapshot data pool.	Change pair status to PAIR.
The external volume includes LDEVs registered to a Thin Image data pool.	Delete the Thin Image data pool.
The external volume includes LDEVs registered to a Dynamic Provisioning pool volume (DP-VOL).	Perform the following operations on DP-VOLs associated with the external volume: • Stop using the DP-VOLs.

Activity in the external volume	Required operation
	• Block the DP-VOLs using Virtual LVI/Virtual LUN.
The external volume includes LDEVs for which Volume Migration processing is in progress.	Delete the migration plans.
* Copy software products are: ShadowImage, ShadowImage for Mainframe, Universal Replicator, Universal Replicator for Mainframe, TrueCopy, TrueCopy for Mainframe, Thin Image, and Copy-on-Write Snapshot.	

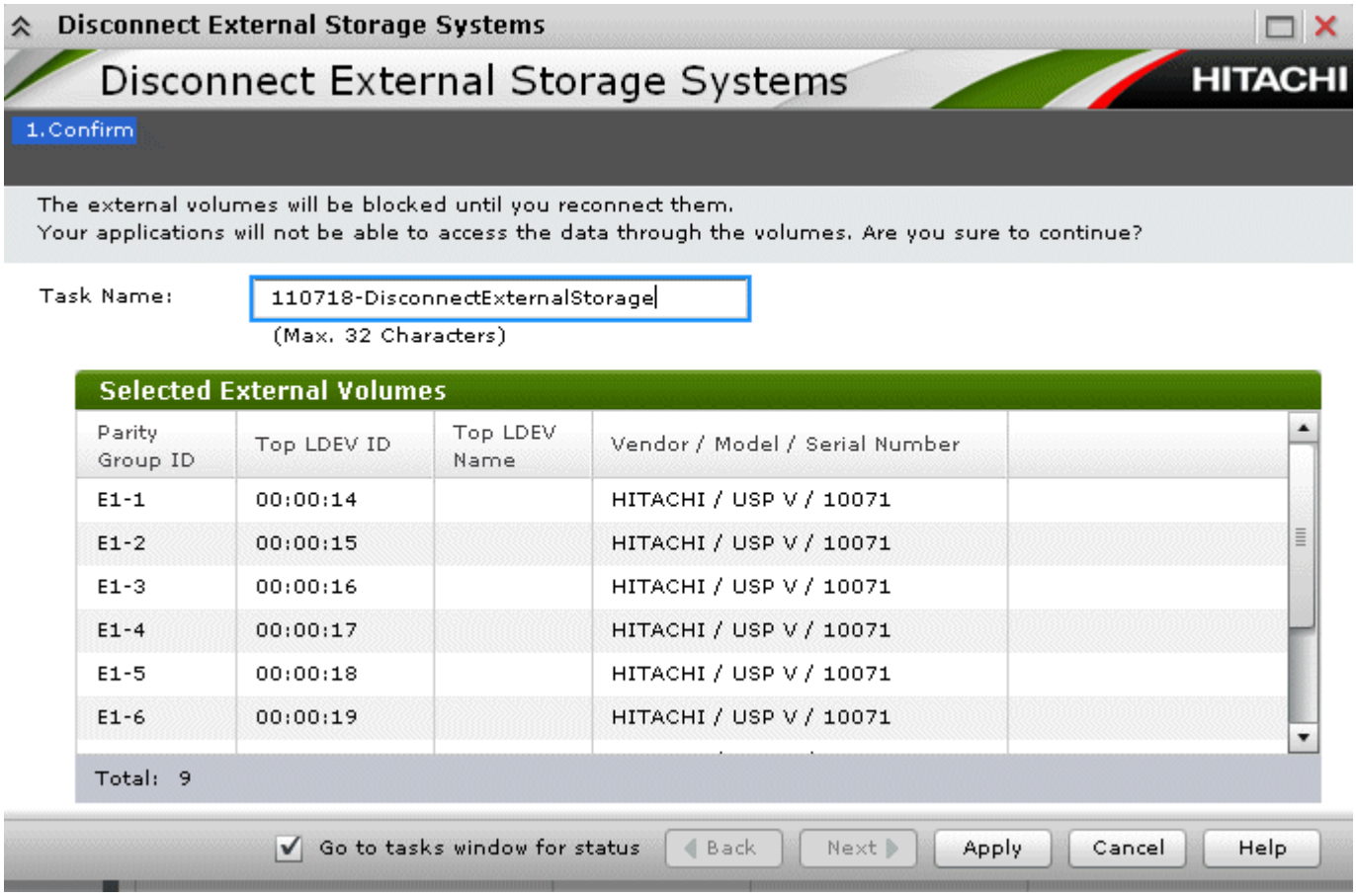
Disconnecting an external storage system, all mapped volumes

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.

Before disconnecting a mapped volume, review Prerequisite requirements on page 5-15.

To disconnect an external system and its mapped volumes

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the row for the external storage system to be disconnected.
3. Click **Disconnect External Storage Systems** at the bottom of the window.
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.

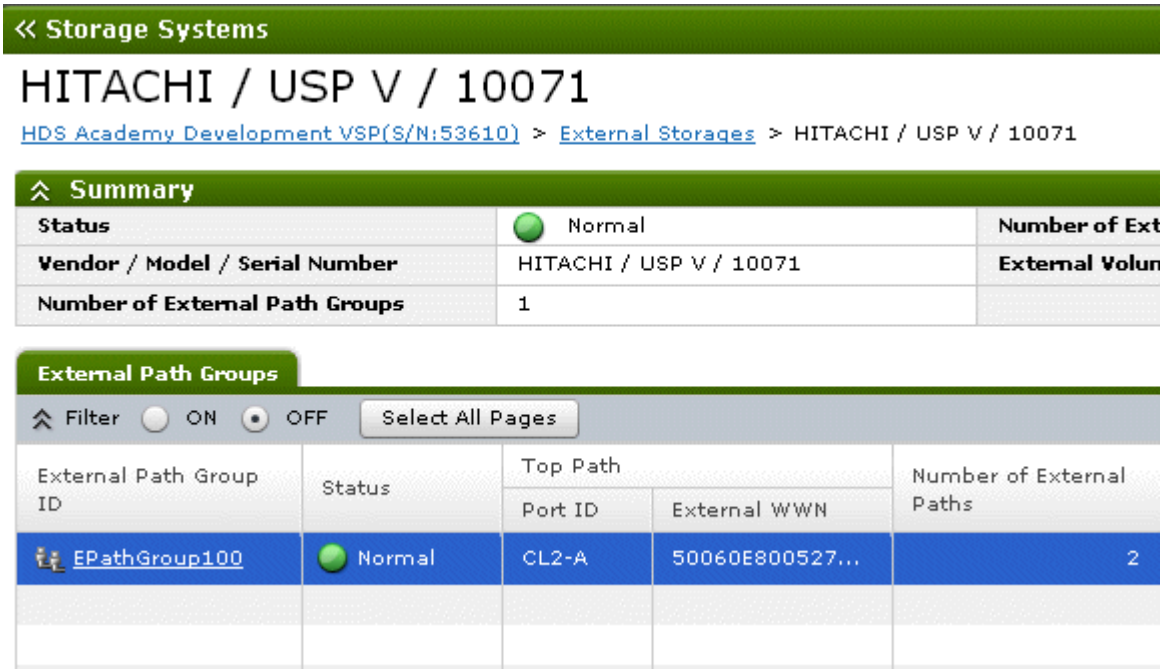
When you finish the procedure, external volume's status displays as **Cache Destage**, even if there is no data left in the cache. You can click **Refresh View** to update the status. When processing is completed, the volumes' status changes to **Disconnect**.

Disconnecting a single mapped volume

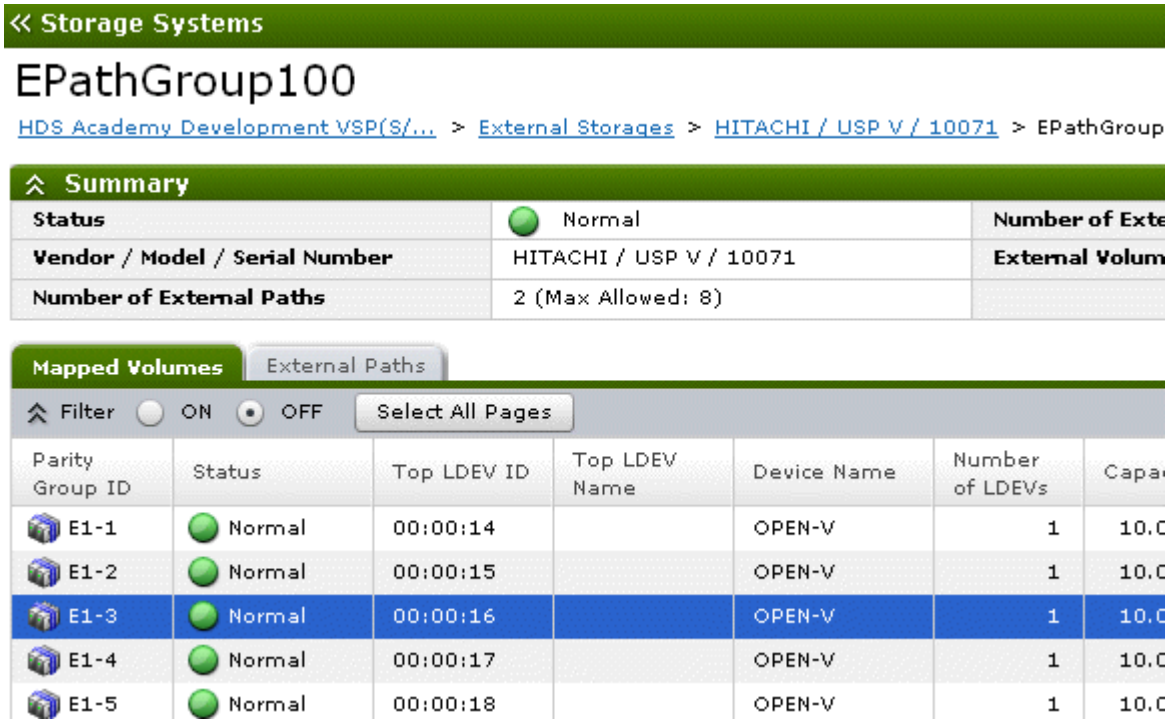
Before disconnecting a mapped volume, review Prerequisite requirements on page 5-15.

To disconnect a mapped volume

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, click the storage system where the mapped volume lives.
3. In the window for the selected external system, select the desired path group.

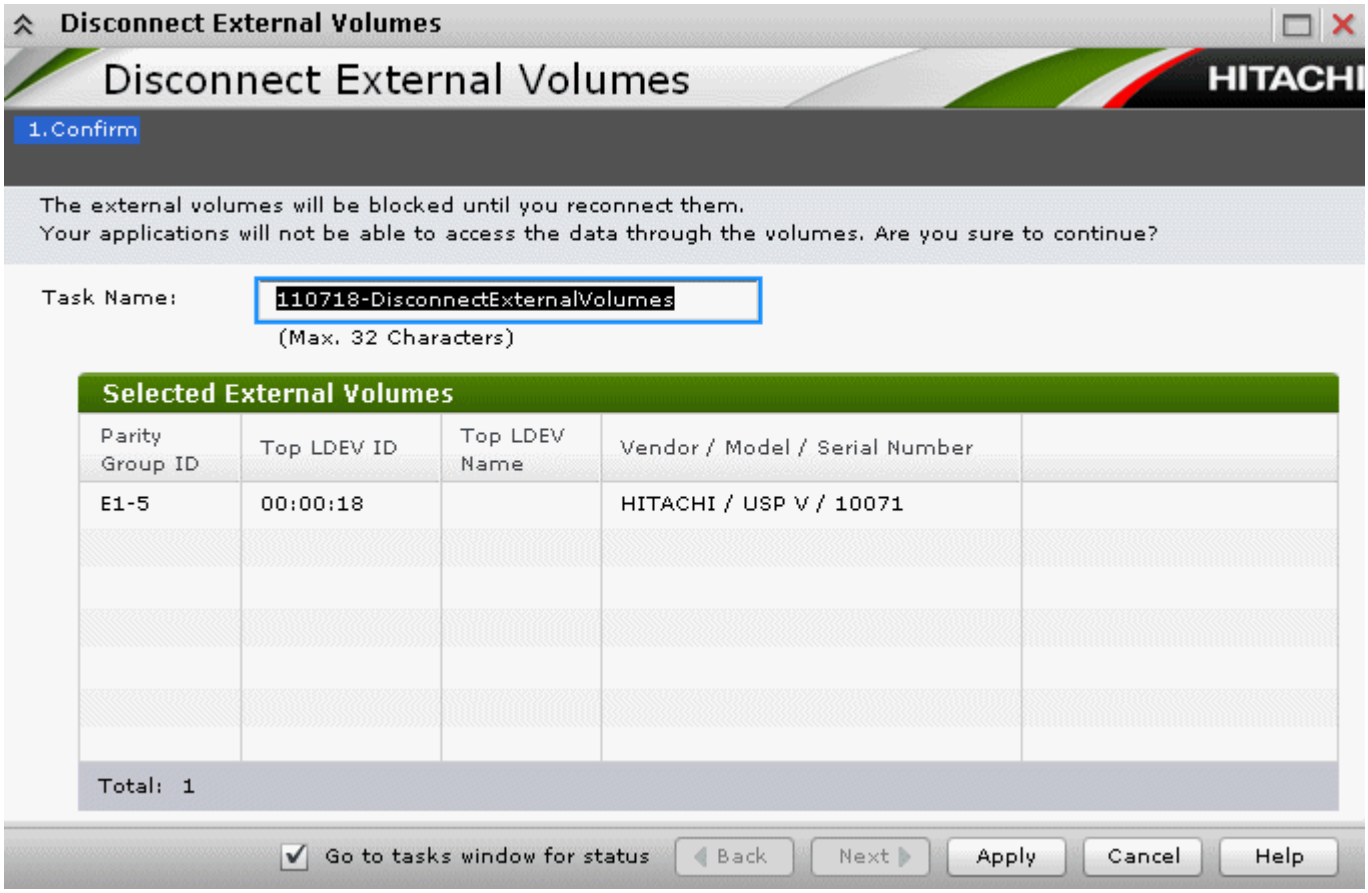


4. In the window for the selected path group, in the **Mapped Volumes** tab, select the row for the volume you want to disconnect.



At the bottom of the window, click **More Actions > Disconnect External Volumes**.

5. In the **Disconnect External Volumes** window, check the volume to be disconnected, accept or enter a new task name, and then click **Apply**.



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 volumes' status changes to **Disconnect**.

Reconnecting external systems and volumes

When you disconnect an external volume or volumes, you can start using them again by reconnecting.

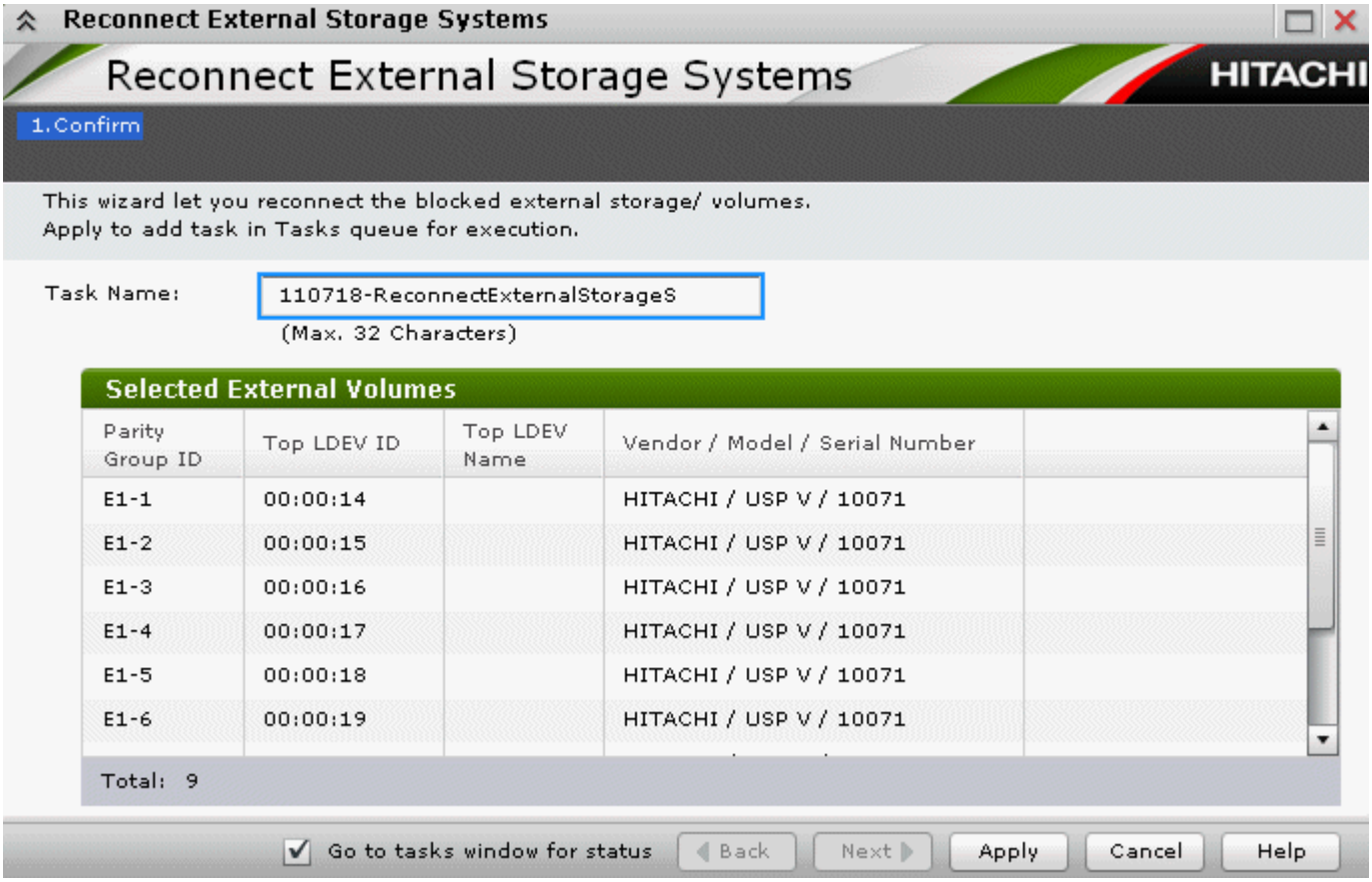
When you reconnect a volume or system, the preserved mapping settings and path status are compared to the current status of the volume. When the status and settings match, the volume is again placed in mapped, Normal status and is available for I/O operations. However, if the external volume is not ready to be resumed, the status of the disconnected volume is Blockade. If this occurs, see General troubleshooting on page 6-2 and proceed as directed.

Reconnecting an external storage system, all mapped volumes

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

To reconnect a disconnected external system and mapped volumes

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the row for the external system to be reconnected.
3. Click **Reconnect External Storage Systems** at the bottom of the window.
4. In the **Reconnect External Storage Systems** window, check the volumes that will be reconnected, accept or enter a new task name, and then click **Apply**.



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

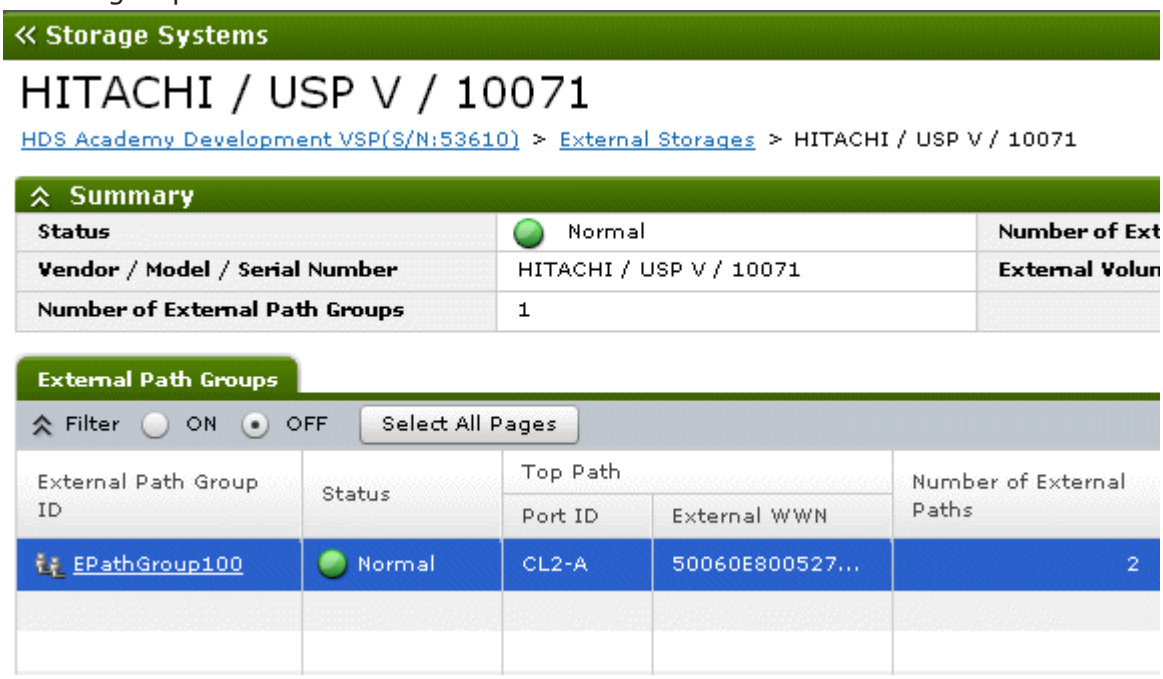
When you finish the procedure, the external volumes' status displays as **Checking**, then **Normal**. If the external storage system cannot be reconnected, the status becomes **Blockade**.

Reconnecting a single mapped volume

To reconnect a disconnected volume

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, click the storage system where the volume to be reconnected resides.

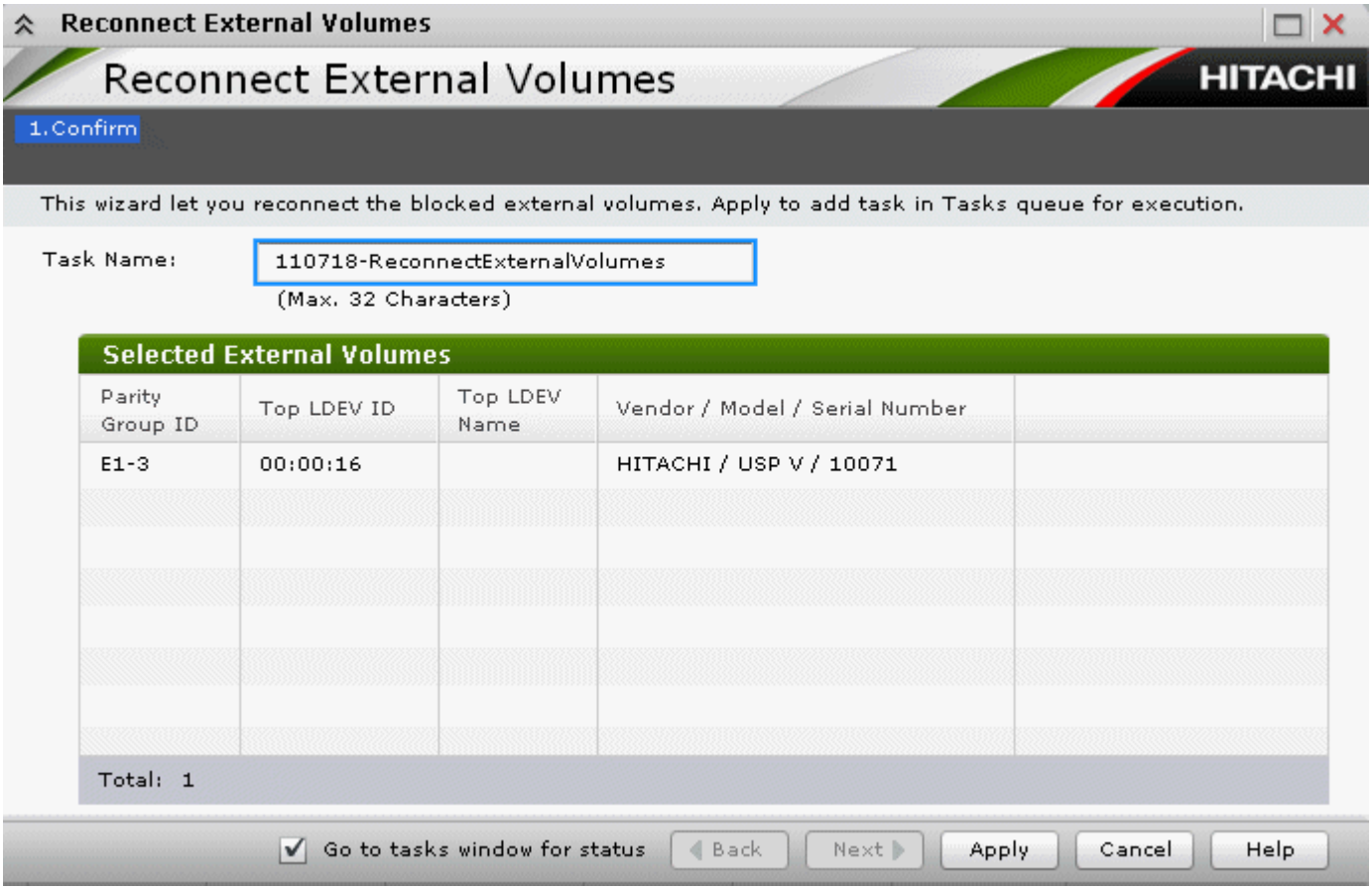
3. In the window for the selected external system, select the desired path group.



4. In the window for the selected path group, in the **Mapped Volumes** tab, select the row for the volume you want to reconnect. Status must be **Disconnect**.

   At the bottom of the window, click **More Actions > Reconnect External Volumes**.

5. In the **Reconnect External Volumes** window, check the volume to be reconnected, accept or enter a new task name, and then click **Apply**.



6. Click **Apply** in the **Confirm** window.

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

Deleting an external volume mapping

You can delete the mapping for an external volume. The data in the external volume is not deleted.

Prerequisite information

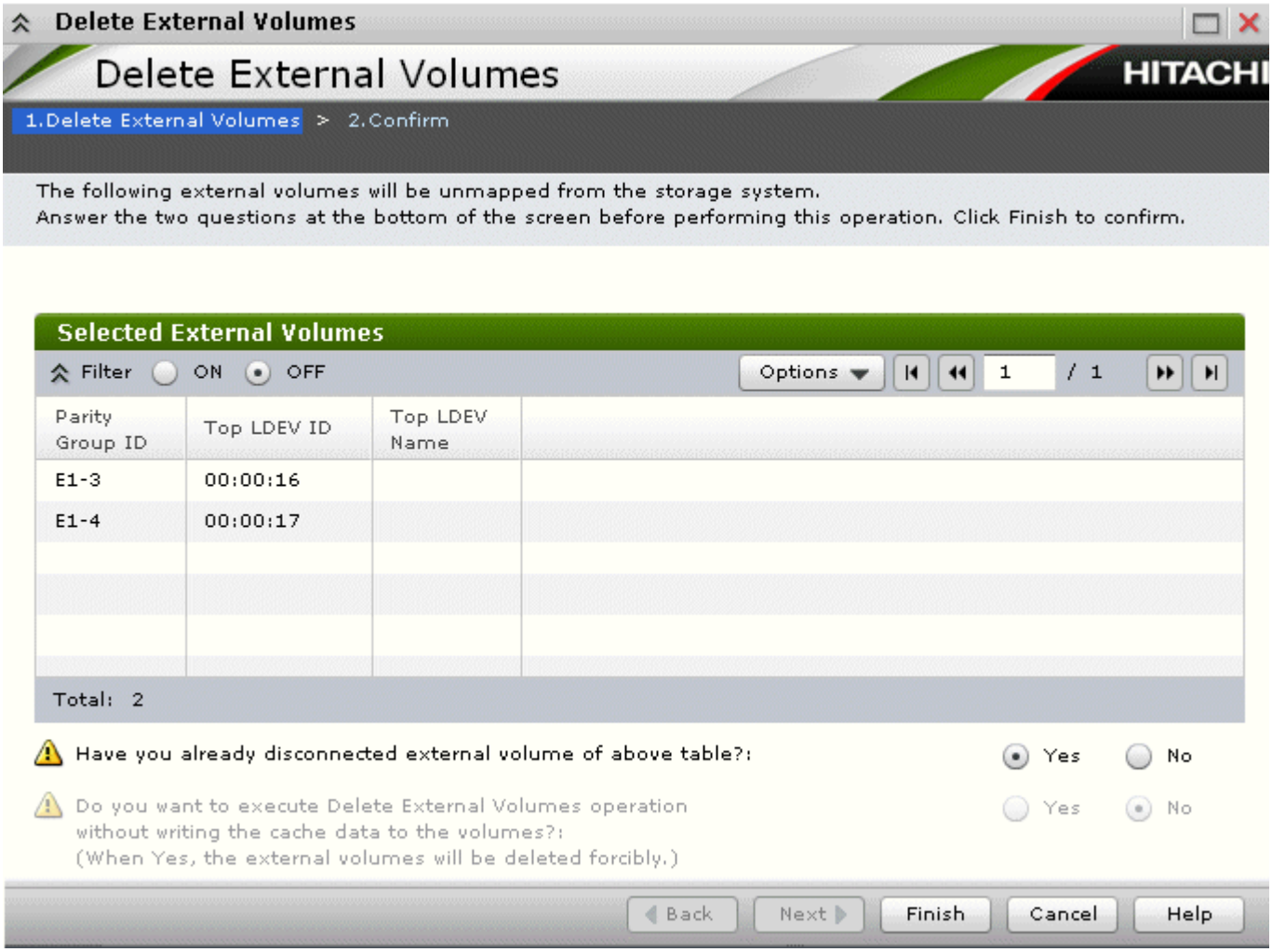
- The external volume or volumes to be deleted must first be disconnected, which results in all data in cache memory being written to the external volume.

  However, you can delete a volume without disconnecting, meaning that data in cache is not destaged to the external volume.
- You cannot delete a mapping while the external volume is used in the following:
  - LUSE volume

    - TrueCopy, Universal Replicator, ShadowImage, Thin Image, or Copy-on-Write Snapshot pair
    - A reserved volume for ShadowImage or Volume Migration.
    - A pool-VOL
- For command devices, stop the application using the external volume as a command device.

To delete the mapping for an external volume

1. In Storage Navigator, click **External Storages** in the **Storage Systems** tree.
2. In the **External Storages** window, select the desired external storage system.
3. In the window for the external system, select a path group.
4. In the window for the path group, select the external volume or volumes that you want to delete.
5. Click **More Actions > Delete External Volumes** at the bottom of the window.
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 field, in the **Do you want to execute Delete External Volumes operation without writing the cache data to the volumes?**, click one of the following:
   - **Yes** to delete the external volumes without writing the data in cache memory into the volumes.

   Note: When **Yes** is selected, the data remaining in cache is not guaranteed.
   - **Cancel** to disconnect the volume or volumes and then perform the delete operation again.

     You cannot continue the operation if **No** is selected.
9. Click **Finish**.

10. In the **Confirm** window, check settings and accept the task name shown or enter a new one. When satisfied click **Apply**.

Powering off and on local, external storage systems

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

The instructions in these topics should be closely followed.

- Prerequisite operations are required.
- A specific order must be followed:
  - When powering off both local and external systems, the local system must be turned off first, then the external system.
  - To power on both systems, the external system must be turned on first, then the local system.

Requirements for external storage system maintenance

You must disconnect the external system and delete external volume mapping before making changes on the external system. When the changes are concluded, you reconnect the system and remap the external volume.

The following changes to the external system require the removal and remapping of the external volume:

- Changing WWNs of 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
- Modification on the host connected directly to a external storage system.

If you want to change the WWNs of part of the target ports that are connected to the local storage system, you do not need to delete the volumes that are mapped to the local storage system.

To change the WWNs of the external storage system without deleting the external volume mapping

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

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 5-22 for instructions.

Powering off and on the external storage system

To power off the external system

1. Stop read and write I/O to the mapped external volume.
2. If the external volume is defined as a DP-VOL in the internal system, block all DP-VOLs for maintenance as follows:

   To block all DP-VOLs in the pool

   a. Click **Pools** in the **Storage Systems** tree.
   b. In the tree, select the pool to be blocked.
   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. Disconnect the external storage system. See Disconnecting external systems and volumes on page 5-15 for instructions.
4. Perform the procedure for powering off the external storage system.

To power on the external system

1. Power on the external storage system.
2. Reconnect the external system. See Reconnecting external systems and volumes on page 5-19 for instructions.
3. If the external volume was defined as a DP-VOL in the local system, restore all blocked DP-VOLs.

   To restore all DP-VOLs in the pool

   a. Click **Pools** in the **Storage Systems** tree.
   b. In the tree, select the pool to be restored.
   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 the local storage system

Prerequisite information

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

To power off the local system, then power on again

1. Stop read and write I/O to the mapped external volume.
2. Perform all necessary operations for powering off the local system.
3. Turn off the power supply of the local storage system.
   Data in local cache memory is written in the external volume when the local system is powered off (all data is destaged).
4. When ready, make sure that the external system is on, and then power on the local system.

Powering off and on both storage systems

To power off both local and external storage systems

1. Stop read or write I/O to the local storage system, including read and write I/O with Fibre Channel connections.
2. Check the documentation for any software functions used with the mapped external volume. For example, if the external volume is used in a ShadowImage pair, see the *Hitachi ShadowImage® User Guide*.
3. Power off the local storage system.
4. When the power supply of the local system is completely off, power off the external system.

To power on both local and external storage systems

1. Power on the external system.
2. When the power supply of the external system is completely on, power on the local system.
3. Resume use of the mapped external volume.
4. Start read or write I/O to the local storage system.
   All read and write I/Os with Fibre Channel connections can be started.

6

Troubleshooting

This topic provides troubleshooting information.

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

Contacting the Hitachi Data Systems customer support

If you need to contact the Hitachi Data Systems customer support, please 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 Storage Navigator.
- The Storage Navigator configuration information (use the FD Dump Tool).
- The service information messages (SIMs), including reference codes and severity levels, displayed by 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://Portal.HDS.com.

General troubleshooting

Check the following table for the problem. After removing an error, retry the operation.

Problem	Possible causes
Storage Navigator cannot access the external volume.	• An error occurred in the switch, or the switch is off. • The cables are not properly connected. • 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.
The external volume cannot be mapped.	• The number of mapped volumes exceeds the maximum number (63,232) available for the local storage system. • There are not enough LDKC:CU:LDEV numbers available for external volume mapping.
The external path is blocked.	• See the problem above, “Storage Navigator cannot access the external volume”. If the problem persists after correcting any errors, continue to the next item. • Confirm that the cable between the local and external system is connected properly. • If the cable is properly connected, disconnect it and then reconnect. After 30 seconds, check the path status.

Problem	Possible causes
	If the path is not restored, call the Hitachi Data Systems customer support.
Action is required for a path status in the **View External LUN Properties** dialog box.	See Troubleshooting external path status on page 6-4.
The volume in the external system cannot be found even after port discovery or volume discovery was performed.	Perform any required action in the message and then retry the operation. If the problem persists, see Troubleshooting port and volume discovery problems on page 6-11.
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 problem above, "The external path is blocked", and then reconnect the volume again.
"?" displays in the **LUN ID (Highest Priority)** column of the **Discovered External Volumes** table (**Add External Volumes** window).	A corresponding external volume was not found for the external path with the highest priority. Confirm the connection with the external system that failed during volume discovery, and perform the operation again.
External volume discovery was not completed because of failure.	Confirm the connection with the external system; also confirm that the external volume is correctly configured in the external system, 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 View** on the Storage Navigator main window. If the status remains **Checking**, perform the reconnect operation again. If the problem persists after a reasonable time, call the Hitachi Data Systems customer support.
After disconnecting an external volume or system, the status does not change from **Cache Destage**.	Click **Refresh View** on the 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, this also depends on the performance and status of the external system. If status does not change from **Cache Destage** after a reasonable time, call the Hitachi Data Systems customer support.

Problem	Possible causes
The message, "INTERVENTION REQUIRED", is issued to the mainframe host as the device status.	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 the problem above, "The external volume is blocked".
The message, "DEVICE ERROR", is issued to the mainframe host as the device status.	See the problem above, "The external volume is blocked"

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 6-6.

Status	Description	Corrective action
Unknown	The path status cannot be determined.	Call the Hitachi Data Systems customer support.
Blockade	The external port is blocked.	The port is blocked because of microcode replacement, package replacement, or other factor. Check the status of the local storage system. If you cannot restore the path, call the Hitachi Data Systems customer support.
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. 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. If you cannot restore the path, call the Hitachi Data Systems customer support.
Illegal request	The reply of the external system was ILLEGALREQUEST. The command cannot be executed to the external	The external system port is recognized. Check the external system settings. If you cannot

Status	Description	Corrective action
	system. Data protection may be set on the external system.	restore the path, call the Hitachi Data Systems customer support.
Command aborted	The reply of the external system was ABORTEDCOMMAND. An error may 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). If you cannot restore the path, call the Hitachi Data Systems customer support.
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 you cannot restore the path, call the Hitachi Data Systems customer support.
LDEV reserved	The external system is in Reserve status. The system cannot be accessed.	Remove the Reserve status on the external system.
Response error	The external system is in blocked status caused by an abnormal reply (Response). You may not be able to access the system, or data protection may be set.	The external system port is recognized. Check the setting and status of the external system. If you cannot restore the path, call the Hitachi Data Systems customer support.
Initiator port	The port attribute of the external system has been changed to "initiator".	Set the port attribute of the external system to "target". If you cannot restore the path, call the Hitachi Data Systems customer support.
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 may need to try this multiple times. If the problem remains, call the Hitachi Data Systems customer support.
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). If you cannot restore the path, call the Hitachi Data Systems customer support.
Cannot detect port	The external path has been removed or the external system port cannot be found. Possible causes are: • The fibre cable is not properly connected.	If you cannot restore the path after checking the possible causes, call the Hitachi Data Systems customer support.

Status	Description	Corrective action
	• 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 may be incorrect.	
Internal error	A program error occurred, or there is a logical contradiction.	Call the Hitachi Data Systems customer support.
Timeout	Processing was retried because of an abnormal reply; however, processing was stopped because of timeout.	The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches). If you cannot restore the path, call the Hitachi Data Systems customer support.
Device check error	An external volume is mapped, but you cannot access the volume in the external system.	Check the volume's status in the external system and take any necessary corrective action. Format the volume if it is not formatted.
Medium error	The external volume has become inaccessible.	Check the volume's status 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

Storage system-specific recovery information is provided for the following errors:

- External device setting changed
- Illegal request
- Cannot detect port

VSP G200, G400, G600

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete Volume and then Add Volume operations using Universal Volume Manager.

Path Status	Description and corrective actions
	• The volume's access attribute may 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, ShadowImage, or global-active device. • The volume's access attribute may 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security may have been enabled by LUN Manager. If so, disable it.

HUS VM, VSP G1000, Virtual Storage Platform, and Universal Storage Platform V/VM

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete Volume and then Add Volume operations using Universal Volume Manager. • The volume's access attribute may 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute may 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct.

Path Status	Description and corrective actions
	• LUN security may have been enabled by LUN Manager. If so, disable it.

Universal Storage Platform / TagmaStore NSC

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager. • The volume's access attribute may 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute may 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security may have been enabled by LUN Manager. If so, disable it.

Lightning 9900 V

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager. • The volume's access attribute may have been changed by Open LDEV Guard. 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that 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 may have been changed by Open LDEV Guard. 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security may have been enabled by LUN Manager. If so, disable it.

Lightning 9900

Path Status	Description and corrective actions
External device setting changed	LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager.
Illegal request or Response error	If the volume is a pair volume, it may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage.
Cannot detect port	• There is a problem with connection to the external storage system. The possible causes are: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security may have been enabled by LUN Manager. If so, disable it.

Thunder 9500V

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Management. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager. • The volume's access attribute may have been changed by Open SDEV Guard. If the volume is protected by the access attribute, release the protection.

Path Status	Description and corrective actions
Illegal request or Response error	• If the volume is a pair volume, it may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute may have been changed by Open SDEV Guard. 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Management. - If the external storage system is connected through switches, make sure that the switch settings are correct. • The host group LUN security may have been enabled by LUN Management. If so, disable it.

HUS/AMS/WMS

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Manager. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager. • The volume's access attribute may 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute may 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Manager. - If the external storage system is connected through switches, make sure that the switch settings are correct. • The host group LUN security may have been enabled by LUN Manager. If so, disable it.

SVS200

Path Status	Description and corrective actions
External device setting changed	• LU path settings may have been changed by LUN Management. Either change the settings back to the values used when the volume was mapped, or perform the Delete LU and then Add LU operations using Universal Volume Manager. • The volume's access attribute may have been changed by LUN Security XP Extension. 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 may be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure that the volume is not set to a pair, such as TrueCopy, Universal Replicator, or ShadowImage. • The volume's access attribute may have been changed by LUN Security XP Extension. 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: - Make sure the fibre cable is connected correctly. - The setting of the topology may not match between the external port and the target port. Make sure that the Fibre Channel ports are set properly using LUN Management. - If the external storage system is connected through switches, make sure that the switch settings are correct. • LUN security may have been enabled by LUN Management. If so, disable it.

Troubleshooting port and volume discovery problems

The following table shows corrective actions you can take for port and volume discovery problems.

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 is correct so that the External port of the local system can communicate with the external system port.
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 to "External".
External volume returned RESERVATION CONFLICT.	Release the reserved state of the external volume.

Problem	Corrective action
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.
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. • Call the Hitachi Data Systems customer support to ask if the external system is supported by Universal Volume Manager. If the system is supported, install the microcode 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 of the external system is in Normal status. • Register the WWN to the external system to allow login from the local system.

Problem	Corrective action
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 external system or the external volume is in the Normal status.

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.

A

Supported external storage systems

This topic provides required configuration settings for many of the supported external storage systems.

- External systems
- VSP G200, G400, G600
- VSP G1000
- HUS VM Storage System
- Virtual Storage Platform
- Universal Storage Platform V/VM
- Universal Storage Platform/TagmaStore NSC
- Lightning 9900 V
- Lightning 9900
- Thunder 9500V
- HUS/AMS/WMS
- SVS200 storage system
- EVA storage system
- Sun StorEdge 6120/6320

- 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, 20000 series
- Storage system with a product name displayed as "(Generic)"

External systems

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

Note: Not all supported systems' information is provided here. If you do not find your storage system, refer to http://www.hds.com/products/storage-systems/specifications/supported-external-storage.html for a complete listing.

VSP G200, G400, G600

Use the following settings on the external system:

- The port must be set to host mode 0C (Windows), or host mode 2C (Windows Extension).

VSP G1000

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 VSP G1000 system uses Open LDEV Guard, set System Option Mode (SOM) 701 to **ON** on the local VSP system.

HUS VM 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**.
- If the external HUS VM Storage System uses Open LDEV Guard, set System Option Mode (SOM) 701 to **ON** on the local VSP 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 VSP system uses Open LDEV Guard, set System Option Mode (SOM) 701 to **ON** on the local VSP 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 USP V/VM system uses Open LDEV Guard, set SOM 701 to **ON** on the local VSP 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 USP system uses Open LDEV Guard, set SOM 701 to **ON** on the local VSP 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 may 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, confirm 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 and WMS 100: **ON** For HUS 150, HUS 130, HUS 110, AMS 2500, AMS 2300, AMS 2100, and AMS 2010: **OFF**
Port Options	Port Option	Optional
Host Connection Mode	Host Connection Mode 1	Set AMS common setting to **Standard Mode**.
	Host Connection Mode 2	Do not specify any parameters for AMS additional settings. For AMS 1000, AMS 500, AMS 200 and 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	95XXXXX	HUS 150
	93XXXXX	HUS 130
	91XXXXX	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 may 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 5-25 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 WMS 100	Controller 0	XXXXXXXXXXXXXXX0
	Controller 1	XXXXXXXXXXXXXXX1
AMS 2100 AMS 2010 AMS 500	Controller 0	XXXXXXXXXXXXXXX0 XXXXXXXXXXXXXXX1
	Controller 1	XXXXXXXXXXXXXXX2 XXXXXXXXXXXXXXX3
HUS 110 HUS 130 AMS 2300 AMS 1000	Controller 0	XXXXXXXXXXXXXXX0 XXXXXXXXXXXXXXX1 XXXXXXXXXXXXXXX2 XXXXXXXXXXXXXXX3

Model	Controller	WWN of Port
	Controller 1	XXXXXXXXXXXXXX4 XXXXXXXXXXXXXX5 XXXXXXXXXXXXXX6 XXXXXXXXXXXXXX7
HUS 150 AMS 2500	Controller 0	XXXXXXXXXXXXXX0 XXXXXXXXXXXXXX1 XXXXXXXXXXXXXX2 XXXXXXXXXXXXXX3 XXXXXXXXXXXXXX4 XXXXXXXXXXXXXX5 XXXXXXXXXXXXXX6 XXXXXXXXXXXXXX7
	Controller 1	XXXXXXXXXXXXXX8 XXXXXXXXXXXXXX9 XXXXXXXXXXXXXXA XXXXXXXXXXXXXXB XXXXXXXXXXXXXXC XXXXXXXXXXXXXXD XXXXXXXXXXXXXXE XXXXXXXXXXXXXXF
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 may 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 5-25 for detailed information on remapping.

Identifying logical volumes using Characteristic1

The Characteristic1 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-timeoutvalue 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; some commands from host to VSP or from VSP to the external system might time out. To keep the proper load, the following is 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 Editing external WWN settings on page 5-6.
- 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 system

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 system.
- On the local VSP storage system, set SOM 720 to **ON** for active path load-balancing support.

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

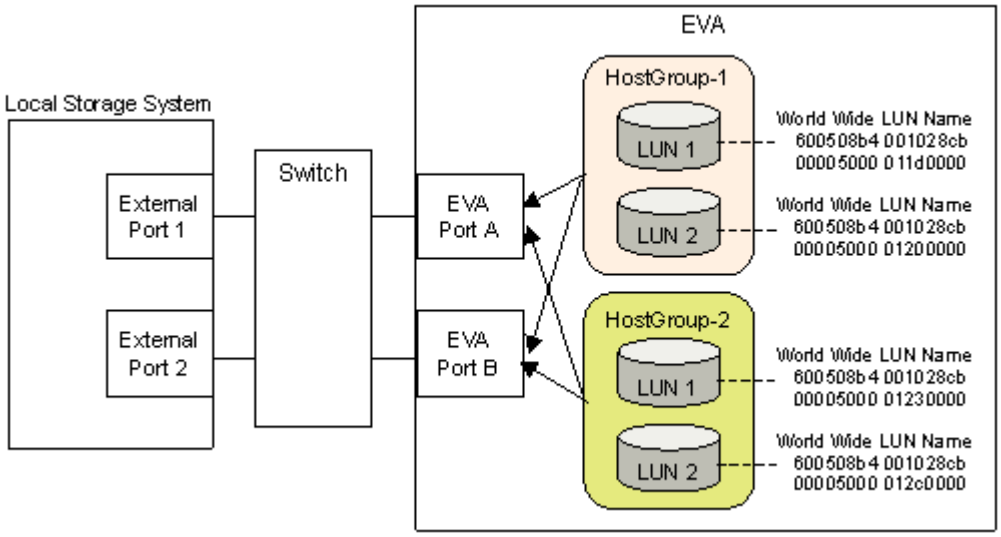
Parameter		Parameter Setting
Add a Host	Host OS	**Windows**

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

Identifying logical volumes using Characteristic2

With an EVA external storage system, LUNs appear as Characteristic1 in 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 Characteristic1.

However, in Storage Navigator, you can identify the logical volumes referring to Characteristic2. The first 32 characters of Characteristic2 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 Portal: https://Portal.HDS.com.

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 the local VSP 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 Portal: https://Portal.HDS.com.

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 Portal: https://Portal.HDS.com.

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 mode for connecting EMC CLARiiON CX series

When you connect an EMC CLARiiON 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 performing

maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

If the status becomes **Not Ready** (cannot access the external storage system), the mapped external volume might be blocked. To restore the mapped external volume that is blocked, you can either select manual restore or automatic restore. When the external storage system has a problem (such as failure, during failure restoration etc.), if you restore the mapped external volume that is blocked to the normal status, the mapped volume might change immediately to blocked status and as a result, the automatic restore might be restrained. If the EMC CLARiiON CX series is connected by setting SOM 1021 to **ON**, then the mapped external volume that is blocked is restored automatically. For more information about using SOM 725 and SOM 1021, log on to the HDS Support Portal to obtain contact information: https://hdssupport.hds.com.

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. Make sure that LUN0 is defined for each port on the EMC CLARiiON CX series side.

EMC VNX series

System option mode for connecting EMC VNX series

When you connect an EMC VNX 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 performing maintenance tasks such as rebooting the controller of the external storage system before the firmware update.

If the status becomes **Not Ready** (cannot access the external storage system), the mapped external volume might be blocked. To restore the mapped external volume that is blocked, you can either select manual restore or automatic restore. When the external storage system has a problem (such as failure, during failure restoration etc.), if you restore the mapped external volume that is blocked to the normal status, the mapped volume might

change immediately to blocked status and as a result, the automatic restore might be restrained. If the EMC VNX series is connected by setting SOM 1021 to **ON**, then the mapped external volume that is blocked is restored automatically. For more information about using SOM 725 and SOM 1021, log on to the HDS Support Portal to obtain contact information: https://hdssupport.hds.com.

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	Disabled

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 VNX series are not supported. Make sure that LUN0 is defined for each port on the EMC VNX series side.

EMC Symmetrix 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 EMC Symmetrix series documentation

Parameter	Parameter Setting
SC3 flag	Enable
SPC2 flag	Disable

On the local VSP 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.

Table A-1 System parameters for connecting IBM V7000 series

Parameter	Parameter setting
host type	Generic

The model name of the IBM V7000 series is displayed as "SVC" on the 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 VSP, as shown in the following table.

Display in VSP		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
Characteristic 1	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 maintenance tasks 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 Portal: https://Portal.HDS.com.

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, 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 3Par T800, F400, V800, V400, 7000, 8000, 10000, or 20000 series documentation.

For 3Par T800 and F400 series

Parameter	Parameter Setting
host mode	generic-legacy (or generic)

For 3Par V800, V400, 7000, 8000, 10000, or 20000 series

Parameter	Parameter Setting
host mode	generic-legacy

The volumes in which "Dynamic optimization" or "Adaptive optimization" is applied must not be used as the external volume of VSP; otherwise the performance of the external volume may possibly be degraded and the operation cannot be guaranteed.

Storage system with a product name displayed as "(Generic)"

The generic Universal Volume Manager profile (available with 70-04-*x*) provides support for connecting Fibre channel attached, external storage systems 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, please contact the Hitachi Data Systems customer support). An HDS representative 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. Updating a VSP to the minimum firmware level 70-05-0*x* automatically installs the generic UVM profile and makes it available.

Support conditions when product name displays as "(Generic)"

When an external storage system is connected to a VSP 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.
- **Characteristic1(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:

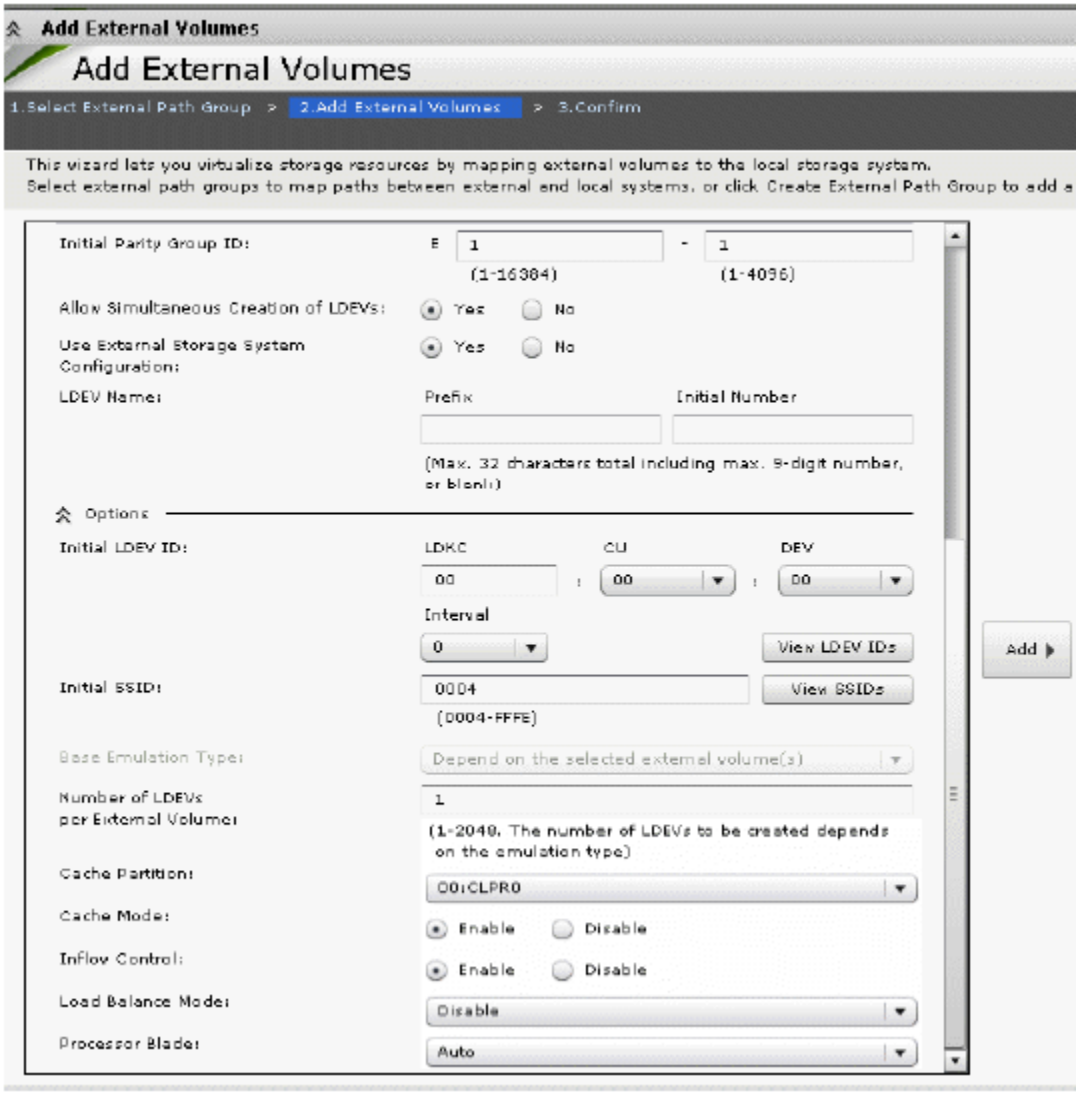
  a. **Normal Round-robin** (For Multi Path)

  b. **Extended Round-robin** (For Multi Path)

  c. **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 Storage Navigator.



Note: If you need a profile that models your specific storage system, please contact the Hitachi Data Systems customer support. HDS will gather the required information and may 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

1. Set up VSP External ports.
2. Connect the external storage FC ports to the VSP External ports.
3. Virtualize at least four LUNs from the external storage.
   - If virtualization fails, please contact the Hitachi Data Systems customer support.
4. Connect two FC ports of the VSP 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.



Note: The collection of information is optional but recommended. HDS asks that if new branded storage is attached that the local HDS representative collect the required data to send to Hitachi. After reviewing the data, Hitachi will add the External Storage Model to a listing of supported models on the HDS website. Hitachi may 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, HDS support may be limited until the data is sent to Hitachi.

B

Remote command devices

This topic provides information for mapping to command devices in external storage systems.

- Overview of remote command devices
- Storage systems supported for remote command devices
- Requirements
- Restrictions and other information
- Mapping a command device

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.

From an OPEN-systems host connected to the local system, you can send Command Control Interface (CCI) commands to the remote command device, which relays them to the external system where they are executed. This is shown in the following figure.

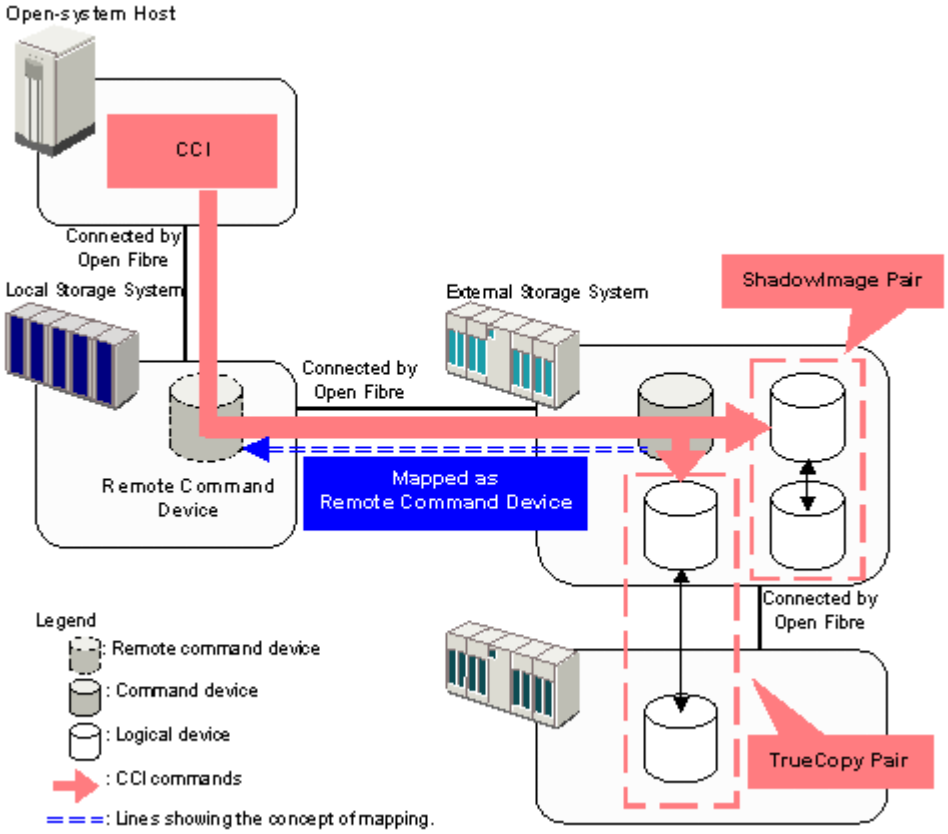


Figure B-1 Outline of remote command device

See the *Command Control Interface User and Reference Guide* for information about command devices.

Storage systems supported for remote command devices

You can map a command device in one of the following external storage system as a remote command device in VSP:

- VSP G200, G400, G600, G800
- Virtual Storage Platform G1000
- 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
- HP 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.

Table B-1 Restrictions on remote command device

Item	Requirement
Emulation type	OPEN-V
Number of LDEVs in an external volume	1
Cache mode	Disable
Minimum capacity	96,000 Blocks (about 47 MB)

Item	Requirement
Maximum capacity	4TB
Maximum number of the available CCI instances per remote command device	16*
* Maximum number of available CCI instances may be less than 16, dependent upon the number of paths between a 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 execute I/O to 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 a LUSE volume using a remote command device.
- You cannot create CVs using the VLL function in the remote command device.
- 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 systems' path mode for external volumes on page 2-15.
- 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.

Mapping a command device

To map a command device, select a command device that can be mapped and follow the procedure in Mapping an external volume on page 4-5.

When mapped, the remote command device appears in the Storage Navigator **Mapped Volumes** window, **Device Name** column as follows:

Storage system	Displayed information in Device Name column
VSP G200, G400, G600, G800 Virtual Storage Platform G1000 Unified Storage VM Virtual Storage Platform 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 P9500 XP24000 XP20000 XP12000 XP10000 XP1024/XP128	Format: "Emulation Type" + "-CM" Example: OPEN V-CM, OPEN-3-CM
Unified Storage Adaptable Modular Storage Workgroup Modular Storage SANRISE9500V series Thunder 9500V series	DF600F-CM

C

Command Control Interface command reference

This topic lists Command Control Interface (CCI) commands that correspond to the Actions you select in Storage Navigator.

- Storage Navigator Action names and CCI commands

Storage Navigator Action names and CCI commands

The following table compares Actions you take in Storage Navigator and corresponding CCI commands.

SN location	SN Action name	CCI command
External Storages	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	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 Storage Navigator windows, dialog boxes, and fields related to Universal Volume Manager.

- ☐ External Storages window
- ☐ Selected external storage system window
- ☐ Selected external path group window
- ☐ Add External Volumes wizard
- ☐ Edit Policies window
- ☐ Edit External Volumes wizard
- ☐ Edit External Path Configuration wizard
- ☐ Edit External WWNs wizard
- ☐ Delete External Volumes wizard
- ☐ Disconnect External Paths wizard
- ☐ Reconnect External Paths wizard
- ☐ Discover External Target Ports window
- ☐ Create External Path Group window

- 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 Processor Blade wizard
- External LDEV Properties window

External Storages window

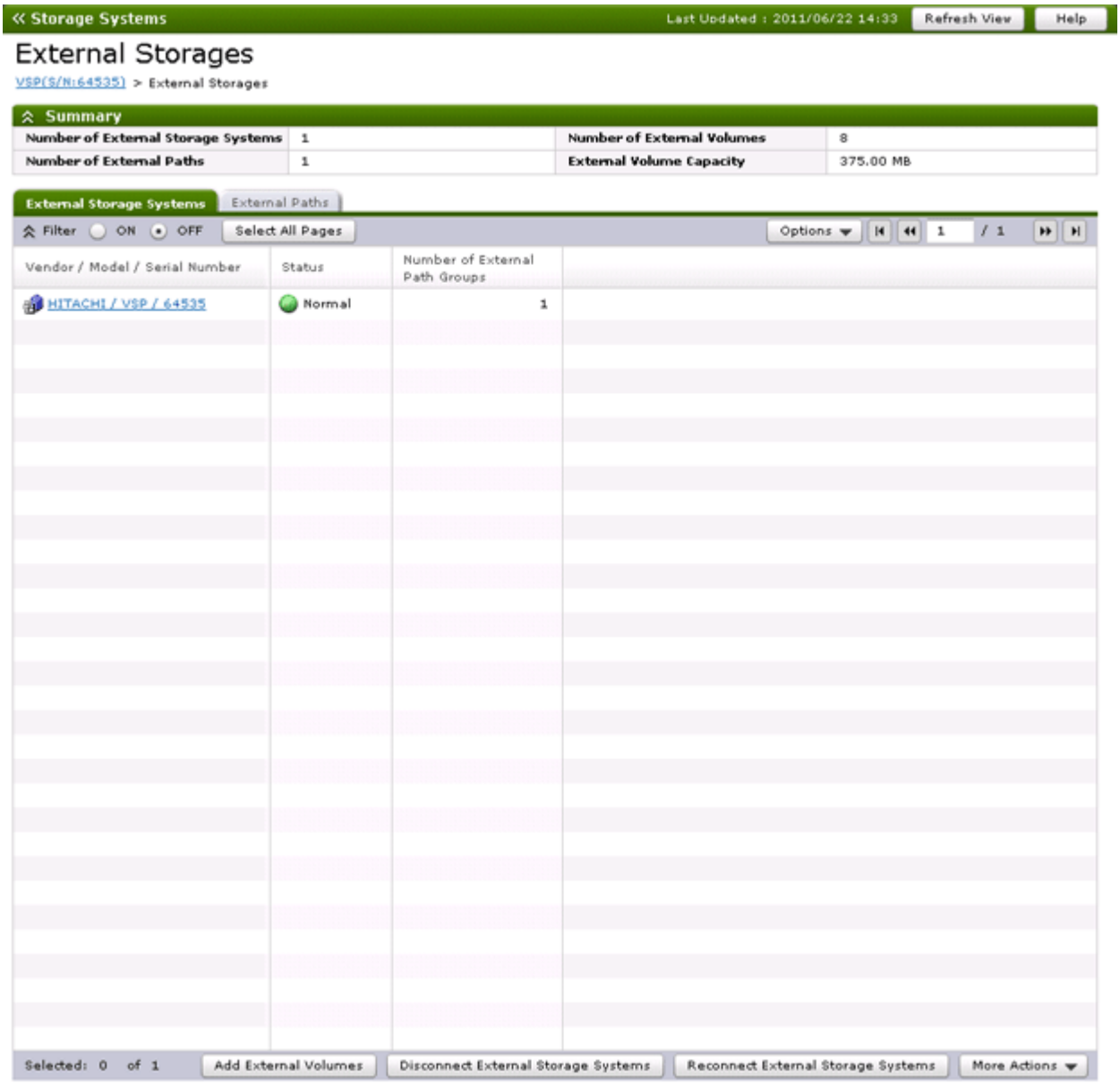
Use this window to view external storage systems.

You can perform these operations from the window:

- Mapping an external volume on page 4-5
- Editing mapping policies on page 5-3
- Disconnecting an external path on page 5-9
- Reconnecting an external path on page 5-10

Information areas in this window:

- Summary on page D-4
- External Storage Systems tab on page D-5
- External Paths tab on page D-5



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 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.
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.
* Appears when you click **More Actions**.	

External Paths tab

Displays the paths connecting mapped external volumes in the external system to VSP.

Item	Description
Port ID	Local system port number.

Item	Description
External WWN	External system port identification number.
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 external path QDepth values.
I/O Timeout (sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Path Blockade Watch(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 Policies*	When clicked, launches the **Edit Policies** window.
Export*	When clicked, allows you to save table information to a file.
* Appears when you click **More Actions**.	

Selected external storage system window

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

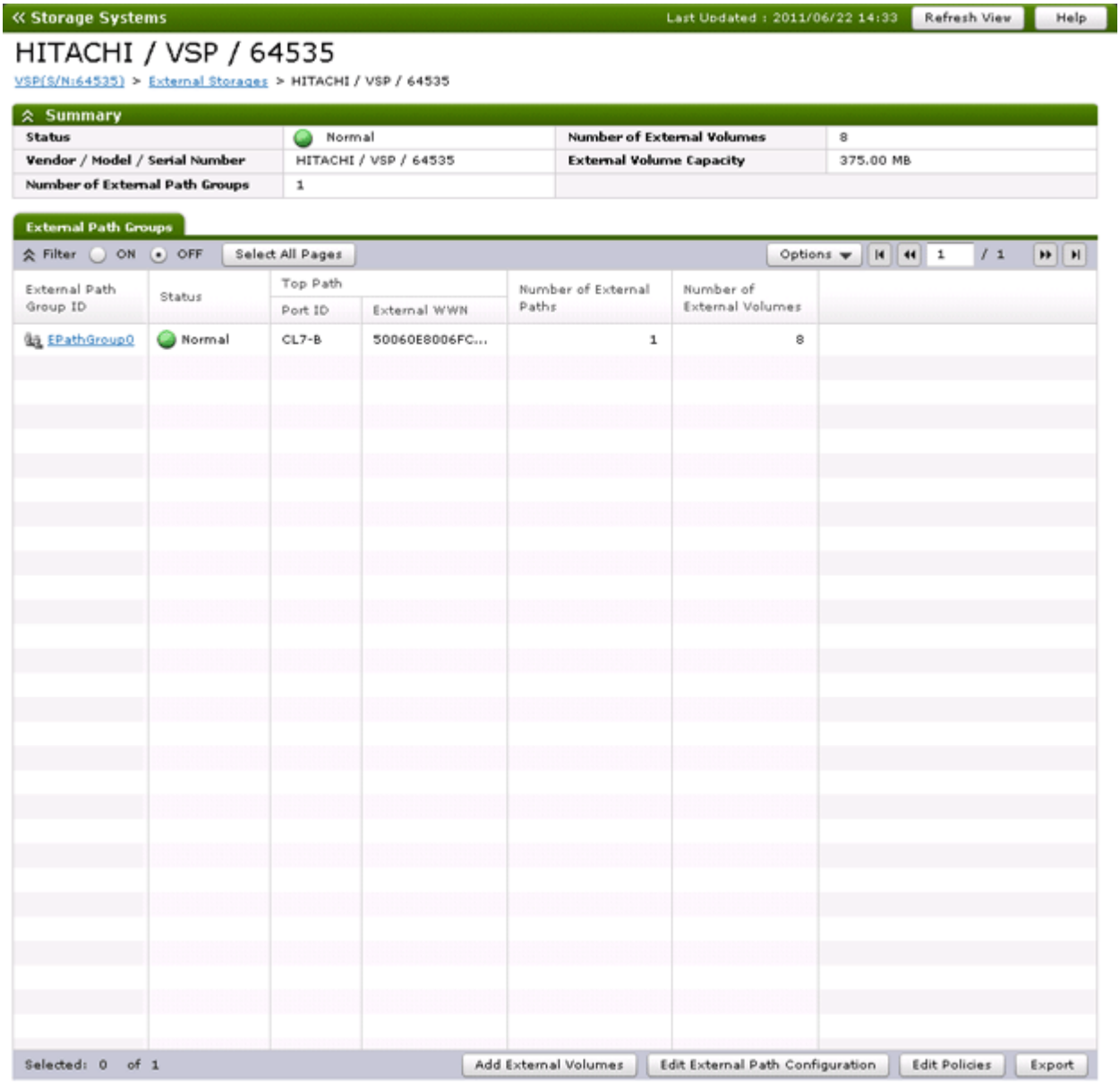
You can perform these operations from the window:

- Mapping an external volume on page 4-5
- Adding an external path to an existing path group on page 5-8

- Changing external path priority on page 5-9
- Removing, replacing an external path on page 5-12
- Editing external volume policies (settings) on page 5-2
- Export table information to a file.

Information areas in this window:

- Summary on page D-7
- External Path Groups tab on page D-8



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. • **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.

Item	Description
	• **Blockade**: The mapping path is blocked. • **Destage Failed**: The writing of data from cache memory to the volume is failed.
Top Path	Highest priority external path.
Port ID	Local system port number.
External WWN	External system port identification number.
Number of External Paths	Number of external paths in the path group.
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.

Selected external path group window

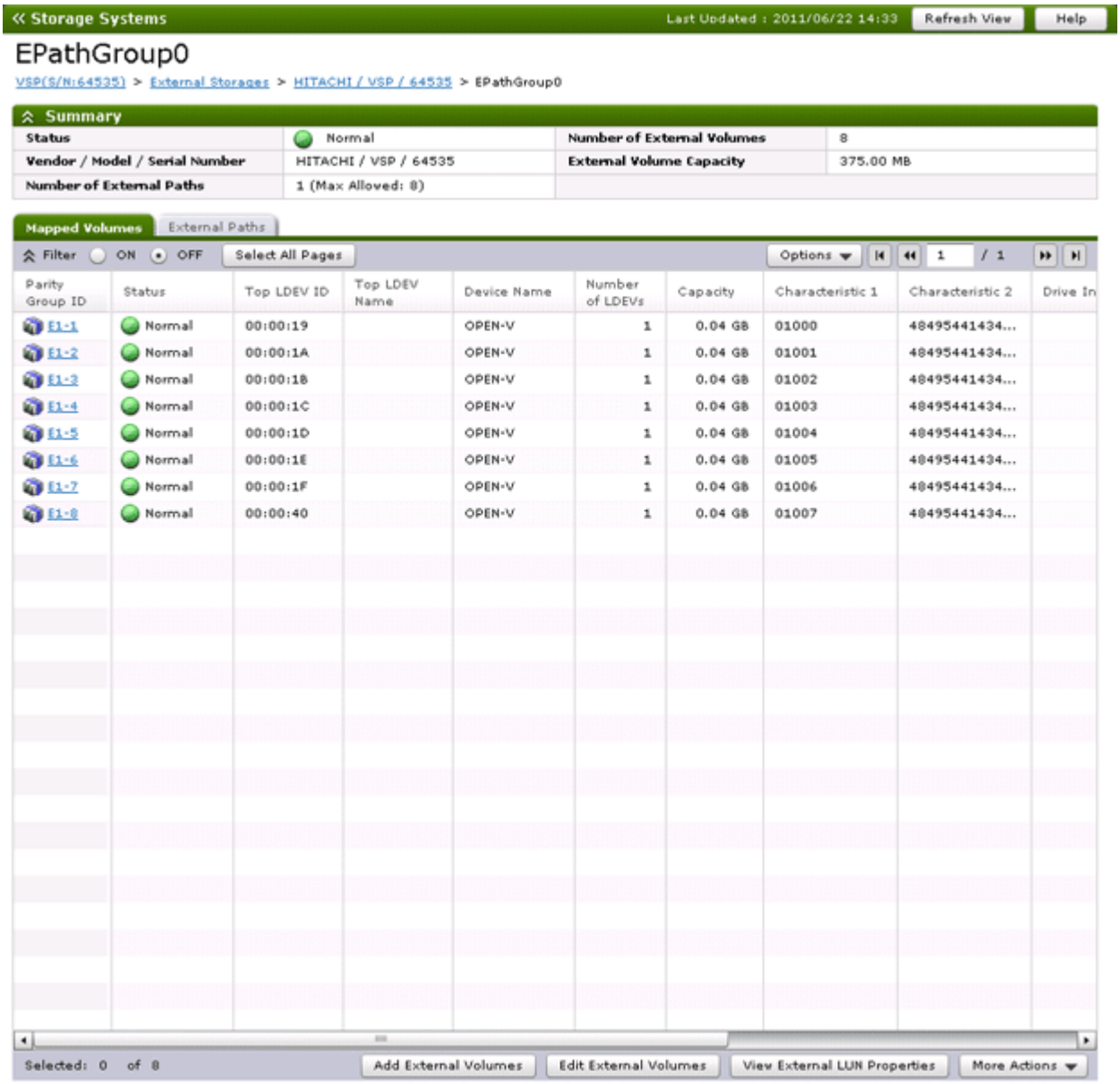
Use this window to view the mapped external volumes using the external path, and view the external paths in the path group.

You can perform these operations from the window.

- Mapping an external volume on page 4-5
- Edit Cache Mode and Inflow Control settings for individual mapped volumes (see Editing mapping policies on page 5-3)
- View path status and external LUN information (see the Status description in the External Storage Systems tab on page D-5 section.)
- Deleting an external volume mapping on page 5-22
- Disconnecting a single mapped volume on page 5-17
- Reconnecting a single mapped volume on page 5-20
- Changing external volume processor blade on page 5-4
- Editing external volume policies (settings) on page 5-2
- Export table information to a file (see the Export button description in External Storage Systems tab on page D-5 section.)

Information areas in this window:

- Summary on page D-10
- Mapped Volumes tab on page D-11
- External Paths tab on page D-13



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.

Item	Description
	• **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.
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 the VSP 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.

Item	Description
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 Hitachi enterprise storage, this field displays the emulation type.
Number of LDEVs	Number of LDEVs created in the external volume.
Capacity	Capacity of the external volume.
Characteristic1	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 may reflect internal numbering.
Characteristic2	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. • VSP • 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 G200, G400, G600 • VSP G1000 • VSP • HUS VM • Universal Storage Platform V/VM
MP Blade ID	Processor blade IDs allocated to the external volume.
Path Mode	Path mode for the external volume's external path. • **Single**: One path is used for I/O to the external volume, with alternate paths available in case of failure. • **Multi**: Multiple paths are used at the same time. • **APLB**: Like Multi, all paths are used; however, they are not used when connected to ports in Passive status. See External paths on page 2-13 for more information.
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.

Item	Description
	• **Disable**: Performs I/O operation with a single path, without load balance. • A hyphen (-) displays when the Path mode is Single.
Cache Mode	Write data from the host to the external system is propagated synchronously (**Disable**) or asynchronously (**Enable**). When the attribute Nondisruptive Migration is selected, - is displayed.
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 an attribute of the parity group. • **Nondisruptive Migration**: The parity group is set to nondisruptive migration. • **-** (hyphen): Parity group whose attribute is not set.
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*	When clicked, launches the **Delete External Volumes** window.
Disconnect External Volumes	When clicked, launches the **Disconnect External Volumes** window.
Reconnect External Volumes	When clicked, launches the **Reconnect External Volumes** window.
Assign MP Blade*	When clicked, launches the **Assign Processor Blade** window.
Edit Policies*	When clicked, launches the **Edit Policies** window.
Export*	When clicked, allows you to save table information to a file.
* Appears when you click **More Actions**.	

External Paths tab

Displays the external paths within the selected path group.

Item	Description
Priority	Priority of external paths.
Port ID	Local system port number.
External WWN	External system port identification number.
Status	Status of external paths. • **Normal**: There are no problems, the system is usable.

Item	Description
	• **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 external path QDepth values.
I/O Timeout (sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Path Blockade Watch(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.

Add External Volumes wizard

Use this wizard to connect external volumes to VSP.

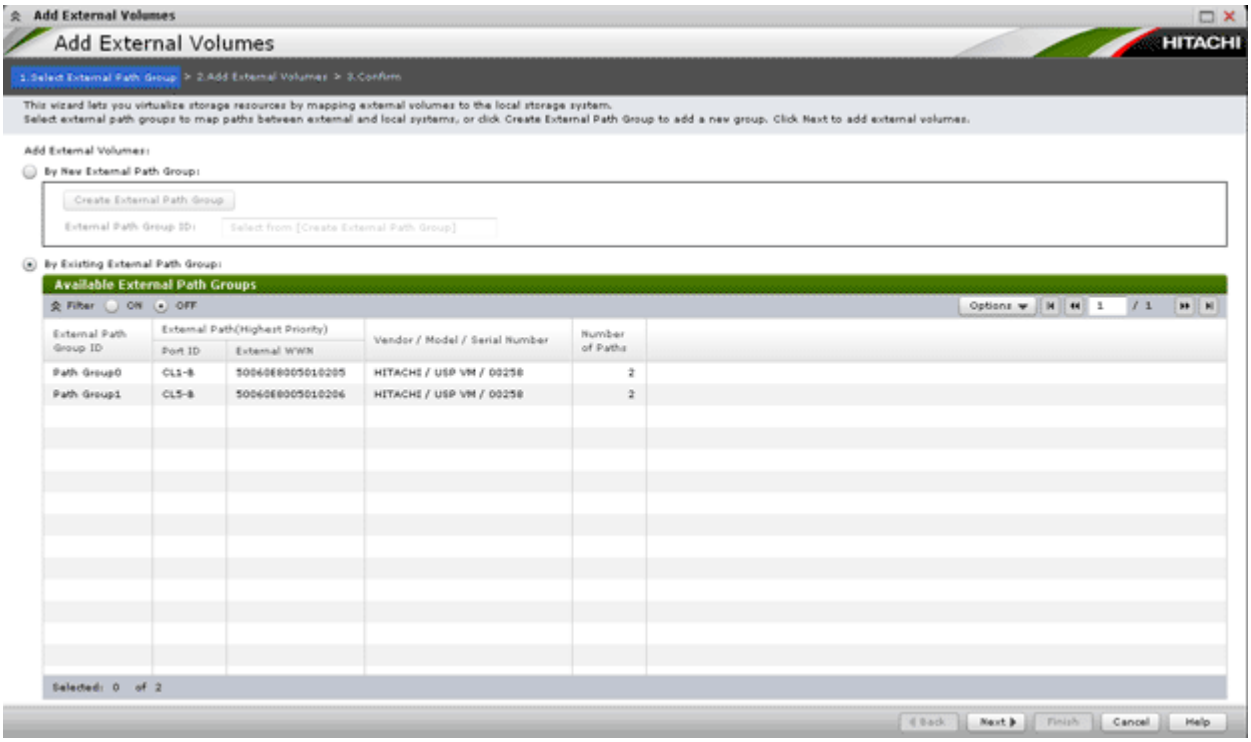
See Mapping an external volume on page 4-5 for instructions.

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

- Select External Path Group window on page D-14
- Add External Volumes window on page D-16
- Confirm window on page D-22

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.
By Existing External Path Group.	Option for using an existing external path group.
Storage system button	When clicked, displays a list of external systems.
Available External Path Groups	External path groups for the ports assigned to the user.
External Path Group ID	Name of the external path group.
External Path (Highest Priority)	External path in the path group with the highest priority.
Port ID	Local system port number.
External WWN	External system port identification number.
Vendor / Model / Serial Number	Identifying information for the external system.
Number of Paths	Number of external paths in the path group.

Add External Volumes window

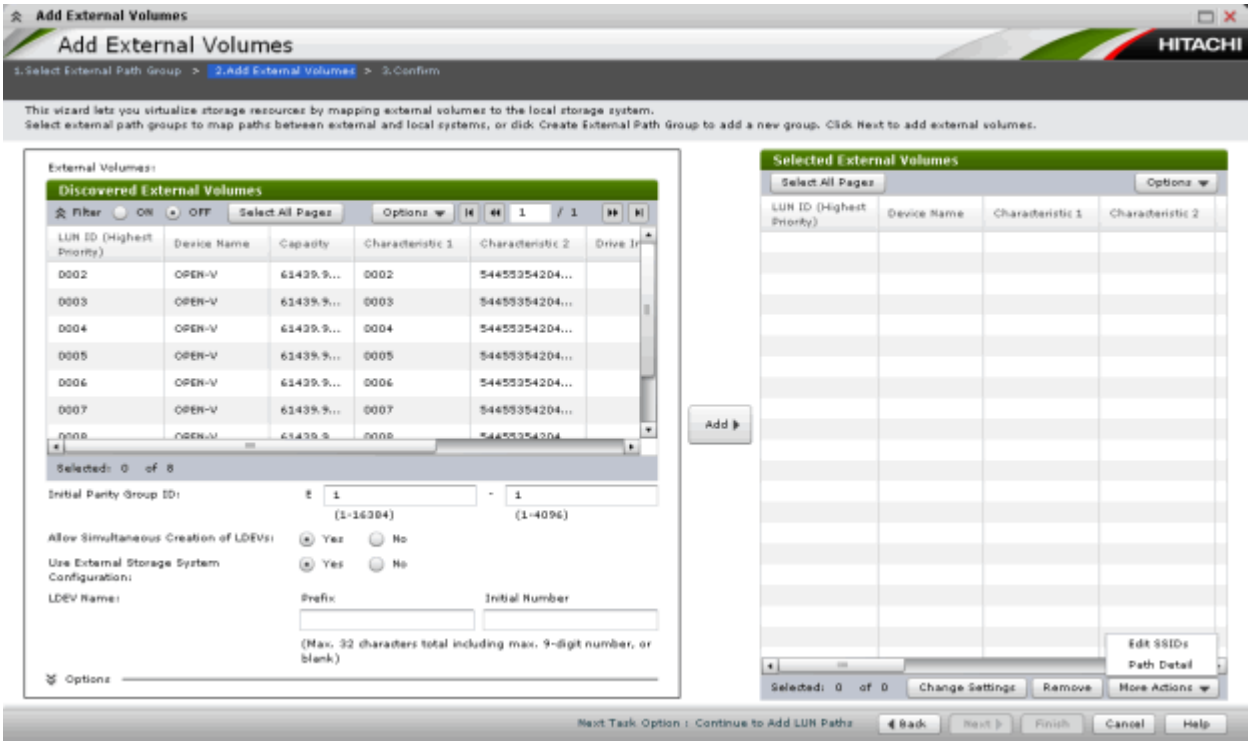
Part of the Add External Volumes wizard, use this window to select and set parameters for external volumes.

Sections in this window:

- Discovered External Volumes on page D-16
- Selected External Volumes on page D-19
- Confirm window on page D-28

Discovered External Volumes

Displays discovered external volumes.



Item	Description
Discovered External Volumes	Volumes in the external system associated with the external port side of the external path and path group.
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 Hitachi enterprise storage, this field displays emulation type.
Capacity	External volume capacity.
Characteristic1	Identification number of the external volume.

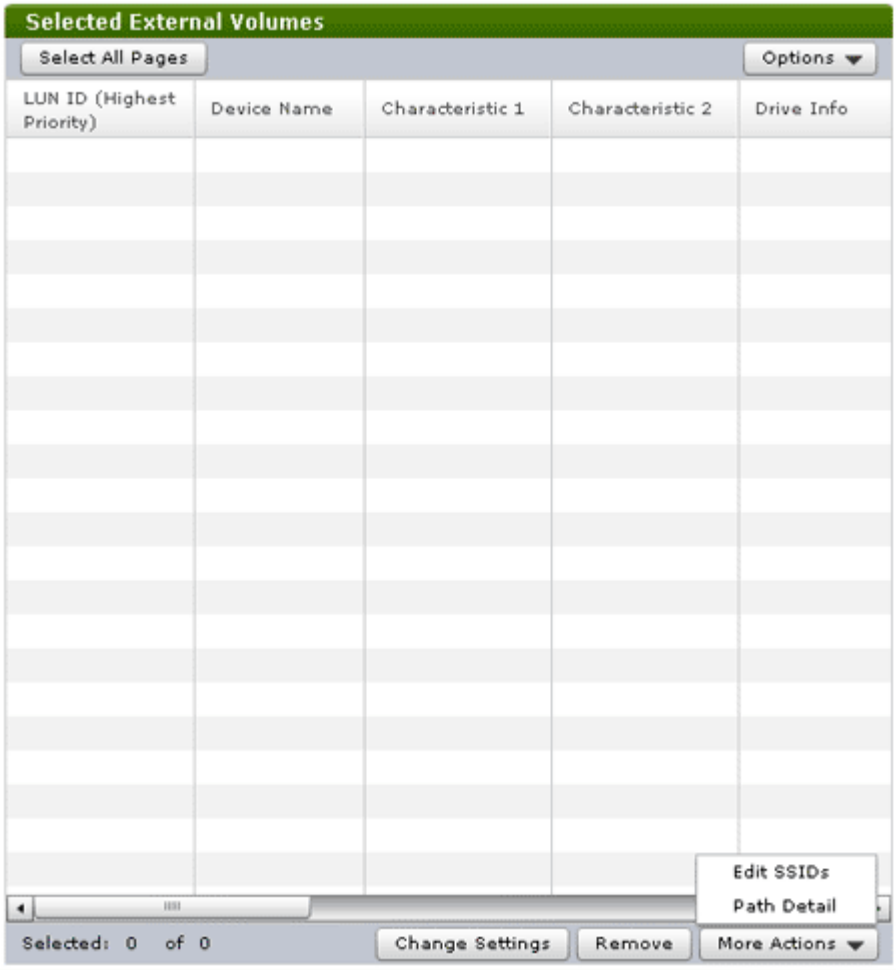
Item	Description
	The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and may reflect internal numbering.
Characteristic2	Identification number of the external volume.
Drive Info	Information about the external volume's drive type. **SATA** displays when the external volume is a SATA drive of following storage systems. • VSP • 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 G200, G400, G600 • VSP G1000 • VSP • HUS VM • Universal Storage Platform V/VM
Path Mode	Displays operation mode of the external path. • **Single**: Ordinarily, external paths that are set from only one port are used even if alternate paths are set, In Single mode, alternate paths are operated only in case of maintenance work failure. • **Multi**: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. • **APLB**: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths that are connected to ports in Passive status are not used.
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.
Allow Simultaneous Creation of LDEVs	LDEVs are automatically created in the internal volume when Yes is selected. If No is selected, you must create LDEV's 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 LDEV's manually.

Item	Description
LDEV Name	Requires a prefix character and initial number, 32 characters maximum (including the initial number). Numbering rule for Initial Number: 1: total 9 numbers (1,2,3,…9) 08: total 92 numbers (08,09,10,…99) 23: total 77 numbers (23,24,25,…99) 098: total 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	VSP searches from this number in ascending order and allocates the next available LDEV ID to the external volume. Ranges for each item: • **LDKC**: 00 • **CU**: From 00 (default) to FE. • **DEV**: The LDEV ID. From 00 (default) to FF. • **Interval**: Interval between LDEV IDs. From 0 (default) to 255.
View LDEV IDs	Shows used, available, and disabled LDEV IDs.
Initial SSID	SSID number. Range can be from 0004 (default) to FFFE.
View SSID	Shows current SSIDs.
Base Emulation Type	External system's emulation type. All supported emulation types except OPEN-L can be specified. See Editing external volume policies (settings) on page 5-2 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 base emulation type.
Cache Partition	CLPR for accessing the external volume. See Editing external volume policies (settings) on page 5-2 for more information.
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 2-6 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 Editing external volume policies (settings) on page 5-2 for more information.

Item	Description
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 the value set in the Edit Policies window. If the product name of an external storage system is displayed as "(generic)", **Disable** is used by default. When the path mode of the external volume is **Single**, this item cannot be selected.
Processor Blade	Processor blade for the external volume. • Range is from MPB0 to MPB7. • Auto (default): Blade is automatically selected by the system. • Blade with lowest number is used when Auto cannot be selected.
Add	When clicked, moves selected volumes to the Selected External Volumes list.

Selected External Volumes

Displays selected external volumes.

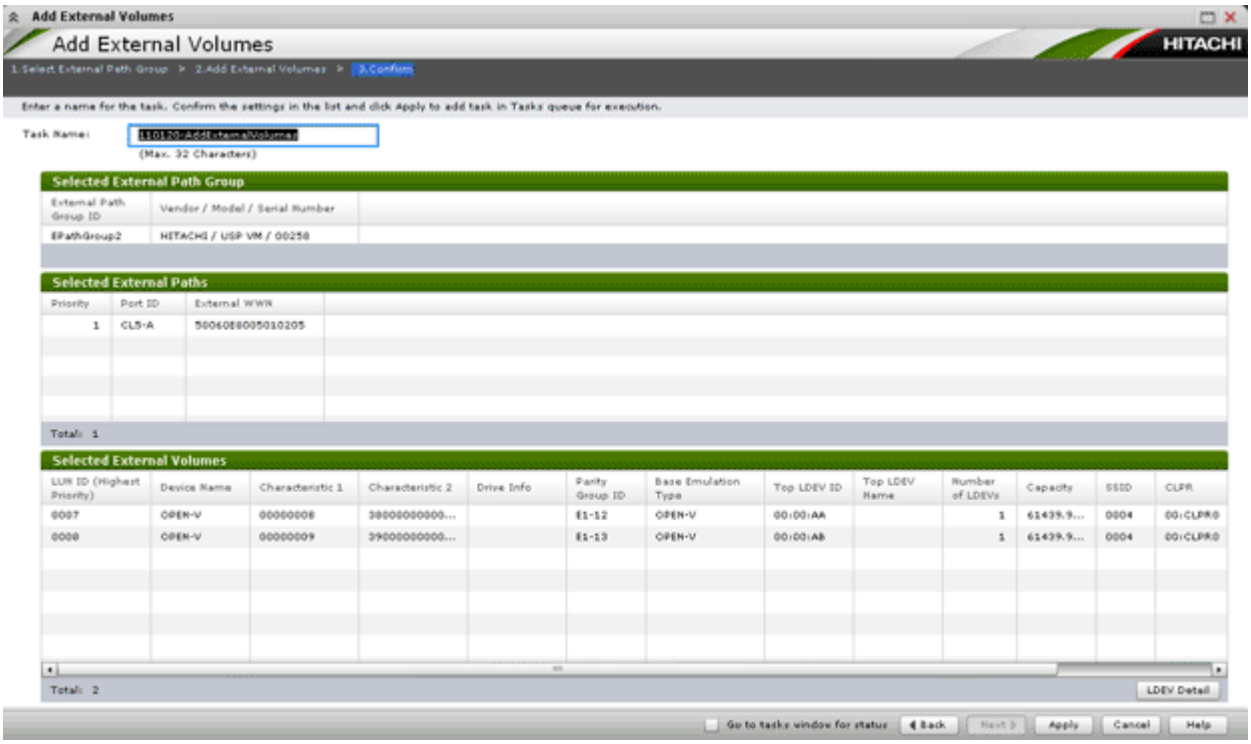


Item	Description
LUN ID(Highest Priority)	External volume's LUN with the highest priority.
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some Hitachi enterprise storage, this field displays emulation type.
Characteristic1	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 may reflect internal numbering.
Characteristic2	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. • VSP • Universal Storage Platform V/VM • HUS/AMS/WMS • SMS

Item	Description
	• Thunder 9500V **SSD** displays when the external volume is the SSD of following storage systems. • VSP G200, G400, G600 • VSP G1000 • VSP • HUS VM • Universal Storage Platform V/VM
Parity Group ID	Parity group numbers.
Base Emulation Type	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	SSIDs.
CLPR	CLPR used for accessing to the mapped external volume.
Path Mode	Displays operation mode of the external path. • **Single**: Ordinarily, external paths that are set from only one port are used even if alternate paths are set, In Single mode, alternate paths are operated only in case of maintenance work failure. • **Multi**: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. • **APLB**: 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.
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. • A hyphen (-) displays when the Path mode is Single.
MP Blade ID	External volume's processor blade IDs.
Change Settings	When clicked, the Change Setting dialog box opens.
Remove	When clicked, removes external volumes from the Selected External Volumes table.

Item	Description
Edit SSIDs*	When clicked, opens the Change SSIDs dialog box.
Path Detail*	When clicked, opens the View External LUN Properties dialog box.
Next Task Option	When clicked, opens the Select LDEV window.
* Appears when you click **More Actions**.	

Confirm 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	Local system port number.
External WWN	External system port identification number.
LUN ID(Highest Priority)	The LUN which is connected to the external path with the highest priority.

Item	Description
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some Hitachi enterprise storage, this field displays emulation type.
Capacity	External volume capacity.
Characteristic1	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 may reflect internal numbering.
Characteristic2	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. • VSP • 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 G200, G400, G600 • VSP G1000 • VSP • HUS VM • Universal Storage Platform V/VM
Parity Group ID	Parity group numbers.
Base Emulation Type	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	SSIDs.
CLPR	CLPR used for accessing to the mapped external volume.
Path Mode	Displays operation mode of the external path. • **Single**: Ordinarily, external paths that are set from only one port are used even if alternate paths are set, In Single mode, alternate paths are operated only in case of maintenance work failure. • **Multi**: When alternate paths are set, external paths from several ports are simultaneously used with load balancing.

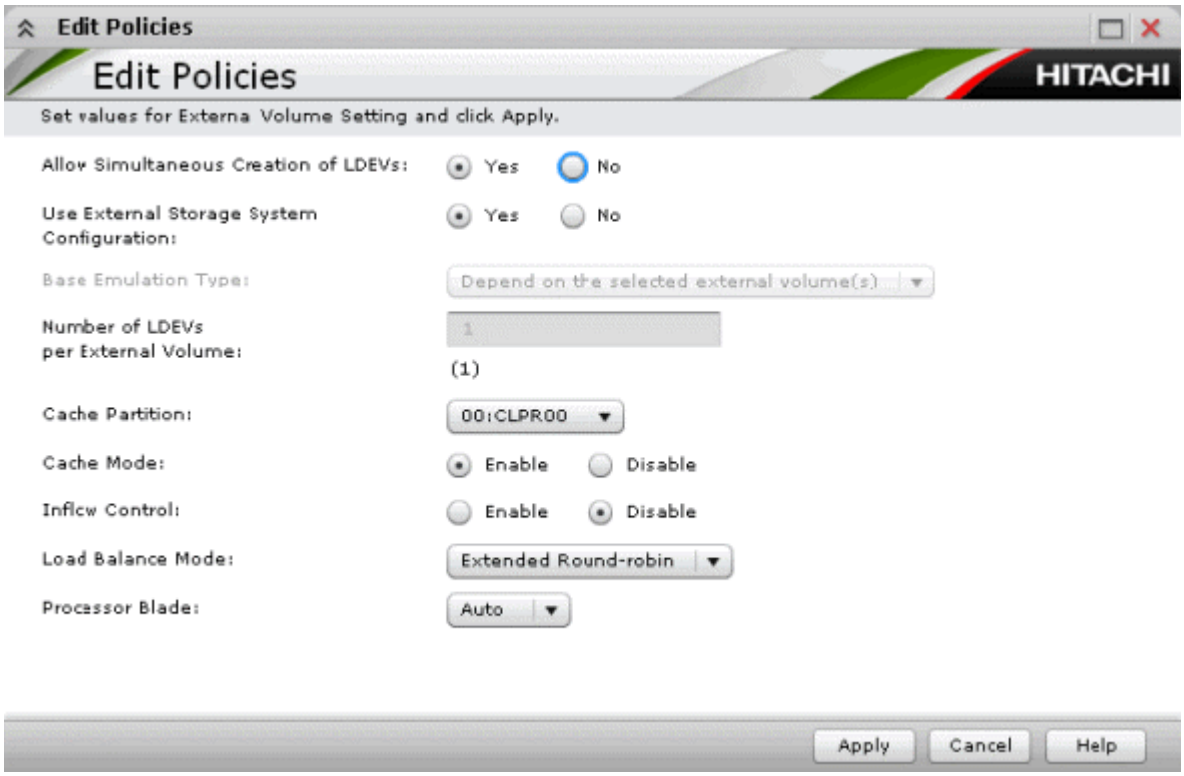
Item	Description
	• **APLB**: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths connected to ports in Passive status are not used.
Load Balance Mode	Displays I/O load balance system for external storage system. • **Normal Round-robin**: 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. • A hyphen (-) displays when the Path mode is Single.
MP Blade ID	External volume's processor blade IDs.
LDEV Detail	External volume's LDEV details.

Note: Information in this **Confirm** window assumes only a single task is executed. If multiple tasks are executed, 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.

See Editing external volume policies (settings) on page 5-2 for information.



Item	Description
Allow Simultaneous Creation of LDEVs	LDEVs are automatically created in the internal volume when Yes is selected. If No is selected, you must create LDEV's 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 LDEV's manually.
Base Emulation Type	External system's emulation type. All supported emulation types except OPEN-L can be specified. See Editing external volume policies (settings) on page 5-2 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 base emulation type.
Cache Partition	CLPR for accessing the external volume. See Editing external volume policies (settings) on page 5-2 for more information.
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 2-6for more information.

Item	Description
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 Editing external volume policies (settings) on page 5-2 for more information.
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**.
Processor Blade	Processor blade for the external volume. • Range is from MPB0 to MPB7. • Auto (default): Blade is automatically selected by the system. • Blade with lowest number is used when Auto cannot be selected.
Internal Volume Usage	Specifies whether to use the internal volume as an external volume (Enable) or not (Disable). The default is Disable.

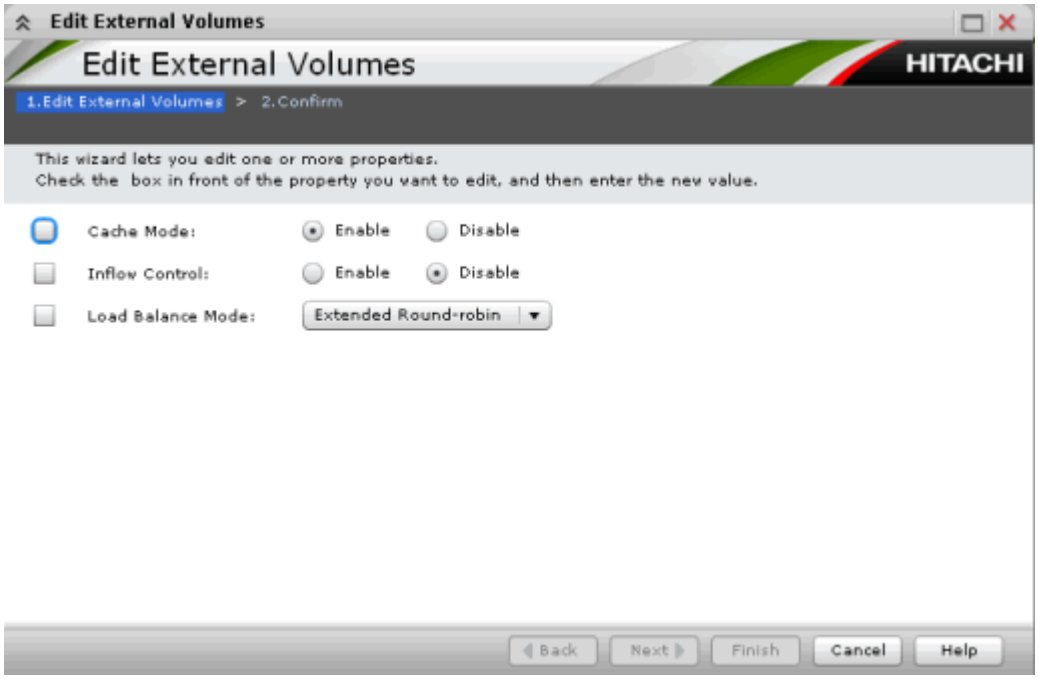
Edit External Volumes wizard

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

The windows in the wizard are:

- Edit External Volumes window on page D-27
- Confirm window on page D-28

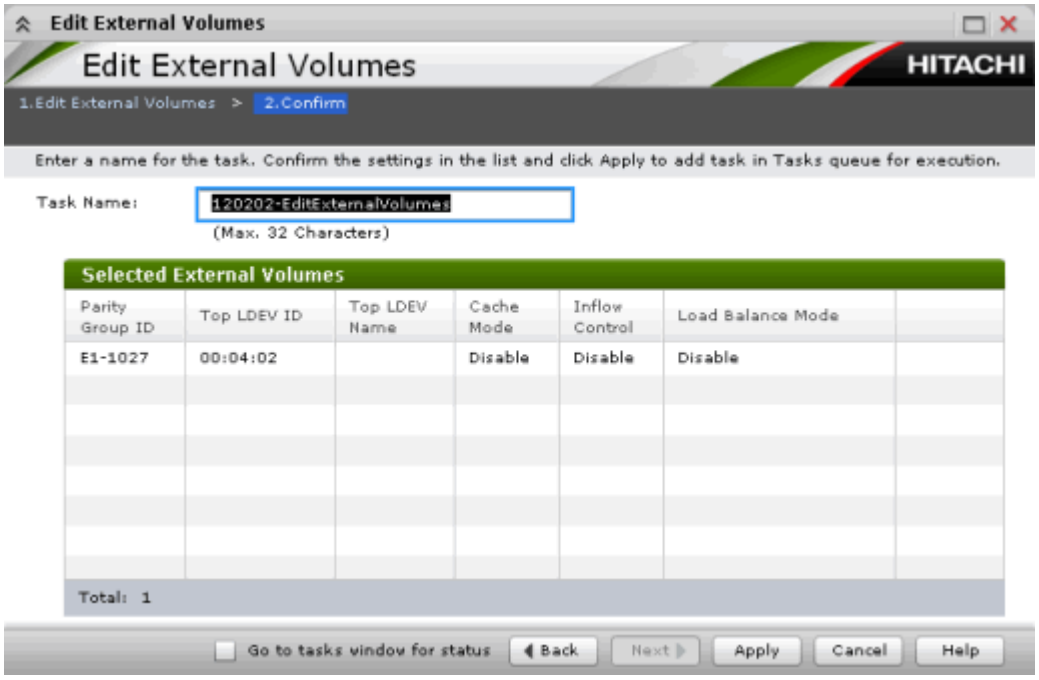
Edit External Volumes window



Item	Description
Cache Mode	• Enable: Write data from the host is propagated asynchronously. • Disable: Write data from the host is propagated synchronously. • This mode will be inactive in external volumes whose attribute is Nondisruptive Migration. See Cache use and external storage performance on page 2-6 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 Editing external volume policies (settings) on page 5-2 for more information.
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. • A hyphen (-) displays when the Path mode is Single.

Item	Description
	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. When the Path Mode of the selected external volume is Single, the item cannot be selected.

Confirm 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 • Disable: Write data from the host is propagated synchronously See Cache use and external storage performance on page 2-6for 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 Editing external volume policies (settings) on page 5-2 for more information.

Item	Description
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. • A hyphen (-) displays when the Path mode is Single.

Edit External Path Configuration wizard

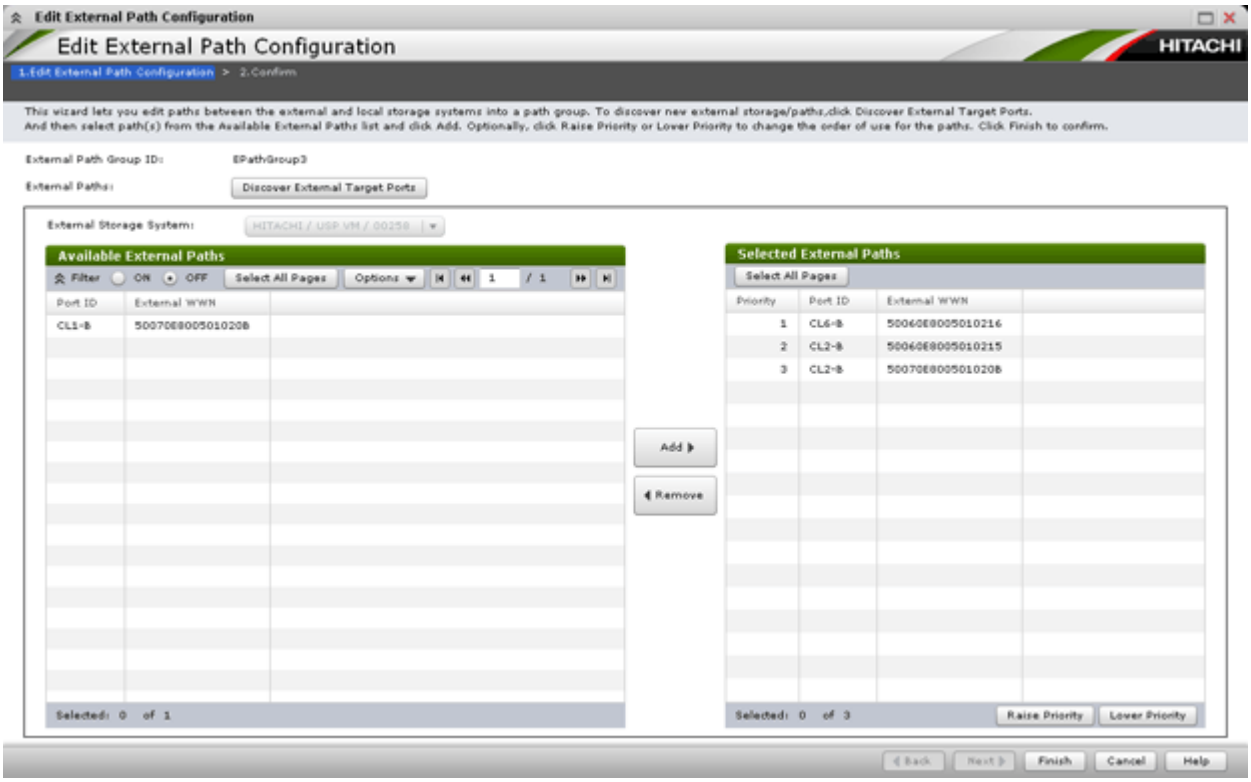
Use this wizard to add and remove external paths to a path group, and to raise and lower path priority.

See Adding an external path to an existing path group on page 5-8 for instructions.

The windows in the wizard are:

- Edit External Path Configuration window on page D-30
- Confirm window on page D-32

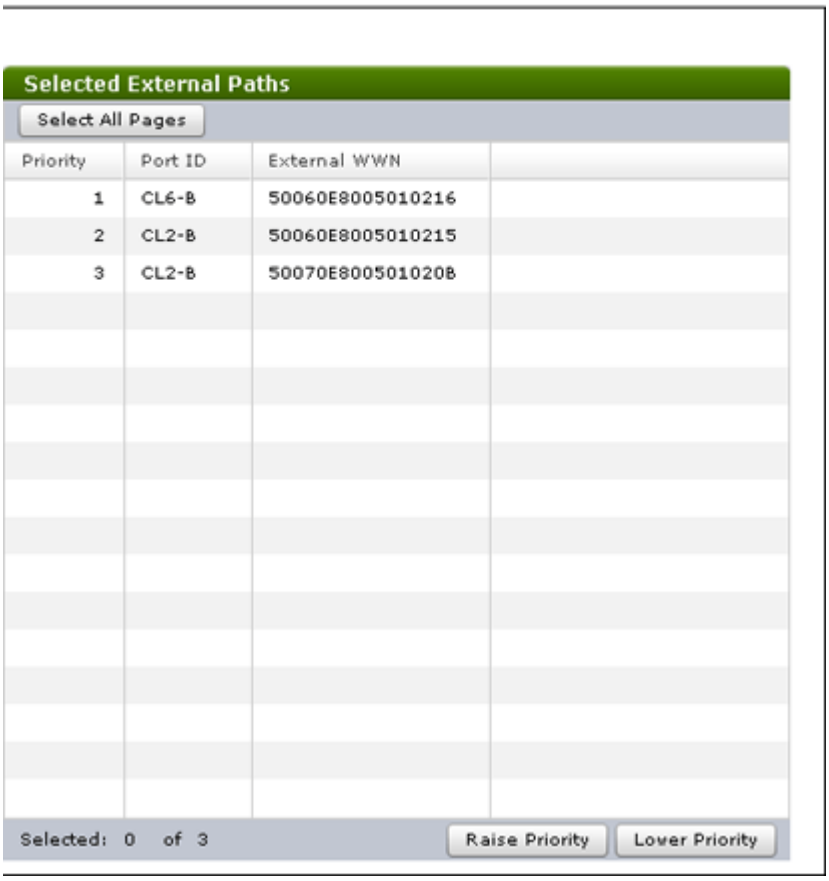
Edit External Path Configuration window



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

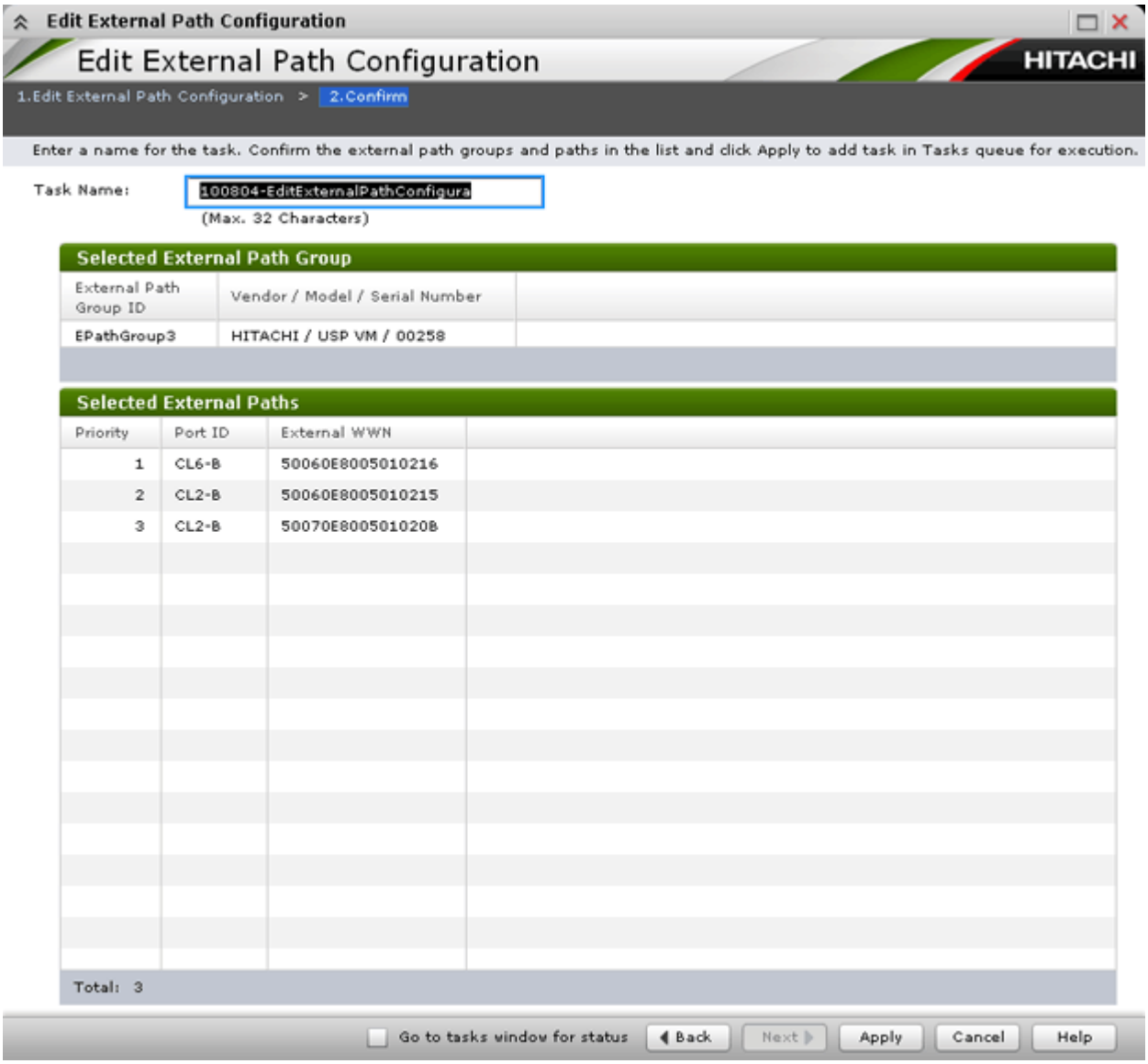
Item	Description
External Path Group ID	Name of the external path group.
External Paths	External path information.
Discover External Target Ports	When clicked, opens the Discover External Target Ports window, which lists available external ports.
External Storage System	The external system selected (greyed out). If no system was selected, allows you to select the system from a list.
Available External Paths	
Port ID	Local system port number.
External WWN	External system port identification number.
Add	When clicked, moves selected paths to the Selected External Paths list.

The following figure shows the **Selected External Paths** pane in the **Edit External Path Configuration** window. The table following the figure provides descriptions for the items in the pane.



Item	Description
Selected External Paths (see preceding figure)	
Remove	When clicked, removes the selected path from the Selected External Paths list.
Priority	Priority of external paths.
Port ID	Local system port number.
External WWN	External system port identification number.
Raise Priority	Raise the priority of the selected external path.
Lower Priority	Lower the priority of the selected external path.

Confirm 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	Local system port number.
External WWN	External system port identification number.

Edit External WWNs wizard

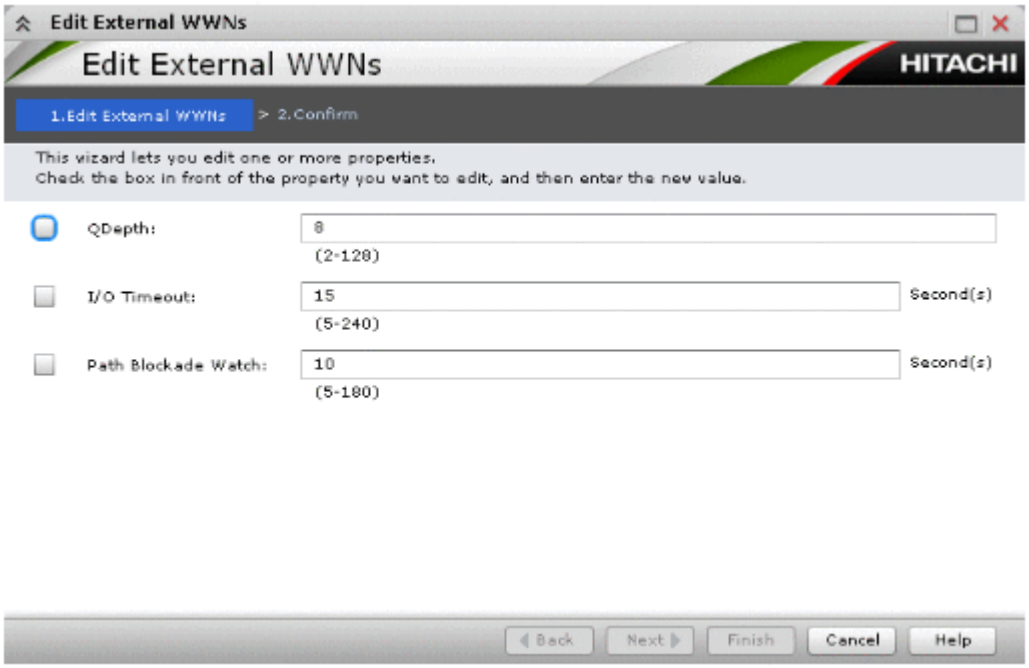
Use this wizard to change the external system's WWN port setting.

See Editing external WWN settings on page 5-6 for instructions.

The windows in the wizard are:

- Edit External WWNs window on page D-33
- Confirm window on page D-34

Edit External WWNs window

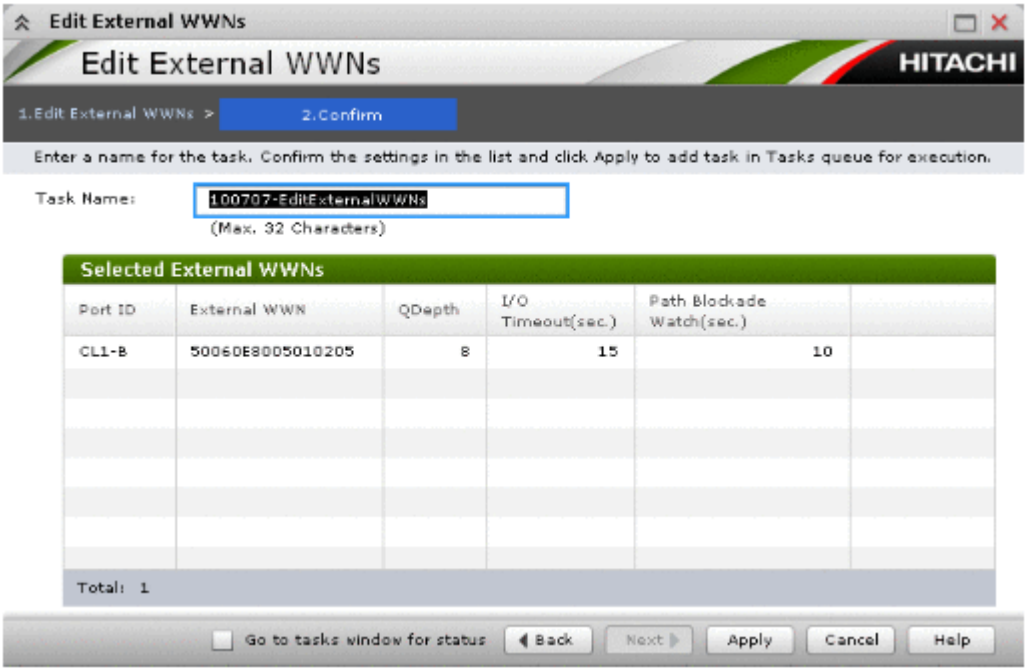


Item	Description
QDepth	Number of Read/Write commands that can be queued to the external volume. 8 is set by default. When **Load Balance Mode** is **Extended Round-robin** and the I/Os issued to the external volume are sequential, the number of Read/Write commands that can be queued at one time is the total of the external path QDepth values.
I/O Timeout (sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Path Blockade Watch(sec.)	Time that elapses from the time that a path goes down to the time when the external volume is blocked. 10 seconds is the default.

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 perform the setting change for the next task before the currently applied task finishes, the setting is only applied to the next task. The result might be different from what you expected.

Confirm window



Item	Description
Port ID	Local system port number.
External WWN	External system port identification number.
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 external path QDepth values.
I/O Timeout (sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.
Path Blockade Watch(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.

Delete External Volumes wizard

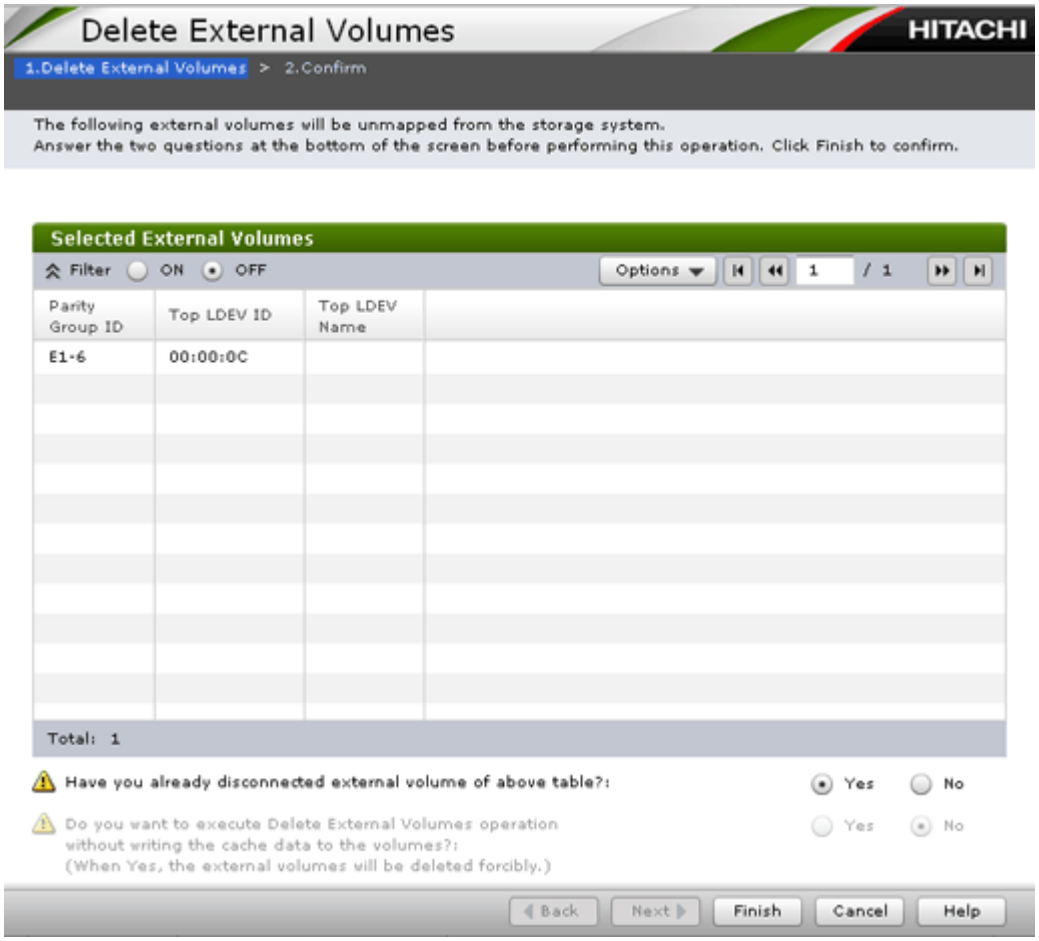
Use this wizard to delete external volume mapping.

See Deleting an external volume mapping on page 5-22 for instructions.

The windows in the wizard are:

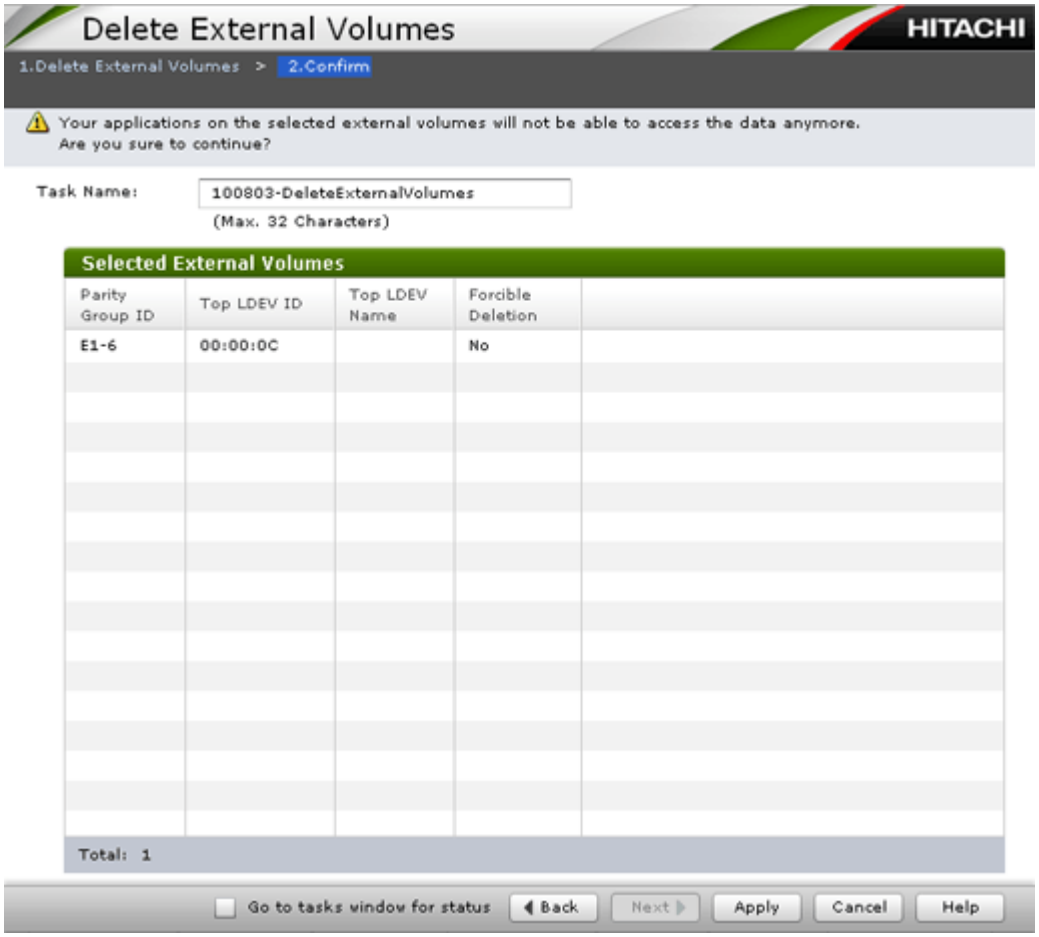
- Delete External Volumes window on page D-35
- Confirm window on page D-36

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.
Have you already disconnected external volume of above table?	• Yes if you have disconnected the external volume you want to delete. • No if you have not disconnected the external volume you want to delete.
Do you want to execute Delete External Volumes operation without writing the cache data to the volumes?	• Yes to delete the external volumes without writing the data in cache memory into the volumes. • No (default). If selected, the operation cannot be completed.

Confirm 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.
Forcible Deletion	Yes: The external volume will be forcibly deleted even if the connection to the external volume has not been disconnected. 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.

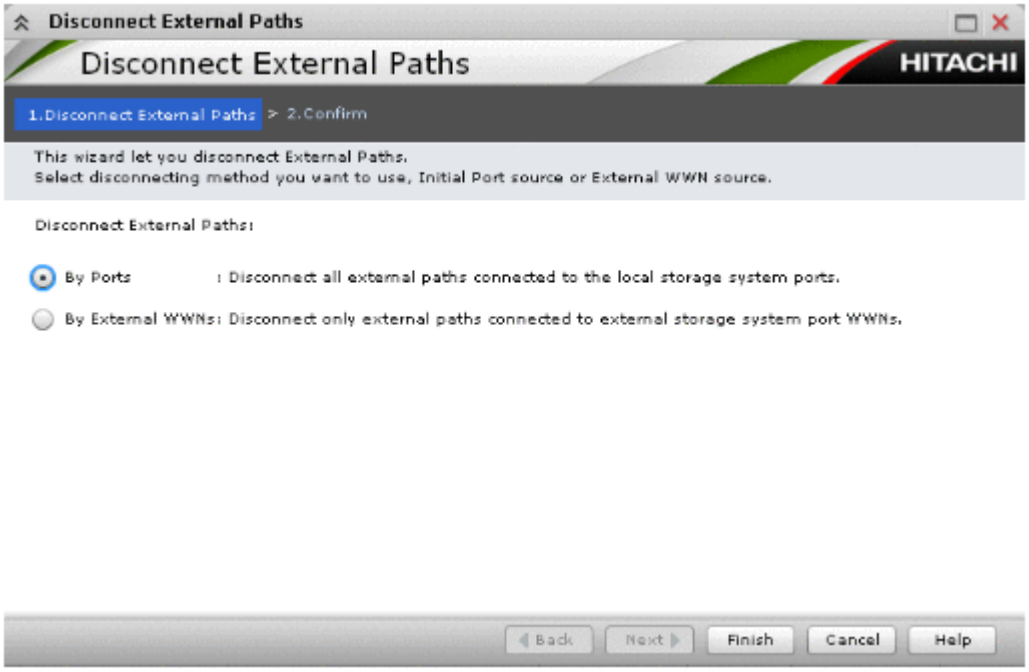
See Disconnecting an external path on page 5-9 for instructions.

The windows in the wizard are:

- Disconnect External Paths window on page D-37

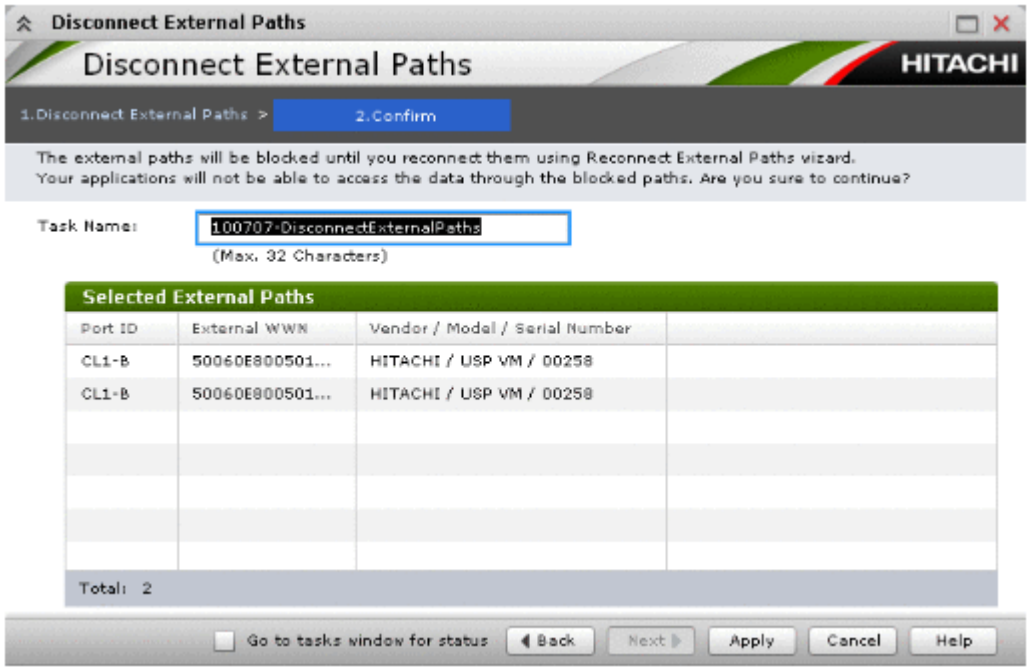
- Confirm window on page D-38

Disconnect External Paths window



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

Confirm window



Item	Description
Port ID	Local system port number.
External WWN	External system port identification number.
Vendor / Model / Serial Number	Identifying information for the external system.

Reconnect External Paths wizard

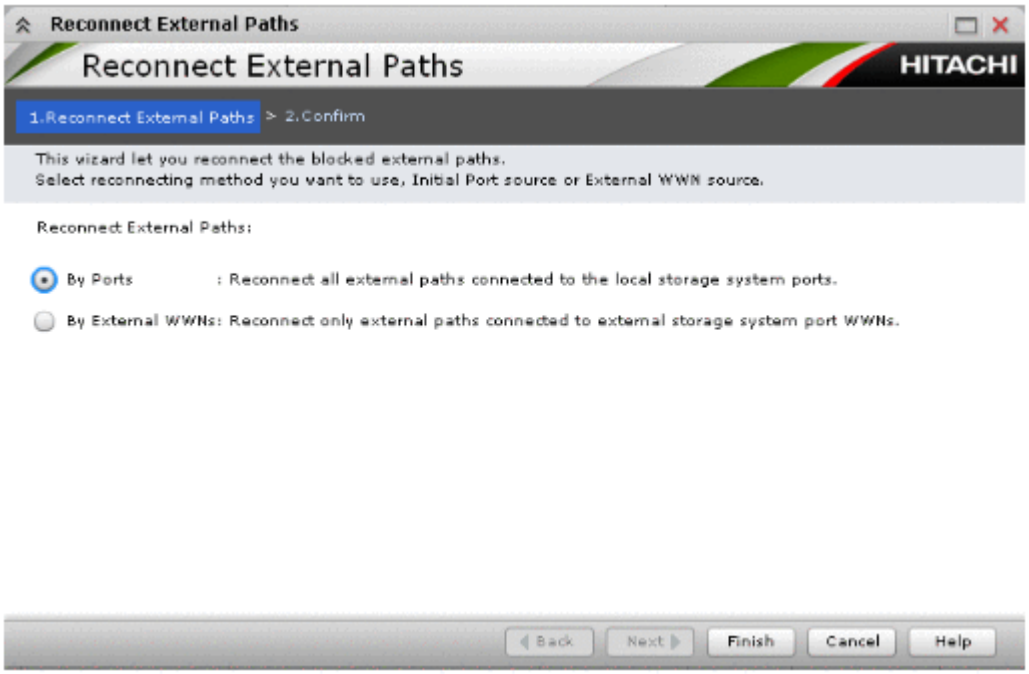
Use this wizard to reconnect external paths.

See Reconnecting an external path on page 5-10 for instructions.

The windows in the wizard are:

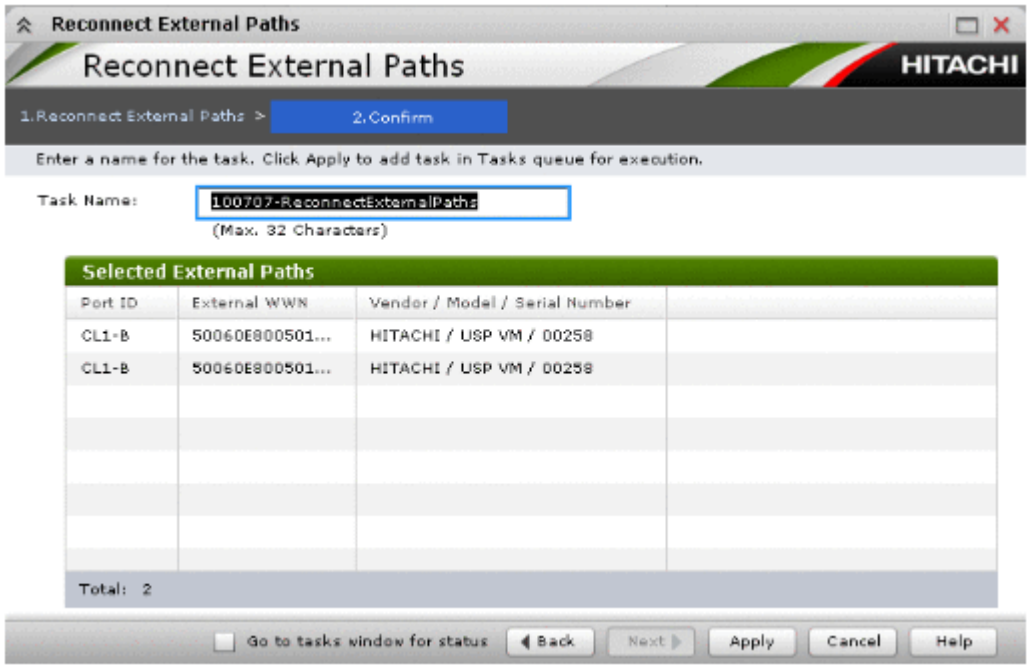
- Reconnect External Paths window on page D-39
- Confirm window on page D-40

Reconnect External Paths window



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 (ports) in the external system.

Confirm window



Selected External Paths table

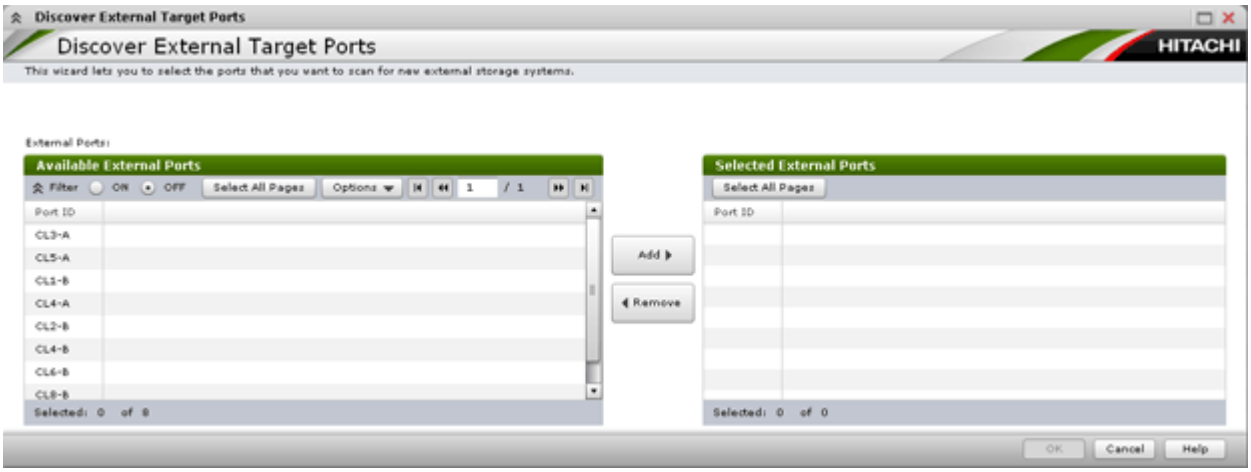
Item	Description
Port ID	Local system port number.
External WWN	External system port identification number.
Vendor / Model / Serial Number	Identifying information for the external system.

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 4-5
- Adding an external path to an existing path group on page 5-8



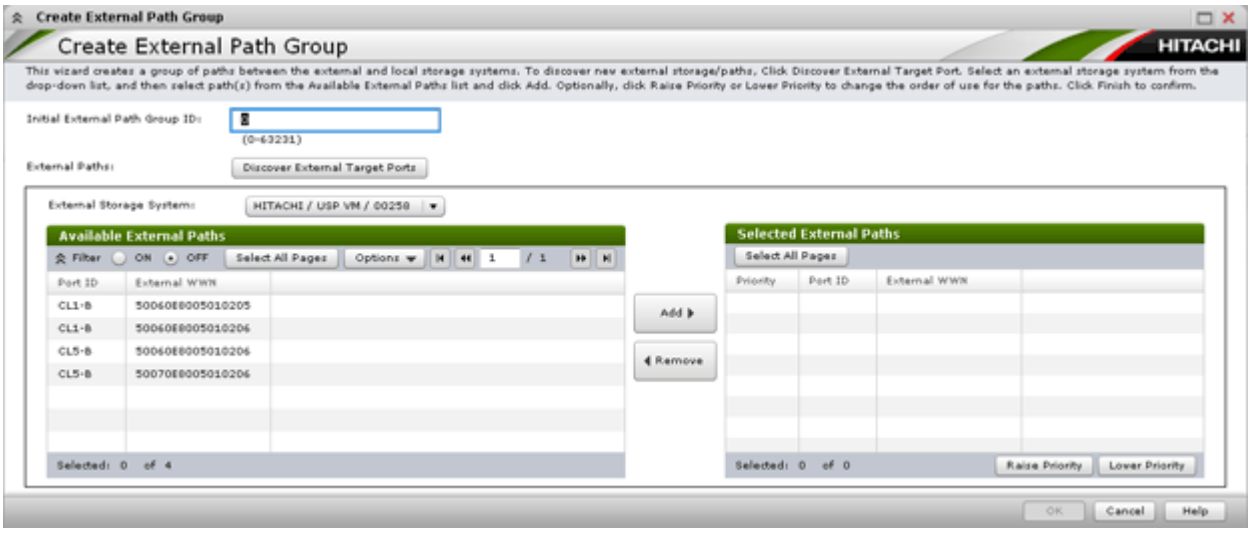
Only external ports assigned to the user display.

Item	Description
Available External Ports	
Port ID	Port number in the local system connecting to the external system.
Add	When clicked, moves selected paths to the Selected External Ports list.
Selected External Paths	
Remove	When clicked, removes the selected path from the Selected External Ports list.
Port ID	External system port number used in the external path.

Create External Path Group window

Use this window to create a new external path group.

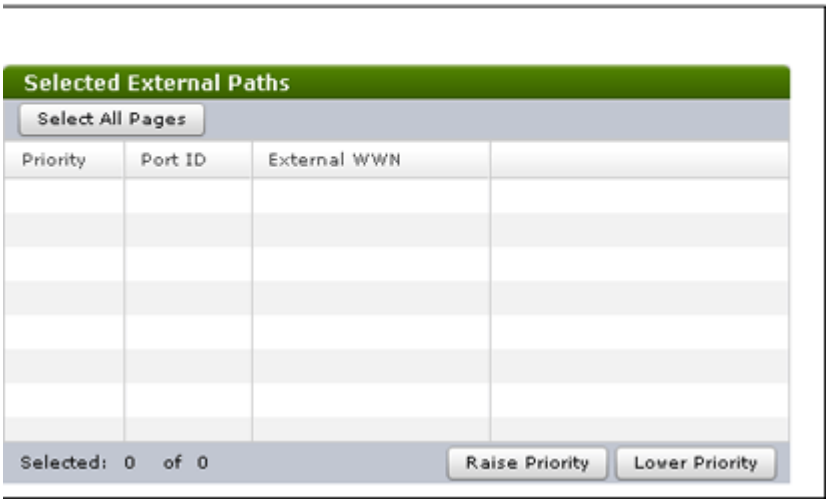
This window is used in the operation, Mapping an external volume on page 4-5.



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. The range can be from 0 to 63,231. 0 is the default.
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	
Port ID	Local system port number.
External WWN	External system port identification number.
Add	When clicked, moves selected paths to the Selected External Paths list.

The following figure displays the **Selected External Paths** pane of the **Create External Path Group** window.



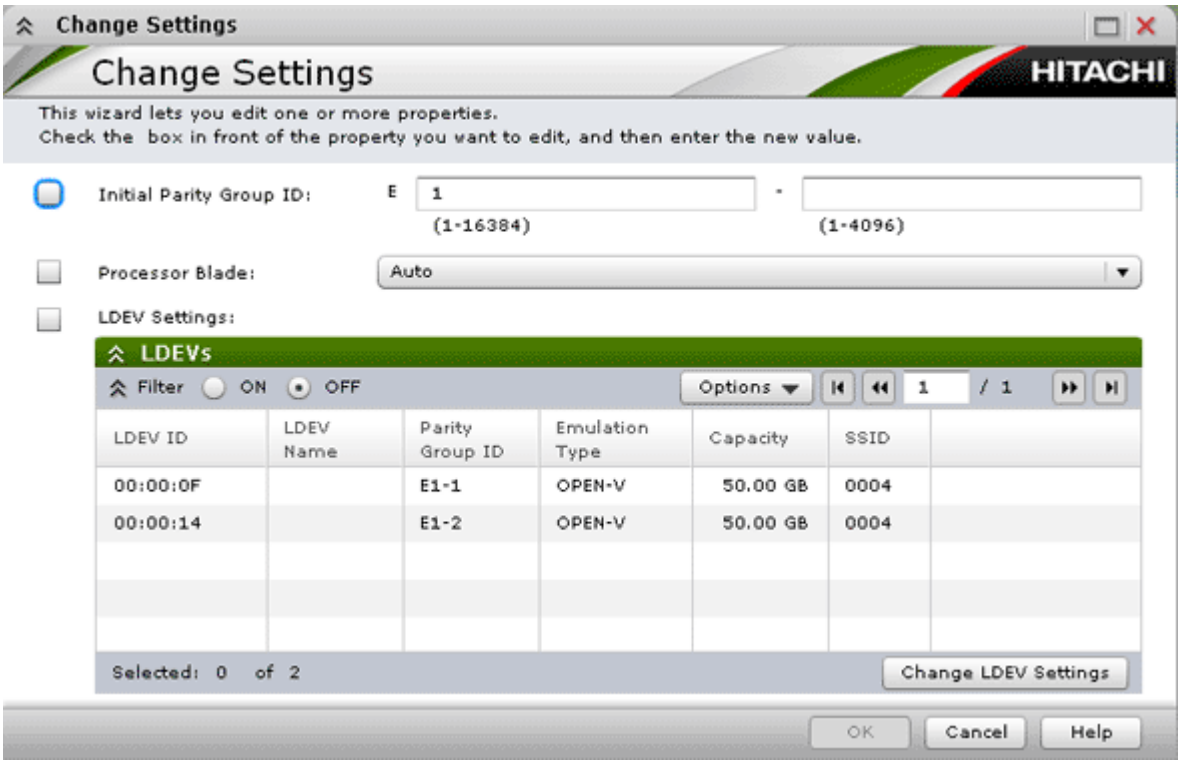
The following table shows the items in the **Selected External Paths** pane and their descriptions.

Item	Description
Selected External Paths (see preceding figure)	
Remove	When clicked, removes the selected path from the Selected External Paths list.
Priority	Priority of external paths.
Port ID	Local system port number.
External WWN	External system port identification number.
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.

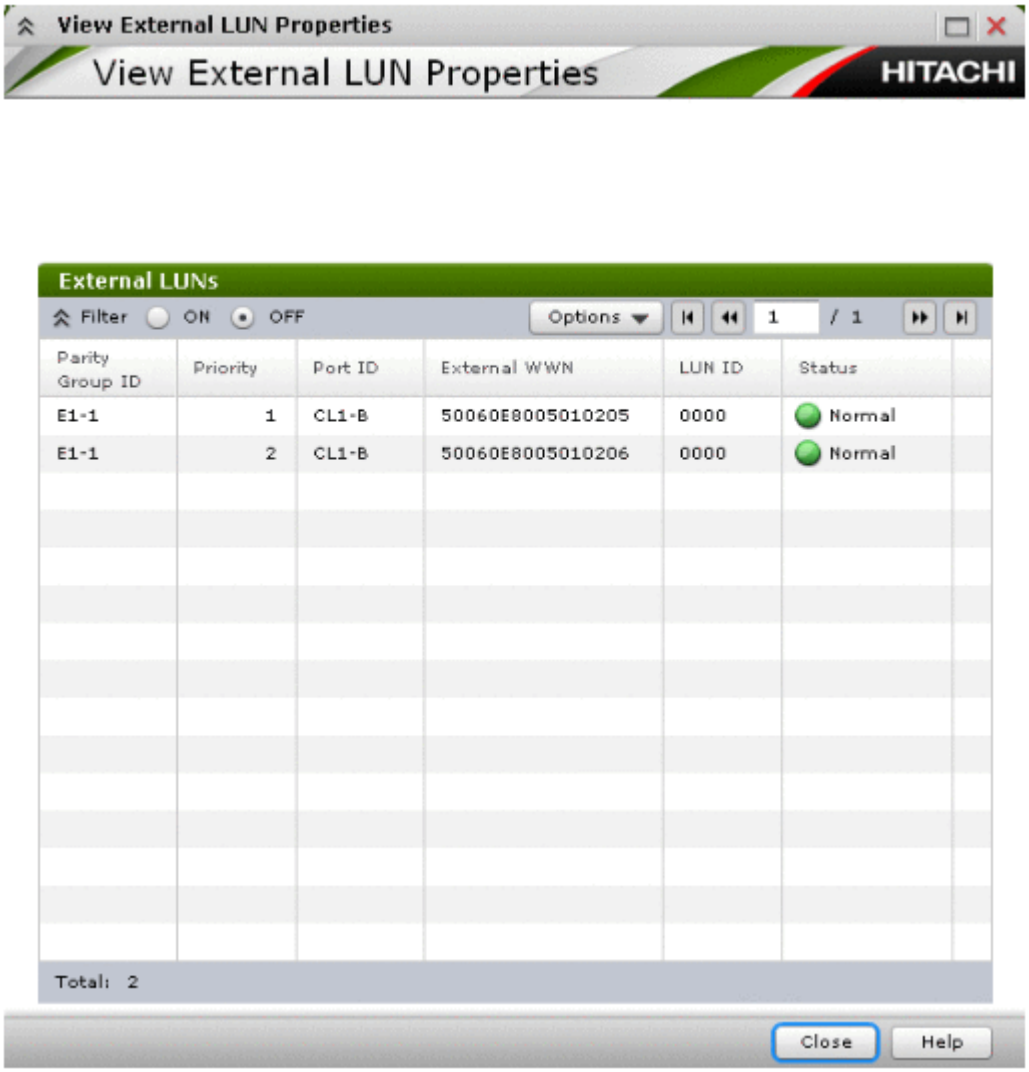
This window is used in the operation, Mapping an external volume on page 4-5.



Item	Description
Initial Parity Group ID	An external volume group number and sequence number. Values range from 1 - 1 to 16384 - 4096. When two or more volumes with different values are selected, blank displays.
Processor Blade	• Range is from MPB0 to MPB7. • Auto (default): Blade is automatically selected by the system, if available. • Blade with lowest number is used when Auto cannot be selected. • When two or more volumes with different values are selected, blank displays.
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	LDEV emulation type.
Capacity	LDEV capacity.
SSID	SSIDs.
Change LDEV Settings	When clicked, opens Change LDEV Settings window.

View External LUN Properties window

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



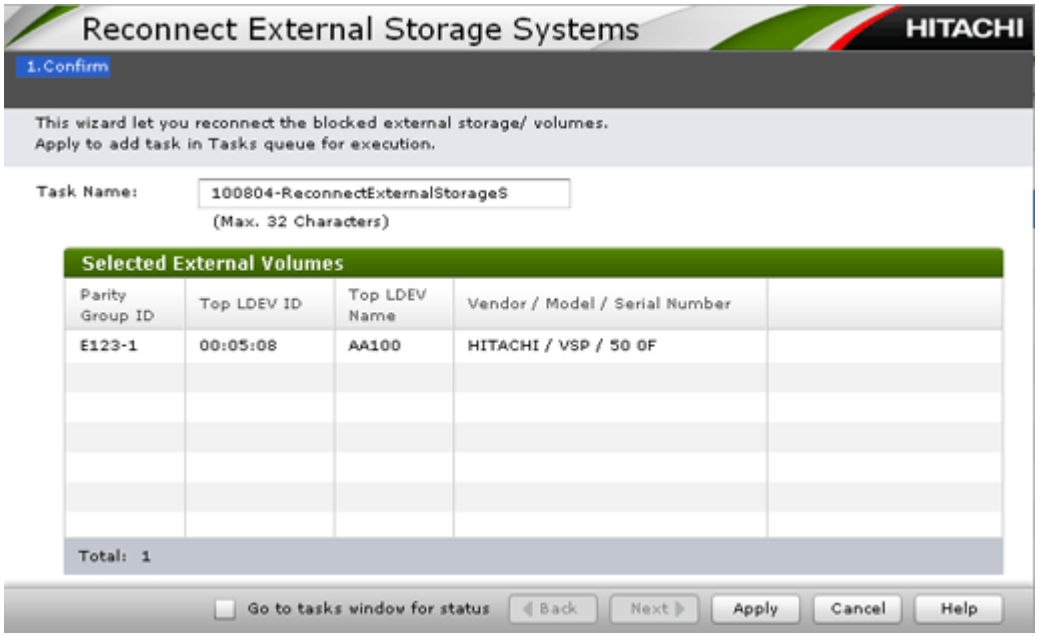
Item	Description
Parity Group ID	Parity group numbers.
Priority	Priority of external paths.
Port ID	Local system port number.
External WWN	External system port identification number.
LUN ID	When the external path is connected to the selected external volume, the LUN ID displays.
Status	Status of external 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.

Item	Description
	• **Normal**: There are no problems, the system is usable. • **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.

Reconnect External Storage Systems window

Use this window to reconnect the external storage system.

See Reconnecting an external storage system, all mapped volumes on page 5-19 for instructions.

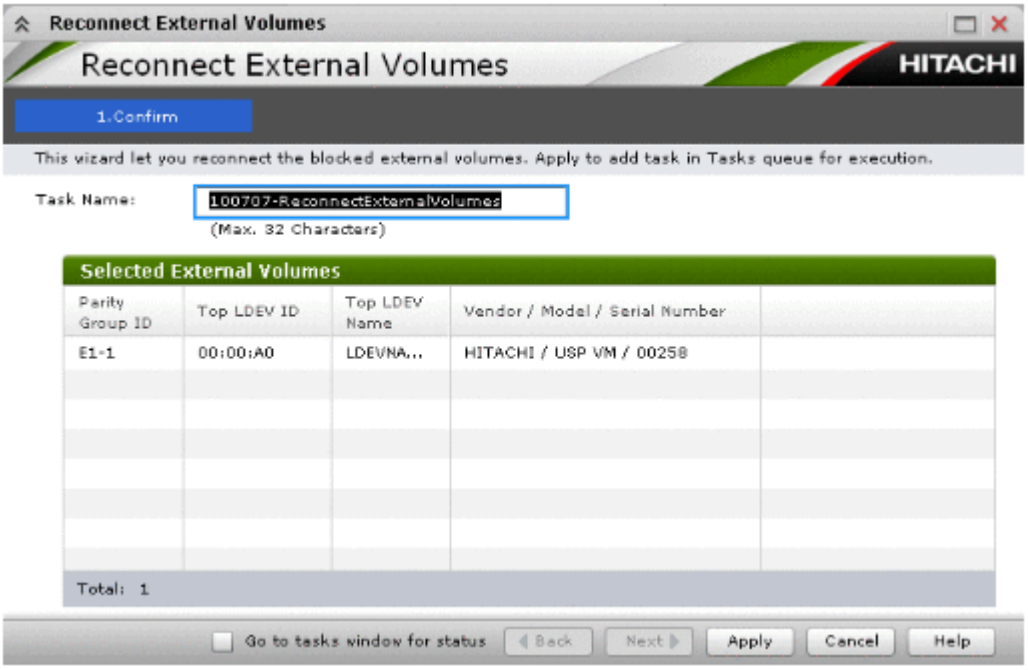


Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external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

Reconnect External Volumes window

Use this window to reconnect the external volume.

See Reconnecting a single mapped volume on page 5-20 for instructions.

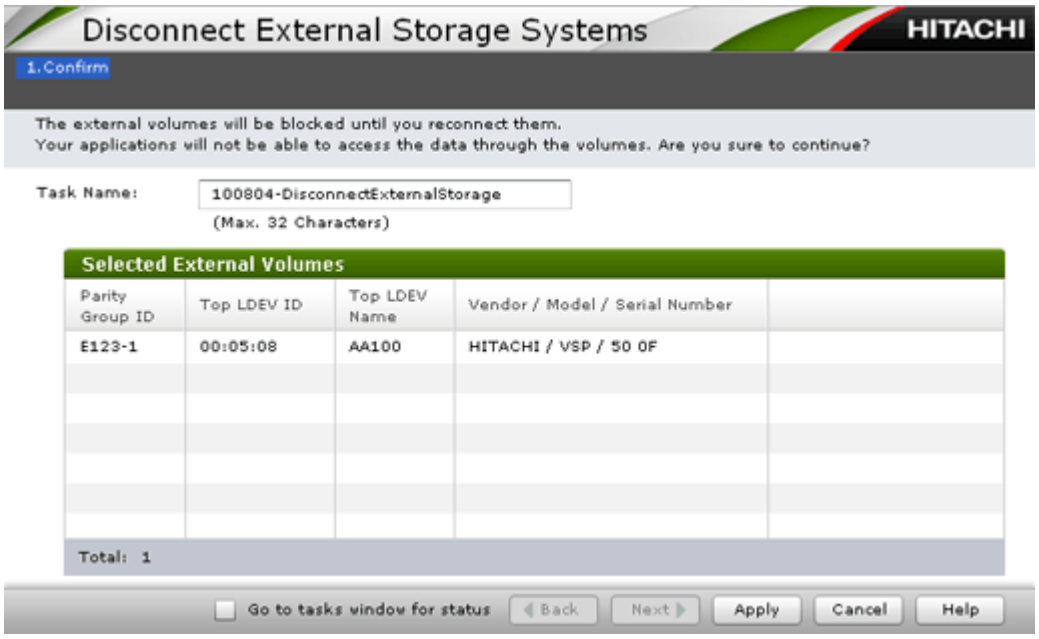


Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external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

Disconnect External Storage Systems window

Use this window to disconnect the storage system

See Disconnecting an external storage system, all mapped volumes on page 5-16 for instructions.

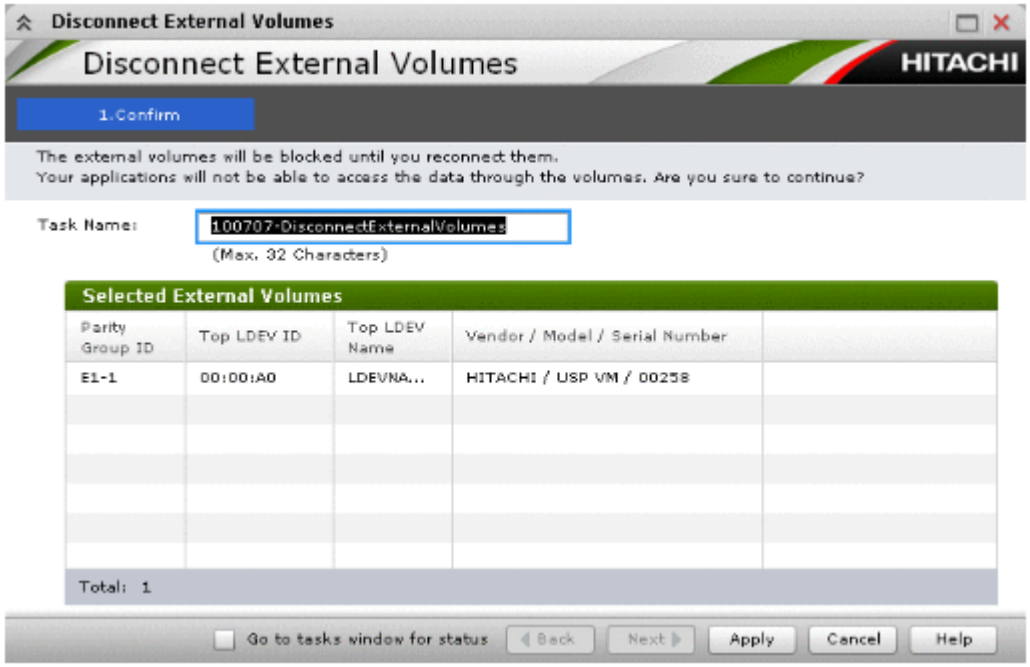


Item	Description
Parity Group ID	Parity group numbers.
Top LDEV ID	External volume's top LDEV ID. Blank displays when an LDEV is not created.
Top LDEV Name	External volume's top LDEV name. Blank displays when an LDEV is not created.
Vendor / Model / Serial Number	Identifying information for the external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

Disconnect External Volumes window

Use this window to disconnect an external volume.

See Disconnecting a single mapped volume on page 5-17 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.

Assign Processor Blade wizard

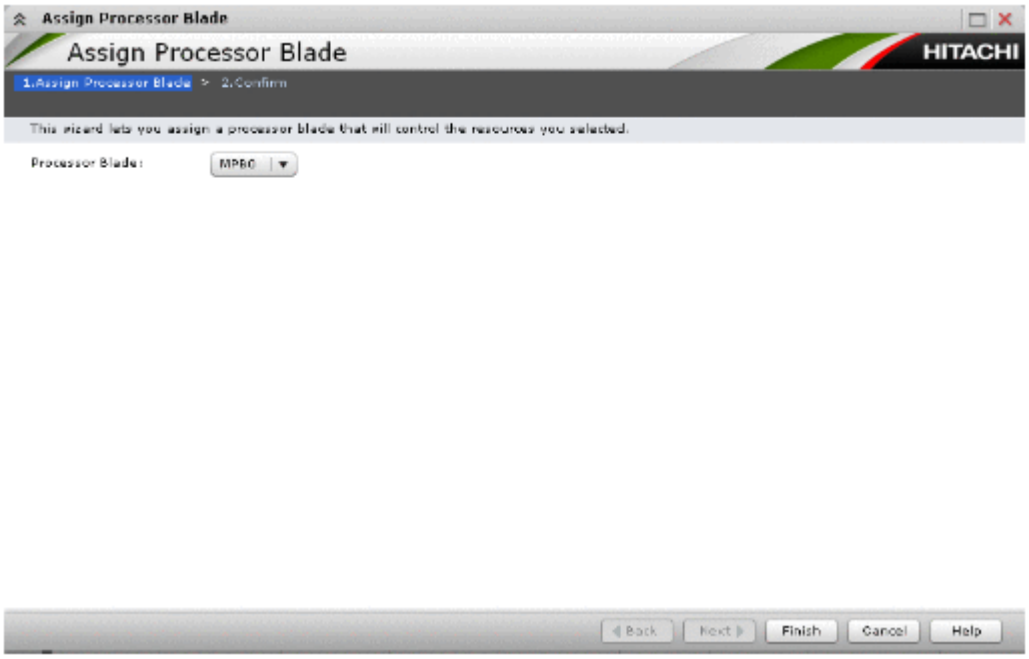
Use this wizard to select a processor blade for the external volume.

See Changing external volume processor blade on page 5-4 for instructions.

The windows in this wizard are:

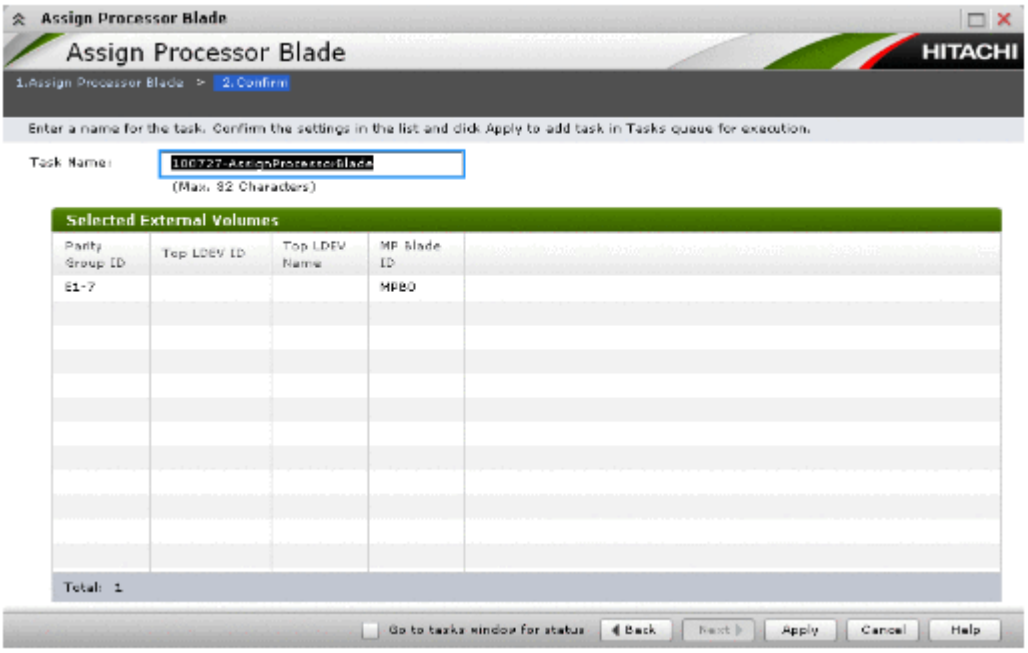
- Assign Processor Blade window on page D-51
- Confirm window on page D-52

Assign Processor Blade window



Item	Description
Processor Blade	Processor blade for the external volume. • Range is from MPB0 to MPB7. • Auto (default): Blade is automatically selected by the system. • Blade with lowest number is used when Auto cannot be selected.

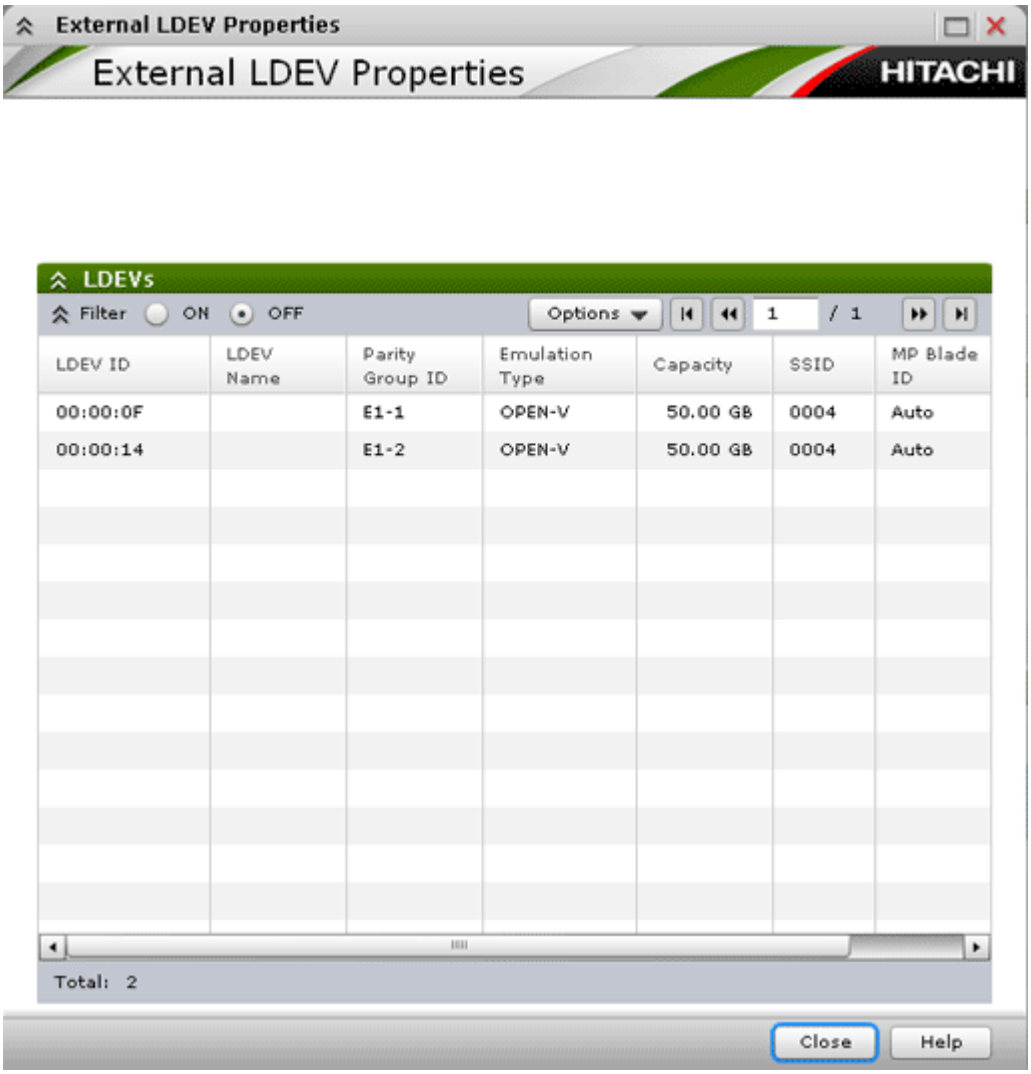
Confirm window



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 ID	Processor blade IDs 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	LDEVs' emulation type.
Capacity	LDEVs' capacity.
SSID	SSIDs.
MP Blade ID	Processor blade IDs allocated to the LDEV.

Glossary

This glossary defines the special terms used in this document. Click the letter links below to navigate.

A

access attribute
The setting on a logical volume (mainframe or open-systems) that determines whether hosts can read and/or write to the volume.

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

AMS
Hitachi Adaptable Modular Storage

APLB
active path load balancing

array
Another name for a storage system.

B

bind mode
In bind mode the Cache Residency Manager extents are used to hold read and write data for specific extents on volumes. 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.

| # | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

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.

CCI
Command Control Interface

CHA
channel adapter. Another name for a front-end director (FED).

channel path
The communication path between a channel and a control unit. A channel path consists of the physical channel path and the logical path.

CLI
command line interface

CLPR
cache logical partition

command device
A dedicated logical volume used only by Command Control Interface to interface with the storage system. Can be shared by several hosts.

copy-on-write
Point-in-time snapshot copy of any data volume within a storage system. Copy-on-Write Snapshot stores only changed data blocks. Therefore, the amount of storage capacity required for each copy is substantially smaller than the source volume.

custom volume (CV)
A customized (variable-sized) volume. The size is defined when Virtual LVI/Virtual LUN is used.

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.

DP
Hitachi Dynamic Provisioning

DP-VOL
Dynamic Provisioning-virtual volume. A virtual volume with no memory space used by Dynamic Provisioning.

dynamic provisioning
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. Dynamic provisioning is also referred to as thin provisioning.

E

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

EXG
external volume group

external port
A fibre-channel port that is configured to be connected to an external storage system for Universal Volume Manager operations.

external volume
A logical volume with data that resides on drives which arephysically located outside the Hitachi RAID storage system.

F

failover
The process of switching operations from the primary path or host to a secondary path or host when the primary path or host fails.

FCIP
fibre-channel internet protocol

H

HDS
Hitachi Data Systems

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

initial copy
A copy operation that copies all data on the primary volume of a copy pair to the secondary volume of the pair. An initial copy operation is performed when a copy pair is created.

internal volume
A logical volume with data that resides on drives which are physically located within the storage system.

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 open-systems 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 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
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. A mainframe volume is called a logical volume image (LVI), and an open-systems volume is called a logical unit. (LU).

LU
logical unit

LUN
logical unit number

LUNM
Hitachi LUN Manager

LUSE
Hitachi LUN Expansion; Hitachi LU Size Expansion

LV
logical volume

LVM
Logical Volume Manager; logical volume management.

M

multi-pathing
A performance and fault-tolerant technique that uses more than one physical connection between the storage system and host system. Also called multipath I/O.

N

NSC
Hitachi TagmaStore® Network Storage Controller

O

OEM
original equipment manufacturer

P

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).

pair status
Indicates the condition of a copy pair. A pair must have a specific status for specific operations. When an operation completes, the status of the pair changes to the new status.

parity group
See RAID group.

path mode
Mode that indicates how a path operates between local and external storage systems. The path modes are multi, single, and APLB.

physical device
A data drive.

pool
A set of volumes that is reserved for storing Thin Image , Copy-on-Write Snapshot data, or Dynamic Provisioning write data.

pool volume (pool-VOL)
A logical volume that is reserved for storing snapshot data for Thin Image, Copy-on-Write Snapshot operations or write data for Dynamic Provisioning.

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 in the primary volume is duplicated synchronously or asynchronously on the secondary volume.
The following Hitachi products use the term P-VOL: Copy-on-Write Snapshot, ShadowImage, ShadowImage for Mainframe, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.

P-VOL
primary volume

R

RAID
redundant array of inexpensive disks

RAID group
A redundant array of inexpensive drives (RAID) 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, which allows the 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
Another name for remote replication.

remote replication
Data replication configuration in which the storage system that contains the original data is at a local site and the storage system that contains the copy of the original data is at a remote site. TrueCopy and Universal Replicator provide remote replication.

S

SATA
serial Advanced Technology Attachment

secondary volume
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": ShadowImage, TrueCopy, Universal Replicator.
See also primary volume (P-VOL).

service information message (SIM)
SIMs are generated by a RAID storage system when it detects an error or service requirement. SIMs are reported to hosts and displayed on Storage Navigator.

snapshot
A point-in-time copy of a data volume in a storage system.

SNMP
simple network management protocol

SOM
system option mode (SOM)

SSD
solid-state drive. Another name for a flash drive.

SSID
storage subsystem ID. SSIDs are used for reporting information from the CU to the mainframe operating system. Each group of 64 or 256 volumes requires one SSID, so there are one or four SSIDs per CU image. The user-specified SSIDs are assigned during storage system installation and must be unique to all connected host operating environments.

S-VOL
secondary volume

system option mode (SOM)
Additional operational parameters for the Unified Storage VM storage systems that enable the storage system to be tailored to unique customer operating requirements. SOMs are set on the service processor.

T

TagmaStore USP
Hitachi TagmaStore® Universal Storage Platform

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

TC
Hitachi TrueCopy®

U

UR
Hitachi Universal Replicator

URz
Hitachi Universal Replicator for Mainframe

USP VM
Hitachi Universal Storage Platform VM

USP V/VM
Hitachi Universal Storage Platform V/VM

UVM
Hitachi Universal Volume Manager

V

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 LUN volume
A custom-size volume with a size defined when Virtual LUN is used. Also called a custom volume (CV).

| # | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z |

virtual volume
A virtual volume in a storage system that has no physical storage space. A V-VOL used for Dynamic Provisioning is called a DP-VOL.

VLL
Virtual LUN

volume
Another name for a logical volume.

VSP
Hitachi Virtual Storage Platform

V-VOL
virtual volume

W

WMS
Hitachi Workgroup Modular Storage

WWN
worldwide name

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MK-90RD7033-14