

Hitachi Virtual Storage Platform 5000 series

Hitachi Virtual Storage Platform E990

**Hitachi Virtual Storage Platform G/F350, G/
F370, G/F700, G/F900**

SVOS RF 9.4

Universal Volume Manager User Guide

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Preface

This guide provides information and instructions for planning, setting up, maintaining, and troubleshooting external volumes connected to the Hitachi Virtual Storage Platform 5000 series, Hitachi Virtual Storage Platform E990, and Hitachi Virtual Storage Platform G/F350, G/F370, G/F700, G/F900 storage systems.

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

Intended audience

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

Readers of this document should be familiar with the following:

- Data processing, RAID storage systems, and their basic functions.
- The Hardware Guide for your storage system model.
- The storage systems connected to your Hitachi storage systems as external storage.
- The Hitachi Device Manager - Storage Navigator software and the *System Administrator Guide*.

Product version

This document revision applies to the following product versions:

- VSP 5000 series: 90-04-04 or later
- VSP E990: 93-02-03 or later
- VSP G/F350, G/F370, G/F700, G/F900: 88-06-02 or later
- SVOS RF 9.4 or later

Release notes

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

Changes in this revision

- Added external storage support (HPE Primera A630, A650, A670, C630, C650, C670).

Document conventions

This document uses the following storage system terminology conventions:





Convention	Description
VSP 5000 series	Refers to the following storage systems: <ul style="list-style-type: none"> ▪ Hitachi Virtual Storage Platform 5100 ▪ Hitachi Virtual Storage Platform 5100H ▪ Hitachi Virtual Storage Platform 5500 ▪ Hitachi Virtual Storage Platform 5500H
VSP E series	Refers to the following storage systems: <ul style="list-style-type: none"> ▪ Hitachi Virtual Storage Platform E990

This document uses the following typographic conventions:

Convention	Description
Bold	<ul style="list-style-type: none"> ▪ Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click OK. ▪ Indicates emphasized words in list items.
<i>Italic</i>	<ul style="list-style-type: none"> ▪ Indicates a document title or emphasized words in text. ▪ Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: <code>pairdisplay -g group</code> <p>(For exceptions to this convention for variables, see the entry for angle brackets.)</p>
Monospace	Indicates text that is displayed on screen or entered by the user. Example: <code>pairdisplay -g oradb</code>

Convention	Description
< > angle brackets	<p>Indicates variables in the following scenarios:</p> <ul style="list-style-type: none"> Variables are not clearly separated from the surrounding text or from other variables. Example: <pre>Status-<report-name><file-version>.csv</pre> Variables in headings.
[] square brackets	Indicates optional values. Example: [a b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a b } indicates that you must choose either a or b.
vertical bar	<p>Indicates that you have a choice between two or more options or arguments. Examples:</p> <p>[a b] indicates that you can choose a, b, or nothing.</p> <p>{ a b } indicates that you must choose either a or b.</p>

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

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

Conventions for storage capacity values

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

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

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

Logical capacity unit	Value
1 block	512 bytes
1 cylinder	Mainframe: 870 KB Open-systems: <ul style="list-style-type: none"> ▪ OPEN-V: 960 KB ▪ Others: 720 KB
1 KB	1,024 (2 ¹⁰) bytes
1 MB	1,024 KB or 1,024 ² bytes
1 GB	1,024 MB or 1,024 ³ bytes
1 TB	1,024 GB or 1,024 ⁴ bytes
1 PB	1,024 TB or 1,024 ⁵ bytes
1 EB	1,024 PB or 1,024 ⁶ bytes

Accessing product documentation

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Thank you!

Chapter 1: Overview of external storage

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

Features

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

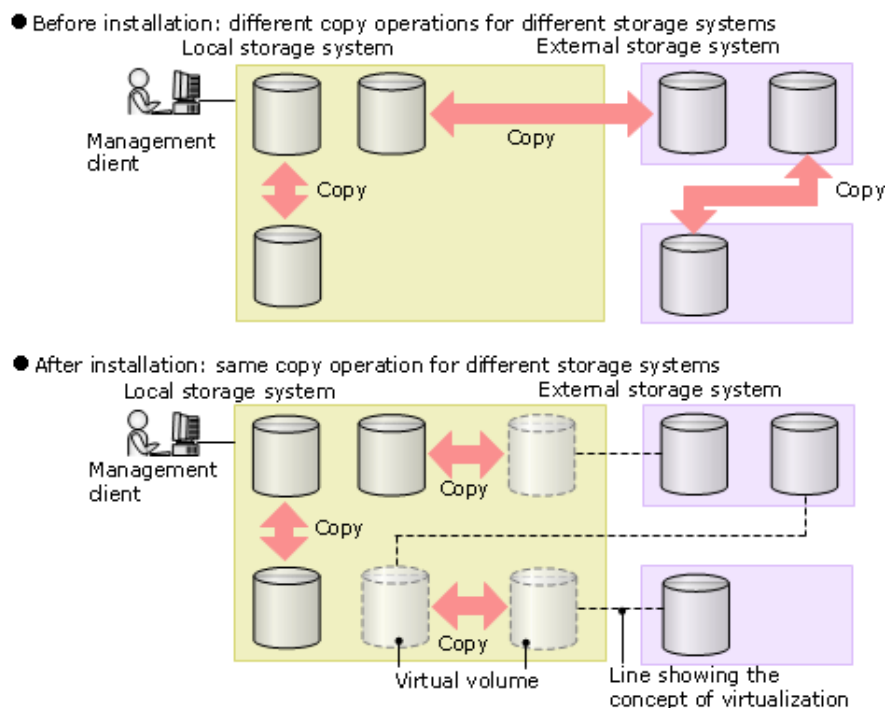
With Universal Volume Manager, the administrator configures the connection from the host to your storage system, and then uses mapped volumes in an external storage system in the same way as volumes in the local storage system.

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

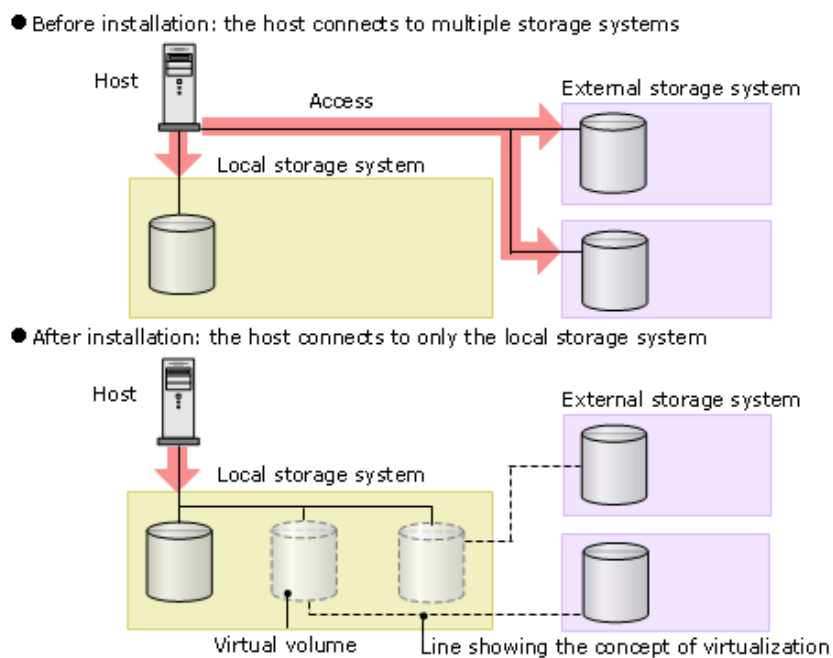
For example, you can use a replication program to perform copy operations between the local storage system and external systems, including the following:

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

This image describes the copy operations before and after installation of Universal Volume Manager.



This image describes the copy operation between the host and multiple storage systems.



System components

Universal Volume Manager consists of several components, including:

- A *local storage system*
 - VSP 5000 series
 - VSP E990
 - VSP G/F350, G/F370, G/F700, G/F900
- One or more external storage systems

The local storage system can connect to various external storage systems. Hosts recognize the volumes in these external storage systems as internal volumes of the local storage system.

- External volumes

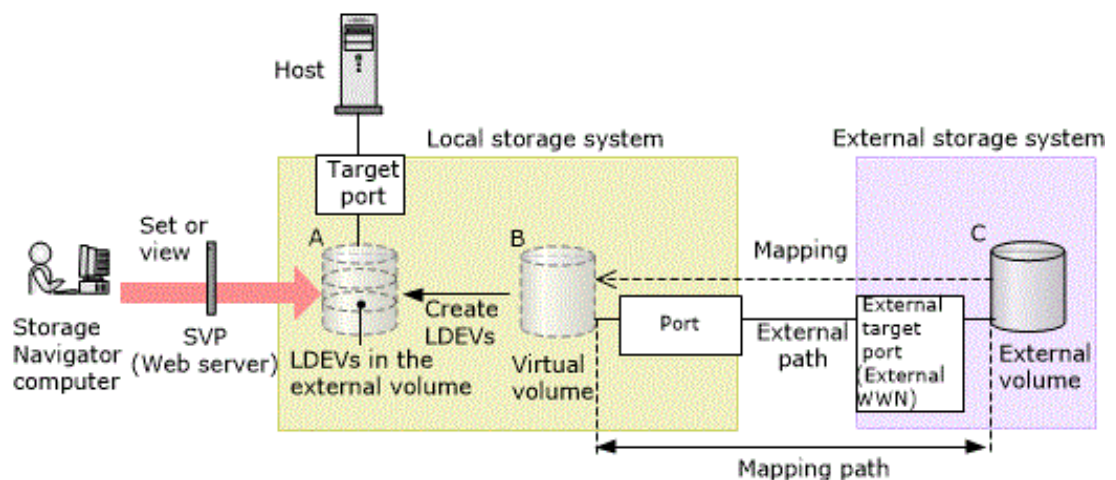
A volume in an external storage system that is mapped to the local storage system is referred to as a *mapped external volume*. After an external volume is mapped, it is used as an *internal volume*, which is a virtual representation of the external volume.

- Internal volumes

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

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

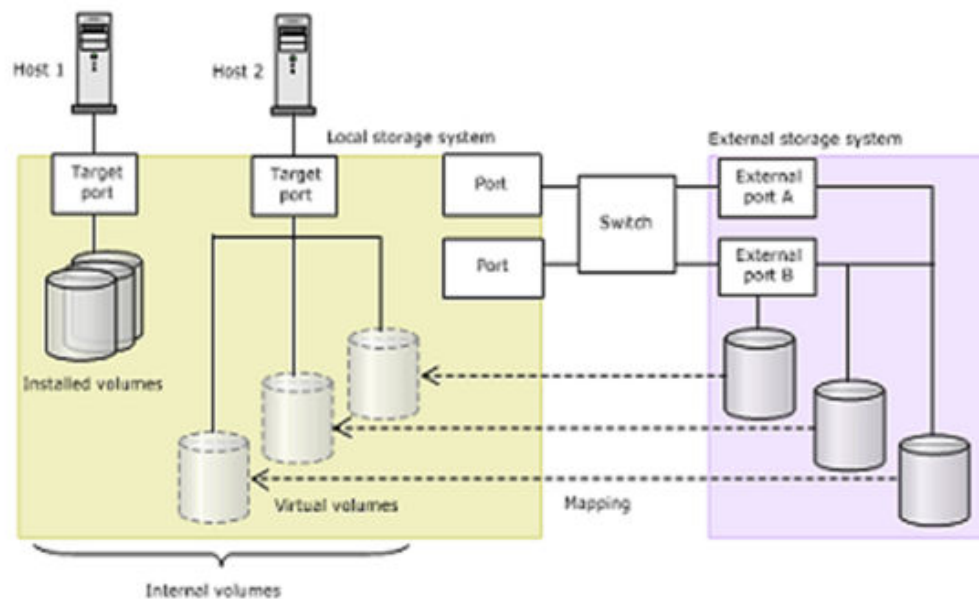
This figure provides an overview of these components:



How Universal Volume Manager works

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

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



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



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

You can create LDEVs in two different ways:

- During mapping, by using Universal Volume Manager.
- After mapping. In this case, the internal volume (the internal volume to which an external volume is mapped) is the virtual device (VDEV), and the LDEV in the external volume is the LDEV.

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

Chapter 2: Requirements and planning

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

Planning workflow

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

Follow this general order to prepare for Universal Volume Manager:

1. Review [System requirements \(on page 20\)](#).
2. Verify that the external storage system whose volumes you want to map is supported by Universal Volume Manager. See Appendix A, [Supported external storage systems \(on page 113\)](#).
3. Verify that the functionality you want is supported for mapped external volumes. See [Supported software for external volumes \(on page 52\)](#).
4. In the external storage system, select a port and set parameters, as necessary. See [Setting up ports on the external system \(on page 59\)](#).
5. In the local storage system, identify the port to be connected to the external storage system and make sure it is specified as an external port. See [Setting port attributes on the local system \(VSP 5000 series\) \(on page 57\)](#).
6. Plan data paths from the local storage system to the external storage system. See [External paths, path modes, and configurations \(on page 25\)](#).
7. In the external storage system, prepare volumes for use in the local storage system. For example, if you plan to use an external volume for replication, verify that it meets the requirements for replication software.

For instructions and additional information for VSP E990 and VSP G350, G370, G700, G900, see [External volume requirements \(on page 22\)](#).

For instructions and additional information for VSP 5000 series, see:

- [Mainframe volumes \(on page 42\)](#)
 - [Open-systems volumes \(on page 43\)](#)
 - [Capacity requirements for volumes \(on page 43\)](#)
8. In the local storage system, configure the external volume groups to which you will assign the external volumes during the mapping operation. See [External volume groups \(on page 25\)](#).

9. Optionally, change the default values of the mapping settings before performing the operation. See [External volume policy settings and functions \(on page 67\)](#).

System requirements

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

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

Item	Description
External storage systems	For details about the supported external storage systems, see Supported external storage systems (on page 113) .
UVM software license	Required. For installation and operations instructions, see the <i>System Administrator Guide</i> for your storage system.
RAID level	The RAID level for all external volumes is RAID 1. RAID 1 is displayed or used in the following cases: <ul style="list-style-type: none"> Internal processing of the local storage system Information about the external storage system that is reported to a host <p>Note: The local storage system uses RAID 1 cache management for external volumes. However, the external storage controller manages the physical RAID method. In addition, a hyphen is displayed instead of the RAID level in Device Manager - Storage Navigator windows.</p>
Maximum number of ports in external storage systems that can be mapped	<ul style="list-style-type: none"> Fibre Channel: 1,024 for each port iSCSI: 512 for each port (127 or less is recommended)
Maximum number of external volumes that can be mapped	<ul style="list-style-type: none"> VSP 5000 series: 63,232 VSP E990: 65,279 VSP G350, VSP F350: 16,383 VSP G370, VSP F370: 32,767 VSP G700, VSP F700: 49,151 VSP G900, VSP F900: 65,279 For Thin Image and Dynamic Provisioning, the total number of external and virtual volumes must not exceed the maximum number for each storage system model.
Maximum number of external volume groups	16,384

Item	Description
Maximum number of external volumes registered in each external volume group	4,096
Number of mapping paths	<ul style="list-style-type: none"> ▪ One required ▪ Two or more recommended ▪ Maximum = 8 per external volume
Minimum capacity of an internal volume (VSP 5000 series)	The minimum capacity of an internal volume depends on the emulation type. See LDEV capacities per emulation type (on page 45) .
Maximum capacity of an internal volume (VSP E990 and VSP G350, G370, G700, G900)	<p>If mapping an external volume of up to 4TB in an external storage system, the internal volume will be defined as 1 LDEV (LU), which is the same as the external volume.</p> <p>You cannot access data that exceeds the maximum capacity of the external volume.</p>
Maximum capacity of an external volume	<p>256 TB (549,755,813,888 blocks) per external volume</p> <p>You can create a volume larger than 256 TB, but can only use 256 TB as a mapped external volume. Data in the additional area cannot be accessed.</p>
Minimum capacity of an external volume	<ul style="list-style-type: none"> ▪ When the attribute of the data direct map is enabled, the capacity is 16,777,216 blocks (about 8,192 MB) for each external volume. ▪ When the attribute of the data direct map is disabled, the capacity is 96,000 blocks (about 47 MB) for each external volume.
Maximum number of external volumes that can be mapped per port	If one external port is connected to several target ports through switches, the maximum number of LUs defined for the connected target ports is 4,096.
Maximum LDEV capacity which can be created from an external volume	<ul style="list-style-type: none"> ▪ If creating an LDEV from an external volume for which data direct mapping is enabled: 256 TB (549,755,813,888 blocks) per external volume ▪ If creating an LDEV from an external volume for which data direct mapping is not enabled: 4 TB (8,589,934,592 blocks) per external volume <p>For details about mapping using virtual volumes for which data direct mapping is enabled, see the <i>Provisioning Guide</i>.</p>

Planning considerations for external storage systems

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

Note the following regarding performance:

- The performance and status of the external system affects the performance of the mapped external volume. A high number of processes running on the external system slows the processing speed of read/write requests and might cause a missing interrupt handler.
- If the host connected to the local storage system issues several I/O requests to be processed by the external storage system, the requests from the host might time out.
- When you run commands from the local storage system that result in more I/O requests being processed than the external storage system can handle, the commands might time out and an error might occur.
- When there is a process running between an external volume and the host, it is important that the Blocked Path Monitoring time of the external volume is the same as or shorter than the timeout period of the process that is running on the host. If the Blocked Path Monitoring time is longer than the timeout period of the process running on the host, the process on the host might time out if the power supply is interrupted or if an error occurs in the external storage system.

External volume requirements

External volumes must meet the Universal Volume Manager requirements.

When planning external volumes, note the following:

- You can use existing data in an external volume after it is mapped to the local storage system, with these restrictions:
 - (VSP 5000 series) You must set the emulation type to OPEN-V when you map the volume.
 - To perform host I/O operations, you must set an LU path from the target port to the mapped volume.
 - An external volume cannot be mapped to a DP Pool that has DP-VOLs with the capacity saving function enabled. Capacity saving features are not supported for external storage.
 - You cannot enable the capacity saving function on a DP-VOL from a DP Pool that has pool volumes from external storage.
- The maximum or minimum available capacity of an external volume depends on the emulation type you specify when mapping the volume.

(VSP 5000 series) For more information, see [Capacity requirements for volumes \(on page 43\)](#).

- You cannot access data stored in an external volume that exceeds the allowed maximum capacity. See the Maximum capacity of an external volume row in [System requirements \(on page 20\)](#).
- Make sure that a mapped external volume is accessed only from the local storage system.
 - Make sure that a mapped external volume is not accessed from a host that is connected to the external storage system.
 - Make sure that a mapped external volume is not manipulated by a copy function or any other functions of the external storage system.
 - Accessing a mapped external volume from the external storage system requires that the volume mapping be disconnected first.
- External volumes that are reserved by a host cannot be mapped as internal volumes. To map these volumes, cancel the reserve settings, remove host access to the volumes, and then perform the mapping operation.
- Do not map multi-platform volumes of external storage systems as internal volumes.
- If an external storage system that uses control unit path ownership is connected to the local storage system, configure the external path to the primary controller in the external storage system as the primary path.

Ownership is the exclusive right to control volumes. A controller that has ownership is called a *primary controller*. If the external path is connected to a controller that does not have ownership, and the path is configured as primary path, the ownership will be transferred, which might affect performance.

- A management LU cannot be used as an external volume.

A management LU receives commands from an application, because it controls or manages the application, and stores control information from the application. An example of a management LU is a Universal Xport LU. (A command device is not a management LU.)

Before performing the external volume mapping operation, perform one of the following operations on the external storage system:

- Delete the management LU from the port to be connected to the local storage system.
- Make sure that at least one LU is used for data storage and has a smaller LUN (LU number) than the LUN of the management LU. Also make sure that the data storage LU is set to the port connected to the local storage system.
- Use the security function and configure the access attribute of the management LU to prohibit read and write operations.

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

The following requirements apply to only to VSP E990 and VSP G350, G370, G700, G900:

- You cannot map an external volume whose capacity is smaller than the minimum capacity required for internal volumes.
- Before the settings of an external storage system are changed, mapping to volumes on the local storage system must be removed by selecting Disconnect External Volumes. After the external storage system settings are changed, volumes can be remapped. Unless external volumes are remapped, they cannot be used on the local storage system.
- If an LU path is configured on an internal volume mapped to an external volume, the external volume mapping cannot be deleted.
- Mapping cannot be deleted for a volume used in a pair for the following programs:
 - TrueCopy
 - Universal Replicator
 - ShadowImage
 - Thin Image
 - Global-active device
- Mapping cannot be deleted for an external volume configured as a pool volume.
- Mapping cannot be deleted for an external volume configured as a quorum disk.

Cache use and external storage performance

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

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

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

- If Cache Mode is enabled, the write-complete response is sent when the write data is in the cache of the local storage system. This can adversely impact overall performance of the local storage system if the I/O rate exceeds the performance capabilities of the external system. If you enable Cache Mode, you must use the same formula for sizing cache in both the local and external storage systems.
- If Cache Mode is disabled, the write-complete response is sent when the write data is accepted by the external storage system. This is the safest action to take and is recommended when there is a possibility that the I/O rate will exceed the short term capabilities of the external storage.

Cache Mode effects with other Hitachi software

Note the following additional effects regarding the Cache Mode setting:

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

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

- (VSP 5000 series) When you set emulation type for a mainframe system, note the following:
 - Data written by a host using a **Format Write** command is asynchronously destaged to the external storage system regardless of the Cache Mode setting.
 - Data written by a host using other Write commands are destaged to the external storage system as configured in the Cache Mode setting.
- (VSP E990 and VSP G350, G370, G700, G900) The external volumes in a Dynamic Provisioning pool must all use the same Cache Mode setting, either Enabled or Disabled.
- (VSP E990 and VSP G350, G370, G700, G900) Dynamic Tiering pool volumes require Cache Mode to be enabled.

External volume groups

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

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

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

You assign external volume group numbers during the mapping procedure.

External paths, path modes, and configurations

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

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

- [Setting port attributes on the local system \(VSP 5000 series\) \(on page 57\)](#)
- [Setting up ports on the external system \(on page 59\)](#)

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.

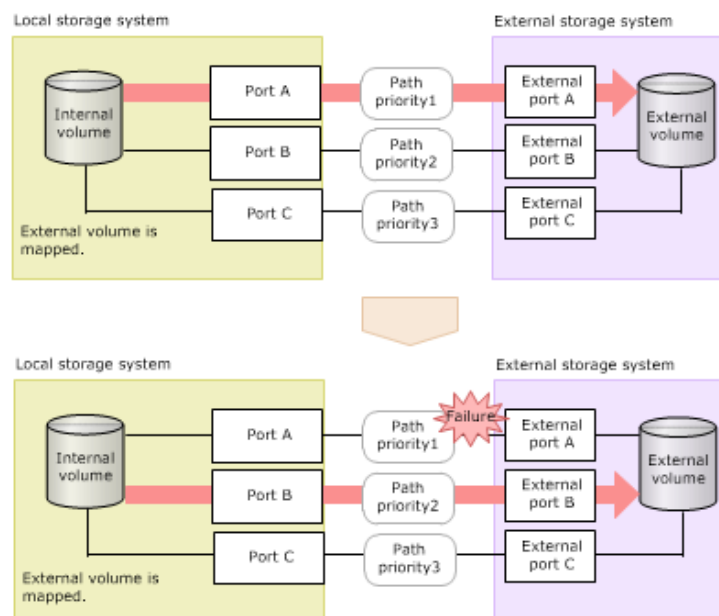
Because workload can spike and cable or switch failures can occur, it is best practice to set up redundant external paths. A maximum of eight paths can be used per mapped external volume. Multiple paths (that is, *redundancy*) allows you to perform I/O operations with external volumes regardless of workload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

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

Single path mode

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

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

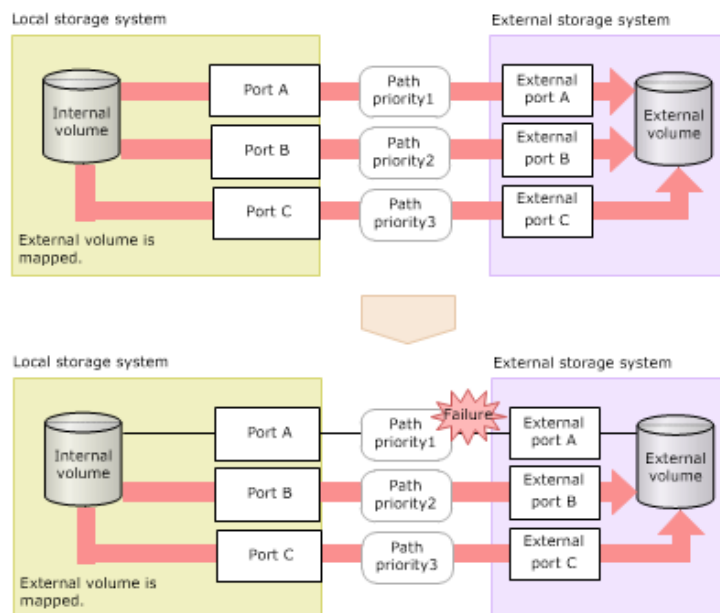


When you restore a path with higher priority than the currently-used path, I/O is switched to the restored path.

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.

This figure illustrates how failure is handled with redundant paths in Multi path mode.



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

Supported external system path mode for external volumes

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

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

Load Balance Mode

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

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

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



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

The following table shows the path mode for many of the supported external storage systems. The table also shows the abbreviation used in Device Manager - Storage Navigator. If your system is not shown below, refer to <https://knowledge.hitachivantara.com/Documents>.

For the specific settings for each external storage system, see [Supported external storage systems \(on page 113\)](#). If there is no description about the settings, the port of the external storage system that connects to the local storage system must be set as a target port. The target port connects to the Windows hosts. For detailed information, please contact the third party vendor.

External storage system	Reference
Hitachi Virtual Storage Platform E990	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP E series
Hitachi Virtual Storage Platform G350, G370, G700, G900 Hitachi Virtual Storage Platform F350, F370, F700, F900	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP Gx00
Hitachi Virtual Storage Platform G400, G600, G800 Hitachi Virtual Storage Platform F400, F600, F800	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP Gx00
Hitachi Virtual Storage Platform 5000 series	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP 5000 series
Hitachi Virtual Storage Platform G1000, G1500, Hitachi Virtual Storage Platform F1500	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP G1000
Hitachi Unified Storage VM	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as HUS VM

External storage system	Reference
Hitachi Virtual Storage Platform	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as VSP
Hitachi Universal Storage Platform V	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as USP V
Hitachi Universal Storage Platform VM	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as USP VM
Hitachi TagmaStore® Universal Storage Platform	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as USP
Hitachi TagmaStore Network Storage Controller	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as NSC
Hitachi Unified Storage	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as HUS
Hitachi Adaptable Modular Storage	<ul style="list-style-type: none"> ▪ Path Mode: <ul style="list-style-type: none"> • Multi: AMS2500, AMS2300, AMS2100, and AMS2010 • Single: AMS1000, AMS500, and AMS200 ▪ Displayed as AMS
Hitachi Workgroup Modular Storage	<ul style="list-style-type: none"> ▪ Path Mode: Single ▪ Displayed as WMS
Hitachi Simple Modular Storage	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as SMS
Hitachi Lightning 9900 V Series	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 9970V or 9980V
Hitachi Lightning 9900 Series	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as: <ul style="list-style-type: none"> • Lightning 9960: 0400 • Lightning 9910: 0401
Hitachi Thunder 9500V series	<ul style="list-style-type: none"> ▪ Path Mode: Single ▪ Displayed as 9500V

External storage system	Reference
Hitachi SANRISE Universal Storage Platform	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as USP
Hitachi SANRISE Network Storage Controller	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as NSC
Hitachi SANRISE 9900V series	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 9970V or 9980V
Hitachi SANRISE 9500V series	<ul style="list-style-type: none"> ▪ Path Mode: Single ▪ Displayed as 9500V
Hitachi SANRISE 2000 series	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as: <ul style="list-style-type: none"> • SANRISE 2800: 0400 • SANRISE 2200: 0401
HP Virtual Storage Platform VX7	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as XP7
HP Virtual Storage Platform VP9500	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as P9500
A/H-6593	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 300
HP H24000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 24000
HP H20000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 20000
HP SANRISE H12000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 12000
HP SANRISE H10000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 10000
HP SANRISE H1024/ H128	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 1024 or 128

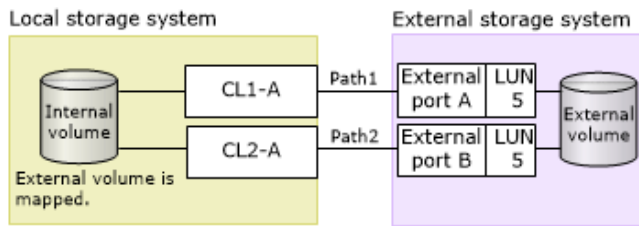
External storage system	Reference
HP SANRISE H512/H48	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 512 or 48
HP SANRISE H256	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 256
HP XP8	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as XP8
HP XP7	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as XP7
HP StorageWorks P9500	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as P9500
HP XP24000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 24000
HP XP20000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 20000
HP XP12000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 12000
HP XP10000	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 10000
HP XP1024/XP128	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 1024 or 128
HP XP512/XP48	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 512 or 48
HP XP256	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as 256
HP StorageWorks Enterprise Virtual Array 3000/4000/5000/6000/8000	<ul style="list-style-type: none"> ▪ Path Mode: Single ▪ Displayed as EVA
SVS200	<ul style="list-style-type: none"> ▪ Path Mode: Multi ▪ Displayed as SVS200

External path configurations - direct and switch

Recommendations for setting up direct and switch external path configurations.

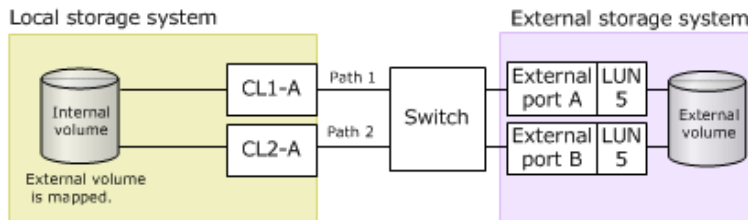
Direct connection

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

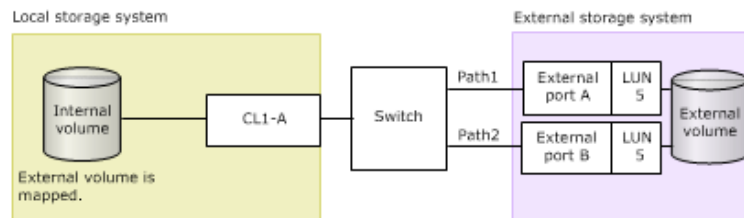


Switch connection

This 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.



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



Mapping policy

The mapping policy is a list of settings that are required for mapping external volumes. Setting mapping policies before you perform a mapping operation is the easiest way to configure your mapping settings. Policies are already available, and you can change the default value. See [External volume policy settings and functions \(on page 67\)](#) to review the settings and edit them if desired.

Considerations for external volume attributes

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

Considerations for external paths

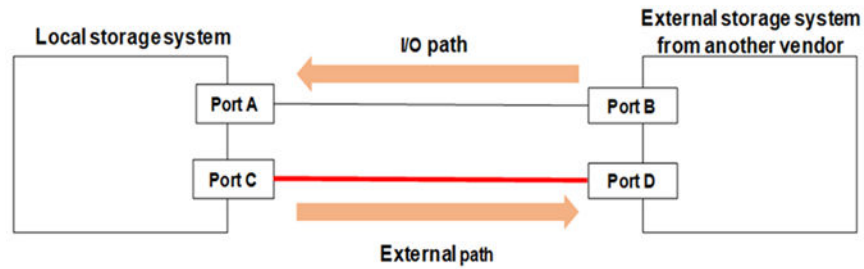
When connecting a local storage system and an external storage system using Fibre Channel, the following routes between a port on the local storage system and a port on the external storage system cannot be used as an external path:

- A route being used for an I/O path for which a port on another vendor's external storage system is defined as a source port and a port on the local storage system as a target port. (I/O path indicates a route that issues I/Os to the local storage system from the external storage system, such as another vendor's storage virtualization function, similar to Universal Volume Manager).
- A route that uses the local storage system port in the I/O path as a source port.

If you use a route that cannot be used as an external path, the connection from the external storage system to the local storage system might be disconnected. Use the routes that can be used as external paths.

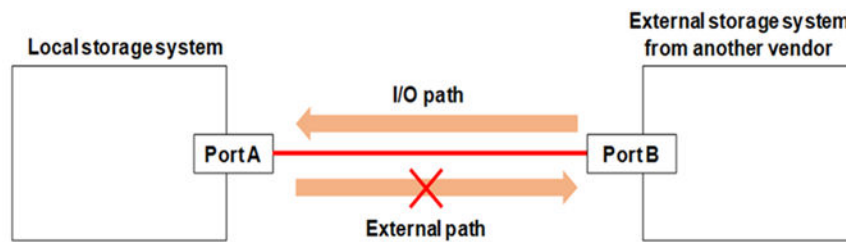
Routes that can be used as external paths

A route that uses the local storage system port in the I/O path as a source port.

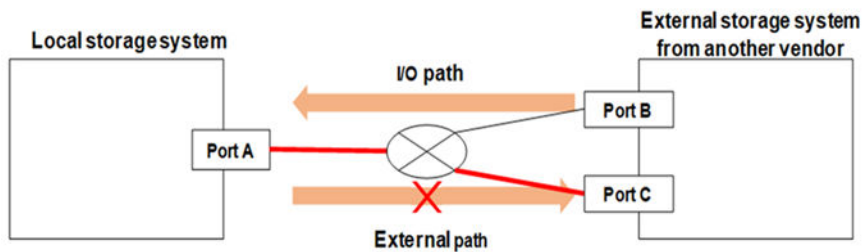


Routes that cannot be used as an external path

A route starting from Port A and ending with Port B cannot be used as an external path. If the route starting from Port A and ending with Port B is used as an external path, the I/O path starting from Port B and ending with Port A might be disconnected.



A route starting from Port A and ending with Port C cannot be used as an external path. If the route starting from Port A and ending with Port C is used as an external path, the I/O path starting from Port B and ending with Port A might be disconnected.



Considerations for using iSCSI

Before configuring a system that uses iSCSI, review the following considerations. For details about iSCSI, see the *Provisioning Guide*. For other considerations when using Universal Volume Manager, see [Planning considerations for external storage systems \(on page 22\)](#).

Considerations for external paths

- (VSP 5000 series) The external volumes that use iSCSI for the external paths cannot be accessed from a mainframe operating system. (The emulation types such as 3390-x cannot be set for the external volumes.)
- When adding an external path to a path group, make sure that it uses the same protocol as the other paths in the group. External paths for Fibre Channel and iSCSI cannot exist in the same path group.
- If iSCSI is used for an external path, set Blocked Path Monitoring to at least 40 seconds (default). If you set a lower value, the external path might be blocked due to network delays, including the spanning tree functionality of a switch.

In addition, if external volumes are accessed from a host, set the command timeout period of the host to a value greater than the value of Blocked Path Monitoring. Otherwise, commands from the host might time out when the external storage system is turned off or a failure occurs.

- After adding an iSCSI path, execute the login test for the iSCSI target to check if you can log in. If there is an iSCSI path from which you cannot log in to the iSCSI target, attempts to connect to the path are made, and the load to storage systems or networks may become high. If this happens, external volumes might not be recognized.
- For an iSCSI path from which you cannot log in to the target, edit the iSCSI target or check settings of the external storage system to make sure you can log in. Alternatively, remove the iSCSI path.

Considerations for data paths

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

Considerations for ports

- When you change parameter settings for an iSCSI port, the iSCSI connection is temporarily disconnected, and then reconnected. Therefore, you should change parameter settings when the I/O load is low to reduce impact on the system.
- When you change settings for an iSCSI port connected to a host, log information might be output to the host. However, this does not indicate a failure. In a system that monitors system logs, if an alert is issued, change the iSCSI port settings, and then check if the host is reconnected.

- For the iSCSI port connecting to storage systems or to the host, set Delayed ACK to Disable.

If Delayed ACK is set to the default value Enable, the host might take a long time to recognize external volumes. For example, 2,048 volumes might take 8 minutes.

- In the **Edit Ports** window, Selective ACK is set to Enable by default. Do not change this setting.
- In an environment in which a delay occurs in a line between storage systems, such as long-distance connections, try various sizes, and then set an optimal window size of iSCSI ports in storage systems at the primary and secondary sites. The maximum value you can set is 1,024 KB. Note that the default window size is 64 KB.
- In Universal Volume Manager, an external path connection is established for each iSCSI target of an external storage system. The maximum number of iSCSI external paths for each port is 512. However, best practice is to set no more than 127 external paths for each port.
- iSCSI ports do not support the fragmentation (splitting packets) functionality. If the maximum transfer unit (MTU) of a switch is smaller than the MTU of the iSCSI port, packets are lost and communication might not be performed correctly. To avoid this problem, set the switch MTU to a value equal to or greater than the iSCSI port MTU. Note that the iSCSI port MTU must be at least 1500.

In a WAN environment in which the MTU value is smaller than 1500, fragmented data cannot be sent or received. In such environment, set a smaller value for the maximum segment size (MSS) of the WAN router according to the WAN environment, and then connect the iSCSI port. Alternatively, use iSCSI in an environment in which the MTU value is 1500 or higher. For details about MTU values for the switch and how to set them, see the documentation for the switch.

- To use Universal Volume Manager on iSCSI ports for which the virtual port mode is enabled, you must use CCI. Additionally, you must use CCI to enable the virtual port mode. Do not set external paths from multiple virtual ports associated with a single iSCSI port of the local storage system to the same iSCSI port of an external storage system. Best practice is to use different iSCSI ports for paths to external storage systems and their alternate paths.
- (VSP E990 and VSP G350, G370, G700, G900) A single port can be used for connections to hosts (target attribute) and storage systems (initiator attribute). However, to minimize the influence to the system if a failure occurs either in a host or storage system, we recommend that you connect ports for hosts and storage systems to separate CHBs.

Notes on network settings

- Best practice is to disable the spanning tree setting on the port of a switch connecting to an iSCSI port. If you enable the spanning tree functionality of a switch, packets might not be looped in the network when the link is up or down. If this happens, the packets might be blocked for approximately 30 seconds. If you must enable the spanning tree settings, enable the port fast functionality of the switch.
- In a network path between storage systems, if you use a line whose transfer speed is slower than the iSCSI port, packets are lost and the line quality is degraded. To avoid this problem, configure the system so that the transfer speed for iSCSI ports and lines is the same.
- The delay in the line between storage systems varies depending on the system environment. Therefore, validate the system first, and then check the optimum window size settings of iSCSI ports. If the influence of the line delay is unacceptable, consider using devices for optimizing or accelerating the WAN speed.
- If you use iSCSI, packets are sent or received using TCP/IP. Therefore, the number of packets might exceed the capacity of the communication line, or packets might be resent. As a result, performance might be greatly affected. Therefore, in critical systems that rely on performance, use Fibre Channel.
- If the external storage system is in the HUS 100 series, the number of iSCSI targets you can search for is limited. If the iSCSI target name is 47 characters (default), you can search up to 170 iSCSI targets.

Considerations for using Fibre Channels

When configuring a system using Fibre Channels, you need to consider the following restrictions. For details about Fibre Channels, see the *Provisioning Guide*.

- When you use Fibre Channel as an external path, if you specify Auto for Port Speed, specify 10 seconds or more for Blocked Path Monitoring. If you want to specify 9 seconds or less, do not set Auto for Port Speed.
- If the time specified for Blocked Path Monitoring is not long enough, the network speed might be slowed down or the period for speed negotiation might be exceeded. As a result, paths might be blocked.

Considerations for executing external volume commands at the same time

If you execute multiple commands for using external volumes at the same time from CCI, REST API, or Storage Advisor Embedded, the commands might fail or you might not obtain the expected result. To avoid this happening, we recommend executing commands in the following table one at a time for a storage system.

Command Type	CCI command
Searching ports	<code>raidcom discover external_storage</code>
Searching volumes	<code>raidcom discover lun</code>
Testing iSCSI target login	<code>raidcom check external_iscsi_name</code>
Searching iSCSI targets	<code>raidcom discover external_iscsi_name</code>



Note: The following operations are not recommended. The command might not be executed correctly.

- A single user executes multiple `raidcom discover external_storage` commands for a single storage system at the same time.
- When multiple users use the same storage system, they execute one or more `raidcom discover external_storage` commands at the same time.

If you execute commands for using external volumes at the same time using CCI and an error occurs, take corrective action described in the following table.



Note: Similar symptoms might occur if you execute commands for external volumes at the same time from REST API or Storage Advisor Embedded.

CCI command	When multiple commands are executed at the same time	Description
<ul style="list-style-type: none"> ▪ raidcom discover external_storage ▪ raidcom discover lun 	<ul style="list-style-type: none"> ▪ The raidcom add path or raidcom delete path command fails with error codes EX_CMDRJE, (SSB1, SSB2): (2EDA, FEEC), (2EDA, FFFF), (2EDB, FFFF), (2EDB, FEEC) ▪ The raidcom add external_grp command fails with error codes EX_CMDRJE, (SSB1, SSB2): (2EDA, FEEC), (2EDB, FEEC). ▪ The raidcom delete external_grp command fails with error code EX_CMDRJE, (SSB1, SSB2): (2EDA, FFFF). 	<p>Cause: Multiple commands were executed at the same time.</p> <p>Action: Wait a while, and then execute the failed commands one at a time. If this problem occurs again, contact customer support.</p>
	<ul style="list-style-type: none"> ▪ The external storage system cannot be displayed by the raidcom discover external_storage command. ▪ LU of the external storage system cannot be displayed by the raidcom discover lun command. 	<p>Cause: Multiple commands were executed at the same time.</p> <p>Action: Make sure that the configuration is correct. Wait a while, and then execute the failed commands one at a time. If this problem occurs again, contact customer support.</p>
<ul style="list-style-type: none"> ▪ raidcom check external_iscsi_name ▪ raidcom discover external_iscsi_name 	<ul style="list-style-type: none"> ▪ The raidcom check external_iscsi_name command fails with error codes EX_CMDRJE, (SSB1, SSB2)=(2E11, 9B01), (2E14, 9B01), (2EBF, FEEC). ▪ The raidcom discover external_iscsi_name command fails with error codes EX_CMDRJE, (SSB1, SSB2)=(2E11, 9B01), (2E114, 9B01), (2EBF, FEEC). 	<p>Cause: Multiple commands were executed at the same time.</p> <p>Action: Wait a while, and then execute the failed commands one at a time. If this problem occurs again, contact customer support.</p>

If you execute commands for using external volumes at the same time using REST API and an error occurs, take corrective action described in the following table. For details about REST API, see the document for REST API or Configuration Manager REST API.

REST API	Corresponding CCI command	Symptom
<ul style="list-style-type: none"> ▪ GET <base-URL> v1/objects/external-storage-ports* ▪ GET <base-URL> /v1/objects/storages/ <storage-device-ID>/external-storage-ports 	<p>raidcom discover external_storage</p>	<ul style="list-style-type: none"> ▪ For GET <base-URL> v1/objects/external-storage-ports, HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.* ▪ No external storage system is displayed.
<ul style="list-style-type: none"> ▪ GET <base-URL> v1/objects/external-storage-luns* ▪ GET <base-URL> /v1/objects/storages/ <storage-device-ID>/external-storage-luns 	<p>raidcom discover lun</p>	<ul style="list-style-type: none"> ▪ For GET <base-URL> v1/objects/external-storage-luns, HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.* ▪ No external storage system is displayed.
<ul style="list-style-type: none"> ▪ POST <base-URL> /v1/objects/iscsi-ports/ <object-ID> /actions/discover/invoke* ▪ POST <base-URL> /v1/objects/iscsi-ports/ <object-ID> /actions/check/invoke* ▪ PUT <base-URL> /v1/objects/storages/ <storage-device-ID> /iscsi-ports/ <object-ID> /actions/discover/invoke ▪ PUT <base-URL>/v1/objects/storages/ <storage-device-ID> /iscsi-ports/ <object-ID> /actions/check/invoke 	<p>raidcom discover external_iscsi_name raidcom check external_iscsi_name</p>	<ul style="list-style-type: none"> ▪ HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.

REST API	Corresponding CCI command	Symptom
<ul style="list-style-type: none"> ▪ POST <base-URL> /v1/objects/external-path-groups/ <object-ID> /actions/add-path/invoke* ▪ POST <base-URL> /v1/objects/external-path-groups/ <object-ID> /actions/remove-path/invoke* ▪ PUT <base-URL> /v1/objects/storages/ <storage-device-ID> /external-path-groups/ <object-ID> /actions/add-path/invoke ▪ PUT <base-URL>/v1/objects/storages/ <storage-device-ID> /external-path-groups/ <object-ID> /actions/remove-path/invoke 	<pre>raidcom add path raidcom delete path</pre>	<ul style="list-style-type: none"> ▪ HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.
<ul style="list-style-type: none"> ▪ POST <base-URL> /v1/objects/external-parity-groups* ▪ POST <base-URL> /v1/objects/storages/ <storage-device-ID> /external-parity-groups 	<pre>raidcom add external_grp</pre>	<ul style="list-style-type: none"> ▪ HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.
<ul style="list-style-type: none"> ▪ DELETE <base-URL> /v1/objects/external-parity-groups/ <object-ID>* ▪ DELETE <base-URL> /v1/objects/storages/ <storage-device-ID> /external-parity-groups/ <object-ID> 	<pre>raidcom delete external_grp</pre>	<ul style="list-style-type: none"> ▪ HTTP status code 503 (Service unavailable) is returned, or a message prompting the user to retry the operation appears.
<p>* For VSP G/F350, G/F370, G/F700, G/F900.</p>		

Additional considerations

Using external storage can have a significant impact on applications. In addition, there are specific considerations and requirements for mainframe and open systems., including capacity requirements

Application performance considerations

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

The following factors can affect application performance:

- For the same physical resources, internal storage typically provides faster response times than external storage.
- External volumes must satisfy the performance characteristics and requirements for any applications that use them.

For example, SATA storage does not provide the performance requirements needed for OLTP applications.

Mainframe volumes

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

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

- (VSP 5000 series) The external volumes that use iSCSI for the external paths cannot be accessed from a mainframe operating system. (The emulation types such as 3390-x cannot be set for the external volumes.)
- Make sure that mainframe external volumes on a mainframe operating system consist of at least one LDEV before mapping.
- When multiple LDEVs exist in an external volume and numerous I/Os are made to them, read/write commands might timeout. When the commands timeout, the SIM (21d2xx) is reported.
- Set the MIH (missing interrupt handler) timer to 45 seconds (which is the recommended value) for mainframe external volumes on a mainframe operating system.
- Pre-existing mainframe volumes on an external storage system cannot be directly connected to the local storage system as external volumes.

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

- Zero-format the external volumes on the external system, map the volumes to the local storage system, then perform the Write to Control Blocks operation on the local system side.
- Map the external volumes to the local storage system and then format the mapped volumes on the local storage system.

After the mapping operation completes, the status of the mapped volume is Blockade; however, after the Write to Control Blocks operation completes or the mapped volume is formatted on the local system, the mainframe host can access the new mainframe volume through the FICON channels of the local storage system.



Note: A good reason to format from the local system side is that if you format the mapped volume from the external system, existing data is deleted and there are no options for retaining it.

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

Open-systems volumes

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

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

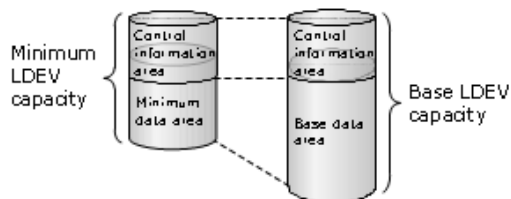
Capacity requirements for volumes

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

Note the following information regarding internal and external volume capacity:

- The LDEV size in the internal volume varies according to the external system's emulation type.
- An external volume whose capacity is less than the minimum LDEV capacity cannot be used.

- An external volume with a capacity that is less than the base LDEV capacity for the emulation type can be used; this causes a custom-sized volume (CV) to be automatically created in the local system during mapping.



- A custom volume in the local system has a minimum capacity, called minimum LDEV capacity.
- Base LDEV capacity must be equal to or greater than the minimum LDEV capacity.

The following figure illustrates minimum and base LDEV capacities.

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

$$\text{Minimum LDEV Capacity} = \text{Minimum Data Area Capacity} + \text{Control Information Area Capacity}$$

$$\text{Base LDEV Capacity} = \text{Base Data Area Capacity} + \text{Control Information Area Capacity}$$

For mainframe systems volumes, other than 3390-A and 3390-V, capacities for the expanded control information area and the adjustment area are also necessary. For details, see [Formula for calculating capacity for 3390-A and 3390-V mainframe volumes \(on page 47\)](#).

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

Idea of LDEV capacity:

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

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

LDEV capacities per emulation type

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

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

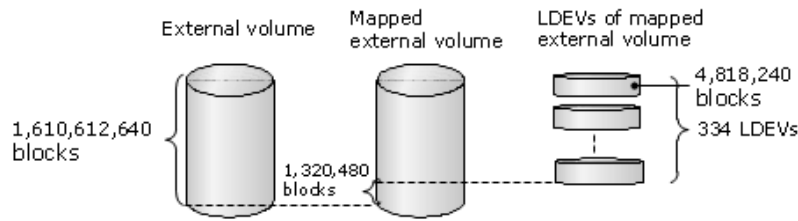
Emulation Type		Minimum Data Area Capacity		Base Area Capacity		Control Information Area Capacity	
		Blocks	Cylinders	Blocks	Cylinders	Blocks	Cylinders
Intermediate volume	3390-3 A -3B -3C	87,000	50	5,809,860	3,339	10,440	6
	3390-9 A -9B -9C	87,000	50	17,429,580	10,017	43,500	25
	3390- LA -LB -LC	87,000	50	57,002,400	32,760	40,020	23
	3390- MA -MB -MC	87,000	50	114,004,800	65,520	92,220	53

Notes:

- a.** If mapping an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled: 16,777,216 blocks
- b.** If mapping an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled: 549,755,813,888 blocks
- c.** For 3380-A and 3390-A, a control information area is required for every 1,113 cylinders.

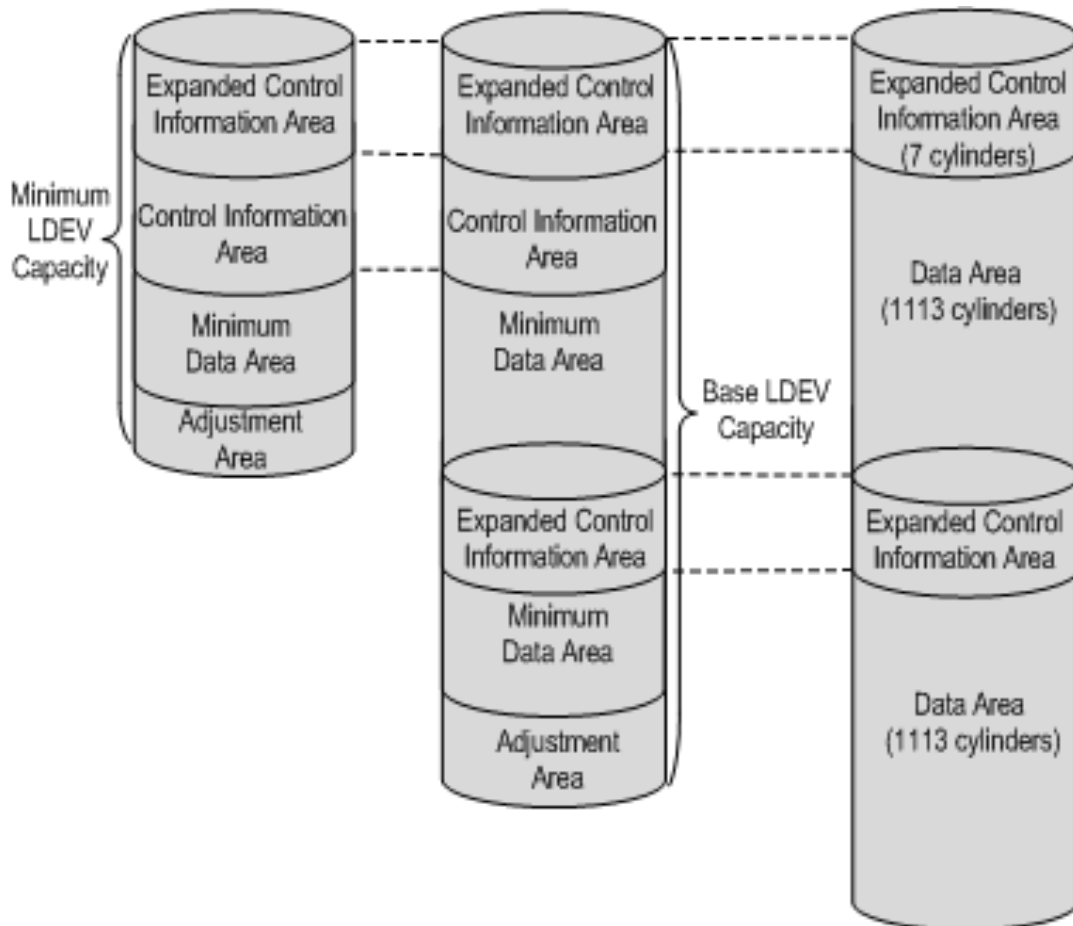
Example: Determining capacity for OPEN-3 volume

This figure shows capacity for an external volume with OPEN-3 emulation type. The capacity is 1,610,612,640 blocks. You can create 334 LDEVs from the base LDEV capacity of 4,818,240 blocks (Base Data Area plus Control Information Area) using the data for OPEN-3 in [LDEV capacities per emulation type \(on page 45\)](#). This process creates free space of 1,320,480 blocks of the mapped external volume. You can create LDEVs in free space.



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

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



Formula for calculating necessary LDEV capacities (in blocks) :

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

$$\text{Minimum LDEV capacity} = \text{ceil}(\{\text{ceil}((\text{Minimum data area capacity} \setminus + \text{Control information area capacity}) / 1,936,620) \times 12,180 \setminus$$

```
+ (Minimum data area capacity \
+ Control information area capacity) / 77,952) × 77,952
```

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

Minimum LDEV capacity and Base LDEV capacity for mainframe systems

Emulation type	Minimum LDEV capacity (blocks)	Base LDEV capacity (blocks)
3390-1	155,904	2,026,752
3390-2	155,904	3,975,552
3390-3	155,904	5,924,352
3390-9	155,904	17,617,152
3390-L	155,904	57,450,624
3390-M	233,856	114,823,296

Volume capacities adjustment for pairs

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

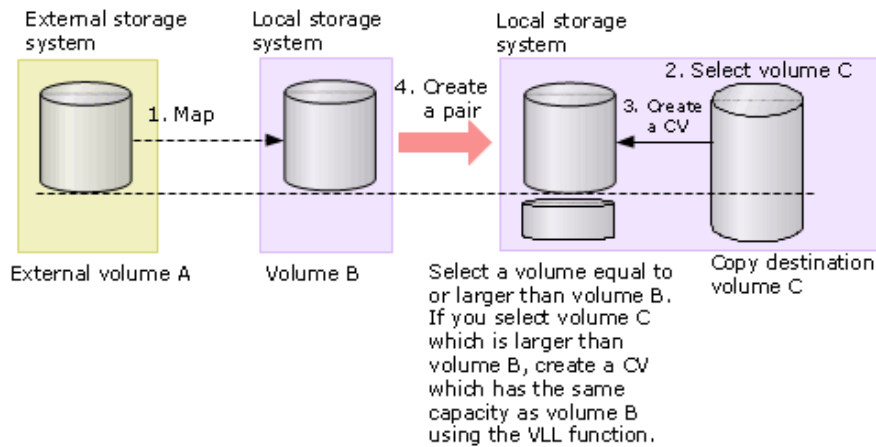
If you need to adjust the capacity of the volume or the external volume before creating the pair, proceed as shown in [Decreasing the size of the S-VOL \(on page 48\)](#) and [Decreasing the size of the external volume S-VOL \(on page 49\)](#).

Decreasing the size of the S-VOL

When the S-VOL is larger than the mapped external volume P-VOL, you must adjust the capacity of the volume.

Procedure

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



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

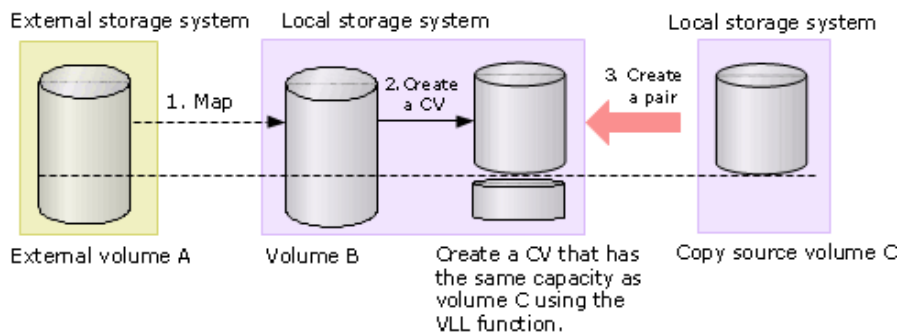
4. Create the pair.

Decreasing the size of the external volume S-VOL

When the mapped external volume S-VOL is larger than the P-VOL, you must adjust the capacity of the external volume.

Procedure

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

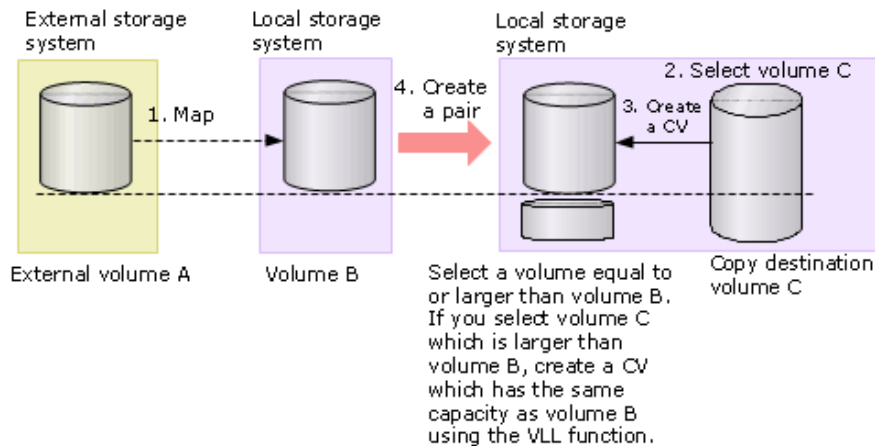


3. Create the pair.

Copying external storage system data

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

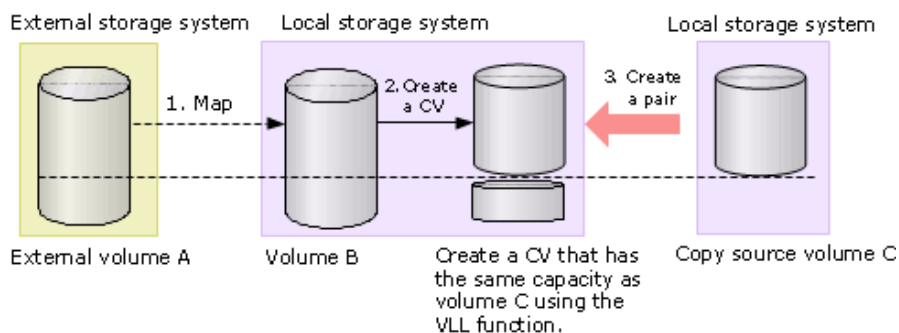
Using an external volume as a P-VOL to copy data



Procedure

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

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



Procedure

1. Use Universal Volume Manager to map the external volume (A) to an internal volume (B) of the local storage system. You will use volume (B) as the S-VOL of a copy pair.

- 2.** Check the capacity of internal volume (B) to which external volume (A) is mapped. If the capacity of internal volume (B) is different than the copy source volume (C), create a CV that has the same capacity as the copy source volume (C).
- 3.** Create the copy pair using copy source volume (C) as the P-VOL and volume (B) as the S-VOL. This configuration makes a copy of the source volume on external volume (A).

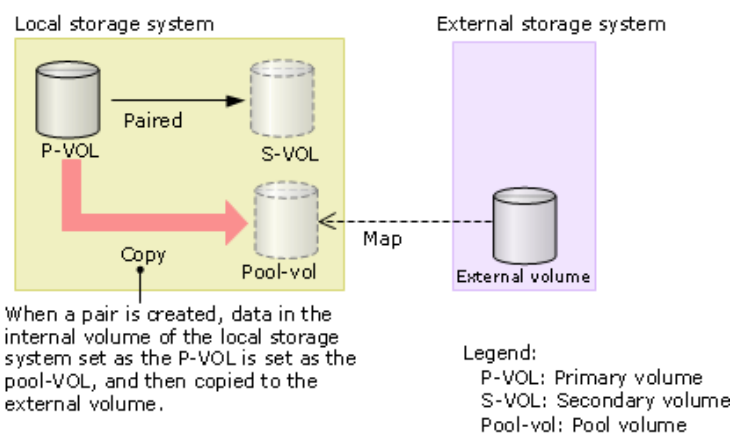
Chapter 3: Supported software for external volumes

You can manage and manipulate data in your mapped volumes.

Thin Image

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

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



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

Mapped external volumes can be used by the following programs:

- Dynamic Provisioning
- Dynamic Tiering
- active flash
- Thin Image

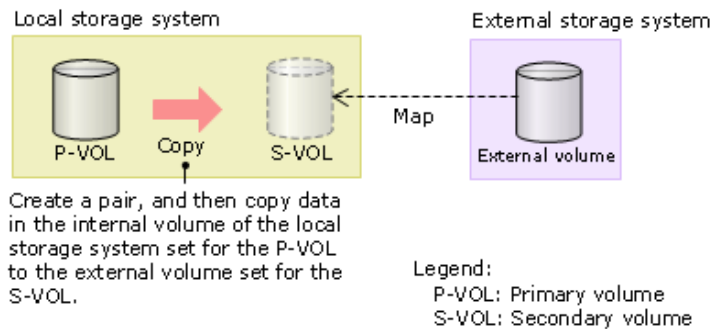
Note the following restrictions:

- If you are using a Thin Image pool, all external volumes in the same pool must use the same Cache Mode setting. For more information about this setting, see [Cache use and external storage performance \(on page 24\)](#).
- **(VSP 5000 series)**A mapped volume that is used as a pool volume must use OPEN-V emulation for open systems and 3390-V emulation for mainframe systems.
- **(VSP E990 and VSP G350, G370, G700, G900)**With Dynamic Tiering, Cache Mode must be set to Enabled.
- **(VSP E990 and VSP G350, G370, G700, G900)**Mapped external volumes can be used as quorum disks for global-active device, but not as pair volumes.

Local replication software

Mapped volumes can be used in pairs for ShadowImage for Mainframe (VSP 5000 series) and ShadowImage. After you map and format an external volume, the volume can be used as a pair volume.

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



Performance Monitor

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

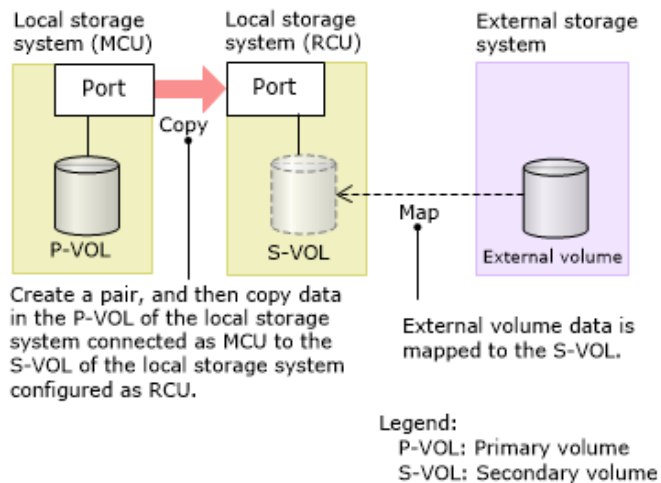
Remote replication software

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

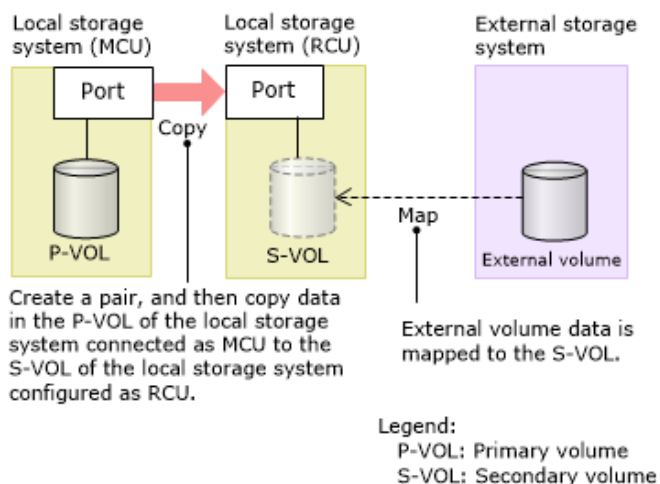
- For open systems:
 - TrueCopy
 - Universal Replicator
- For mainframe systems:
 - TrueCopy for Mainframe
 - Universal Replicator for Mainframe

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

Using a mapped external volume for UR or URz



Using a mapped external volume for TC or TCz



SNMP Agent

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

Virtual LVI/LUN

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

For mainframe external volumes, perform the Write to Control Blocks operation immediately after mapping. See the *Provisioning Guide* for information.

Global-active device

Mapped external volumes can be used as pair volumes for global-active device. To adjust volume capacity, see [Copying external storage system data \(on page 49\)](#).

Chapter 4: Setting up external volumes

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

Workflow for setting up external volumes

Before you begin setting up Universal Volume Manager, consult the topics in [Planning workflow \(on page 19\)](#) to make sure you have completed all planning tasks.

For VSP 5000 series:

1. Set up ports on the local and external storage systems. See the following:
 - [Setting port attributes on the local system \(VSP 5000 series\) \(on page 57\)](#)
 - [Setting up ports on the external system \(on page 59\)](#)
2. [Optional] Edit mapping settings before starting the mapping operation. For details, see [External volume policy settings and functions \(on page 67\)](#).

You can also make changes during the mapping operation or accept the default settings.

3. Map each external volume to an internal volume. The following settings are required:
 - Set the emulation type of the external volume to OPEN-V.
 - Set the number of LDEVs per external volume to 1.

For details, see [Mapping an external volume \(on page 59\)](#).

4. After an external volume is successfully mapped, perform the one of the following depending on the emulation type of the volume:
 - For mainframe emulations, format the volume or perform the Write to Control Blocks operation. For details, see the *Provisioning Guide*.
 - For OPEN-system emulation, define LU paths to hosts. For details, see the *Provisioning Guide*.

For VSP E990, VSP Gx00 models, and VSP Fx00 models:

1. Set up ports. For details, see [Port setup \(VSP E990 and VSP G350, G370, G700, G900\) \(on page 58\)](#).

2. [Optional] Edit mapping settings before starting the mapping operation. For details, see [External volume policy settings and functions \(on page 67\)](#).

You can also make changes during the mapping operation or accept the default settings.

3. Map each external volume to an internal volume. For details, see [Mapping an external volume \(on page 59\)](#).
4. After an external volume is successfully mapped, define LU paths to hosts. For details, see the *Provisioning Guide*.

Setting port attributes on the local system (VSP 5000 series)

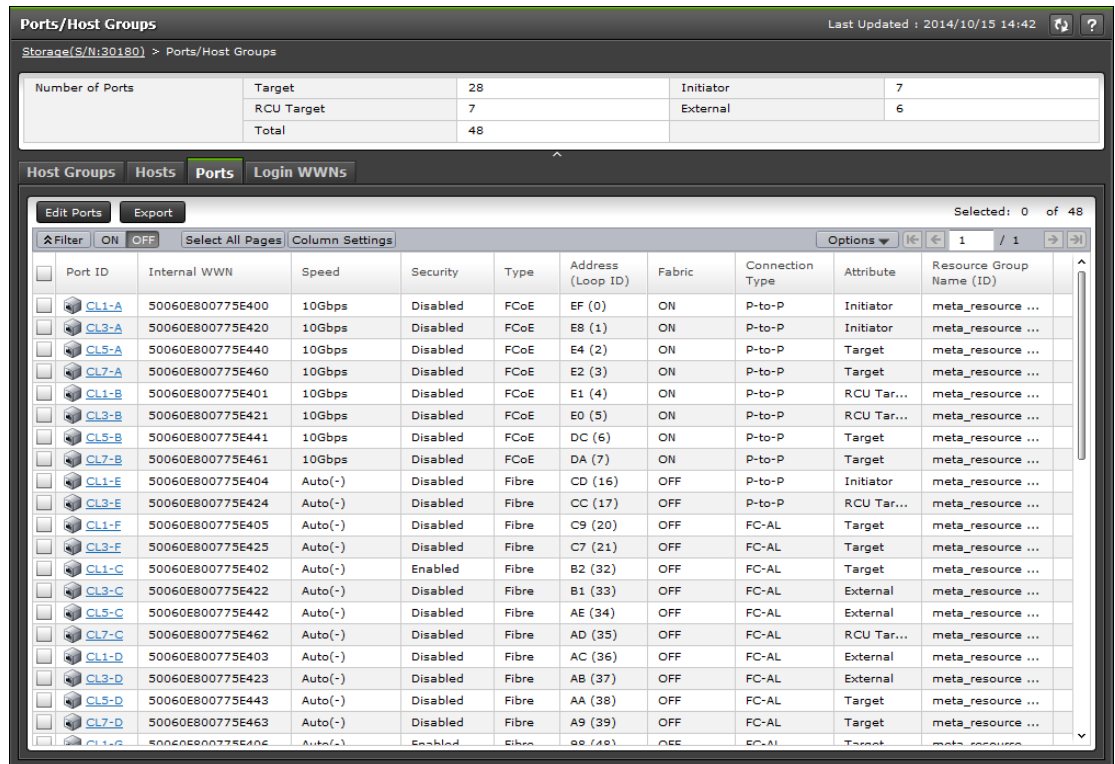
The port attribute of a local storage system connected to an external storage system must be specified as Bidirectional. For information on setting up ports, see the user guide of your external storage system.

Before you begin

- For details about the Edit Ports wizard, see the *Provisioning Guide*.
- You must have the Storage Administrator (System Resource Management) role.

Procedure

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



4. In the **Edit Ports** window, select **Bidirectional** in the **Port Attribute** box.
5. For help with other settings, see the *Provisioning Guide*.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Port setup (VSP E990 and VSP G350, G370, G700, G900)

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

Setting up ports on the external system

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

Make sure the external system ports you use have enough capacity for the read/write workload planned for the external volumes. See the discussion in [External paths \(on page 26\)](#) for more information. Refer to the documentation for the external system for full information.

Procedure

1. Configure the topology settings according to the configuration of the connection (fabric or loop).
2. Set the data transfer speed according to the connection configuration.
3. Set parameters for the ports on the external system as required for connecting with your VSP 5000 series or VSP G/F350, G/F370, G/F700, G/F900 system. For your specific external system, see [Supported external storage systems \(on page 113\)](#). If you do not find your external system in the section, see <https://knowledge.hitachivantara.com/Documents> to make sure your system is supported and then refer to the documentation for the system's ports.
4. Define LUNs and present them on the port on the external system.

Limitations on mapping an external volume

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

Following are the limitations on mapping an external volume:

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

Mapping an external volume

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

Note the following restrictions and conditions:

- Attributes set for the external volume before mapping, such as port security, LUN security, and Volume Retention Manager attributes are discarded when the external volume is mapped. If the original attributes are required, reset them in the local storage system after mapping.
- Volumes for which the T10 PI attribute is enabled cannot be specified as an external volume.
- When the external volume is a command device, it is mapped as a remote command device. For important information about mapping command devices, see [Using a remote command device \(on page 137\)](#).



Note:

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

- Numbers already in use.
- Numbers not assigned to the user.
- (VSP 5000 series) Numbers already assigned to another emulation group (which consists of LDEVs that are grouped every 32 LDEV numbers).
- (VSP 5000 series) Model or serial number and LDEV ID or virtual LDEV ID of the storage system and the virtual storage machine do not match in the mainframe volume or the interim volume that you create.
- (VSP 5000 series) To determine whether the LDEV number can be assigned, click View LDEV IDs in the **Add External Volumes** window when you map the external volume.

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- Before you map the external volume, determine whether any application is using the volume. If you find any, stop them before mapping.

For example, before mapping a command device, make sure CCI commands are not being run.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **External Storage**.
3. In the **External Storage** window, on the **External Storage Systems** tab, click **Add External Volumes**.
4. In the **Add External Volumes** window, select an existing path group or create a new one.
 - To use an existing external path group, select **By Existing External Path Group**, and then select the desired path group from the **Available External Paths** table.
 - To create a new external path group, select **By New External Path Group**, click **Create External Path Group**, and specify the following options.

Option	Description
Initial External Path Group ID	The storage system searches IDs from the initial ID you specify in ascending order and allocates an ID that can be used. The default is 0. Specify a value in the following range: 0 to 63,231
External Paths	If the port or WWN/iSCSI target name you want is not in the Available External Paths table, click Discover External Target Ports , add ports, and then click OK .
External Storage System	Select the desired external storage system.
Available External Paths	Select the desired port IDs, and then click Add .

5. Set the priority for a path by selecting it, and then clicking **Raise Priority** or **Lower Priority**.
6. When you have finished setting the external path groups, click **OK** and then click **Next**.
7. In the **Discovered External Volumes** table, select the desired external volumes.
8. In **Initial Parity Group ID**, enter an external volume group number and sequential number. You can use the group number to place similar external volumes in a group. For example, you could assign the same external volume group number to volumes used for a copy function.
 - The range is from 1 - 1 to 16384 - 4096.
 - To map an external volume with more than 4 TB by using a virtual volume for which Data Direct Mapping is enabled, select **Enable** in **Data Direct Mapping**. When you do, **Yes** is automatically selected for **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.

For details about mapping using virtual volumes for which Data Direct Mapping is enabled, see the *Provisioning Guide*.
9. Specify **Allow Simultaneous Creation of LDEVs**.
 - To allow the system to automatically create LDEVs in the external volume, select **Yes**. To manually create LDEVs, select **No**.
 - If the external volume is a command device, select **Yes** for both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**.
10. Specify **Use External Storage System Configuration**.
 - If you select **Yes**, **Base Emulation Type** is disabled and the emulation type is set based on the LDEV name of the external storage system.
 - If you select **No**, **Base Emulation Type** is enabled so you can select the type.

- If you select **Yes** in both **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**, one LDEV with the same capacity as the OPEN-V external volume will be created.
 - If you select **Disable** in **Data Direct Mapping** and the external volume is larger than 4 TB, one 4 TB LDEV will be created.
- 11.** In **LDEV Name**, enter the prefix character and the initial number.
If you enter a prefix character and an initial number, their combined value can be a maximum of 32 characters, including the initial number (numerical value of 9 digits or less). Note the following numbering rule:
- 1: Total of 9 numbers (1, 2, 3, ...9)
 - 08: Total of 92 numbers (08, 09, 10, ...99)
 - 23: Total of 77 numbers (23, 24, 25, ...99)
 - 098: Total of 902 numbers (098, 099, 100, ...999)
- 12.** Click **Options** (if not already expanded). If you have previously edited mapping settings (policies), you might not want to change the options. However, review the following steps, because some fields in **Options** are affected by the preceding steps.
- 13.** In the expanded **Options**, 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**.

Option	Description
LDKC	Enter 00.
CU	Enter the CU number. The default is 00. Specify a value in the following range: <ul style="list-style-type: none"> ▪ VSP 5000 series: 00 to FE ▪ VSP E990: 00 to FE ▪ VSP G350, VSP F350: 00 to 3F ▪ VSP G370, VSP F370: 00 to 7F ▪ VSP G700, VSP F700: 00 to BF ▪ VSP G900, VSP F900: 00 to FE
DEV	Enter the LDEV ID, which can be from 00 to FF. The default is 00.
Interval	Enter an interval between LDEV IDs, which can be from 0 to 255. The default is 0.

- 14.** (VSP 5000 series) In **Initial SSID**, enter the SSID, which can be from 0004 to FFFE. The default is 0004.
You can review the current SSIDs by clicking **View SSIDs**.

15. (VSP 5000 series) 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.

16. In **Number of LDEVs per External Volume**, enter the number of LDEVs to be created when the volume is mapped. This field is greyed out if you selected **Yes** in **Allow Simultaneous Creation of LDEVs** and **Use External Storage System Configuration**, and **1** displays.

(VSP 5000 series) For details, see [Capacity requirements for volumes \(on page 43\)](#).

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



Note: For more information about the **Cache Partition**, **Cache Mode**, and **Inflow Control** settings, see [External volume policy settings and functions \(on page 67\)](#).

18. In **Cache Mode**, select **Enable** to propagate write data asynchronously from cache to the external storage system. Select **Disable** to propagate data synchronously.

- 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.

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

20. In **MP Unit ID**, select the MP unit for the external volume, making sure to assign them so that work is evenly distributed across the available processors.

To automatically assign an MP unit, select **Auto** (the default). If **Auto** is not available, the MP unit with the lowest number is selected by default. Otherwise, select either MPU-10 or MPU-20.

21. Click **Add**.

22. If you need to change settings for an added volume, select it in the **Selected External Volumes** table, click **Change Settings**, make necessary changes, and then click **OK**.

23. To add LUN paths, click **Next** in the **Add External Volumes** window. For details, see the *Provisioning Guide*.

24. Click **Finish** when ready.

25. In the confirmation window, review all settings, and then accept the task name or enter one.

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

26. Click **Apply**.

Preparing mapped volumes for use

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

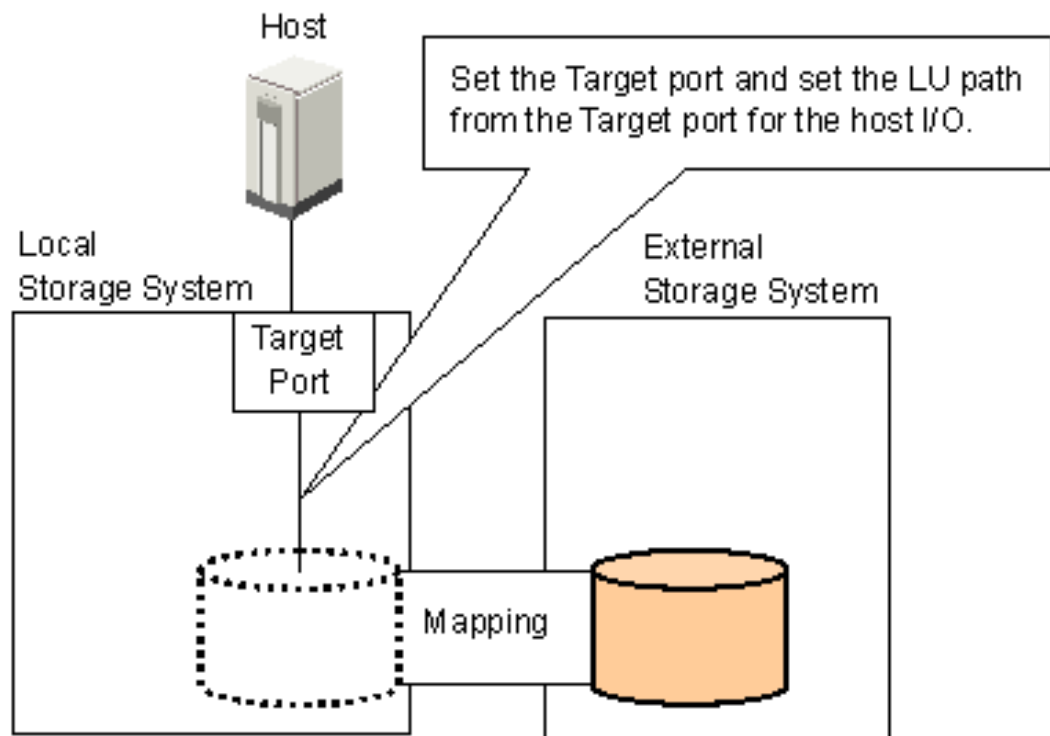
Before you begin

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


Procedure


1. (VSP 5000 series) Depending on the emulation type, perform one of the following:
 - For mainframe emulation, the status of the mapped volume becomes **Blockade** after mapping. Format the volume to change to a normal status.

For zero-formatted external volumes, 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 after the formatting. For instructions, see the *Provisioning Guide*.
 - 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.
2. (VSP E990 and VSP G350, G370, G700, G900) The status of the mapped volume automatically becomes **Normal**. If you need to initialize the data area of the mapped volume, format the volume.
3. For each mapped volume (regardless of the emulation type), set an LU path from a target port to the internal volume, as shown in the following figure.
The LU path enables host I/O to the mapped volume.




Legend

 : Internal volume where the external volume is mapped

 : External volume

Use of mapped volumes

After external volumes are mapped and ready for use, you can perform the operations supported by Universal Volume Manager. Review supported software products and operations in [Supported software for external volumes \(on page 52\)](#).

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

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

Recognition of the local system from the external system

Though the local and external systems are connected, the external system might not recognize the local system. You can make the external system recognize the local system by performing the Discover External Target Ports operation. If the path mapping operation does not finish after 15 minutes, though, the external system might not be able to recognize the local system. See [Adding an external path to an existing path group \(on page 74\)](#) for instructions.

Chapter 5: Monitoring and maintenance

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

Monitoring external volumes and paths

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

Before you begin

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

Procedure

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

External volume policy settings and functions

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

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

- Base Emulation Type (VSP 5000 series): Specify OPEN-V to use existing data in an external volume from VSP 5000 series, VSP G1500, and VSP F1500.

If you use an emulation type other than OPEN-V, the volume requires a specific area for management data. This results in a volume capacity after mapping that is less than the actual external volume capacity. For more information about calculating the capacity of external volumes, see [Capacity requirements for volumes \(on page 43\)](#).

- Cache Mode: I/O to and from the local storage system always uses cache. Write operations are always backed up in duplex cache. The Cache Mode setting specifies whether write data from the host is written to the external volume asynchronously (Enable) or synchronously (Disable).
 - Enable: After receiving the data into the local system's cache memory, the system signals the host that the I/O operation has completed, and then asynchronously destages the data to the external volume.
 - Disable (default): After synchronously writing the data to the external volume, the local system signals the host that an I/O operation has completed.

For additional information, see [Cache use and external storage performance \(on page 24\)](#).

- Cache Partition: Cache memory can be partitioned by using Virtual Partition Manager to configure a cache logical partition (CLPR) for the mapped volumes. Cache logical partitions are often used to limit cache-use by accessing slower external storage volumes.

We strongly recommend that you place external storage array groups in a CLPR other than CLPR0. For details about CLPR, see the *Performance Guide*.

- Inflow Control: When the write operation to the external volume cannot be completed, Inflow Control specifies whether the write operation to cache memory is limited (Enable) or continued (Disable).
 - Enable: The write operation to cache is limited and I/O from the host is not accepted. Limiting the write operation prevents the accumulation of data that cannot destage to cache memory.
 - Disable (default): I/O sent from the host during the retry operation is written to cache memory. When write operations to the external volume are again possible, data in cache memory is destaged to the external volume.
- Use ALUA as Path Mode: In the local storage system, you can select whether ALUA mode is used as the path mode. If ALUA is supported in the profile information of the external storage, Enable is used by default. Otherwise, Disable is used. For information on ALUA mode, see [Supported external system path mode for external volumes \(on page 27\)](#).

- **Load Balance Mode:** Select Depends on the selected external volume(s), Normal Round-robin, Extended Round-robin, or Disable as a Load Balance Mode for the external storage system. By default, Normal Round-robin (recommended) is set. However, when the product name of the storage system is displayed as (generic), Depends on the selected external volume(s) is used by default.

If Single is set as the Path Mode or Disable is set for Use ALUA as Path Mode, Load Balance Mode cannot be specified.

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

Editing mapping policies for external volumes

Before you begin

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

Procedure

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



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

6. Click **Apply**.

Cautions for changing the MP unit

- Changes to the MP unit ID for an external volume should be made during off-peak hours when the I/O load is as low as possible. Do not change the MP unit ID when the I/O load is high -- for example: during initial copy of ShadowImage, TrueCopy, global-active device, or Universal Replicator.
- After you change the MP unit ID for an external volume, wait more than 30 minutes before you try to change the MP unit ID again for the same external volume.
- When you change the MP unit ID for an external volume, you should use Performance Monitor before and after the change to check the load status.
- Before and after changes are made, it is recommended that the cache write-pending rate (%) for all CLPRs is lower than 50%.
- Do not change the MP unit IDs for several external volumes during a short period of time. As a guideline, you can change 10% or less of the total number or the full workload of external volumes to which the same MP unit ID is assigned at the same time.

Changing the MP unit assigned to an external volume

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- See [Cautions for changing the MP unit \(on page 70\)](#).

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select one or more external volumes, and then select **More Actions > Assign MP Unit**.
5. In the **Assign MP Unit** window, select the desired MP unit.

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

The choices you see are dependent on the configuration of the device. They range from **MPU0** to **MPU7** (VSP 5000 series)



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

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

6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Changing path mode to ALUA mode (Enable or Disable)

You can select whether ALUA mode is used as the path mode. See [Supported external system path mode for external volumes \(on page 27\)](#).

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select **Enable** or **Disable** as the **Use ALUA as Path Mode** property.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

8. Click **Apply** to submit the task.

Changing I/O mode for external storage systems

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

For more information, see [Supported external system path mode for external volumes \(on page 27\)](#).

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select the **Load Balance Mode** property, and then click **Extended Round-robin**, **Normal Round-robin**, or **Disable**.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : ; , * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Changing the port settings of an external storage system

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

However, note the following:

- If the current setting is error-free, it is best to continue using it.
- For an external volume with normal I/O, set I/O Timeout from 5 - 15 seconds.

- Use the external system's recommended values for other port settings.
- If you are going to change several parameters for the same external WWN or the same external iSCSI target, ensure that a task is completed before you perform the next task. If you perform a new task before the prior task is completed, the prior task might not be applied.

Before you begin

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

Procedure

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



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

4. Click **Finish**.
5. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
6. Click **Apply** to submit the task.

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.

Adding an external path to an existing path group

Before you begin

You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.
4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, select an external path or paths from the **Available External Paths** list and click **Add**.

If the **External Storage System** or the **External WWN** that you want is not available in the dialog box, click **Discover External Target Ports** and add the port that connects to the WWN.
6. To change the priority of external paths, click **Raise Priority** or **Lower Priority** in the **Selected External Paths** list.
7. Click **Finish**.
8. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.

You can enter up to 32 letters, numbers, and symbols, except these:

```
\ / : , ; * ? " < > |
```
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Adding an iSCSI path

Before you begin

You must have the Storage Administrator (Provisioning) role.

Procedure

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

4. In the **Discover iSCSI Targets** window, for **Local Port ID**, select the port connected to the external storage system of the local storage system.
5. For **Remote IP Address**, enter the IP address of the external storage system port.
6. For **Remote TCP Port Number**, enter the TCP port number of the external storage system port (1 to 65535).
7. Click **Add**.
The targets that you entered will be added to the **Discovery List** table. You can add up to eight targets.
8. Click **OK**.
9. In the **Add iSCSI Paths** window, select the iSCSI path to be added from the **Available iSCSI Paths** table.
10. For **Authentication Method**, select **CHAP** or **None**.
For either authentication methods, select one of the following options for **Mutual CHAP**:
 - **Enable**: Authentication is bidirectional.
 - **Disable**: Authentication is unidirectional.
 If you select **CHAP** and enable mutual CHAP, you must specify a user name and secret. If you disable mutual CHAP, the user name and secret are optional.
11. Click **Add**.
The selected iSCSI path will be added to the **Selected iSCSI Paths** table.
Up to 4,096 iSCSI paths can be added including those paths that were already added.
12. Click **Finish**.
13. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
 \ / : , ; * ? " < > |
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
14. Click **Apply** to submit the task.

Editing an iSCSI target

Before you begin

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

Procedure

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

- a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab, and then click **Edit iSCSI Targets**.
 3. For **Authentication Method**, select **CHAP** or **None**.
For either authentication method, select one of the following options for **Mutual CHAP**:
 - **Enable**: Authentication is bidirectional.
 - **Disable**: Authentication is unidirectional.
 If you select **CHAP** and enable mutual CHAP, you must specify a user name and secret. If you disable mutual CHAP, the user name and secret are optional.
 4. Click **Finish**.
 5. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
 \ / : , ; * ? " < > |
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
 6. Click **Apply** to submit the task.

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 \(on page 26\)](#) for more information on path priorities for Single and Multi mode.

Before you begin

You must have the Storage Administrator (Provisioning) role.

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.
4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, in the **Selected External Paths** list, select the desired path and click **Raise Priority** or **Lower Priority**.
6. Repeat the previous step to continue moving the path higher or lower. Move other paths as needed.

7. Click **Finish**.
8. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Executing a login test for an iSCSI target

Before you begin

You must have the Storage Administrator (Provisioning) role.

Procedure

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

Disconnecting an external path

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

An external path is disconnected for the following reasons:

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

Before you begin

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

Procedure

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

- a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
- b. Click **External Storage**.
2. Click the **External Paths** tab.
3. On the **External Paths** tab, select a path group.
4. Click **Disconnect External Paths**.
5. In the **Disconnect External Paths** window, select one of the following:
 - For Fibre Channel ports, select either **By Ports** or **By External WWNs**.
 - For iSCSI ports, select either **By Ports** or **By External Storage Ports**.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
 \ / : , ; * ? " < > |
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Deleting an iSCSI path

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. In the **External Storage** window, click the **iSCSI Paths** tab.
3. Select the iSCSI path that you want to delete, and then click **Delete iSCSI Paths**.
4. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
 \ / : , ; * ? " < > |
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
5. Click **Apply** to submit the task.

Reconnecting an external path

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

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. Click the **External Paths** tab.
3. On the **External Paths** tab, select a path group.
4. Click **Reconnect External Paths**.
5. In the **Reconnect External Paths** window, select one of the following:
 - For Fibre Channel ports, select either **By Ports** or **By External WWNs**.
 - For iSCSI ports, select either **By Ports** or **By External Storage Ports**.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Changing the cache mode setting of the external volume

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

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

Before you begin

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

Item to Review	Description
Cache mode and pool volumes	When a volume is registered to a pool as a pool volume, the cache mode setting should be the same among all the pool volumes in the pool.
Cache mode and remote command devices	When the volume is a remote command device, you cannot change the cache mode from Disable to Enable.

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external storage system.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select an external volume, and then click **Edit External Volumes**.
5. On the **Edit External Volumes** window, select the **Inflow Control** property, and then click **Enable** or **Disable**.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Removing or replacing an external path

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



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

Before you begin

- Before removing a path, make sure it is disconnected. See [Disconnecting an external path \(on page 77\)](#) for instructions.

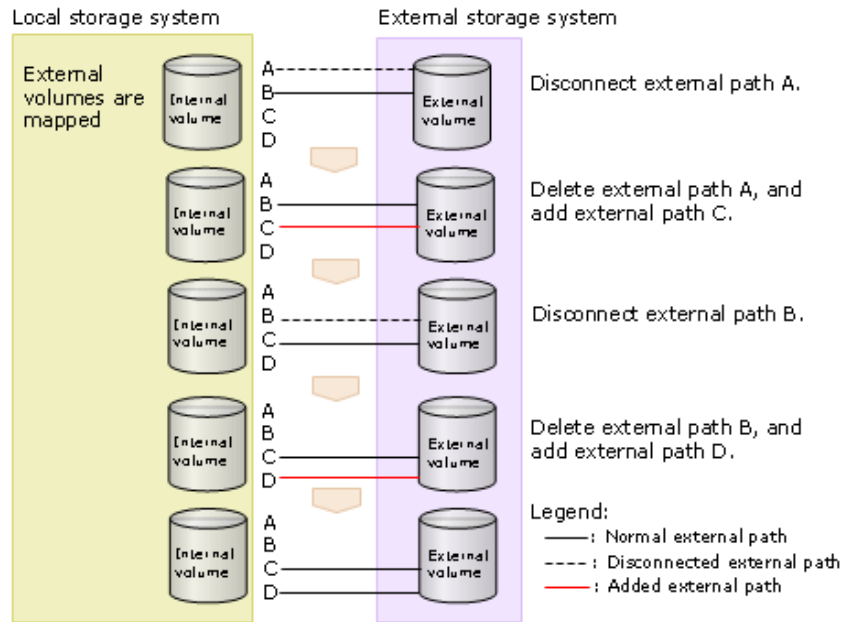
Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system.
3. On the **External Path Groups** tab, select a path group.
4. Click **Edit External Path Configuration**.
5. In the **Edit External Path Configuration** window, in the **Selected External Paths** list, select the path to be removed, and then click **Remove**.
6. Click **Finish**.
7. In the confirmation window:
 - a. Confirm the settings.
 - b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
 - c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply**.
If you are replacing the path, see [Adding an external path to an existing path group \(on page 74\)](#).

Replacing all external paths

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

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



Procedure

1. Disconnect **external path A**. See [Disconnecting an external path \(on page 77\)](#).
2. Disconnect the cable for **external path A**, then remove it. See [Removing or replacing an external path \(on page 80\)](#).
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 \(on page 74\)](#).

When **external path C** status is **Normal**, then both **external path B** and **external path C** are set, and you can replace the next path.

4. Disconnect **external path B**.
5. Disconnect the cable for **external path B**, then remove it.
6. Make sure the cable for **external path D** is connected, and then add this path to an existing path group.

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

Disconnecting external systems and volumes

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

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

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

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

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



Note: Before you delete a DP-VOL that has the Data Direct Mapping attribute, it is necessary to disconnect the external volume that has the Data Direct Mapping attribute. Disconnecting the external volume that has the Data Direct Mapping attribute might output SIM RC=627xxx (xxx is the pool ID) indicating pool-VOLs blockage. For more information regarding deleting a DP-VOL that has the Data Direct Mapping attribute, see the *Provisioning Guide*.

Prerequisites for disconnecting external systems

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

Activity in the external volume	Required operation
I/O to the external volume from the open system host is in progress.	Stop I/O to the volume and unmount the volume from the host. Host I/O is forcibly stopped if you disconnect when I/O is in progress.
The external volume is online from the mainframe host. (VSP 5000 series)	Stop the host I/Os to the volume and perform the Vary Offline operation.
<p>The external volume includes LDEVs used in pair operations with the following copy software products:</p> <ul style="list-style-type: none"> ▪ ShadowImage ▪ ShadowImage for Mainframe (VSP 5000 series) ▪ Universal Replicator ▪ Universal Replicator for Mainframe (VSP 5000 series) ▪ TrueCopy ▪ TrueCopy for Mainframe (VSP 5000 series) ▪ Thin Image ▪ Global-active device 	<p>Delete the pair.</p> <p>You can disconnect without deleting a ShadowImage or ShadowImage for Mainframe pair when pair status is PSUE or Suspend/SUSPER.</p>

Activity in the external volume	Required operation
The external volume includes LDEVs registered to a Thin Image data pool.	Delete Thin Image data pool.
The external volume includes LDEVs registered to a Dynamic Provisioning pool volume (DP-VOL).	Perform all of the following operations on DP-VOLs associated with the external volume: <ul style="list-style-type: none"> ▪ Stop using the DP-VOLs. ▪ Use the Block LDEVs window to block the DP-VOLs. ▪ If the Data Direct Mapping attribute is enabled for the external volume, block only the related DP-VOL. ▪ When a virtual volume for which Compression or Deduplication and Compression is enabled is created from a DP pool, if a failure occurs in the pool-VOL registered in the pool, recover the failure of the pool-VOL. In addition, if a deduplication system data volume is created, block it.
The external volume includes LDEVs for which Volume Migration processing is in progress.	Delete the migration plans.
The external volume is used in a global-active device quorum disk.	Delete the quorum disk settings.

Disconnecting an external storage system, all mapped volumes

Before you begin

- You must have the Storage Administrator (Provisioning) role.
- Before disconnecting a mapped volume, review [Prerequisites for disconnecting external systems \(on page 83\)](#).

Procedure

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

Result

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

Disconnecting a single mapped volume**Before you begin**

- You must have the Storage Administrator (Provisioning) role.
- Before disconnecting a mapped volume, review [Prerequisites for disconnecting external systems \(on page 83\)](#).

Procedure

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

Result

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

Deleting an external volume mapping

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

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for an external system
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select the external volume.
5. Click **More Actions > Delete External Volumes** and select .
6. In the **Delete External Volumes** window, verify the external volumes you want to delete.
7. For **Have you already disconnected external volume of above table?**, click one of the following:
 - **Yes** if you have already disconnected the volumes.
 - **No** if you have not disconnected the volumes.
8. If you clicked **No** in the previous step, then, for **Do you want to execute Delete External Volumes operation without writing the cache data to the volumes?**, click **Yes** or **No**.



Caution: If you click **Yes**, the mapping can be deleted, however the data in cache memory that has not been written to the volumes cannot be guaranteed (Forcibly deleting external volumes).

:

9. Click **Finish**.
10. In the confirmation window:
 - a. Confirm the settings.

- b. Accept the default task name or enter a unique name.
You can enter up to 32 letters, numbers, and symbols, except these:
`\ / : , ; * ? " < > |`
- c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

11. Click **Apply** to submit the task.

Reconnecting external systems and volumes

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

When you reconnect external systems or volumes, the preserved mapping settings and path statuses are compared to the current statuses. When the statuses and settings match, each volume is mapped, placed in Normal status, and is available for I/O operations. However, if an external volume is not ready to be resumed, the status of the disconnected volume is Blockade. If this problem occurs, see [General troubleshooting \(on page 94\)](#).

Reconnecting an external storage system and all mapped volumes

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

Before you begin

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

Procedure

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

Result

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

Reconnecting a single mapped volume

Before you begin

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

Procedure

1. Open the **External Storage** window.
 - a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - b. Click **External Storage**.
2. On the **External Storage Systems** tab, click the link for the storage system with the volume to be reconnected.
3. On the **External Path Groups** tab, click the link for a path group.
4. On the **Mapped Volumes** tab, select the external volume.
5. Click **More Actions > Reconnect External Volumes**.
6. In the **Reconnect External Volumes** window, select the row of the volume to be reconnected, and then accept or enter a new task name.
7. Click **Apply** in the confirmation window.
8. When you finish the procedure, the external volume status displays as **Checking**, and then **Normal**. If the volume cannot be resumed because the mapped settings and the external volume status are not in sync, the status becomes **Blockade**.

Requirements for external storage system maintenance

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

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

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

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

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

Procedure

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

Next steps

Before deleting external volume mapping, make sure that the volume has no LU paths and is not part of a copy pair. See [Deleting an external volume mapping \(on page 85\)](#) for instructions.

Powering off and on storage systems

The method you use for powering off and on local and external storage systems affects how data is handled.

Powering off and on external storage systems

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

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



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

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

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

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



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

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

Powering off external storage systems (scheduled shutdown)

Before you begin

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

Procedure

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

I/O operations to the external volumes are not allowed, and data in cache memory of the local storage system is written to the external volumes.
4. Perform any other operations required for powering off the external storage system.
5. Power off the external storage system.



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

Reconnecting external storage systems after powering off

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

Before you begin

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

Procedure

1. Power on the external storage system.
2. Reconnect the external system.
For details, see [Reconnecting external systems and volumes \(on page 87\)](#).
3. If any external volumes were defined as DP-VOLs in the local storage system, use the steps listed in the following procedure to restore all blocked DP-VOLs.
 - a. Open the **Pools** window.
 - i. Click **Storage Systems**, and then expand the **Storage Systems** tree.
 - ii. Click **Pools**.
 - b. On the **Pools** tab, click the link for the pool you want to block.
 - c. Select the **Virtual Volumes** tab.
 - d. Click **Select All Pages**.
 - e. On the menu bar, click **Actions > Logical Device > Restore LDEVs**.
 - f. In the **Restore LDEVs** window, confirm the settings and enter the task name in **Task Name**.
 - g. Click **Apply** in the confirmation window.

Powering off and on local storage systems

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

Powering off local storage systems (scheduled shutdown)

Procedure

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

Reconnecting local storage systems after powering off

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

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

Procedure

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

Powering off and on local and external storage systems

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

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

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

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

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

Powering off local and external storage systems

Procedure

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

Powering on local and external storage systems

Procedure

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

Chapter 6: Troubleshooting

See the following tables for troubleshooting information for Universal Volume Manager.

General troubleshooting

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

Symptom	Possible causes and troubleshooting steps
Hitachi Device Manager - Storage Navigator cannot access an external volume.	<ul style="list-style-type: none">▪ An error occurred in the switch, or the switch is off.▪ A cable between the local and external system is not connected properly.▪ The external volume was deleted in the external system.▪ An error occurred in the external volume.▪ The path is changed in the external system.▪ The port attribute in the local storage system is changed.▪ Topology information is not properly set.
An external volume cannot be mapped.	<ul style="list-style-type: none">▪ The number of mapped volumes exceeds the maximum number available for the local storage system:<ul style="list-style-type: none">- VSP 5000 series: 63,231- VSP E990: 65,279- VSP G350, VSP F350: 16,383- VSP G370, VSP F370: 32,767- VSP G700, VSP F700: 49,151- VSP G900, VSP F900: 65,279▪ There are not enough LDKC:CU:LDEV numbers available for external volume mapping.

Symptom	Possible causes and troubleshooting steps
An external volume cannot be deleted.	Forcibly delete external volumes if you cannot disconnect the external storage system or external volumes due to causes, such as removing the external storage system before you delete external volumes. To forcibly delete external volumes, select Yes for "Do you want to execute the Delete External Volumes operation without writing the cache data to the volumes?" For details about the procedure, see Deleting an external volume mapping (on page 88) (on page 85) .
An external path is blocked.	<ol style="list-style-type: none"> 1. See the preceding problem, "Device Manager - Storage Navigator cannot access the external volume". If the problem persists after correcting any errors, continue to step 2. 2. Confirm that the cables between the local and external systems are connected properly. 3. If the cables are properly connected, disconnect and then reconnect them. After 30 seconds, check the path status.
Action is required for a path status in the View External LUN Properties dialog box.	See Troubleshooting external path status (on page 97) .
The volume in the external system cannot be found even after port discovery or volume discovery was performed.	Follow any instructions given in the error message or messages and then retry the operation. If the problem persists, see Troubleshooting port and volume discovery problems (on page 110) .
As a result of the port discovery, the external storage system displayed as Unknown is added to External storage system, and the external storage system is not recognized.	The external storage system is connected by using a route that cannot be used as an external path. See Troubleshooting port and volume discovery problems (on page 110) .
The external volume is blocked.	<ul style="list-style-type: none"> ▪ 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.	<p>When errors occur in all external paths, the local storage system changes the status of the external volume to Blockade.</p> <ol style="list-style-type: none"> 1. Reconnect the volume or storage system. 2. If the volume's status still does not change to Normal, restore the path as described in the preceding problem, "The external path is blocked", and then reconnect the volume again.

Symptom	Possible causes and troubleshooting steps
The ? sign displays in the LUN ID (Highest Priority) column of the Discovered External Volumes table in the Add External Volumes window.	<p>A corresponding external volume was not found for the external path with the highest priority.</p> <p>Look for problems with the connection to the external system that failed during volume discovery. Fix any problems, and perform the operation again.</p>
External volume discovery was not completed because of failure.	<p>Look for problems with the connection to the external system; also verify that the external volume is correctly configured in the external system. Fix any problems, and then perform the operation again.</p> <p>If the error message indicates "An external volume that can be added was not found by the result of Volume Discovery. (error code: 00622-105241)", the external volume discovery might have failed because the external storage system is connected by using a route that cannot be used as an external path. See Troubleshooting port and volume discovery problems (on page 110).</p>
After reconnecting an external volume or system, 10 minutes have passed but the status has not change from Checking.	Click Refresh on the Device Manager - Storage Navigator main window. If the status remains Checking, perform the reconnect operation again.
After disconnecting an external volume or system, the status does not change.	<p>Click Refresh on the Device Manager - Storage Navigator main window.</p> <p>Note that the time required for write processing from cache to the external volume depends on volume capacity. More time is required for larger volumes. Processing speed is about 20 MB/s. However, the processing speed also depends on the performance and status of the external storage system.</p>
(VSP 5000 series) A message saying that intervention is required is issued to the mainframe host.	<p>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.</p> <p>If the device is blocked as a result of the status transition, see the row "The external volume is blocked." above.</p>
(VSP 5000 series) A message saying that the device is blocked is issued to the mainframe host.	See the row "The external volume is blocked." above.

Troubleshooting external path status

After you select External Storage from the Storage Systems tree in Storage Navigator, 'Warning' is displayed in the Status field of the **External Storage** window when there is an abnormal mapping path in the external volume group of the corresponding external storage. You can check details about the abnormal mapping path in the **View External LUN Properties** window.

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 \(on page 99\)](#). If you cannot resolve the issue, contact customer support.

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

Status	Description	Corrective action
Command aborted	The reply of the external system was ABORTEDCOMMAND. An error might have occurred on the external system side.	The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches) and correct any problems.
Busy	The external system is in the BUSY status.	The external system port is recognized. Check whether the external system configuration causes excessive load on the system. If the load is excessive, lower the load.
Response error	The external system is in blocked status caused by an abnormal reply (Response). You might not be able to access the system, or data protection might be set.	The external system port is recognized. Check the settings and status of the external system and fix any problems.
Initiator port	The port attribute of the external system has been changed to "initiator".	Set the port attribute of the external system to "target".
Destage Failed	The writing of data from cache memory to the external volume failed.	Reconnect the external volume or system. When status is Normal, disconnect the volume or system. You might need to try this multiple times.
Unknown port	The port attribute of the external system is unknown.	<p>The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches), and fix any problems.</p> <p>When alternate paths are configured for the external system, the following conditions might cause the unknown port status. If that is the case, verify the path configuration and add the required paths, if any.</p> <ul style="list-style-type: none"> ▪ The number of paths for external volume group is less than the ones for the external path group. ▪ The path configurations between the external path group and the external volume group are inconsistent.

Status	Description	Corrective action
Cannot detect port	<p>The external path has been removed or the external system port cannot be found. Possible causes are:</p> <ul style="list-style-type: none"> ▪ The cable is not properly connected. ▪ The topology does not match between the external and target ports. ▪ Because security is set on the port, the external system cannot be recognized from the local system. ▪ If the external system is connected through switches, the switch setting might be incorrect. 	<p>If you cannot restore the path after checking the possible causes, contact customer support.</p>
Internal error	<p>A program error occurred, or there is a logical contradiction.</p>	<p>Contact customer support.</p>
Timeout	<p>Processing was retried after an abnormal reply. However, processing stopped because of a timeout.</p>	<p>The external system port is recognized. Check external system settings and the physical connection to the external system (cables and switches).</p>
Device check error	<p>An external volume is mapped, but you cannot access the volume in the external system.</p>	<p>Check the status of the volume in the external system and take any necessary corrective action.</p> <p>Format the volume if it is not formatted.</p>
Medium error	<p>The external volume has become inaccessible.</p>	<p>Check the status of the volume in the external system and take any necessary corrective action.</p> <p>Format the volume if it is not formatted.</p>

Troubleshooting path errors for specific storage systems

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

VSP 5000 series troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete an LU and then add an LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, ShadowImage, or global-active device. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. <p>Verify whether the cables are connected correctly, and then set the ports correctly by using LUN Manager.</p> <p>LUN security might have been enabled by using LUN Manager. If so, verify whether the LUN security setting is correct.</p>

VSP G1x00 and VSP F1500 troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, ShadowImage, Thin Image, or global-active device. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by using LUN Manager. If so, check whether the LUN security setting is correct.

VSP and HUS VM, and USP VM troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, or ShadowImage. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

VSP E990, VSP G/F350, G/F370, G/F700, G/F900 troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings might have been changed by using LUN Manager. If this happens, either: <ul style="list-style-type: none"> • Use LUN Manager to change the settings back to the values used when the volume was mapped. • Use Universal Volume Manager software to delete the LU, and then add it again. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as ShadowImage, TrueCopy, Universal Replicator, or global-active device. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

VSP G200, G/F400, G/F600, G/F800 troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings might have been changed by using LUN Manager. If this happens, either: <ul style="list-style-type: none"> • Use LUN Manager to change the settings back to the values used when the volume was mapped. • Use Universal Volume Manager software to delete the LU, and then add it again. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as ShadowImage, TrueCopy, Universal Replicator, or global-active device. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. <p>Make sure the cables are connected correctly, and then use LUN Manager to set the ports properly.</p> ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

HUS, AMS, WMS troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

TagmaStore USP/NSC troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Lightning 9900 V troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy, Universal Replicator, or ShadowImage. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Lightning 9900 troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU.

Path Status	Description and corrective actions
Illegal request or Response error	The volume might be set for a data copy pair. Make sure that the volume is not set as a HOMRCF or HORC pair. If it is set, the volume might be protected. If it is protected, change the pair status or delete the pair.
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Thunder 9500V troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as TrueCopy or ShadowImage. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.

Path Status	Description and corrective actions
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ The host group LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

SVS200 troubleshooting

Path Status	Description and corrective actions
External device setting changed	<ul style="list-style-type: none"> ▪ LU path settings can be changed by using LUN Manager. Either change the settings back to the values used when the volume was mapped, or use Universal Volume Manager software to delete LU and then add LU. ▪ The access attribute of the volume might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.
Illegal request or Response error	<ul style="list-style-type: none"> ▪ If the volume is a pair volume, it might be protected because of the pair status. If this is the case, change the pair status or delete the pair. Make sure the volume is not set to a pair such as Business Copy XP, Continuous Access XP, Continuous Access XP Journal. ▪ The volume's access attribute might have been changed by Data Retention Utility. If the volume is protected by the access attribute, release the protection.

Path Status	Description and corrective actions
Cannot detect port	<ul style="list-style-type: none"> ▪ There is a problem with connection to the external storage system. The possible causes are: <ul style="list-style-type: none"> • Cable connection. Make sure the cable is connected correctly. • Port settings. The topology settings of the local storage system port and the external storage system port might not match. Use LUN Manager to make sure that the ports are set properly. • Switch settings. If the external storage system is connected through switches, make sure that the switch settings are correct. ▪ LUN security might have been enabled by LUN Manager. If so, check whether the LUN security setting is correct.

Troubleshooting port and volume discovery problems

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

Problem	Corrective action
The port on the local storage system and port on the external system are not connected.	Connect the external port of the local system and the external system port.
The cable for the switch is not connected correctly, or the switch's port is blocked.	Connect the cable to the correct port on the switch. Or change the port status to Normal status.
Zoning for the switch is not set appropriately.	Make sure the zoning configuration allows the external port of the local system to communicate with the external system port.
External volume returned RESERVATION CONFLICT.	Release the reserved state of the external volume.
Port security is set on the external system.	Cancel the port security setting or change the security of the external system so that the local system can access the port of the external system.
No LU is configured on the external system port.	Configure an LU on the port.

Problem	Corrective action
<p>External volume capacity is less than the supported capacity for Universal Volume Manager.</p>	<p>Perform one of the following:</p> <ul style="list-style-type: none"> ▪ 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.
<p>The external volume is configured as a management LU.</p>	<p>If a management LU, such as Universal Xport LU, is configured on the external system port, perform one of the following:</p> <ul style="list-style-type: none"> ▪ 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.
<p>Remote command devices of the external system are cascaded.</p>	<p>Perform one of the following:</p> <ul style="list-style-type: none"> ▪ 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.
<p>External system information retrieved by port discovery is not found in the profile information.</p>	<p>Perform one of the following:</p> <ul style="list-style-type: none"> ▪ Connect an external system supported by Universal Volume Manager. ▪ Contact customer support to ask if the external system is supported by Universal Volume Manager. If the system is supported, install the firmware version that supports the external system or install the profile information of the external system.
<p>Login to the external system failed.</p>	<p>Perform one of the following:</p> <ul style="list-style-type: none"> ▪ Make sure that the port status of the external system is Normal. ▪ Register the WWN to the external system to allow login from the local system.

Problem	Corrective action
<p>The external volume is not in Normal status, or a failure or error occurred in retrieving information from the external system.</p>	<p>Make sure that the status of the external system or the external volume is Normal.</p>
<p>The external storage system is connected by using a route that cannot be used as an external path.</p>	<p>If the result of the port discovery is Unknown, the following route that cannot be used as an external path is used:</p> <p>The route being used for I/O path for which a port on the external storage system is defined as a source port and a port on the local storage system as a target port.</p> <p>Connect the external storage system by using routes other than the above.</p>
<p>(VSP 5000 series) The external system is not connected to the Bidirectional port on the local system.</p>	<p>Connect the external system to the bidirectional port of the local system. If necessary, change the local system port setting to Bidirectional.</p>

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.

Appendix A: Supported external storage systems

External systems

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



Note: Not all information on supported systems is provided here. If you do not find your storage system, refer to <https://knowledge.hitachivantara.com/Documents> for a complete listing.

VSP 5000 series

Use the following settings on the external system:

- The port on VSP 5000 series storage systems connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C:(Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on VSP 5000 series storage systems connected to the local storage system must be set to Target port or Bidirectional port.

VSP G1x00 and VSP F1500

Use the following settings on the external system:

- The port on VSP G1x00 and VSP F1500 storage systems connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C:(Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on VSP G1x00 and VSP F1500 storage systems connected to the local storage system must be set to Target port.
- If the external storage system uses Data Retention Utility, set System Option Mode (SOM) 701 to ON on the local storage system.

VSP E990

Use the following settings on the external system:

The port on VSP E990 connected to the local storage system must be set to the host group for the Windows hosts (host mode 2C: Windows Extension or host mode 0C: (Deprecated) Windows). There are no functional differences between the host modes 2C and 0C. It is recommended to set the host mode 2C.

VSP G130, G/F350, G/F370, G/F700, G/F900

Use the following settings on the external system:

The port on VSP G130, G/F350, G/F370, G/F700, G/F900 connected to the local storage system must be set to the host group for the Windows hosts (host mode 2C: Windows Extension or host mode 0C: (Deprecated) Windows). There are no functional differences between the host modes 2C and 0C. It is recommended to set the host mode 2C.

VSP G200, G/F400, G/F600, G/F800

Use the following settings on the external system:

The port on VSP G200, G400, G600, G800 or VSP F400, F600, F800 connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C: (Deprecated) Windows or host mode 2C: Windows Extension).

VSP

Use the following settings on the external system:

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

HUS VM

Use the following settings on the external system:

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

USP V/VM

Use the following settings on the external system:

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

TagmaStore USP/NSC

Use the following settings on the external system:

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

Host mode option for a volume larger than 2 TB

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

XP8

Use the following settings on the external system:

- The port on XP8 storage systems connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C:(Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on XP8 storage systems connected to the local storage system must be set to Target port or Bidirectional port.

XP7

Use the following settings on the external system:

- The port on XP7 storage systems connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C: (Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on XP7 storage systems connected to the local storage system must be set to Target port.
- If the external storage system uses Data Retention Utility, set System Option Mode (SOM) 701 to ON on the local storage system.

Lightning 9900 V

Use the following settings on the external system:

- The port on the Lightning 9900 V storage system connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C: (Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on the Lightning 9900 V storage system connected to the local storage system must be set to Target port.

Lightning 9900

Use the following settings on the external system:

- The port on the Lightning 9900 storage system connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C: (Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on the Lightning 9900 storage system connected to the local storage system must be set to Target port.

Thunder 9500V

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

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

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

Window Names	Parameters	Parameter Settings
System Startup Settings	Start Attribute	
	Single Mode	Use when the Thunder 9500V is in a one-controller configuration.
	Dual Active Mode	Use when the Thunder 9500V is in a two-controller configuration. Be sure to specify that Data Share Mode will be used.
	Hot Stand-By Mode	Do not specify this parameter.
Common 1	Delay Planned Shutdown	Optional
OPTION 1	SCSI Fibre Channel Common Options	Optional
OPTION 2	SCSI Fibre Channel Common Options	Optional
Data Striping	Operation if the processor failure occurs	Reset if 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

Window Names	Parameters	Parameter Settings
	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	XXXXXXXXXXXXXXXX0
		XXXXXXXXXXXXXXXX1
	Controller 1	XXXXXXXXXXXXXXXX2
XXXXXXXXXXXXXXXX3		
9580V 9585V	Controller 0	XXXXXXXXXXXXXXXX0
		XXXXXXXXXXXXXXXX1

Model	Controller	WWN of Port
		XXXXXXXXXXXXXXXXX2 XXXXXXXXXXXXXXXXX3
	Controller 1	XXXXXXXXXXXXXXXXX4 XXXXXXXXXXXXXXXXX5 XXXXXXXXXXXXXXXXX6 XXXXXXXXXXXXXXXXX7
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

System parameters must be specified for ports on HUS, AMS, and WMS storage systems when used with Universal Volume Manager. You can specify or omit any other parameters. Also, ensure the following two settings using Storage Navigator Modular or Storage Navigator Modular2:

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

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

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

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

Storage System	Displayed Serial Number	Model
HUS	95XXXXXX	HUS 150
	93XXXXXX	HUS 130
	91XXXXXX	HUS 110
AMS	87XXXXXX	AMS 2500
	85XXXXXX	AMS 2300
	83XXXXXX	AMS 2100, AMS 2010

Storage System	Displayed Serial Number	Model
	77XXXXXX	AMS 1000
	75XXXXXX	AMS 500
	73XXXXXX	AMS 200
WMS	71XXXXXX	WMS 100
In serial numbers, "X" is an arbitrary number or character.		

When the model of HUS/AMS/WMS storage system is changed, the Serial Number is changed as well. If the HUS/AMS/WMS storage system is used as an external storage system, the mapped external volume might be blocked. To correct this problem, you can delete the mapping of the external volume and remap it to use the blocked external volume. See [Requirements for external storage system maintenance \(on page 88\)](#) for detailed information on remapping.

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

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

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

Model	Controller	WWN of Port
AMS 200	Controller 0	XXXXXXXXXXXXXXXXX0
WMS 100	Controller 1	XXXXXXXXXXXXXXXXX1
AMS 2100	Controller 0	XXXXXXXXXXXXXXXXX0
AMS 2010		XXXXXXXXXXXXXXXXX1
AMS 500	Controller 1	XXXXXXXXXXXXXXXXX2
		XXXXXXXXXXXXXXXXX3
HUS 110	Controller 0	XXXXXXXXXXXXXXXXX0
HUS 130		XXXXXXXXXXXXXXXXX1
AMS 2300		XXXXXXXXXXXXXXXXX2
AMS 1000		XXXXXXXXXXXXXXXXX3
	Controller 1	XXXXXXXXXXXXXXXXX4
		XXXXXXXXXXXXXXXXX5
		XXXXXXXXXXXXXXXXX6

Model	Controller	WWN of Port
		XXXXXXXXXXXXXXXXX7
HUS 150 AMS 2500	Controller 0	XXXXXXXXXXXXXXXXX0
		XXXXXXXXXXXXXXXXX1
		XXXXXXXXXXXXXXXXX2
		XXXXXXXXXXXXXXXXX3
		XXXXXXXXXXXXXXXXX4
		XXXXXXXXXXXXXXXXX5
		XXXXXXXXXXXXXXXXX6
	Controller 1	XXXXXXXXXXXXXXXXX8
		XXXXXXXXXXXXXXXXX9
		XXXXXXXXXXXXXXXXXA
		XXXXXXXXXXXXXXXXXB
		XXXXXXXXXXXXXXXXXC
		XXXXXXXXXXXXXXXXXD
		XXXXXXXXXXXXXXXXXE
XXXXXXXXXXXXXXXXXF		
Note: In WWNs, "X" is an arbitrary number or character. The ports in a physical storage system have the identical value.		

When the model of HUS/AMS/WMS storage system is changed, the WWN of the port is changed as well. If the HUS/AMS/WMS storage system is used as an external storage system, the mapped external path might be blocked. To correct this problem, you can delete the mapping of the external path and remap it to use the blocked external path. See [Requirements for external storage system maintenance \(on page 88\)](#) for detailed information on remapping.

Identifying logical volumes using Volume Properties

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

Caution on using the power savings option

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

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

HUS and AMS 2000 series guidelines

- If a failure occurs in an HUS or AMS 2000 series system, responses from local storage systems to the HUS or AMS 2000 series system might be delayed. To prevent requests from external storage systems from timing out, configure the local storage systems as follows:

- Set the I/O timeout value of the local storage system to 35 seconds.
- Set the timeout value of the external storage system to $(I/O\text{-}timeout\text{-}value \times 2) + margin$. For example:

$$(35 \text{ seconds} \times 2) + 10 \text{ seconds} = 80 \text{ seconds}$$

- Avoid unnecessary load to the external storage system. Path mode between storage systems is Multi mode. Therefore, when many external paths and mapping volumes are mapped, the load to the external system is high, and some commands from a host to the local storage system or from the local storage system to an external system might time out. To keep the proper load, the following settings are recommended:
- Specify two external paths. Set the paths to the ports of each controller of the AMS 2000 series system.
- Set the queue to 500 or fewer commands issued at the same time from a AMS 2000 series system. The formula to calculate the number of queue commands per system is as follows.

$$number\text{-}of\text{-}queues \times number\text{-}of\text{-}external\text{-}paths \times number\text{-}of\text{-}concurrent\text{-}external\text{-}volume\text{-}commands < 500$$

For more information about command queue settings, see [Changing the port settings of an external storage system \(on page 72\)](#).

- 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 on the SVS200 storage system connected to the local storage system must be set to the host group for the Windows hosts (host mode 0C: (Deprecated) Windows or host mode 2C: Windows Extension).
- The attribute of the port on the SVS200 storage system connected to the local storage system must be set to Target port.

EVA storage systems

Use the following settings on the external system:

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

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

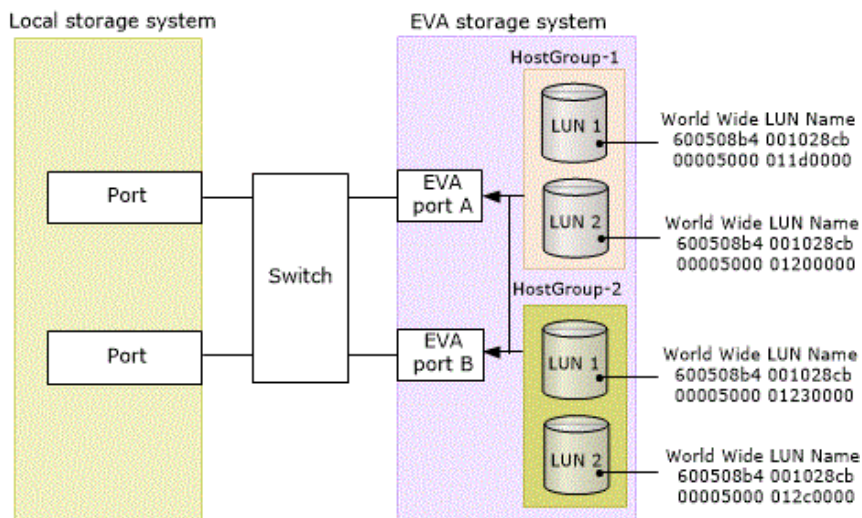
Parameter		Parameter Setting
Add a Host	Host OS	Windows

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

Identifying logical volumes using Device ID

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

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



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

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

HPE Nimble Storage

A local storage system uses HPE Nimble Storage (which supports ALUA) in Active/Standby configuration, and treats the standby paths as blocked paths. Even if some of the paths are blocked, it is not a problem if the paths connected to the active controller work normally.

HPE Primera A630, A650, A670, C630, C650, C670

System option parameters for connecting HPE Primera A630, A650, A670, C630, C650, C670

When you connect HPE Primera A630, A650, A670, C630, C650, C670 as an external storage system, you must set a system parameter according to the following table. For connection parameters not shown, refer to the documentation for your model.

Parameter	Parameter Setting
host type	generic-ALUA (generic or generic-legacy)

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

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 Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

System option parameters for connecting Sun StorEdge 6120/6320

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

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

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

Parameter	Parameter Setting
port host	SUN

Sun StorageTek FlexLine 380

System Option Mode for connecting Sun StorageTek FlexLine 380

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

For more information about using SOM 725, log on to the Hitachi Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

System option parameters for connecting Sun StorageTek FlexLine 380

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

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

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

Sun StorageTek 2540

System Option Mode for connecting Sun StorageTek 2540

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

For more information about using SOM 725, log on to the Hitachi Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

System option parameters for connecting Sun StorageTek 2540

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

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

Parameter	Parameter Setting
host type	Windows 2K non Clustered DMP

Sun StorageTek V2X2

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



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

EMC CLARiiON CX series

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

System option modes for connecting EMC CLARiiON CX series

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

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

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

For more information about using SOM 725 and SOM 1021, log on to the Hitachi Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

System parameters for connecting EMC CLARiiON CX series

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

Parameter	Setting
Initiator Type	CLARiiON Open
Failover Mode	2
ArrayCommPath	Disabled

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



Note:

- Volumes created with Individual Disk Units (JBOD disks) of EMC CLARiiON CX series are not supported.
- For each port in the EMC CLARiiON CX side, make sure to define LUN 0 (VSP E990 and VSP G350, G370, G700, G900) or the LU number (VSP 5000 series).

EMC VNX series

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

System option modes for connecting EMC VNX series

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

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

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

For more information about using SOM 725 and SOM 1021, log on to the Hitachi Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

System parameters for connecting EMC VNX series

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

Parameter	Setting
Initiator Type	CLARiiON Open
Failover Mode	2
ArrayCommPath	Disable

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



Note:

- Volumes created with Individual Disk Units (JBOD disks) of EMC CLARiiON VNX series are not supported.
- For each port in the EMC CLARiiON VNX side, make sure to define LUN 0 (VSP E990 and VSP G350, G370, G700, G900) or the LU number (VSP 5000 series).

EMC Symmetrix series/DMX series/V-MAX

Universal Volume Manager treats DMX series and V-MAX as EMC Symmetrix series.

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

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

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

Parameter*	Parameter Setting	
	Override Checked?	Enable Checked?
SCSI_3(SC3) flag	Yes	Yes
SCSI_Support1(OS2007)	Yes	No
SPC2_Protocol_Version(SPC 2) flag	Yes	No
* The Consistent LUNs parameter should also be checked.		

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

IBM® DS3000/DS4000/DS5000 series

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

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

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

IBM® V7000 series

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

Parameter	Parameter setting
host type	generic

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

IBM® SVC series

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

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

Parameter	Parameter Setting
host type	generic

IBM® XIV series

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

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

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

Fujitsu FibreCAT CX series

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

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

Parameter	Parameter Setting
Initiator Type	CLARiiON Open
Failover Mode	2

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

System option mode for connecting Fujitsu FibreCAT CX series

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

For more information about using SOM 725, log on to the Hitachi Vantara Support Connect: <https://knowledge.hitachivantara.com/Documents>

Fujitsu ETERNUS DX60/80/90 S2 and Fujitsu ETERNUS 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 ETERNUS DX60/80/90 S2 or Fujitsu ETERNUS DX400 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

Fujitsu ETERNUS DX8900 S4/DX8900 S3/DX8700 S3/DX60 S5/DX100 S5/DX200 S5/DX500 S5/DX600 S5/DX900 S5/AF150 S3/AF250 S3/AF650 S3

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 ETERNUS DX8900 S4/DX8900 S3/DX8700 S3/DX60 S5/DX100 S5/DX200 S5/DX500 S5/DX600 S5/DX900 S5/AF150 S3/AF250 S3/AF650 S3 documentation.

Parameter	Parameter Setting
Setup Host Response	Default

SGI IS4600 series

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

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

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

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

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

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

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

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

Settings and considerations for connecting to Linux or Window 2012 servers

Considerations for connecting to Linux Servers

When connecting to Linux servers via iSCSI, please note:

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

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

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

Considerations for connecting to LinuxIO (LIO)

When connecting to LinuxIO (LIO) via iSCSI, do not use external volumes beyond their usage as a Quorum disk for global-active device operations.

Considerations for connecting to Windows Server 2012

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

Considerations for connecting to Windows Server 2016 Datacenter

When connecting to Windows Server 2016 Datacenter via iSCSI, do not use external volumes beyond their usage as a Quorum disk for global-active device operations.

Connection to storage systems from other vendors

If connecting another vendor's storage system as an external storage system, a port needs to be configured as a target port connected to a Windows host. The external storage system might have settings that prohibit access from the local storage system. In such a case, you must configure the settings to allow access from the local storage system. For detailed information, please contact the third party vendor.

Storage system with a product name displayed as (generic)

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

Support conditions when product name displays as (generic)

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

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

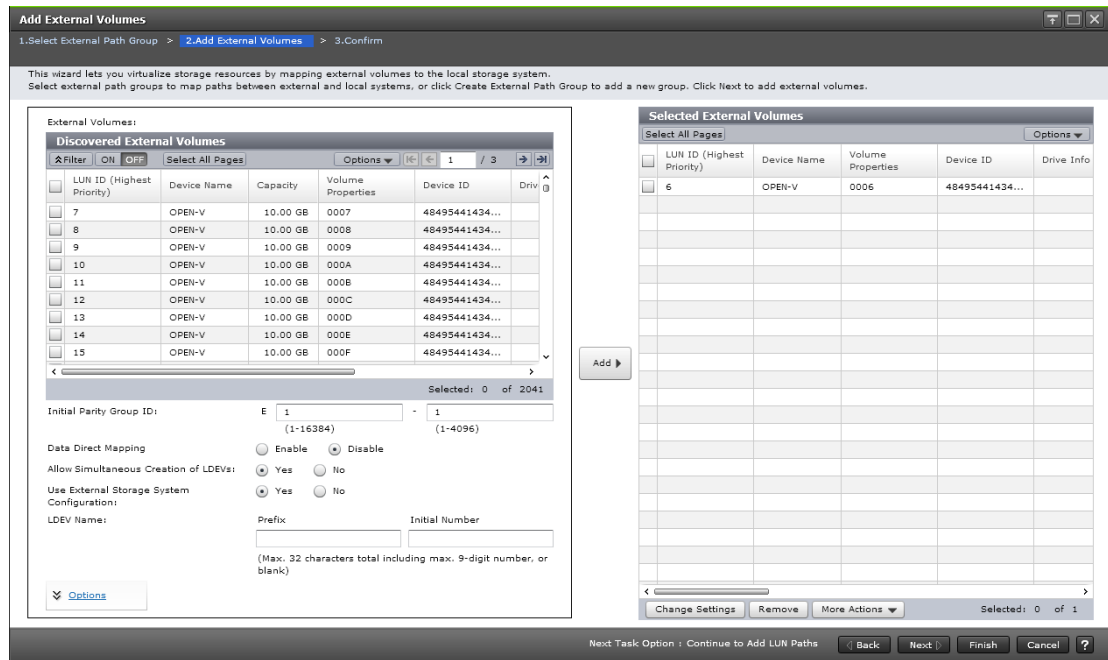


Note: If multiple generic storage systems of the same vendor are connected, they are displayed as a single storage system. As a result, if Disconnect External Storage Systems or Reconnect External Storage Systems is run for generic storage systems, all the generic storage system volumes are disconnected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

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

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

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



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

Virtualization support requirements

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

Suggested virtualization procedure

**Note:**

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

Procedure

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

Appendix B: Using a remote command device

When you configure a remote command device in your storage system, you can perform operations in an externally attached storage system by issuing Command Control Interface (CCI) commands to the remote command device in your (local) storage system.

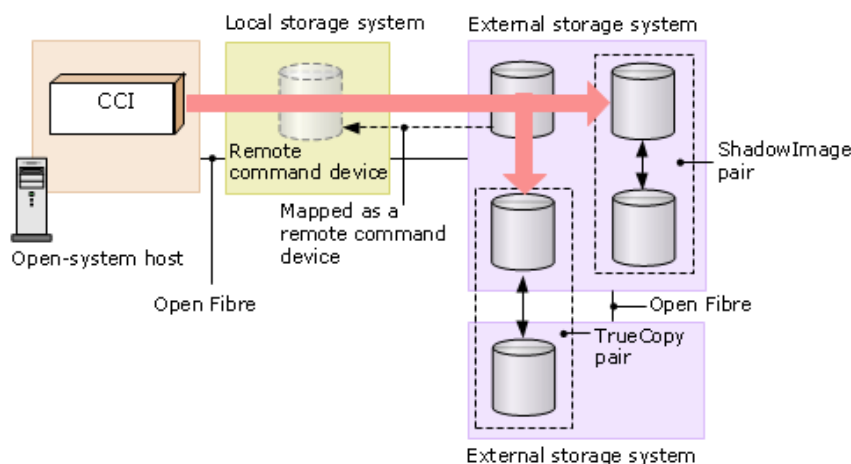
Overview of remote command devices

A remote command device is a volume that is used to transfer CCI commands to a command device on an external storage system. To use a remote command device, you map to an external volume that is already configured as a CCI command device on the external storage system. The mapped volume then becomes a remote command device.

After mapping to an external command device, you can issue CCI commands (for example, ShadowImage, TrueCopy, or other commands) to the remote command device in the local storage system. The CCI commands are relayed from the remote command device to the command device in the external storage system where they are executed, as shown in the following figure.



Note: When you map to an external command device, the license for Universal Volume Manager is not required.



Requirements for mapping a command device as a remote command device

This table shows requirements for mapping a command device as a remote command device.

Item	Requirement
(VSP 5000 series) Emulation type	OPEN-V
Number of LDEVs in an external volume	1
Cache mode	Disable
Minimum capacity	96,000 Blocks (about 47 MB)
Maximum capacity	4 TB
Maximum number of the available CCI instances per remote command device	16 However, the maximum number of available CCI instances might be less, depending on the number of paths between the local storage system and an external storage system.

Restrictions and other information

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

- The remote command device cannot be identified by port discovery or volume discovery process that takes place during the mapping operation.
- When an external storage system (A) has a remote command device (B) (that is, when a command device in another external storage system (C) is mapped to this external storage system (A)), make sure that the remote command device (B) does not have the smallest LUN on the port in the external storage system (A).
- You cannot send I/O to the remote command device.
- You cannot receive I/O from the remote command device.
- You cannot set command device disable on the remote command device.
- You cannot set command device security on the remote command device.
- Do not set the command device security on the external storage system side for the command device that is mapped as a remote command device.
- You cannot create CVs in 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 systems is listed in [Supported external system path mode for external volumes \(on page 27\)](#).
- 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.

Supported remote command device storage systems and information

You can map command devices in the following external storage systems as a remote command device in the local storage system. After the remote command device is mapped, the device appears in the Device Name column of the **Mapped Volumes** window as follows:

Storage system	Information displayed in Device Name column
VSP E990 VSP G350, G370, G700, G900, F350, F370, F700, F900 VSP G200, G400, G600, G800, VSP F400, F600, F800 VSP 5000 series VSP G1000, G1500, VSP F1500 Virtual Storage Platform Unified Storage VM Universal Storage Platform V Universal Storage Platform VM SANRISE Universal Storage Platform SANRISE Network Storage Controller SANRISE9900V series TagmaStore Universal Storage Platform TagmaStore Network Storage Controller Lightning 9900V series	Format: "Emulation Type" + "-CM" Example: OPEN-V-CM

Storage system	Information displayed in Device Name column
VX7 VP9500 H24000 H20000 SANRISE H12000 SANRISE H10000 SANRISE H1024/H128 XP8 Storage XP7 Storage P9500 XP24000, XP20000 XP12000, XP10000 XP1024/XP128	
Unified Storage Adaptable Modular Storage Workgroup Modular Storage SANRISE9500V series Thunder 9500V series	DF600F-CM

Appendix C: Command Control Interface command reference

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

Device Manager - Storage Navigator actions and CCI commands

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

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

Ranges of parameters for CCI command options

The following table specifies the valid ranges of parameters for CCI command options. For details, see the Command Control Interface Command Reference.

Parameter	Range
External volume path group number	0 to 63,231
External volume group number	gno: 1 to 16,384 sgno: 1 to 4,096

Appendix D: Universal Volume Manager GUI reference

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

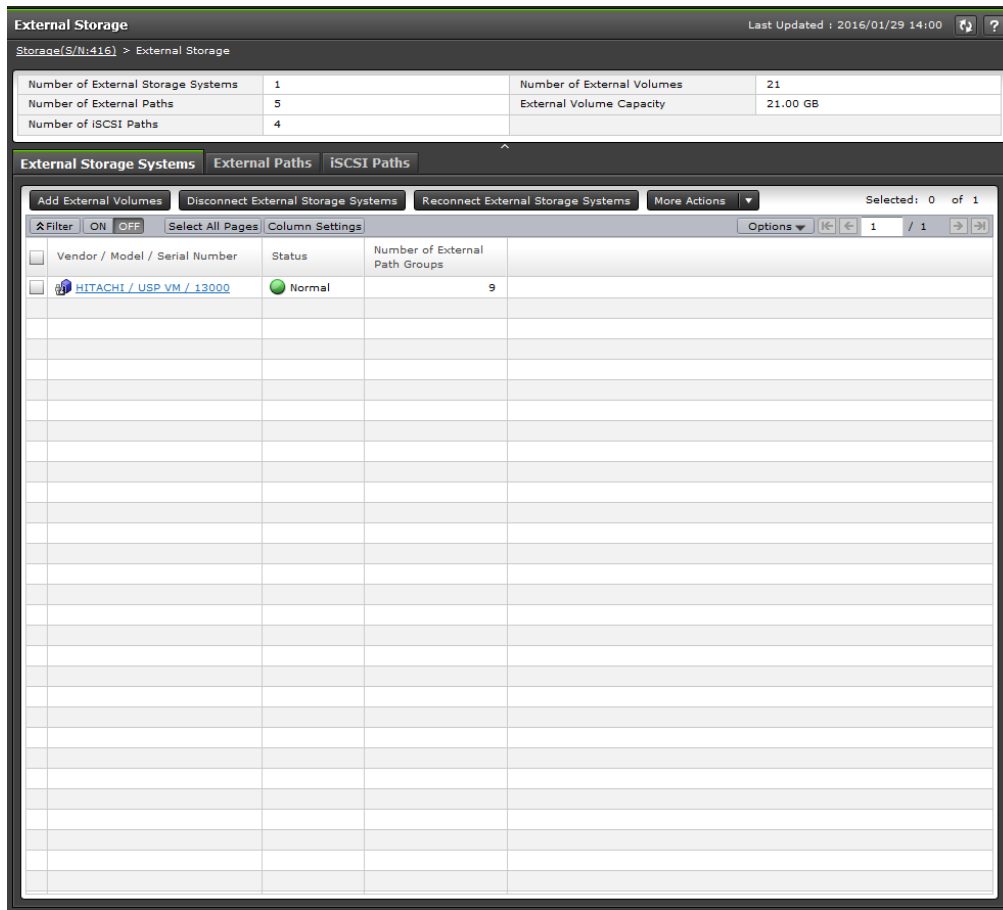
External Storage window

Summary

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

External Storage Systems tab

Use this tab to view information about 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	Status of the external volume: <ul style="list-style-type: none"> 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.

Item	Description
	<ul style="list-style-type: none"> ▪ 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

External Paths tab

Use this tab to view information about the paths connecting mapped external volumes in the external system to your storage system.

Port ID	Type	Virtual Port ID	External IP Address	WWN / iSCSI Target Name	Vendor / Model / Serial Number	Status	QDepth	I/O Timeout(sec)	Blocked Monitor
CLA-D	iSCSI	0	192.168.0.85	iqn.1994-04.jp.co.hitachi.rsd....	HITACHI / VSP G1000 / 00050	Normal	8	15	
CLA-D	iSCSI	15	192.168.0.85	iqn.1994-04.jp.co.hitachi.rsd....	HITACHI / VSP G1000 / 00050	Normal	8	15	
CLC-D	iSCSI	0	192.168.0.86	iqn.1994-04.jp.co.hitachi.rsd....	HITACHI / VSP G1000 / 00050	Normal	8	15	

Item	Description
Port ID	Port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system

Item	Description
External	Information about the target port of the external storage system: <ul style="list-style-type: none"> IP Address: Target port IP address when the port type is an iSCSI port. TCP Port Number¹: Target TCP port number when the port type is an iSCSI port. Not displayed by default. To display the item, change the settings in the Column Settings window. WWN / iSCSI Target Name: WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI port, the iSCSI target name is displayed.
Vendor / Model / Serial Number	Identifying information for the external system
Status	Status of external paths: <ul style="list-style-type: none"> 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 the default. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of read/write commands that can be queued at one time is the total of the QDepth values of all the external paths.
I/O Timeout(sec.)	Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.

iSCSI Paths tab

Local			Remote						
Port ID	Virtual Port ID	CHAP User Name	IP Address	TCP Port Number	iSCSI Target Name	Authentication Method	Mutual CHAP	CHAP User Name	Used
	0		192.168.0.85	3260	iqn.1994-04.j...	None	Disabled		Yes
	15		192.168.0.85	3260	iqn.1994-04.j...	None	Disabled		Yes
	0		192.168.0.86	3260	iqn.1994-04.j...	None	Disabled		No
	0		192.168.0.86	3260	iqn.1994-04.j...	None	Disabled		Yes
	2		192.168.0.86	3260	iqn.1994-04.j...	None	Disabled		No
	2		192.168.0.86	3260	iqn.1994-04.j...	None	Disabled		No

Item	Description
Local	Local storage system port information: <ul style="list-style-type: none"> Port ID: Port ID Virtual Port ID: Virtual port ID CHAP User Name: CHAP user name, if specified
Remote	Remote storage system port information: <ul style="list-style-type: none"> IP Address: IP address TCP Port Number: TCP port number iSCSI Target Name: iSCSI target name Authentication Method: Method for authentication Mutual CHAP: Mutual CHAP setting CHAP User Name: CHAP user name, if specified
Used	Whether volume is mapped as an external volume: <ul style="list-style-type: none"> Yes: Used as an external path. No: Not used as an external path.

Selected external storage system window

The screenshot displays the 'External Path Groups' configuration window in the Hitachi Universal Volume Manager GUI. The window title is 'HITACHI / VSP G1000 / 00050' and it shows the system status as 'Normal'. Key details include: Vendor/Model/Serial Number: HITACHI / VSP G1000 / 00050, Number of External Volumes: 2, and External Volume Capacity: 204.80 MB.

The main table lists the configured external path groups:

External Path Group ID	Status	Type	Top Priority Path		External IP Address	External WWN / iSCSI Target Name	Number of External Paths	Number of External Vo
			Port ID	Virtual Port ID				
EPPathGroup0	Normal	iSCSI	CLC-D	0	192.168.0.86	iqn.1994-04.jp.co.hitachirrd.r0.t.0...	2	
EPPathGroup1	Normal	iSCSI	CLA-D	0	192.168.0.85	iqn.1994-04.jp.co.hitachirrd.r0.t.0...	1	

Summary

Item	Description
Status	<p>Status of external storage systems:</p> <ul style="list-style-type: none"> ▪ 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.
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 volume

External Path Groups tab

Item	Description
External Path Group ID	<p>Name of the external path group.</p> <p>When the link is clicked, the list of the group's external paths is displayed.</p>
Status	<p>Status of external path groups:</p> <ul style="list-style-type: none"> ▪ 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
	<ul style="list-style-type: none"> ▪ Cache Destage: The writing of data from cache memory to the external volume is in progress. ▪ Warning: There are mapping paths whose status is not normal. You can check their status in the View External LUN Properties window. ▪ Blockade: The mapping path is blocked. ▪ Destage Failed: The writing of data from cache memory to the volume is failed.
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port ▪ Mixed: Configuration with Fibre Channel and iSCSI ports
Top Priority Path	External path that has the highest priority: <ul style="list-style-type: none"> ▪ Port ID: External port of the local storage system. ▪ Virtual Port ID: Virtual port of the local storage system when the port type is iSCSI. ▪ External IP Address : For iSCSI ports, target port IP address. ▪ External TCP Port Number*: For iSCSI ports, target TCP port number. Not displayed by default. To display the item, change the settings in the Column Settings window. ▪ External WWN / iSCSI Target Name: <ul style="list-style-type: none"> • For Fibre Channel ports, WWN of the target port. • For iSCSI ports, iSCSI target name
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

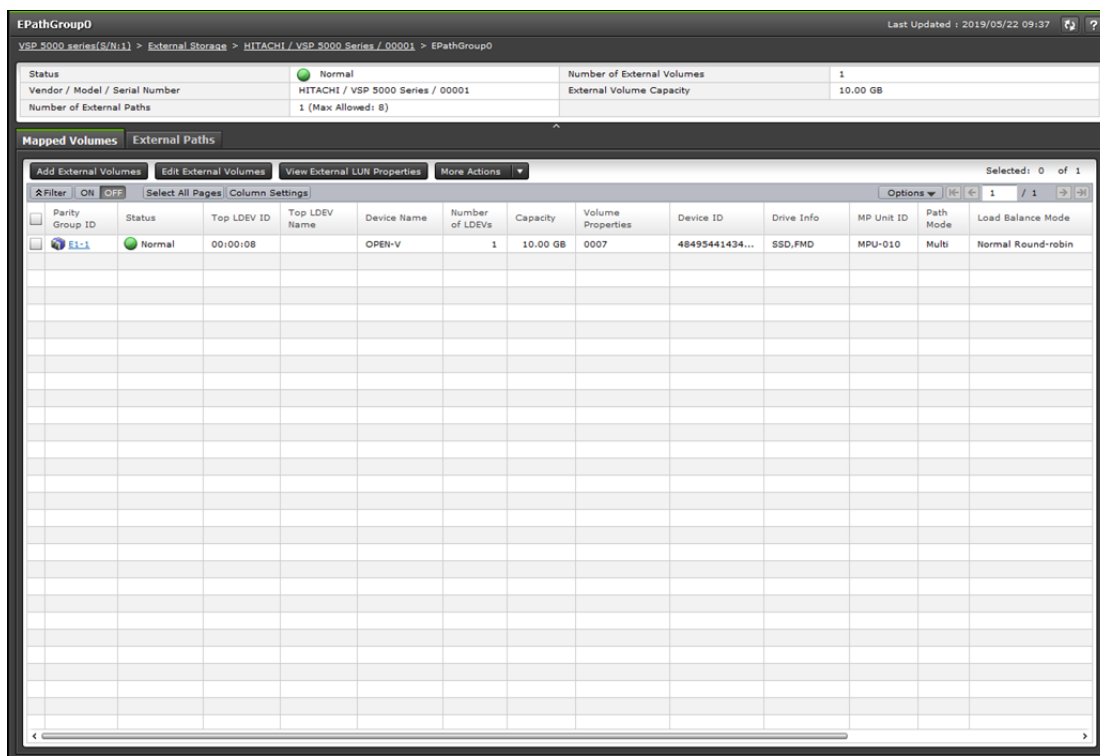
Selected external path group window

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

Item	Description
Status	Status of path groups: <ul style="list-style-type: none"> ▪ Normal: There are no problems, the path group is usable. ▪ Disconnect: The path group has been intentionally disconnected. ▪ Checking: The system is checking the mapping path status. ▪ Unknown: The status of the mapping path is not known. ▪ Cache Destage: The writing of data from cache memory to the external volume is in progress. ▪ Warning: There are mapping paths whose status is not normal. You can check their status in the View External LUN Properties window. ▪ Blockade: The mapping path is blocked. ▪ Destage Failed: The writing of data from cache memory to the volume is failed.
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

The external volumes mapped to your storage system using the selected path group are displayed.



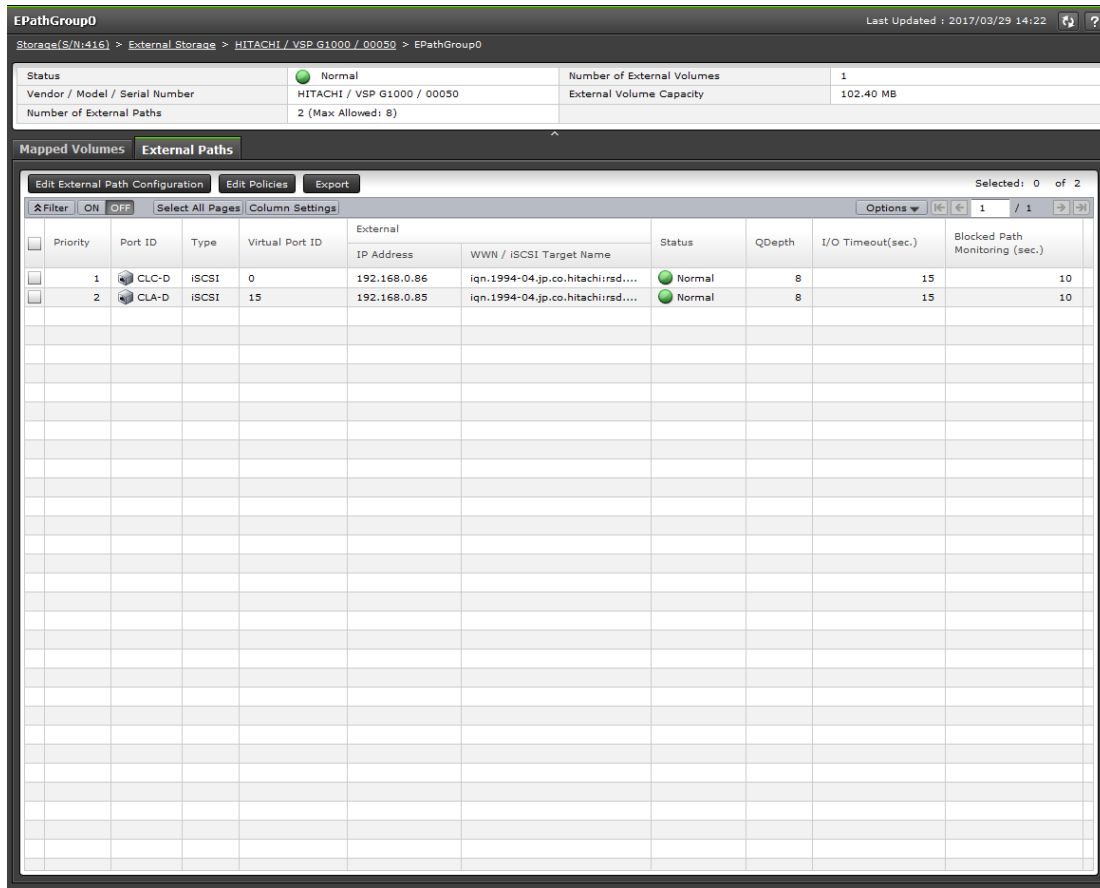
Item	Description
Parity Group ID	Parity group numbers for the mapped external volumes. When the link is clicked, a list of LDEVs in the mapped volume and parity group is displayed.
Status	<p>Status of the external volume:</p> <ul style="list-style-type: none"> ▪ Normal: There are no problems, the volume 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.

Item	Description
Top LDEV ID	External volume's top LDEV ID
Top LDEV Name	External volume's top LDEV name
Device Name	Product ID of Standard Inquiry. This is the name defined by the standard body that controls SCSI. This name varies according to the storage system vendor. For example, for some enterprise storage systems, the emulation type is displayed.
Number of LDEVs	Number of LDEVs created in the external volume
Capacity	Capacity of the external volume
Volume Properties	<p>Identification number of the external volume.</p> <p>The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.</p>
Device ID	Identification number of the external volume
Drive Info	<p>Information about the external volume's drive type:</p> <ul style="list-style-type: none"> ▪ SATA: Drive type of external volumes is SATA. ▪ SSD,FMD: Drive type of external volumes is SSD or FMD. ▪ (For VSP 5000 series) SCM: Drive type of external volumes is SCM. SCM is displayed only when the SCM drive is mounted on a VSP 5000 series storage system. SSD, FMD is displayed, however, when the DKCMAIN program version is earlier than 90-04-04-00/00.
MP Unit ID	ID of the MP unit allocated to the external volume
Path Mode	<p>Path mode for the external volume's external path:</p> <ul style="list-style-type: none"> ▪ Single: Ordinarily, only one external path is used even if alternate paths are set. Alternate paths are available in case of failure. ▪ Multi: Multiple paths are used at the same time. ▪ ALUA: Like Multi, all paths are used; however, they are not used when connected to ports in Passive status. <p>See External paths (on page 26) for more information.</p>

Item	Description
<p>Path Mode on Profile</p> <p>Not displayed by default. To display the item, change the setting in the Column Settings window of the table option.</p>	<p>Path mode on the profile information of the external storage system:</p> <ul style="list-style-type: none"> ▪ Single: Ordinarily, only one external path is used even if alternate paths are set. ▪ Multi: When alternate paths are set, external paths from several ports are used simultaneously with load balancing.
<p>ALUA Settable</p> <p>Not displayed by default. To display the item, change the setting in the Column Settings window of the table option.</p>	<p>Whether ALUA can be set as the Path Mode in the external storage system:</p> <ul style="list-style-type: none"> ▪ Enable: Enables ALUA Mode. ▪ Disable: Disables ALUA Mode.
<p>ALUA Permitted</p> <p>Not displayed by default. To display the item, change the setting in the Column Settings window of the table option.</p>	<p>Whether ALUA can be set as the Path Mode in the local storage system:</p> <ul style="list-style-type: none"> ▪ Enable: ALUA Mode is used. ▪ Disable: ALUA Mode is not used.
<p>Load Balance Mode</p>	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> ▪ Normal Round-robin: Load balance is performed in round-robin system. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance.
<p>Cache Mode</p>	<p>How write data from the host to the external system is propagated:</p> <ul style="list-style-type: none"> ▪ Disable: synchronously ▪ Enable: asynchronously <p>When nondisruptive migration is specified as the attribute, the cache modes are displayed:</p> <ul style="list-style-type: none"> ▪ Through: Write and read requests are transferred from the host to the external storage system. The local system's cache is not used. ▪ Write Sync: Write data is reflected from the host to the external storage system synchronously. If read or write is performed while data is being written to the external storage system, the read or write operation waits until the ongoing write operation is completed.

Item	Description
	<ul style="list-style-type: none"> ▪ Check Condition (VSP E990 and VSP G350, G370, G700, G900): Indicates that write or read commands from the host were rejected. ▪ Pending (VSP E990 and VSP G350, G370, G700, G900): Holds write and read commands from the host. <p>While cache mode operations are in progress, status is reported for cache mode changes:</p> <ul style="list-style-type: none"> ▪ (Changing): Transition to the displayed cache mode is in progress. ▪ (Error): Transition to the displayed cache mode has failed and maintenance work is required.
Inflow Control	Write operation to cache memory is limited (Enable) or continued (Disable) when the write operation to the external volume cannot be performed.
Attribute	<p>Attribute of the parity group:</p> <ul style="list-style-type: none"> ▪ Nondisruptive migration: Parity group that has the nondisruptive migration attribute. ▪ (blank): No attribute is set.
<p>Data Direct Mapped LDEV</p> <p>Not displayed by default. To display the item, change the setting in the Column Settings window of the table option.</p>	<p>LDEV ID of the mapped DP-VOL:</p> <ul style="list-style-type: none"> ▪ - (hyphen): Data Direct Mapping attribute is disabled. ▪ (blank): A V-VOL that has the Data Direct Mapping attribute is not set to the pool that has the Data Direct Mapping attribute. <p>When clicked, the LDEV Properties window is displayed.</p>

External Paths tab

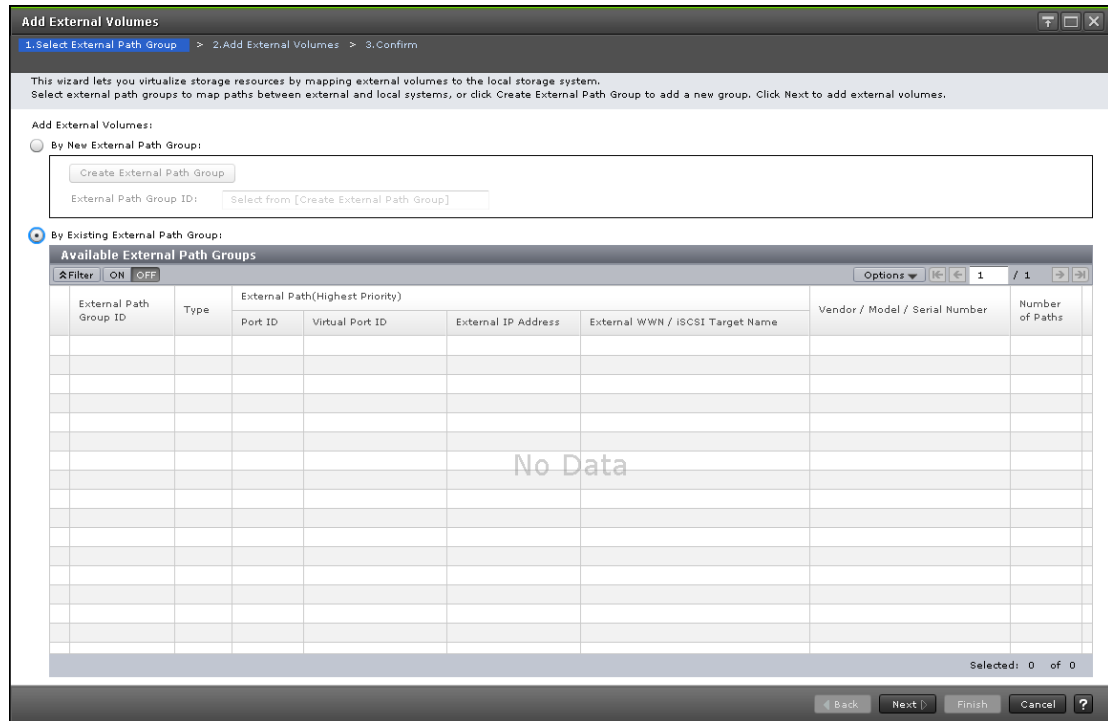


Item	Description
Priority	Priority of external paths
Port ID	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system

Item	Description
External	<p>Information about the target port of the external storage system:</p> <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when the port type is an iSCSI port. ▪ TCP Port Number: Target TCP port number when the port type is an iSCSI port. Not displayed by default. To display the item, change the settings in the Column Settings window. ▪ WWN / iSCSI Target Name: WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI, the iSCSI target name is displayed.
Status	<p>Status of external paths:</p> <ul style="list-style-type: none"> ▪ 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	<p>Number of read/write commands that can be queued to the external volume. 8 is set by default:</p> <p>When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of read/write commands that can be queued at one time is the total of the QDepth values of all the external paths.</p>
I/O Timeout(sec.)	<p>Number of seconds that should pass before I/O to the external volume times out. 15 seconds is the default.</p>
Blocked Path Monitoring (sec.)	<p>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.</p>

Add External Volumes wizard

Select External Path Group window



Item	Description
By New External Path Group	Option for setting up a new external path group
External Path Group ID	Number to identify the new external path group. Blank by default. A value in the following range must be specified: 0 to 63,231.
By Existing External Path Group	Option for using an existing external path group

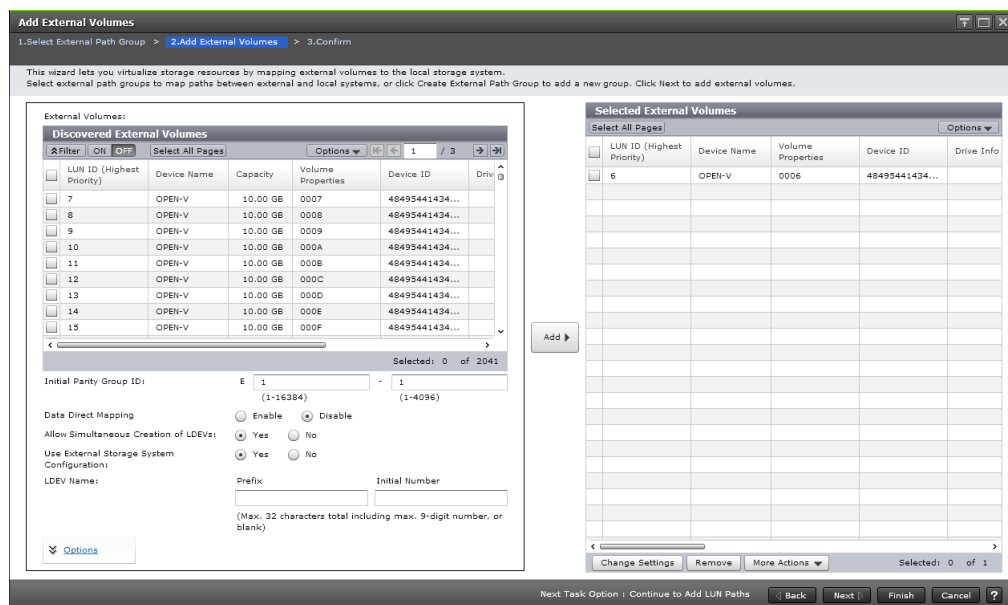
Available External Path Groups table

Item	Description
External Path Group ID	Name of the external path group
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port ▪ Mixed: Configuration with Fibre Channel port and iSCSI port

Item	Description
External Path (Highest Priority)	<p>External path that has the highest priority:</p> <ul style="list-style-type: none"> ▪ Port ID: External port of the local storage system ▪ Virtual Port ID: Virtual port of the local storage system when the port type is iSCSI ▪ External IP Address : For iSCSI ports, target port IP address ▪ External TCP Port Number: For iSCSI ports, target TCP port number. Not displayed by default. To display the item, change the settings in the Column Settings window. ▪ External WWN / iSCSI Target Name: <ul style="list-style-type: none"> • For Fibre Channel ports, WWN of the target port • For iSCSI ports, iSCSI target name
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

Use this window to display discovered external volumes and to make related selections.



Discovered External Volumes

Item	Description
LUN ID(Highest Priority)	External LUN with the highest priority. ?: Indicates that an external volume is not found. In this case, confirm the connection with the external system, and then perform the operation again.
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some enterprise storage systems, emulation type is displayed.
Capacity	External volume capacity
Volume Properties	Identification number of the external volume. The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.
Device ID	Identification number of the external volume
Drive Info	Information about the external volume's drive type: <ul style="list-style-type: none"> ▪ SATA: Drive type of external volumes is SATA. ▪ SSD,FMD: Drive type of external volumes is SSD or FMD. ▪ (For VSP 5000 series) SCM: Drive type of external volumes is SCM. SCM is displayed only when the SCM drive is mounted on a VSP 5000 series storage system. SSD, FMD is displayed, however, when the DKCMAIN program version is earlier than 90-04-04-00/00.
Path Mode	Operation mode of the external path: <ul style="list-style-type: none"> ▪ Single: Ordinarily, only one external path is used even if alternate paths are set. In Single mode, alternate paths are used only in case of maintenance work failure. ▪ Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing.
ALUA Settable	Whether ALUA can be set as the Path Mode in the external storage system: <ul style="list-style-type: none"> ▪ Enable: Enables ALUA Mode. ▪ Disable: Disables ALUA Mode.
Discovery Result	Status of the result: <ul style="list-style-type: none"> ▪ Normal ▪ An error code

Item	Description
Initial Parity Group ID	An external volume group number and sequence number. Values range from 1 - 1 (default) to 16384 - 4096.
Data Direct Mapping	Whether to enable the Data Direct Mapping attribute: <ul style="list-style-type: none"> ▪ Enable: Enables the Data Direct Mapping attribute. ▪ Disable: Disables the Data Direct Mapping attribute (Default).
Allow Simultaneous Creation of LDEVs	Whether LDEVs in the external volume are created simultaneously: <ul style="list-style-type: none"> ▪ Yes: LDEVs are automatically created in the external volume. ▪ No: LDEVs must be created manually. <p>By default, the value in the Edit Policies window is set. If Enable is specified for Data Direct Mapping, Yes is selected automatically.</p>
Use External Storage System Configuration	Whether the external volume's configuration for the LDEVs is used: <ul style="list-style-type: none"> ▪ Yes: Configuration is used if Yes is specified in Allow Simultaneous Creation of LDEVs. ▪ No: Configuration is not used. LDEVs must be configured manually. <p>By default, Yes is selected. If Enable is specified for Data Direct Mapping, Yes is selected automatically.</p>
LDEV Name	LDEV name. Requires a prefix character and initial number, 32 characters maximum (including the initial number). Numbering rule for Initial Number: <ul style="list-style-type: none"> ▪ 1: Total of 9 numbers (1, 2, 3, ...9) ▪ 08: Total of 92 numbers (08, 09, 10, ...99) ▪ 23: Total of 77 numbers (23, 24, 25, ...99) ▪ 098: Total of 902 numbers (098, 099, 100, ...999)
Initial LDEV ID	Starting number from which the storage system searches in ascending order. The next available LDEV ID is allocated to the external volume.
LDKC	LDKC number. 00 can be set for the value.
CU	CU number. Possible values for each model: <ul style="list-style-type: none"> ▪ VSP 5000 series: 00 to FE ▪ VSP E990: 00 to FE

Item	Description
	<ul style="list-style-type: none"> ▪ VSP G350, VSP F350: 00 to 3F ▪ VSP G370, VSP F370: 00 to 7F ▪ VSP G700, VSP F700: 00 to BF ▪ VSP G900, VSP F900: 00 to FE Default is 00.
DEV	LDEV identifier. Value between 00 and FF can be set. Default is 00.
Interval	Interval between the LDEV IDs. The specified interval will be kept and the LDEV ID will be set to each LDEV in external volume. From 0 (default) to 255.
View LDEV IDs	Used, available, and disabled LDEV IDs.
Initial SSID (VSP 5000 series)	SSID number. Range can be from 0004 (default) to FFFE.
View SSID (VSP 5000 series)	Current SSIDs. For information on the Edit SSIDs window, see the <i>Provisioning Guide</i> .
Base Emulation Type (VSP 5000 series)	External system's emulation type. All supported emulation types except OPEN-L can be specified. See External volume policy settings and functions (on page 67) for more information.
Number of LDEVs per External Volume	Maximum number of LDEVs to be created in the external volume when the volume is mapped. Depends on base emulation type and the capacity of the external volume. If Enable is specified for Data Direct Mapping, 1 is selected automatically.
Cache Partition	CLPR for accessing the external volume. The range can be from CLPR0 to CLPR31. The default is the value set in the Edit Policies window. See External volume policy settings and functions (on page 67) for more information.
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously. ▪ Disable: Write data from the host is propagated synchronously. (VSP 5000 series) Except the data written directly by the host, data (such as written by ShadowImage) will be propagated asynchronously regardless of the Cache Mode settings. The default is the value set in the Edit Policies window. See Cache use and external storage performance (on page 24) for more information.

Item	Description
Inflow Control	<ul style="list-style-type: none"> ▪ Enable: Write data is limited or prevented from being written to cache memory when the write operation cannot be performed. ▪ Disable: Write data is allowed to be written to cache when the write operation cannot be performed. <p>See External volume policy settings and functions (on page 67) for more information.</p>
Use ALUA as Path Mode	<p>Whether ALUA is used as the Path Mode:</p> <ul style="list-style-type: none"> ▪ Enable: ALUA mode is enabled. Default if ALUA mode can be set as the Path Mode. ▪ Disable: ALUA mode is disabled. Default if ALUA mode cannot be set as the Path Mode. <p>(VSP 5000 series) If the product name of an external storage system is displayed as (generic), the selected external volume or volumes is used by default.</p>
Load Balance Mode	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> ▪ Depends on the selected external volume(s): If Enable is set for ALUA Settable on the external volume, Normal Round-robin is set for Load Balance Mode automatically. If Disable is set for ALUA Settable, Disable is set for Load Balance Mode automatically. ▪ Normal Round-robin: Load balance is performed in round-robin system. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance. <p>The default is the value set in the Edit Policies window.</p> <p>If the product name of an external storage system is displayed as (generic), Depends on the selected external volume(s) is used by default.</p> <p>This item cannot be selected when the path mode of the external volume is Single or Disable is selected for Use ALUA as Path Mode.</p>

Item	Description
MP Unit ID	<p>MP unit ID for the external volume:</p> <ul style="list-style-type: none">▪ MPU-10 or MPU-20 can be selected.▪ Auto (default): The unit is automatically selected by the system.▪ If Auto cannot be selected, the unit with lowest number is used.

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 enterprise storage systems, the emulation type is displayed.
Volume Properties	<p>Identification number of the external volume.</p> <p>The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.</p>
Device ID	External volume's identification number
Drive Info	<p>Information about the external volume's drive type:</p> <ul style="list-style-type: none"> ▪ SATA: Drive type of external volumes is SATA. ▪ SSD,FMD: Drive type of external volumes is SSD or FMD. ▪ (For VSP 5000 series) SCM: Drive type of external volumes is SCM. SCM is displayed only when the SCM drive is mounted on a VSP 5000 series storage system. SSD, FMD is displayed, however, when the DKCMAIN program version is earlier than 90-04-04-00/00.
Parity Group ID	Parity group numbers
Base Emulation Type (VSP 5000 series)	External volume's emulation type
Top LDEV ID	External volume's top LDEV ID
Top LDEV Name	External volume's top LDEV name
Number of LDEVs	External volume's number of LDEVs
Capacity	External volume's capacity
SSID (VSP 5000 series)	SSIDs
CLPR	CLPR used for accessing to the mapped external volume
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously ▪ Disable: Write data from the host is propagated synchronously <p>See Cache use and external storage performance (on page 24) for more information.</p>

Item	Description
Inflow Control	<ul style="list-style-type: none"> ▪ 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. <p>See External volume policy settings and functions (on page 67) for more information.</p>
Path Mode	<p>Operation mode of the external path:</p> <ul style="list-style-type: none"> ▪ Single: Ordinarily, only one external path is used even if alternate paths are set. In Single mode, alternate paths are used only in case of maintenance work failure. ▪ Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. ▪ ALUA: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths connected to ports in Passive status are not used.
ALUA Permitted	<p>Whether ALUA can be set as the Path Mode in the local storage system:</p> <ul style="list-style-type: none"> ▪ Enable: ALUA Mode is used. ▪ Disable: ALUA Mode is not used.
Load Balance Mode	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> ▪ Normal Round-robin: Load balance is performed in round-robin system. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance.
MP Unit ID	ID of the MP unit of the external volume
Attribute	Attribute of the external volume
Edit SSIDs (VSP 5000 series) Not displayed by default. Displayed when you click More Actions.	When clicked, the Edit SSIDs window is displayed, and you can change the SSID of the selected external volume. For information on the Edit SSIDs window, see the <i>Provisioning Guide</i> .

Add External Volumes confirmation window



Note: Information in this confirmation window is displayed when only a single task is performed. If multiple tasks are performed, all configuration items are displayed.

Add External Volumes

1. Select External Path Group > 2. Add External Volumes > 3. Confirm

Enter a name for the task. Confirm the settings in the list and click Apply to add task in Tasks queue for execution.

Task Name: (Max. 32 Characters)

Selected External Path Group		
External Path Group ID	Vendor / Model / Serial Number	
EPathGroup1	HITACHI / VSP-G1000 / 00050	

Selected External Paths						
Priority	Port ID	Type	Virtual Port ID	External		
				IP Address	WWN / iSCSI Target Name	
1	CL5-A	Fibre	-	-	50060E8007003250	
2	CL2-A	Fibre	-	-	50060E8007003200	

Total: 2

Selected External Volumes												
<input type="checkbox"/> LUN ID (Highest Priority)	Device Name	Volume Properties	Device ID	Drive Info	Parity Group ID	Base Emulation Type	Top LDEV ID	Top LDEV Name	Number of LDEVs	Capacity	SSID	CLPR
<input checked="" type="checkbox"/> 1	OPEN-V	0008	48495441434...		E1-3	OPEN-V	00:00:11		1	1.00 GB	0004	0:CLPR

Total: 1

Item	Description
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	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> Fibre: Fibre Channel port iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system
External	Information about the target port of the external storage system: <ul style="list-style-type: none"> IP Address: Target port IP address when the port type is an iSCSI port WWN / iSCSI Target Name: WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI, the iSCSI target name is displayed.

Item	Description
LUN ID(Highest Priority)	LUN that is connected to the external path with the highest priority
Device Name	Name of the storage system reported to the host by the external volume. The displayed name differs by vendor. For some enterprise storage systems, emulation type is displayed.
Capacity (VSP 5000 series)	External volume capacity
Volume Properties	<p>Identification number of the external volume.</p> <p>The value is used by UVM to identify the LUN across multiple paths. The value is provided by the external system and might reflect internal numbering.</p>
Device ID	Identification number of the external volume
Drive Info	<p>Information about the external volume's drive type:</p> <ul style="list-style-type: none"> ▪ SATA: Drive type of external volumes is SATA ▪ SSD,FMD: Drive type of external volumes is SSD or FMD ▪ (For VSP 5000 series) SCM: Drive type of external volumes is SCM. SCM is displayed only when the SCM drive is mounted on a VSP 5000 series storage system. SSD, FMD is displayed, however, when the DKCMAIN program version is earlier than 90-04-04-00/00.
Parity Group ID	Parity group numbers
Base Emulation Type (VSP 5000 series)	External volume's emulation type
Top LDEV ID	External volume's top LDEV ID
Top LDEV Name	External volume's top LDEV name
Number of LDEVs	External volume's number of LDEVs
Capacity	External volume capacity
SSID (VSP 5000 series)	SSIDs
CLPR	CLPR used for accessing to the mapped external volume
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously. ▪ Disable: Write data from the host is propagated synchronously. <p>See Cache use and external storage performance (on page 24) for more information.</p>

Item	Description
Inflow Control	<ul style="list-style-type: none"> ▪ Enable: Write data is limited or prevented from being written to cache memory when the write operation cannot be performed. ▪ Disable: Write data is allowed to be written to cache when the write operation cannot be performed. <p>See External volume policy settings and functions (on page 67) for more information.</p>
Path Mode	<p>Operation mode of the external path:</p> <ul style="list-style-type: none"> ▪ Single: Ordinarily, only one external port is used even if alternate paths are set. In Single mode, alternate paths are used only in case of maintenance work failure. ▪ Multi: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. ▪ ALUA: When alternate paths are set, external paths from several ports are simultaneously used with load balancing. External paths connected to ports in Passive status are not used.
ALUA Permitted	<p>Whether ALUA can be set as the Path Mode in the local storage system:</p> <ul style="list-style-type: none"> ▪ Enable: ALUA Mode is used. ▪ Disable: ALUA Mode is not used.
Load Balance Mode	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> ▪ Normal Round-robin: Load balance is performed in round-robin system. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance.
MP Unit ID	IDs of the external volume's MP unit
Attribute	External volume's attribute

Edit Policies window

Edit Policies [T] [□] [X]

Set values for External Volume Setting and click Apply.

Allow Simultaneous Creation of LDEVs: Yes No

Use External Storage System Configuration: Yes No

Base Emulation Type: Depends on the selected external volume(s) ▼

Number of LDEVs per External Volume: 1 (1)

Cache Partition: 0:CLPR0 ▼

Cache Mode: Enable Disable

Inflow Control: Enable Disable

Load Balance Mode: Normal Round-robin ▼

MP Unit ID: Auto ▼

Internal Volume Usage: Enable Disable

[Apply] [Cancel] [?]

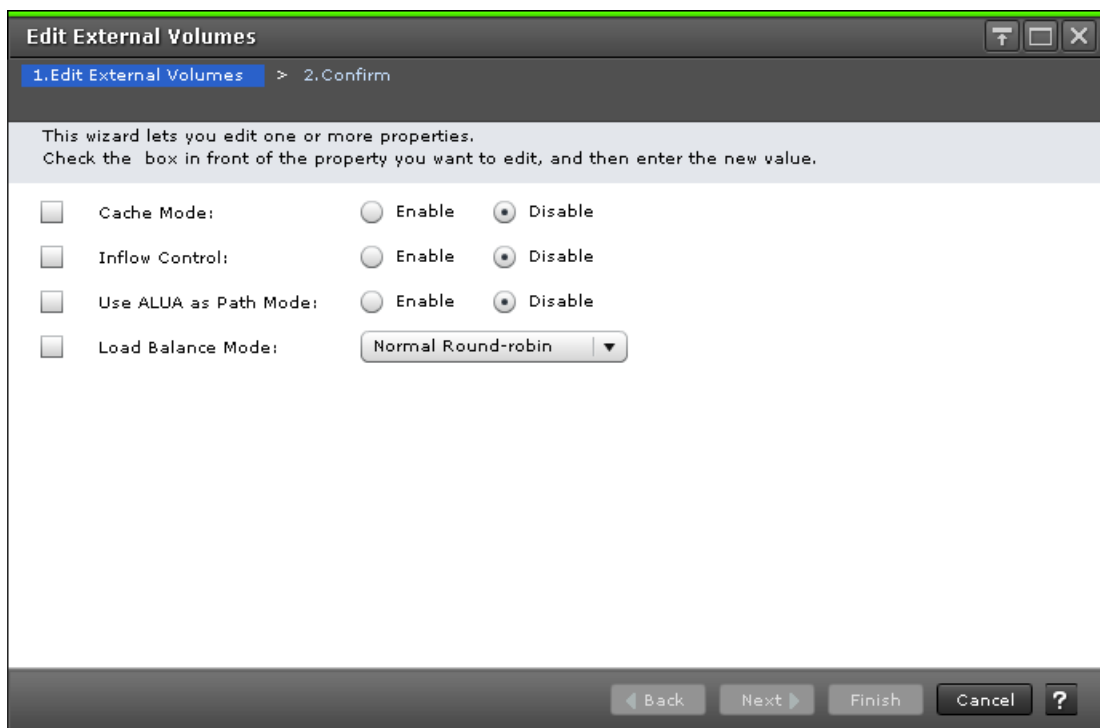
Item	Description
Allow Simultaneous Creation of LDEVs	Whether LDEVs are automatically created in the external volume: <ul style="list-style-type: none"> Yes: LDEVs are automatically created. No: LDEVs must be created manually.
Use External Storage System Configuration	Whether the external volume's configuration for the LDEVs is used: <ul style="list-style-type: none"> Yes: Configuration is used if Yes is specified in Allow Simultaneous Creation of LDEVs. No: Configuration is not used. LDEVs must be configured manually.
Base Emulation Type (VSP 5000 series)	External system's emulation type. All supported emulation types except OPEN-L can be specified. See External volume policy settings and functions (on page 67) for more information.
Number of LDEVs per External Volume	Number of LDEVs to be created in the local system when the volume is mapped. Depends on the base emulation type (VSP 5000 series) or capacity of the external volume (VSP E990 and VSP G350, G370, G700, G900).
Cache Partition	CLPR for accessing the external volume

Item	Description
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously. ▪ Disable: Write data from the host is propagated synchronously. <p>See Cache use and external storage performance (on page 24) for more information.</p>
Inflow Control	<ul style="list-style-type: none"> ▪ Enable: Write data is limited or prevented from being written to cache memory when the write operation cannot be performed. ▪ Disable: Write data is allowed to be written to cache when the write operation cannot be performed.
Load Balance Mode	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> ▪ Normal Round-robin: Load balance is performed in round-robin system. This is the default. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance.
MP Unit ID	<p>MP unit ID for the external volume:</p> <ul style="list-style-type: none"> ▪ Auto (default): Unit is automatically selected by the system. ▪ If Auto cannot be selected, the unit with the lowest number is the default.

Edit External Volumes wizard

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

Edit External Volumes window



Item	Description
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously. ▪ Disable: Write data from the host is propagated synchronously. <p>See Cache use and external storage performance (on page 24) for more information.</p>
Inflow Control	<ul style="list-style-type: none"> ▪ Enable: Write data is limited or prevented from being written to cache memory when the write operation cannot be performed. ▪ Disable: Write data is allowed to be written to cache when the write operation cannot be performed.
Use ALUA as Path Mode	<p>Whether ALUA is used as the Path Mode:</p> <ul style="list-style-type: none"> ▪ Enable: ALUA mode is enabled. ▪ Disable: ALUA mode is disabled. <p>The value that is set for the selected external volume is used as the default. If two or more external volumes with different values are selected, the item is placed in non-selected status. If the ALUA mode cannot be set for the selected external volume, Enable cannot be selected.</p>

Item	Description
Load Balance Mode	<p>I/O load balance system for external storage system:</p> <ul style="list-style-type: none"> Normal Round-robin: Load balance is performed in round-robin system. Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. Disable: I/O operation is performed with a single path, without load balance. <p>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.</p>

Edit External Volumes confirmation window

Item	Description
Parity Group ID	Parity group numbers
Top LDEV ID	External volume's top LDEV ID
Top LDEV Name	External volume's top LDEV name

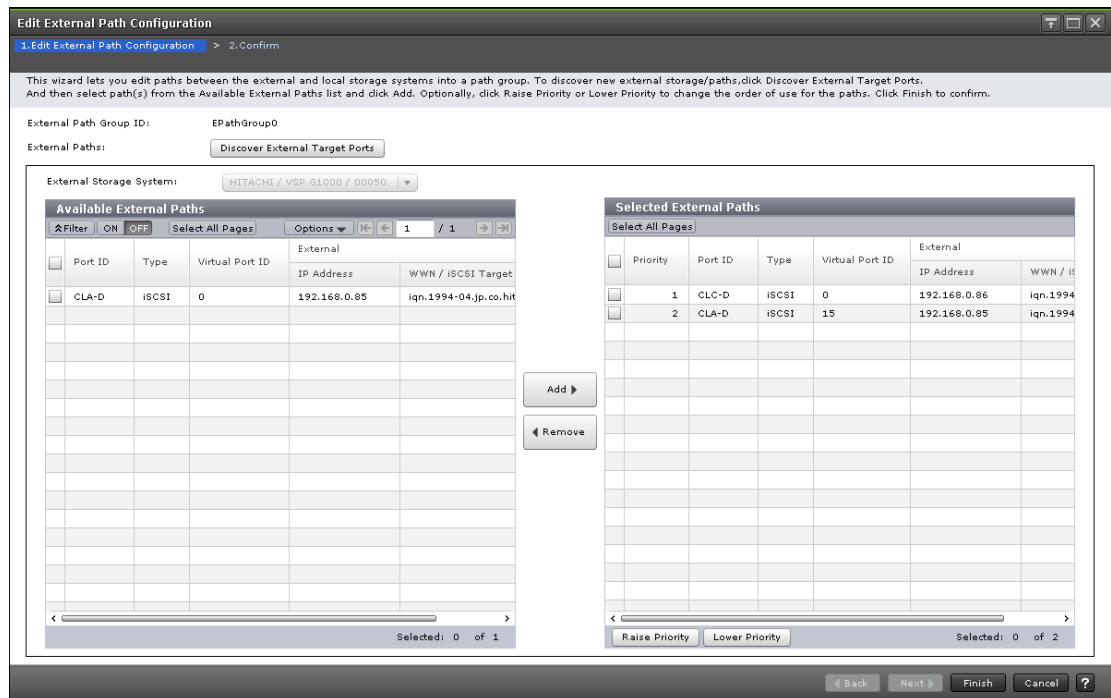
Item	Description
Cache Mode	<ul style="list-style-type: none"> ▪ Enable: Write data from the host is propagated asynchronously. ▪ Disable: Write data from the host is propagated synchronously. <p>When nondisruptive migration is specified as the Attribute, the cache modes are displayed:</p> <ul style="list-style-type: none"> ▪ Through: Write and read requests are transferred from the host to the external storage system. The local system's cache is not used. ▪ Write Sync: Write data is reflected from the host to the external storage system synchronously. If read or write is performed while data is being written to the external storage system, the read or write operation waits until the ongoing write operation is completed. ▪ Check Condition (VSP E990 and VSP G350, G370, G700, G900): Indicates that write or read commands from the host were rejected. ▪ Pending (VSP E990 and VSP G350, G370, G700, G900): Holds write and read commands from the host. <p>While cache mode operations are in progress, status is reported for cache mode changes:</p> <ul style="list-style-type: none"> ▪ (Changing): Transition to the displayed cache mode is in progress. ▪ (Error): Transition to the displayed cache mode has failed and maintenance work is required. <p>See Cache use and external storage performance (on page 24) for more information.</p>
Inflow Control	<ul style="list-style-type: none"> ▪ Enable: Write data is limited or prevented from being written to cache memory when the write operation cannot be performed. ▪ Disable: Write data is allowed to be written to cache when the write operation cannot be performed.
Path Mode	<p>External path of the external volume:</p> <ul style="list-style-type: none"> ▪ Single: One external path is used, with alternate paths available in case of failure. ▪ Multi: Multiple paths are used at the same time. ▪ ALUA: Like Multi, all paths are used; however, they are not used when connected to ports in Passive status. For more information, see External paths (on page 26).

Item	Description
ALUA Permitted	Whether ALUA can be set as the Path Mode in the local storage system: <ul style="list-style-type: none"> ▪ Enable: ALUA Mode is used. ▪ Disable: ALUA Mode is not used.
Load Balance Mode	I/O load balance system for external storage system: <ul style="list-style-type: none"> ▪ Normal Round-robin: Load balance is performed in round-robin system. ▪ Extended Round-robin: Load balance system is automatically switched for sequential I/O and random I/O. ▪ Disable: I/O operation is performed with a single path, without load balance.

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.

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
External Storage System	External system selected (initially unavailable). If no system was selected, allows you to select the system from a list.

Available External Paths tab

Item	Description
Port ID	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system
External	Information about the target port of the external storage system: <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when the port type is an iSCSI port. ▪ WWN / iSCSI Target Name: WWN to show the target port when the port type is a Fibre Channel port. If the port type is iSCSI, the iSCSI target name is displayed.

Item	Description
External	<p>Information about the target port of the external storage system:</p> <ul style="list-style-type: none"> IP Address: Target port IP address when the port type is an iSCSI port. WWN / iSCSI Target Name: WWN to show the target port when the port type is Fibre Channel. If the port type is iSCSI, the iSCSI target name is displayed.

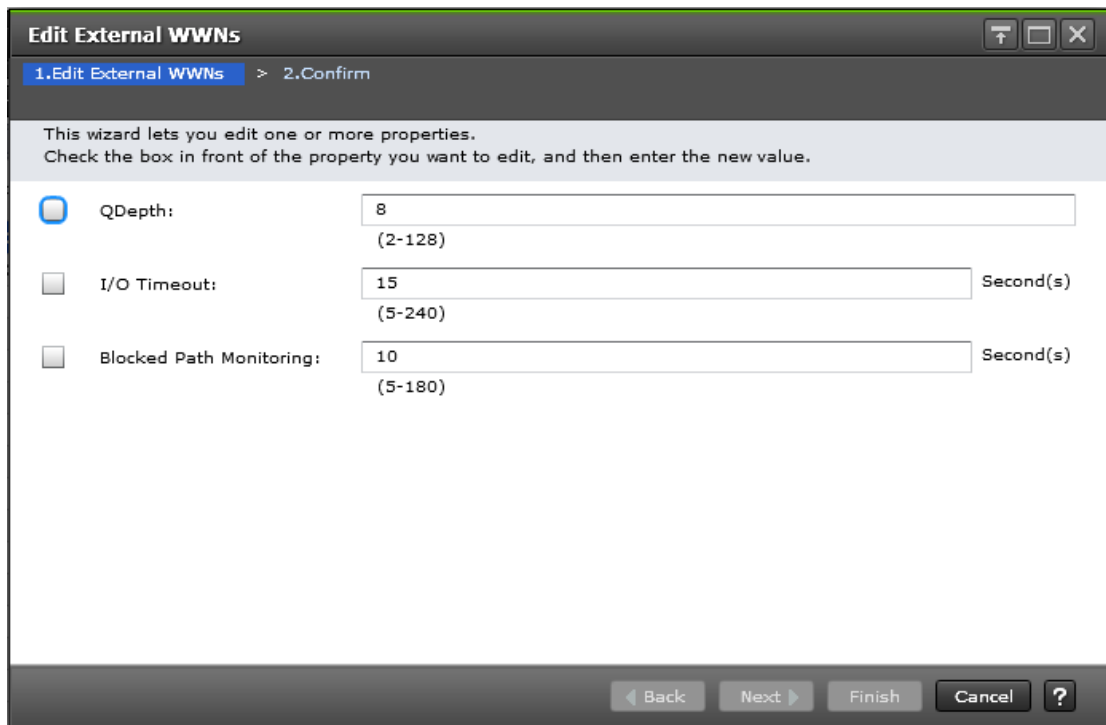
Edit External Path Configuration confirmation window

Item	Description
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	External port of the local storage system
Type	<p>Port type:</p> <ul style="list-style-type: none"> Fibre: Fibre Channel port iSCSI: iSCSI port

Item	Description
Virtual Port ID	Virtual port of the local storage system
External	Information about the target port of the external storage system: <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when the port type is an iSCSI port. ▪ WWN / iSCSI Target Name: WWN to show the target port when the port type is Fibre Channel. If the port type is iSCSI, the iSCSI target name is displayed.

Edit External WWNs wizard

Edit External WWNs window

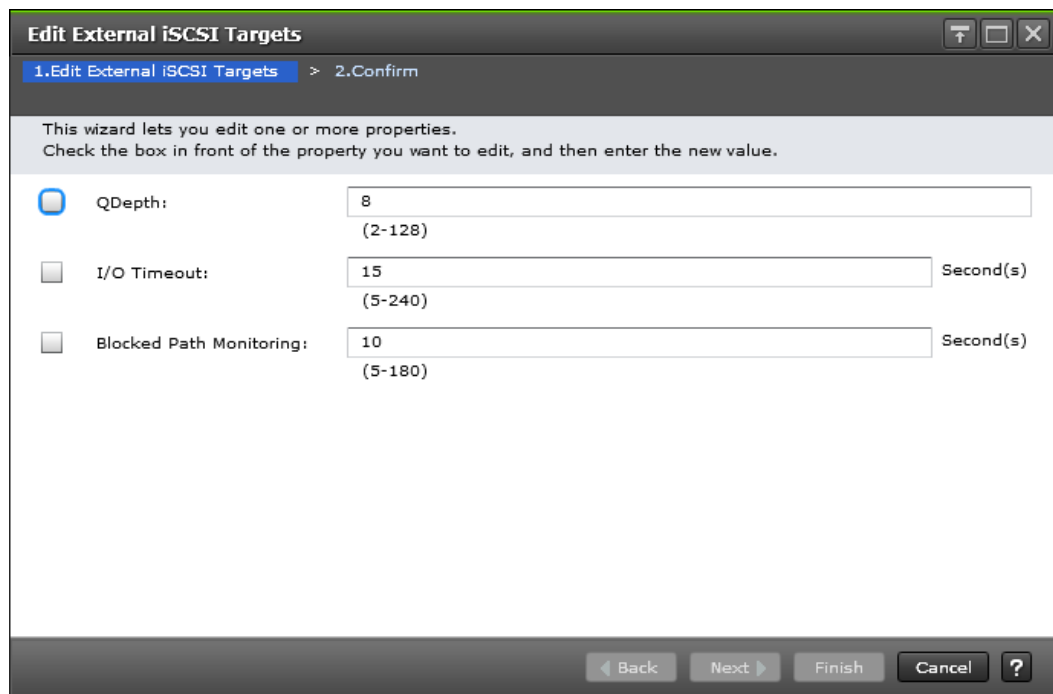


Item	Description
QDepth	Number of read/write commands that can be queued to the external volume. The numbers 2 through 128 can be entered. When two or more external paths with different values are selected, the field is blank.

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

Edit External iSCSI Targets wizard

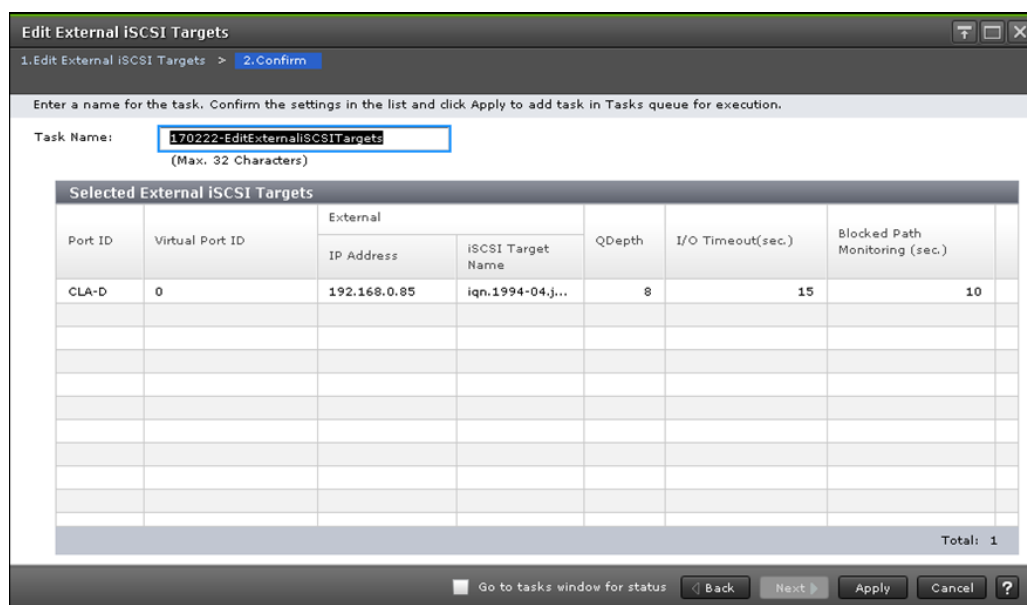
Edit External iSCSI Targets window



Item	Description
QDepth	Number of read/write commands that can be queued to the external volume. The numbers 2 through 128 can be entered. When two or more external paths with different values are selected, the field is blank.

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

Edit External iSCSI Targets confirmation window



Item	Description
Port ID	Port connected to the external storage system for the local storage system
Virtual Port ID	Virtual port of the local storage system
External	Target port information for the external storage system: <ul style="list-style-type: none"> IP Address: IP address of the target port iSCSI Target Name: iSCSI target name of the target port

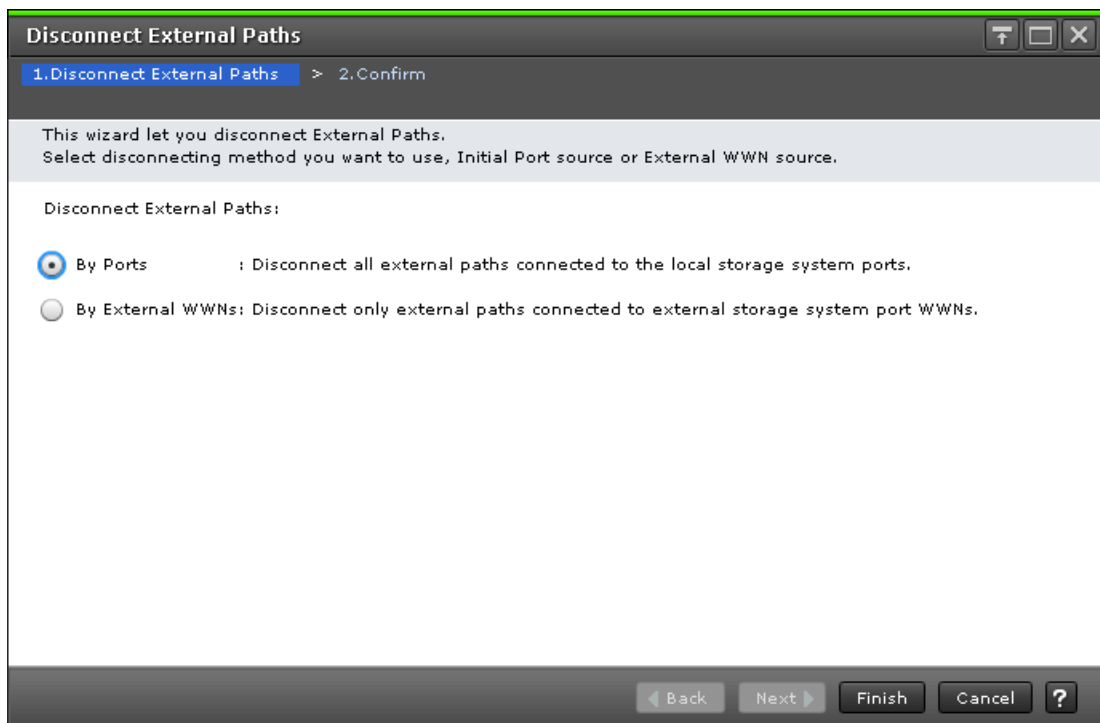
Item	Description
QDepth	Number of read/write commands that can be queued to the external volume. When Load Balance Mode is Extended Round-robin and the I/Os issued to the external volume are sequential, the number of read/write commands that can be queued at one time is the total of the QDepth values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

Item	Description
Parity Group ID	Parity group numbers
Top LDEV ID	External volume's top LDEV ID
Top LDEV Name	External volume's top LDEV name
Attribute	External volume's attribute
Forcible Deletion	Yes: The external volume will be forcibly deleted even if the connection to the external volume has not been disconnected. No: The external volume will be deleted after confirming that the connection to the external volume is disconnected.

Disconnect External Paths wizard

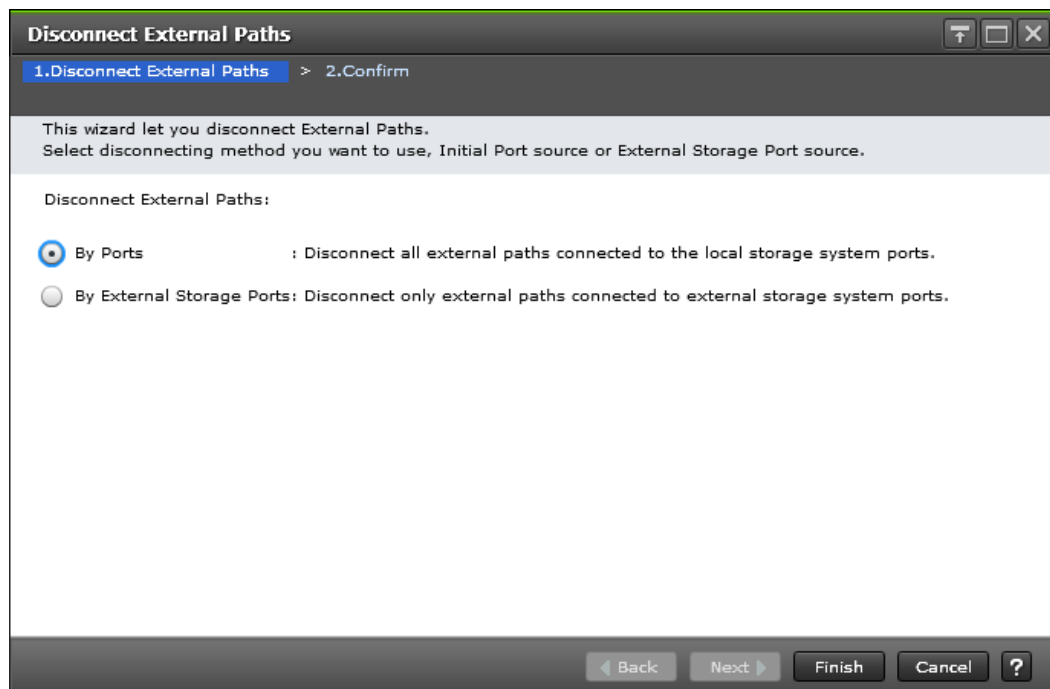
Disconnect External Paths window

For Fibre Channel ports



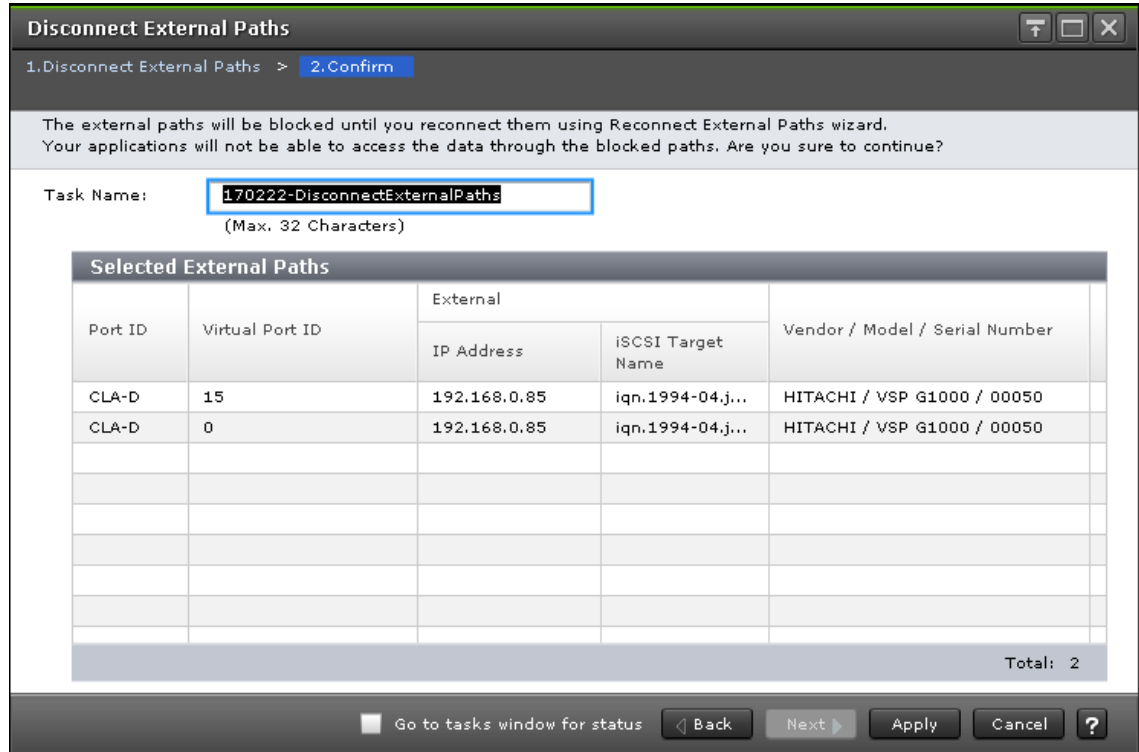
Item	Description
Disconnect External Paths	<ul style="list-style-type: none"> By Ports (default): Use of all the external paths connected to the specified port in the local system is stopped. By External WWNs: Use of all the external paths connected to the specified WWNs (ports) in the external system is stopped.

For iSCSI ports



Item	Description
Disconnect External Paths	<ul style="list-style-type: none"> By Ports (default): Use of all the external paths connected to the specified port in the local system is stopped. By External Storage Ports: Use of all the external paths connected to the external system is stopped.

For iSCSI ports

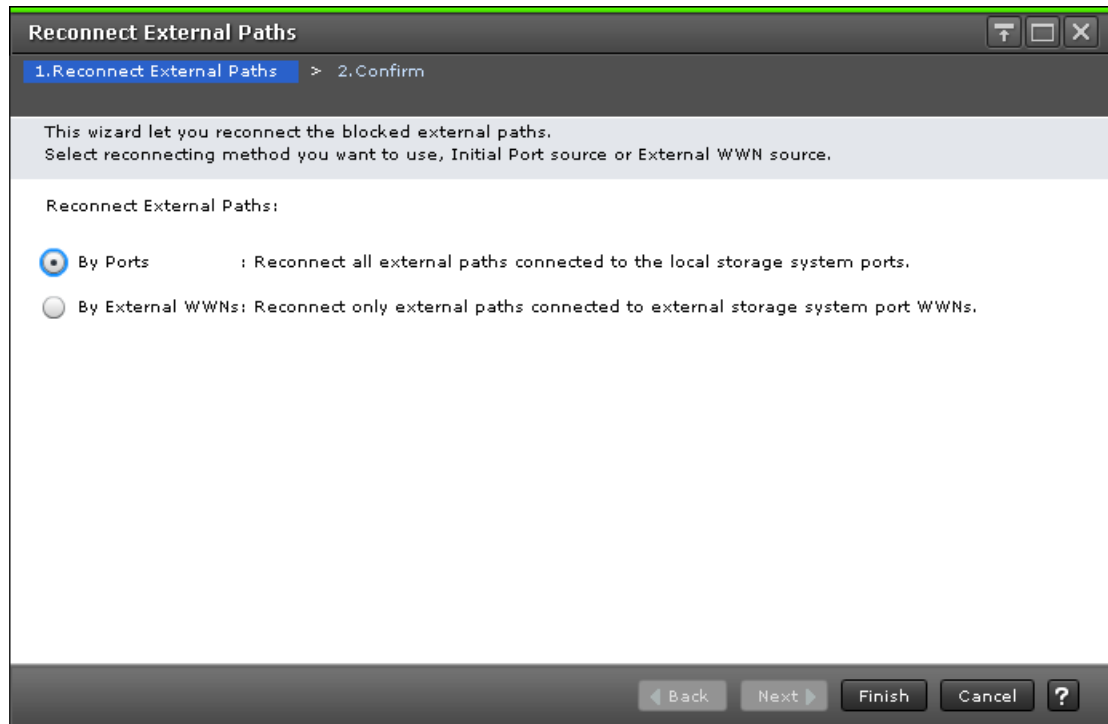


Item	Description
Port ID	External port of the local storage system
Virtual Port ID	Virtual port of the local storage system
External	Target port information for the external storage system: <ul style="list-style-type: none"> ▪ IP Address: IP address of the target port ▪ iSCSI Target Name: iSCSI target name of the target port
Vendor / Model / Serial Number	Identifying information for the external system

Reconnect External Paths wizard

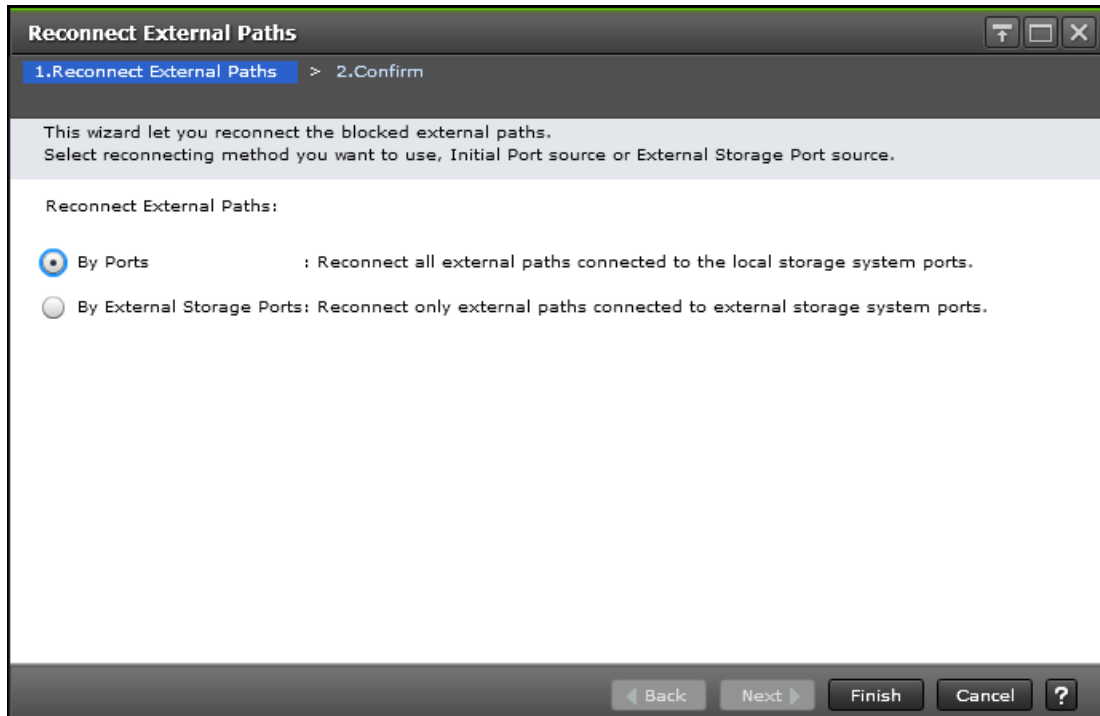
Reconnect External Paths window

For Fibre Channel ports



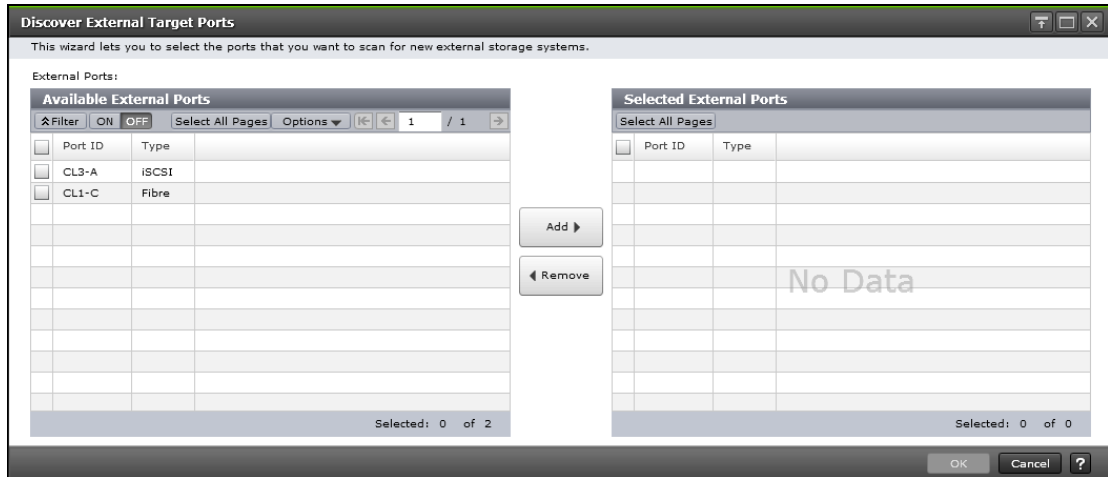
Item	Description
Reconnect External Paths	<ul style="list-style-type: none"> ▪ By Ports (default): All external paths connected to the specified port in the local system are reconnected. ▪ By External WWNs : All external paths connected to the specified WWNs in the external system are reconnected.

For iSCSI ports



Item	Description
Reconnect External Paths	<ul style="list-style-type: none"> ▪ By Ports (default): All external paths connected to the specified port in the local system are reconnected. ▪ By External Storage Ports: All external paths connected to the specified ports in the external system are reconnected.

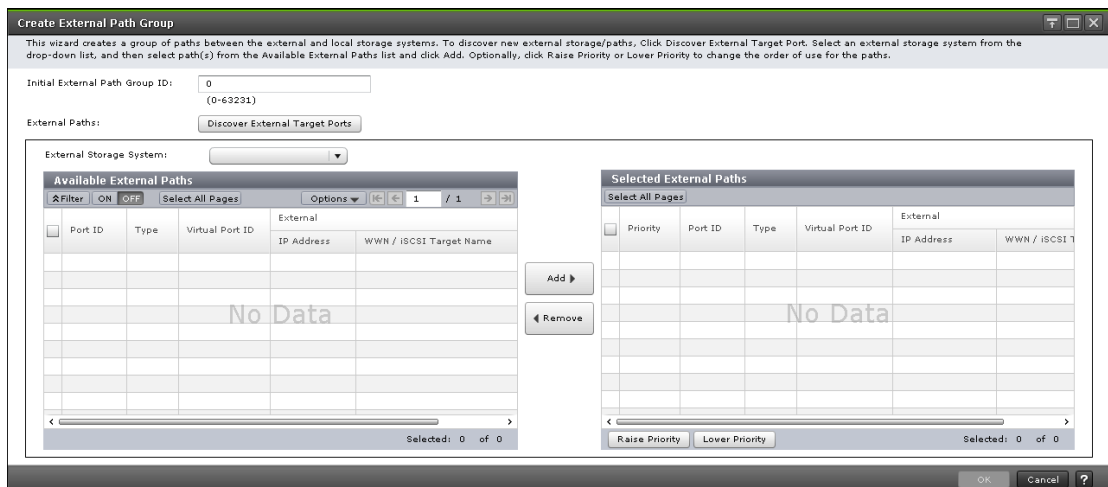
Discover External Target Ports window



Only external ports assigned to the user display.

Item	Description
Port ID (In the list of available and selected external paths)	Port number in the local system connecting to the external system
Type (In the list of available and selected external paths)	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port

Create External Path Group window



Only paths with ports assigned to the user can display.

Item	Description
Initial External Path Group ID	An initial ID for the path group. The storage system searches IDs in ascending order from this value and allocates an ID that can be used. Range of values: 0 to 63,231 The default is 0.
External Storage System	External system selected (not initially available). If no system was selected, allows you to select the system from a list.

Available External Paths

Item	Description
Port ID	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system
External	Information about the external storage system's target port <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when port type is iSCSI port ▪ WWN / iSCSI Target Name: WWN to show the target port when port type is Fibre Channel. If the port type is iSCSI, the iSCSI target name is displayed.

Selected External Paths

Selected External Paths						
<input type="button" value="Select All Pages"/>						
<input type="checkbox"/>	Priority	Port ID	Type	Virtual Port ID	External	
					IP Address	WWN / iSCSI T
No Data						
<input type="button" value="Raise Priority"/> <input type="button" value="Lower Priority"/> Selected: 0 of 0						

Item	Description
Priority	Priority of external paths
Port ID	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system
External	Information about the external storage system's target port: <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when port type is iSCSI port ▪ WWN / iSCSI Target Name: WWN to show the target port when port type is Fibre Channel. If the port type is iSCSI, iSCSI target name is displayed.

Change Settings window

Item	Description
Initial Parity Group ID	An external volume group number and sequence number. Values range from 1 - 1 to 16384 - 4096. The default is the value set on the selected external volume. When two or more volumes with different values are selected, these fields are blank.
MP Unit ID	<ul style="list-style-type: none"> ▪ Auto: Can be selected when there is one or more MP units whose auto assignment function is enabled. The default is the value set on the selected external volume. ▪ If Auto cannot be selected, the unit with the lowest number is used. ▪ When two or more volumes with different values are selected, (blank) is displayed.
LDEV Settings	If changes to LDEV settings are made, must be checked to proceed.
LDEV ID	LDEV IDs allocated to the external volume
LDEV Name	LDEV names
Parity Group ID	Parity group numbers

Item	Description
Emulation Type (VSP 5000 series)	LDEV emulation type
Capacity	LDEV capacity
SSID (VSP 5000 series)	SSIDs
Resource Group Name (ID)	Name and ID of the resource group for the LDEV
Virtual Storage Machine	<ul style="list-style-type: none"> ▪ Model / Serial Number: Model and serial number of the virtual storage machine for the LDEV ▪ Attribute: Virtual attribute of the LDEV. When the virtual attribute is not set, (blank) is displayed.

View External LUN Properties window

The screenshot shows a window titled "View External LUN Properties" with a table of external LUNs. The table has columns for Parity Group ID, Priority, Port ID, Type, Virtual Port ID, and External (IP Address, TCP Port Number, WWN / iSCSI Target Name). There are two rows of data.

Parity Group ID	Priority	Port ID	Type	Virtual Port ID	External			LU
					IP Address	TCP Port Number	WWN / iSCSI Target Name	
E1-1	1	CLC-D	iSCSI	0	192.168.0.86	3260	iqn.1994-04.jp.co.hitachi:rsd...	0
E1-1	2	CLA-D	iSCSI	15	192.168.0.85	3260	iqn.1994-04.jp.co.hitachi:rsd...	0

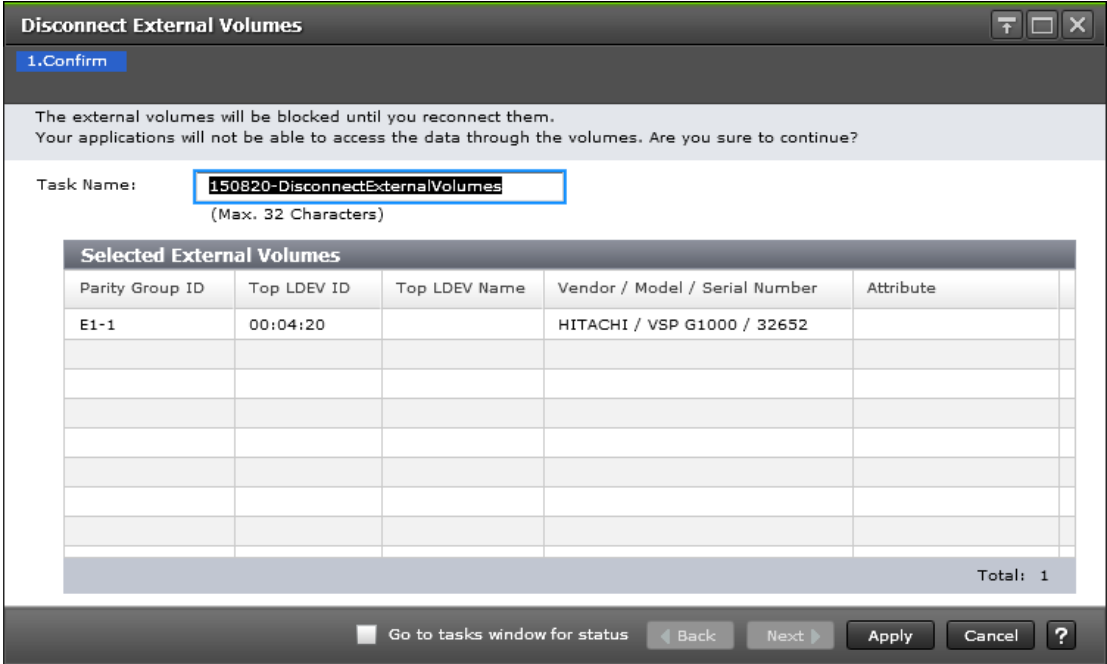
Total: 2

Item	Description
Parity Group ID	Parity group numbers
Priority	Priority of external paths

Item	Description
Port ID	External port of the local storage system
Type	Port type: <ul style="list-style-type: none"> ▪ Fibre: Fibre Channel port ▪ iSCSI: iSCSI port
Virtual Port ID	Virtual port of the local storage system
External	Information about external storage system's target port: <ul style="list-style-type: none"> ▪ IP Address: Target port IP address when port type is iSCSI port ▪ TCP Port Number: Target TCP port number when port type is iSCSI port ▪ WWN / iSCSI Target Name: WWN to show the target port when port type is Fibre Channel. If the port type is iSCSI, iSCSI target name is displayed.
LUN ID	When the external path is connected to the selected external volume, the LUN ID is displayed.
Status	Status of external paths: <ul style="list-style-type: none"> ▪ Unknown: The status of the mapping path is not known. ▪ Checking: The system is checking the mapping path status. ▪ Blockade: The mapping path is blocked. ▪ Normal: There are no problems, the system is usable. ▪ 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.

Item	Description
	<ul style="list-style-type: none"> ▪ Response Error: The external system is blocked because of an abnormal reply. ▪ Initiator Port: The port attribute of the external system has been changed to the initiator port. ▪ Unknown Port: The port attribute of the external system is not known. ▪ Cannot Detect Port: The path has been removed or the external system port cannot be found. ▪ Timeout: Processing was retried because an abnormal reply was returned; however, processing has timed out. ▪ Passive: The external system port is not active. Port status is normal but the port is not used for I/O. ▪ Standby: The external system port is standing by. The port status is normal but cannot receive I/O. ▪ Target Error: Port failures, such as controller blockade, are detected on the external system. ▪ Unavailable: The reply from the external system was Unavailable. The external system demands to change the connected port. Once the status becomes Unavailable, the primary path is changed to an alternate path in Standby status. When the primary path is available, the status changes to Normal. ▪ Backoff: The reply from the external system was Backoff. A temporary error has occurred in the external volume and the path is waiting for recovery. The primary path is not changed to the alternate path immediately. After recovery, the status changes to Normal. ▪ Destage Failed: The writing of data from cache memory to the volume has failed.
Target Port Asymmetric Access State	<p>When the path mode is ALUA, the port state of the external storage system:</p> <ul style="list-style-type: none"> ▪ Active/Optimized: The performance is in a good state. ▪ Active/Non-Optimized: Data can be sent and received, but the performance is inferior to Active/Optimized. <p>A space is displayed in one of the following cases:</p> <ul style="list-style-type: none"> ▪ The path mode is other than ALUA. ▪ Mapping of an external volume is not completed.

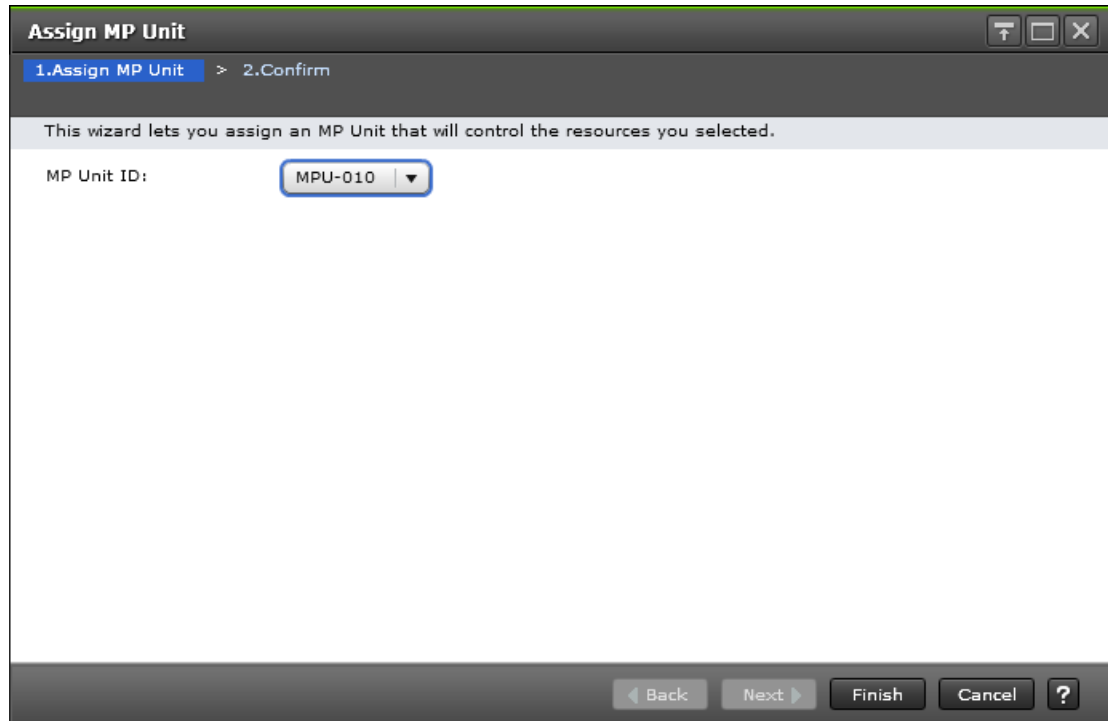
Disconnect External Volumes window



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

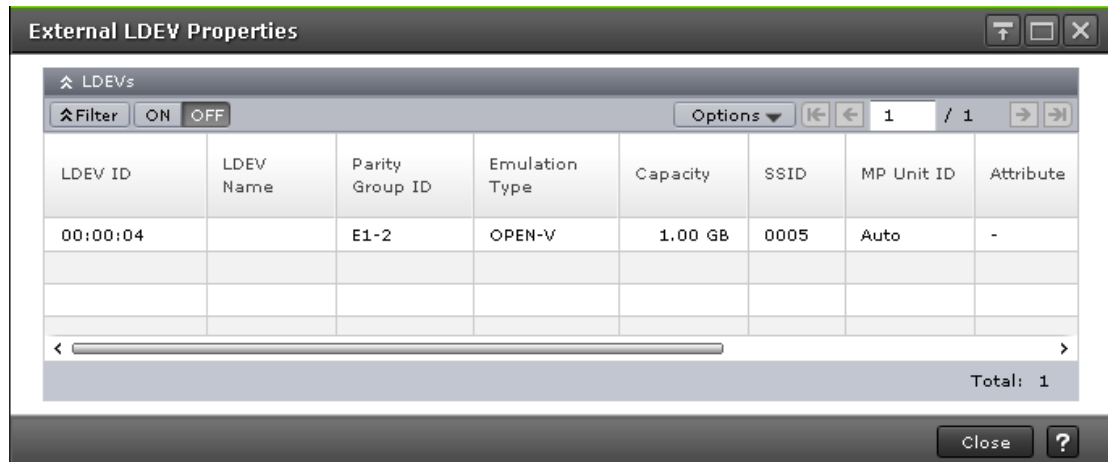
Assign MP unit wizard

Assign MP Unit window



Item	Description
MP Unit ID	MP unit ID for the external volume. The default is the value set on the selected external volume. When two or more volumes with different values are selected, (blank) displays.

External LDEV Properties window



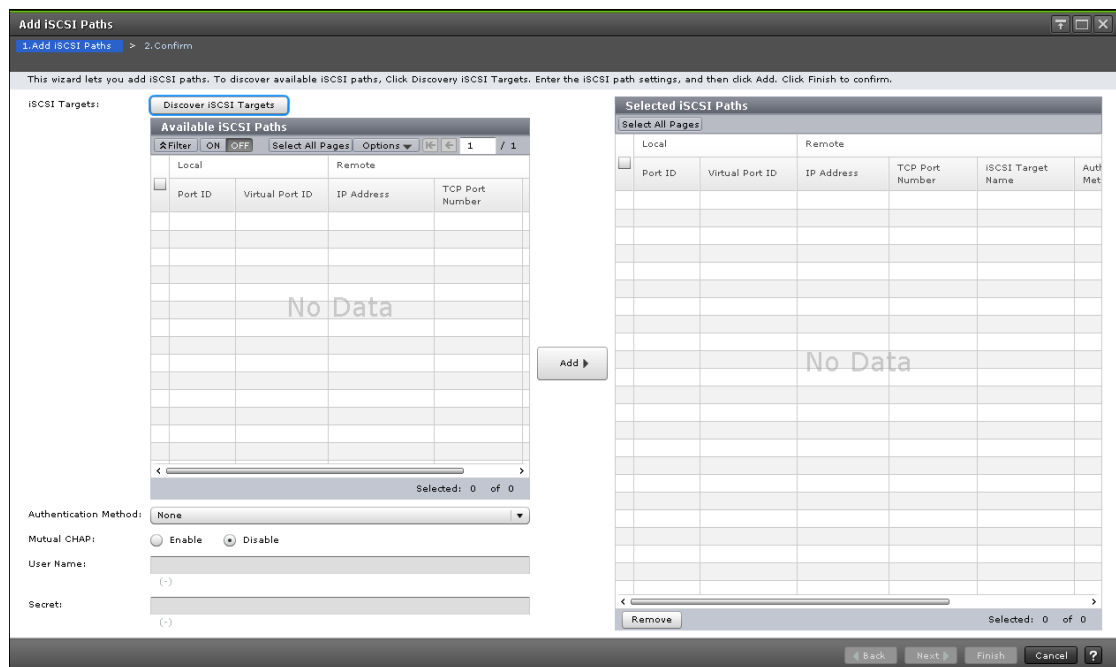
LDEVs table

Item	Description
LDEV ID	LDEV IDs allocated to the external volume
LDEV Name	LDEV names
Parity Group ID	Parity group numbers
Emulation Type (VSP 5000 series)	LDEV's emulation type
Capacity	LDEV's capacity
SSID (VSP 5000 series)	LDEV's SSIDs
MP Unit ID	MP unit IDs allocated to the LDEV
Attribute	LDEV's attribute
Resource Group Name (ID)	Name and ID of the resource group for the LDEV.
Attribute (VSP 5000 series)	External volume's attribute
Virtual Storage Machine	<ul style="list-style-type: none"> ▪ Model / Serial Number: Model and serial number of the virtual storage machine for the LDEV ▪ Attribute: Virtual attribute of the LDEV. When the virtual attribute is not set, (blank) is displayed.

Item	Description
External	Information about external storage system's target port: <ul style="list-style-type: none"> IP Address: Target port IP address when port type is iSCSI port WWN / iSCSI Target Name: WWN to show the target port when port type is Fibre Channel. If the port type is iSCSI, iSCSI target name is displayed.
LUN ID	When the external path is connected to the selected external volume, the LUN ID is displayed.
Status	Status of external paths: <ul style="list-style-type: none"> Unknown: The status of the mapping path is not known. Normal: There are no problems, the system is usable.

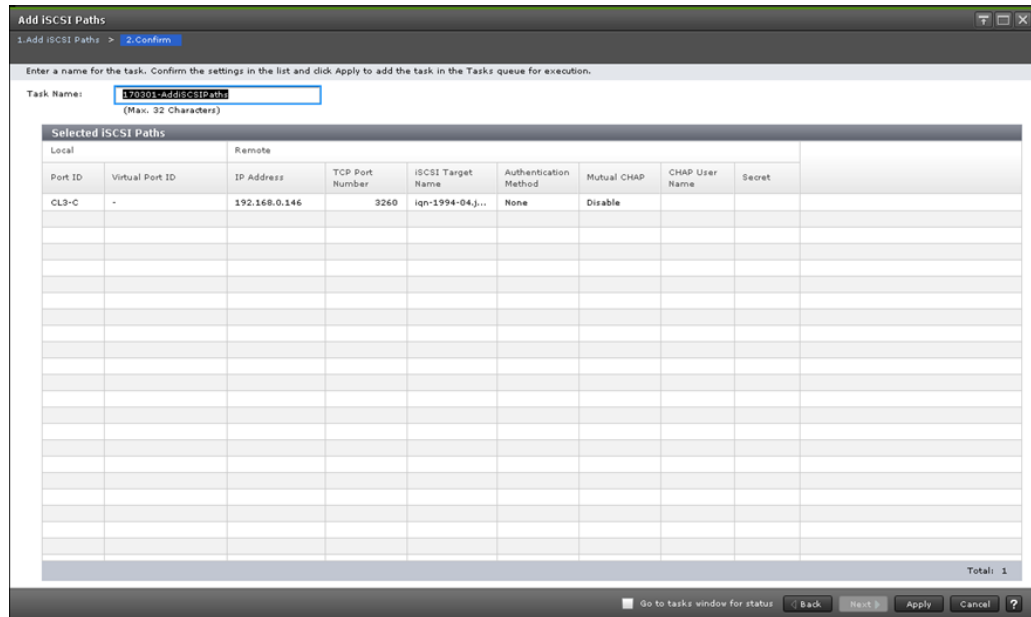
Add iSCSI Paths wizard

Add iSCSI Paths window



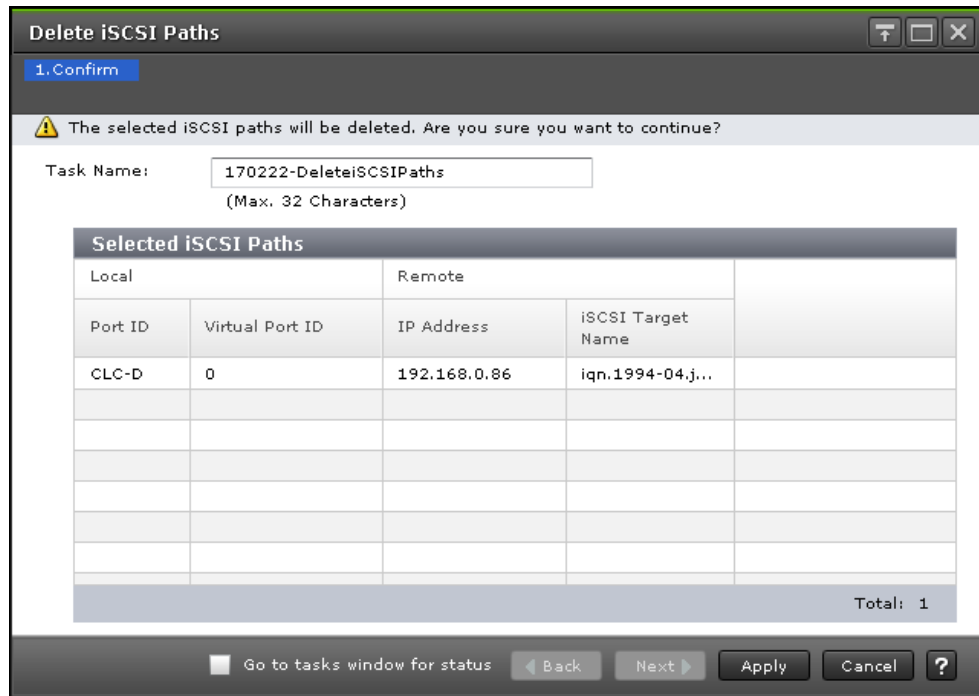
Item	Description
Available iSCSI Paths table: Local	Local storage system port information: <ul style="list-style-type: none"> ▪ Port ID: External port ▪ Virtual Port ID: Virtual port
Available iSCSI Paths table: Remote	Remote storage system port information: <ul style="list-style-type: none"> ▪ IP Address: IP address ▪ TCP Port Number: TCP port number ▪ iSCSI Target Name: iSCSI target name
Authentication Method	<ul style="list-style-type: none"> ▪ CHAP ▪ None
Mutual CHAP	Whether to enable mutual CHAP: <ul style="list-style-type: none"> ▪ Enable: Authentication is bidirectional. ▪ Disable: Authentication is unidirectional.
User Name	Case-sensitive user name. Up to 223 characters are allowed. Valid characters: Alphanumeric characters and symbols (. - + @ _ = : / [] ~)
Secret	Secret for host authentication. Between 12 and 32 letters are allowed. Valid characters: Alphanumeric characters and symbols (. - + @ _ = : / [] ~)
Selected iSCSI Paths table: Local	Local storage system port information: <ul style="list-style-type: none"> ▪ Port ID: External port ▪ Virtual Port ID: Virtual port
Selected iSCSI Paths table: Remote	Remote storage system port information: <ul style="list-style-type: none"> ▪ IP Address: IP address ▪ TCP Port Number: TCP port number ▪ iSCSI Target Name: iSCSI target name ▪ Authentication Method: Method for authentication ▪ Mutual CHAP: Mutual CHAP setting ▪ CHAP User Name: CHAP user name, if specified

Add iSCSI Paths confirmation window



Item	Description
Local	Local storage system port information: <ul style="list-style-type: none"> Port ID: External port Virtual Port ID: Virtual port
Remote	Remote storage system port information: <ul style="list-style-type: none"> IP Address: IP address TCP Port Number: TCP port number iSCSI Target Name: iSCSI target name Authentication Method: Method for authentication Mutual CHAP: Mutual CHAP setting CHAP User Name: CHAP user name, if specified Secret: If a Secret is set, *****(6 asterisks) are displayed.

Delete iSCSI Paths window



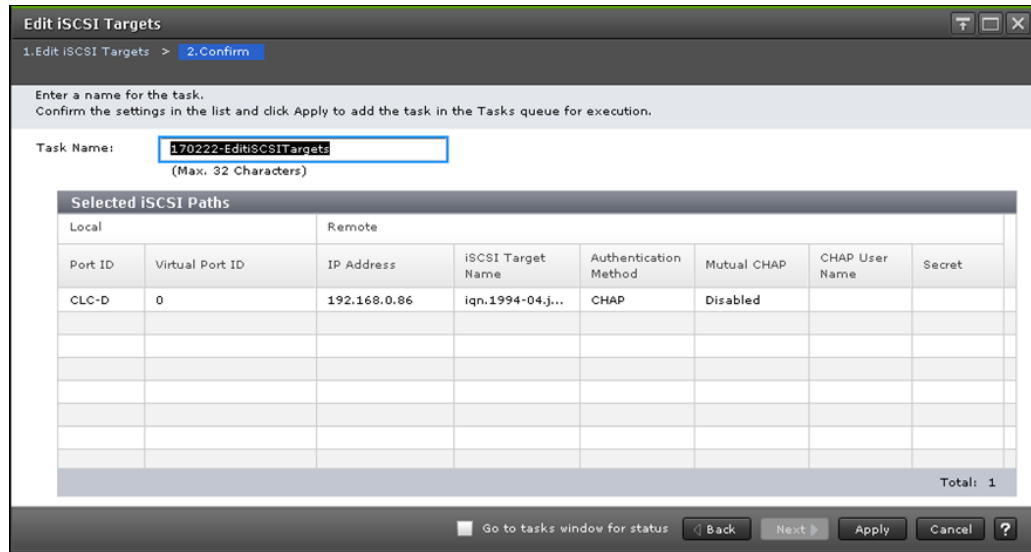
Item	Description
Local	Local storage system port information: <ul style="list-style-type: none"> Port ID: External port Virtual Port ID: virtual port
Remote	External storage system port information: <ul style="list-style-type: none"> IP Address: IP address iSCSI Target Name: iSCSI target name

Edit iSCSI Targets wizard

Edit iSCSI Targets window

Item	Description
Authentication Method	<ul style="list-style-type: none"> ▪ CHAP ▪ None
Mutual CHAP	Whether to enable mutual CHAP: <ul style="list-style-type: none"> ▪ Enable: Authentication is bidirectional. ▪ Disable: Authentication is unidirectional.
User Name	Case-sensitive user name. Up to 223 characters are allowed. Usable characters: Alphanumeric characters and symbols (. - + @ _ = : / [] ~)
Secret	Secret for host authentication. Numbers from 12 to 32 characters can be used. Usable characters: Alphanumeric characters and symbols (. - + @ _ = : / [] ~)

Edit iSCSI Targets confirmation window



Item	Description
Local	<p>Local storage system port information:</p> <ul style="list-style-type: none"> Port ID: external port Virtual Port ID: virtual port
Remote	<p>External storage system port information:</p> <ul style="list-style-type: none"> IP Address: IP address iSCSI Target Name: iSCSI target name Authentication Method: Method for authentication Mutual CHAP: Mutual CHAP setting CHAP User Name: CHAP user name, if specified Secret: If Secret is set, ***** (6 asterisks) are displayed.

Discover iSCSI Targets window

Item	Description
Local Port ID	Port connected to external storage system of the local storage system
Local Virtual Port ID	Virtual port of the local storage system
Remote IP Address	IP address of the external storage system port: <ul style="list-style-type: none"> IPv4: If the external storage system supports IPv4, the address must be entered. IPv6: If the external storage system supports IPv6, the address must be entered.
Remote TCP Port Number	TCP port number of external storage system port. Numbers from 1 to 65535 are allowed.
Local - Discovery List table	Displays the local storage system port information: <ul style="list-style-type: none"> Port ID: external port Virtual Port ID: virtual port.
Remote - Discovery List table	External storage system port information: <ul style="list-style-type: none"> IP Address: IP address TCP Port Number: TCP port number

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