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Hitachi Virtual Storage Platform

70-06-5*x*

Provisioning Guide for Open Systems

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Preface

This document describes and provides instructions for performing operations on the Hitachi Virtual Storage Platform (VSP) storage system.

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

Intended audience

This document is intended for system administrators, Hitachi Vantara representatives, and authorized service providers who install, configure, and operate the Hitachi Virtual Storage Platform (VSP) storage system.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The Hitachi VSP storage system and the *VSP User and Reference Guide*.
- The Storage Navigator software and the *Storage Navigator User Guide*.

Product version

This document revision applies to VSP microcode 70-06-5*x* 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 parameter ranges for CCI commands issued to the VSP storage system.

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	▪ Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click **OK**. ▪ Indicates emphasized words in list items.
Italic	▪ Indicates a document title or emphasized words in text. ▪ Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: `pairdisplay -g group` (For exceptions to this convention for variables, see the entry for angle brackets.)
`Monospace`	Indicates text that is displayed on screen or entered by the user. Example: `pairdisplay -g oradb`
< > angle brackets	Indicates variables in the following scenarios: ▪ Variables are not clearly separated from the surrounding text or from other variables. Example: `Status_<report-name><file-version>.csv` ▪ Variables in headings.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.

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

Logical capacity unit	Value
	Open-systems: ▪ OPEN-V: 960 KB ▪ Others: 720 KB
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1{,}024^2$ bytes
1 GB	1,024 MB or $1{,}024^3$ bytes
1 TB	1,024 GB or $1{,}024^4$ bytes
1 PB	1,024 TB or $1{,}024^5$ bytes
1 EB	1,024 PB or $1{,}024^6$ bytes

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Thank you!

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Introduction to provisioning

Provisioning a storage system requires balancing the costs of the solution with the benefits that the solution provides. The following is an overview of provisioning strategies that you can implement on the Hitachi Virtual Storage Platform to support your business.

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- ☐ Disadvantages
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- ☐ Custom-sized provisioning
- ☐ Expanded LU provisioning
- ☐ When to use custom-sized provisioning
- ☐ When to use expanded-LU provisioning
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- ☐ Dynamic Provisioning Overview
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- ☐ Dynamic Provisioning concepts

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- [ ] Dynamic Provisioning advantages
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About provisioning

Provisioning is a method of managing storage system devices or volumes. Some provisioning methods are host-based, while others use existing storage system capabilities such as logical unit size expansion (LUSE) or concatenated array groups. Some provisioning methods are hardware-based, and others are software-based. Each technique has its particular use and benefit, for example, capacity, reliability, performance, or cost considerations, in a given storage environment. Used in the wrong scenario, each can be expensive, awkward, time consuming to configure and maintain, and can be potentially error prone. Your support representatives are available to help you configure the highest quality solution for your storage environment.

Provisioning strategies falls into two fundamental categories:

- Basic provisioning on page 1-3 (or traditional provisioning). Basic provisioning includes logical devices (LDEVs), custom-sized volumes, and expanded-LU volumes.
- Dynamic Provisioning Overview on page 1-8 (or virtual provisioning). Thin provisioning includes pooling physical storage and creating logical devices for hosts.

Basic provisioning

Several basic provisioning techniques traditionally are used to manage storage volumes. These strategies are useful in specific scenarios based on user needs, such as whether you use open or mainframe storage systems, or you prefer manual or automated control of your storage resources.

Basic provisioning relies on carving up physical storage into smaller units. Custom sizing is possible, and requires using Virtual LUN software. If a larger capacity logical unit is required, expanding the size of a logical volume is possible and requires the use of LUN Expansion software.

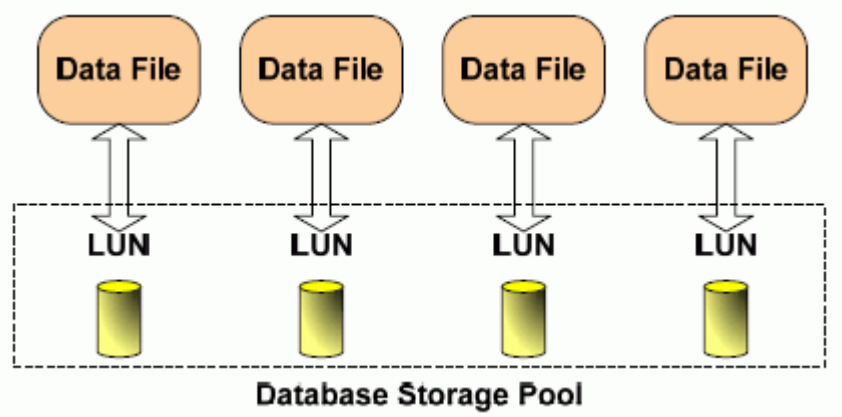
Basic provisioning includes:

- Fixed-sized provisioning on page 1-4
- Custom-sized provisioning on page 1-6
- Expanded LU provisioning on page 1-7

Fixed-sized provisioning

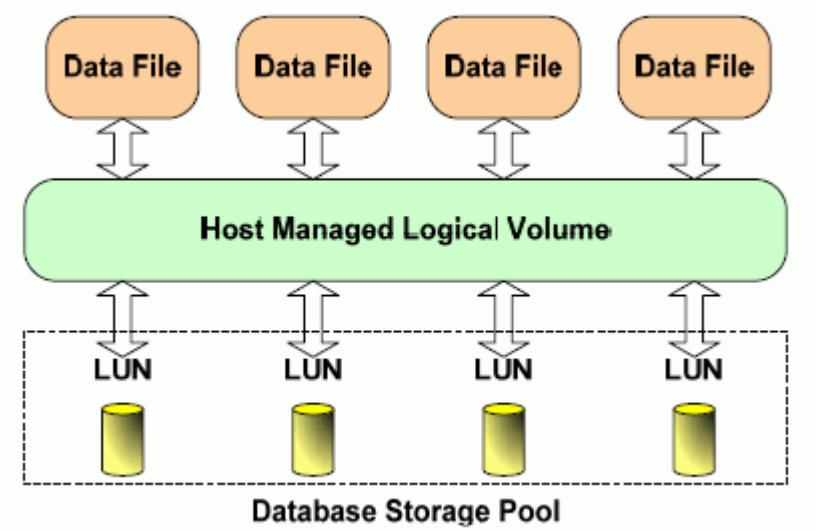
Two traditional fixed-size host-based volume management methods typically are used on open systems to organize storage space on a server. One method is the direct use of physical volumes as devices for use either as raw space or as a local or clustered file system. These are fixed-size volumes with a fixed number of disks, and as such, each has a certain inherent physical random input/output operation per second (IOPS) or sequential throughput (megabytes per second) capacity. A System Administrator manages the aggregate server workloads against them. As workloads exceed the volume's available space or its IOPS capacity, the user contents are manually moved onto a larger or faster (more spindles) volume, if possible.

The following figure illustrates a simple fixed-size provisioning environment using individual LU volumes on a host:



The alternative is to use a host-based Logical Volume Manager (LVM) when the planned workloads require either more space or IOPS capacity than the individual physical volumes can provide. LVM is the disk management feature available on UNIX-based operating systems, including Linux, that manages their logical volumes.

The following illustrates a fixed-size provisioning environment using LUNs in host-managed logical volumes:



In either case, hosts recognize the size as fixed regardless of the actual used size. Therefore, it is not necessary to expand the volume (LDEV) size in the future if the actual used size does not exceed the fixed size.

When such a logical volume runs out of space or IOPS capacity, you can replace it with one that was created with even more physical volumes and then copy over all of the user data. In some cases, it is best to add a second logical volume and then manually relocate just part of the existing data to redistribute the workload across two such volumes. These two logical volumes would be mapped to the server using separate host paths.

Disadvantages

Some disadvantages to using fixed-sized provisioning are:

- If you use only part of the entire capacity specified by an emulation type, the rest of the capacity is wasted.
- After creating fixed-sized volumes, typically some physical capacity will be wasted due to being less than the fixed-size capacity.
- In a fixed-sized environment, manual intervention can become a costly and tedious exercise when a larger volume size is required.

When to use fixed-sized provisioning

Fixed-sized provisioning is a best fit in the following scenarios:

- When custom-sized provisioning is not supported.

Custom-sized provisioning

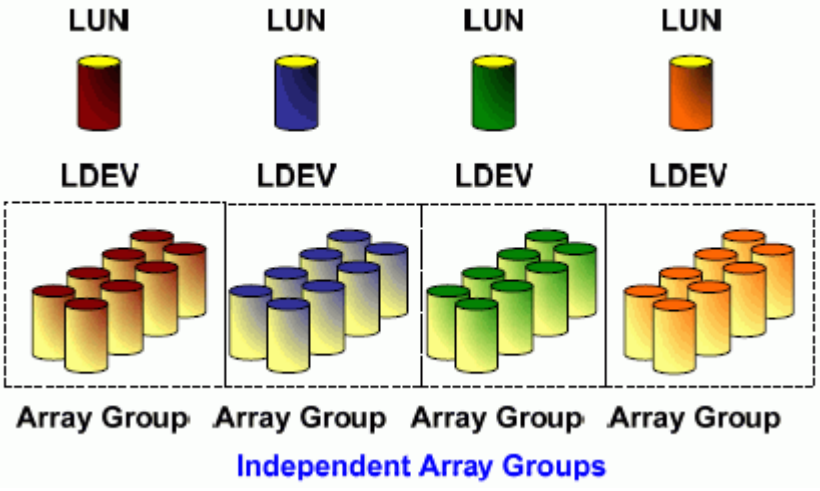
Custom-sized (or variable-sized) provisioning has more flexibility than fixed-sized provisioning and is the traditional storage-based volume management strategy typically used to organize storage space.

To create custom-sized volumes on a storage system, an administrator creates volumes of the desired size from individual array groups. These volumes are then individually mapped to one or more host ports as a logical unit.

Following are three scenarios where custom-sized provisioning is an advantage:

- In fixed-sized provisioning, when several frequently accessed files are located on the same volume and one file is being accessed, users cannot access the other files because of logical device contention. If the custom-sized feature is used to divide the volume into several smaller volumes and I/O workload is balanced (each file is allocated to different volumes), then access contention is reduced and access performance is improved.
- In fixed-sized provisioning, not all of the capacity may be used. Unused capacity on the volume will remain inaccessible to other users. If the custom-sized feature is used, smaller volumes can be created that do not waste capacity.
- Applications that require the capacity of many fixed-sized volumes can instead be given fewer large volumes to relieve device addressing constraints.

The following illustrates custom-sized provisioning in an open-systems environment using standard volumes of independent array groups:



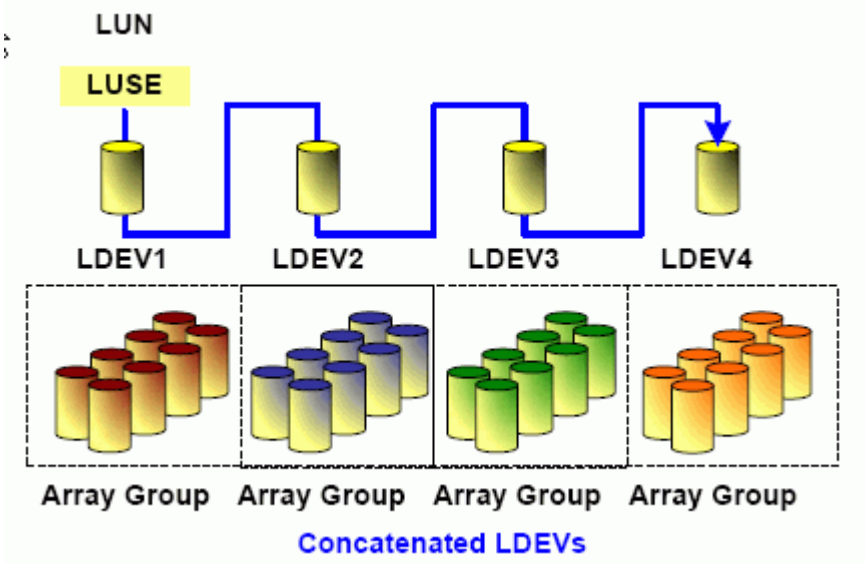
To change the size of a volume already in use, you first create a new volume larger (if possible) than the old one, and move the contents of the old volume to the new one. The new volume must be defined in the IOGEN of the host as a different volume.

A disadvantage is that this manual intervention can become costly and tedious and this provisioning strategy is appropriate only in certain scenarios.

Expanded LU provisioning

If a volume larger than the largest volume is needed in a custom-size volume, the traditional storage system-based solution is to use the logical unit size expansion (LUSE) feature to configure an expanded logical unit (LU). This method is merely a simple concatenation of LDEVs, which is a capacity rather than a performance configuration.

The following illustrates a simple expanded LU environment, where LDEVs are concatenated to form a LUSE volume.



When to use custom-sized provisioning

Use custom-sized provisioning when you want to manually control and monitor your storage resources and usage scenarios.

When to use expanded-LU provisioning

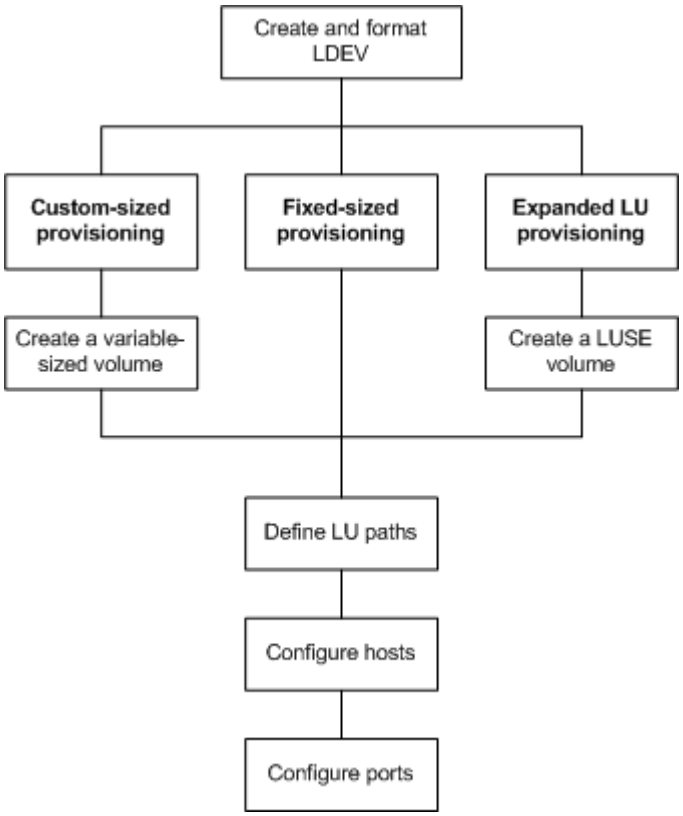
Expanded-LU provisioning is a best fit in the following scenarios:

- In an open systems environment.
- When you want to manually control and monitor your storage resources and usage scenarios.
- To combine open-systems volumes to create an open-systems volume (LU) larger than 2.8 TB.
- When thin provisioning is not an option.

For detailed information, see Configuring expanded LU provisioning on page 4-1.

Basic provisioning workflow

The following illustrates the basic provisioning workflow:



Virtual LUN software is used to configure custom-sized provisioning. For detailed information, see Configuring custom-sized provisioning on page 3-1.

Dynamic Provisioning Overview

Thin provisioning is an approach to managing storage that maximizes physical storage capacity. Instead of *reserving* a fixed amount of storage for a volume, it simply assigns capacity from the available physical pool when data is actually written to disk.

Thin provisioning includes:

- Dynamic Provisioning concepts on page 1-9
- Dynamic Tiering on page 1-12

Dynamic Provisioning

Though basic or traditional provisioning strategies can be appropriate and useful in specific scenarios, they can be expensive to set up, awkward and time consuming to configure, difficult to monitor, and error prone when maintaining storage.

Although Dynamic Provisioning requires some additional steps, it is a simpler alternative to the traditional provisioning methods. It uses thin provisioning technology that allows you to allocate *virtual storage capacity* based on anticipated future capacity needs, using *virtual volumes* instead of physical disk capacity.

Overall storage use rates may improve because you can potentially provide more virtual capacity to applications while using fewer physical disks. It can provide lower initial cost, greater efficiency, and storage management freedom for storage administrators. In this way, Dynamic Provisioning software:

- Simplifies storage management
- Provides balanced resources and more optimized performance by default without inordinate manual intervention.
- Maximizes physical disk usage
- May reduce device address requirements over traditional provisioning by providing larger volume sizes.

Dynamic Provisioning concepts

Dynamic Provisioning is a volume management feature that allows storage managers and System Administrators to efficiently plan and allocate storage to users or applications. It provides a platform for the array to dynamically manage data and physical capacity without frequent manual involvement.

Dynamic Provisioning provides three important capabilities: thin provisioning of storage, enhanced volume performance, and larger volume sizes.

Dynamic Provisioning is more efficient than traditional provisioning strategies. It is implemented by creating one or more Dynamic Provisioning pools (DP pools) of physical storage space using multiple LDEVs. Then, you can establish virtual DP volumes (DP-VOLs) and connect them to the individual DP pools. In this way, capacity to support data can be randomly assigned on demand within the pool.

DP-VOLs are of a user-specified logical size without any corresponding physical space. Actual physical space (in 42-MB pool page units) is automatically assigned to a DP-VOL from the connected DP pool as that volume's logical space is written to over time. A new volume does not have any pool pages assigned to it. The pages are *loaned out* from its connected pool to that DP volume until the volume is reformatted or deleted. At that point, all of that volume's assigned pages are returned to the pool's free page list. This handling of logical and physical capacity is called *thin provisioning*. In many cases, logical capacity will exceed physical capacity.

Dynamic Provisioning enhances volume performance. This is an automatic result of how DP-VOLs map capacity from individual DP pools. A pool is created using from one to 1024 LDEVs (pool volumes) of physical space. Each pool volume is sectioned into 42-MB pages. Each page is consecutively laid down on a number of RAID stripes from one pool volume. The pool's 42-MB pool pages are assigned on demand to any of the DP-VOLs that are connected to that pool. Other pages assigned over time to that DP-VOL randomly originate from the next free page of some other pool volume in the pool.

Setting up a Dynamic Provisioning environment requires a few extra steps. You still configure various array groups to a desired RAID level and create one or more volumes (LDEVs) on each of them (see Creating an LDEV on page 3-13). Then set up a Dynamic Provisioning environment by creating one or more DP pools of physical storage space that are each a collection of some of these LDEVs (DP pool volumes). This pool structure supports creation of Dynamic Provisioning virtual volumes (DP-VOLs), where 42-MB pages of data are randomly assigned on demand.

For detailed information, see Configuring thin provisioning on page 5-1.

When to use Dynamic Provisioning

Dynamic Provisioning is a best fit in an open-systems environment in the following scenarios:

- Where the aggregation of storage pool capacity usage across many volumes provides the best opportunity for performance optimization.
- For stable environments and large consistently growing files or volumes.
- Where device addressing constraints are a concern.

Dynamic Provisioning advantages

Advantages	Without Dynamic Provisioning	With Dynamic Provisioning
Reduces initial costs	You must purchase physical disk capacity for expected future use. The unused capacity adds costs for both the storage system and software products.	You can logically allocate more capacity than is physically installed. You can purchase less capacity, reducing initial costs and you can add capacity later by expanding the pool. Some file systems take up little pool space. For more details, see Operating system and file system capacity on page 5-9.
Reduces management costs	You must stop the storage system to reconfigure it.	When physical capacity becomes insufficient, you can add pool capacity without service interruption.

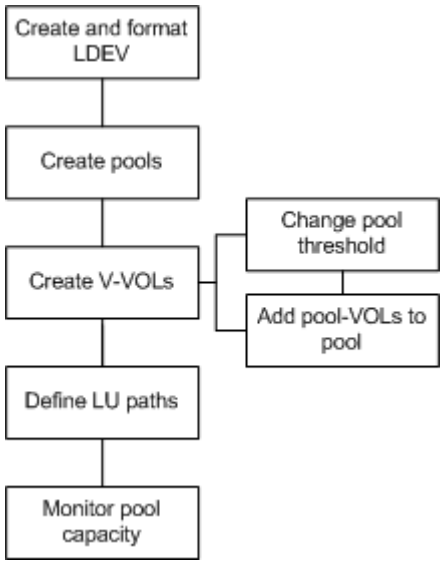
Advantages	Without Dynamic Provisioning	With Dynamic Provisioning
		In addition, with Dynamic Tiering you can configure pool storage consisting of multiple types of data drives, including SSD, SAS, SATA, and external volumes. This eliminates unnecessary costs.
Reduces management labor and increases availability of storage volumes for replication	As the expected physical disk capacity is purchased, the unused capacity of the storage system also needs to be managed on the storage system and on licensed VSP products.	VSP product licenses are based on used capacity rather than the total defined capacity. You do not need to use LUSE because you can allocate volumes of up to 60 TB regardless of physical disk capacity. Dynamic Tiering allows you to use storage efficiently by automatically migrating data to the most suitable data drive.
Increases the performance efficiency of the data drive	Because physical disk capacity is initially purchased and installed to meet expected future needs, portions of the capacity may be unused. I/O loads may concentrate on just a subset of the storage which might decrease performance.	Effectively combines I/O patterns of many applications and evenly spreads the I/O activity across available physical resources, preventing bottlenecks in parity group performance. Configuring the volumes from multiple parity groups improves parity group performance. This also increases storage use while reducing power and pooling requirements (total cost of ownership).

Dynamic Provisioning advantage example

To illustrate the merits of a Dynamic Provisioning environment, assume you have twelve LDEVs from 12 RAID 1 (2D+2D) array groups assigned to a DP pool. All 48 disks contribute their IOPS and throughput power to all DP volumes assigned to that pool. Instead, if more random read IOPS horsepower is desired for a pool, then it can be created with 32 LDEVs from 32 RAID 5 (3D+1P) array groups, thus providing 128 disks of IOPS power to that pool. Up to 1024 LDEVs may be assigned to a single pool, providing a considerable amount of I/O capability to just a few DP volumes.

Dynamic Provisioning work flow

The following illustrates the Dynamic Provisioning workflow.



Dynamic Tiering

After using Dynamic Provisioning software to virtualize LUs and pool storage into a thin provisioning strategy, the array now has all the elements in place to offer automatic self-optimizing storage tiers provided by Hitachi Dynamic Tiering software (HDT). Using Dynamic Tiering, you can configure a storage system with multiple storage tiers using different kinds of data drives, including SSD, SAS, SATA, and external volumes. This helps improve the speed and cost of performance. Dynamic Tiering extends and improves the functionality and value of Dynamic Provisioning. Both use pools of physical storage against which virtual disk capacity, or V-VOLs, is defined. Each thin provisioning pool can be configured to operate either as a DP pool or a Dynamic Tiering pool.

Automated tiering of physical storage is the logical next step for thin provisioned enterprise arrays. Automated tiering is the ability of the array to dynamically monitor and relocate data on the optimum tier of storage. It focuses on data segments rather than entire volumes. The functionality is entirely within the array without any mandated host level involvement. Dynamic Tiering adds another layer to the thin provisioned environment.

Using Dynamic Tiering you can:

- Configure physical storage into tiers consisting of multiple kinds of data drives, including SSD, SAS, and SATA. Although host volumes are conventionally configured from a common pool, the pool is efficiently configured using multiple kinds of data disk drives. Placing data that needs high performance while reducing storage costs by using high cost disks such as SSDs as efficiently as possible, resulting in data that is accessed infrequently being placed on lower cost physical storage.

- Automatically migrate small portions of host volumes to the most suitable data drive according to access frequency. Frequently accessed data is migrated to higher speed hard disk drives (for example, SSD). Infrequently accessed data is migrated to lower cost and lower speed hard disk drives (for example, SATA) to use the storage efficiently.

Dynamic Tiering simplifies storage administration by automating and eliminating the complexities of efficiently using tiered storage. It automatically moves data on pages in Dynamic Provisioning virtual volumes to the most appropriate storage media, according to workload, to maximize service levels and minimize total cost of storage.

Dynamic Tiering gives you:

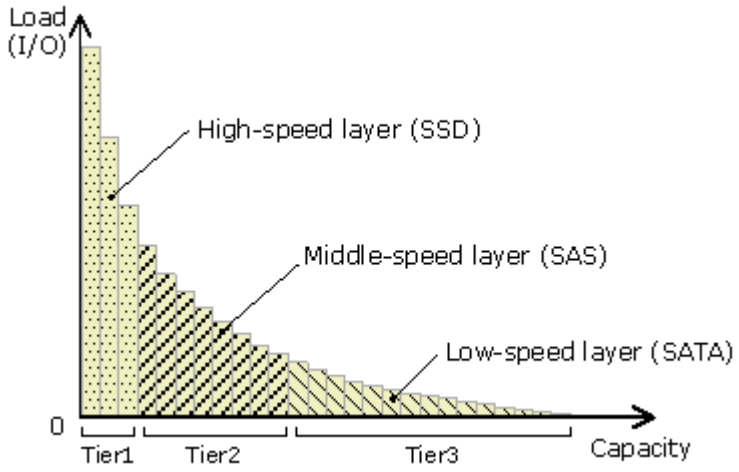
- Improved storage resource usage
- Improved return on costly storage tiers
- Reduced storage management effort
- More automation
- Nondisruptive storage management
- Reduced costs
- Improved performance

Tiers concept

When not using Dynamic Tiering, data is allocated to only one kind of data drive (typically an expensive high-speed hard disk drive) without regard to the workload to the volumes because the volumes are configured with only one kind of data drive. When using Dynamic Tiering, the higher speed data drive is automatically allocated to the volumes of high workload, and the lower speed drive to the volumes of low workload,. This improves performance and reduces costs.

Dynamic Tiering places the host volume's data across multiple tiers of storage contained in a pool. There can be up to three tiers (high-, medium-, and low-speed layers) in a pool. Dynamic Tiering determines tier usage based on data access levels. It allocates the page with high I/O load to the upper tier, which contains a higher speed drive, and the page with low I/O load to the lower tier, which contains a lower speed drive.

The following figure illustrates the basic tier concept.



When to use Dynamic Tiering

Dynamic Tiering is the best fit in an environment in which Dynamic Provisioning is a good fit.

For detailed information, see Configuring thin provisioning on page 5-1.

Data retention strategies

After provisioning your system, you can assign access attributes to open-system volumes to protect the volume against read, write, and copy operations and to prevent users from configuring LU paths and command devices. Use the Data Retention Utility to assign access attributes.

For more information, see Configuring access attributes on page 6-1.

Resource groups strategies

A storage system can connect to multiple hosts and be shared by multiple divisions in a company or by multiple companies. Many storage administrators from different organizations can access the storage system. Managing the entire storage system can become complex and difficult. Potential problems are that private data might be accessed by other users, or a volume in one organization might be destroyed by mistake by a storage administrator in another organization.

To avoid such problems, use Hitachi Resource Partition Manager software to set up resource groups that allow you to manage one storage system as multiple virtual private storage systems. The storage administrator in each resource group can access only their assigned resources and cannot access other resources. Configuring resource groups prevents the risk of data leakage or data destruction by another storage administrator in another resource group.

The resources such as LDEVs, parity groups, external volumes, ports, or host groups can be assigned to a resource group. These resources can be combined to flexibly compose a virtual private storage system.

Resource groups should be planned and created before creating volumes. For more information, see Configuring resource groups on page 2-1.

Complimentary strategies

Functions related to provisioning

For the following functions, see the appropriate manuals:

- Replication: ShadowImage, TrueCopy, Universal Replicator
- External storage: Universal Volume Manager
- Migration: Volume Migration (contact the customer support)
- Partitioning: Virtual Partition Manager (*Performance Guide*)

Key terms

The following are provisioning key terms:

Term	Description
access attributes	Security function used to control the access to a logical volume. Access attributes are assigned to each volume: read only, read/write, and protect.
CV (variable volume)	Customized Volume. A fixed volume that is divided into arbitrary sizes.
DP pool	A group of DP-VOLs. The DP pool consists of one or more pool-VOLs.
DP-VOL	Dynamic Provisioning virtual volume.
expiration lock	Security option used to allow or not allow changing of the access attribute on a volume.
FV	Abbreviation for fixed-sized volume.
LUSE	Logical Unit Size Expansion (LUSE).
LUSE volume	A set of LDEVs defined to one or more hosts as a single logical unit (LU). A LUSE volume can be a concatenation of two to 36 LDEVs that are then presented to a host as a single LU.
meta_resource	A resource group in which additional resources (other than external volumes) and the resources existing before installing Resource Partition Manager belong.
page	In Dynamic Provisioning, a page is 42 MB of continuous storage in a DP-VOL that belongs to a DP-pool.
pool	A set of volumes that are reserved for storing Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot write data.

Term	Description
pool threshold	In a thin provisioned storage system, the proportion (%) of used capacity of the pool to the total pool capacity. Each pool has its own pool threshold values for warning and depletion.
pool-VOL, pool volume	A volume that is reserved for storing snapshot data for Thin Image or Copy-on-Write Snapshot operations or write data for Dynamic Provisioning.
resource group	A group that is assigned one or more resources of the storage system. The resources that can be assigned to the resource group are LDEV IDs, parity groups, external volumes, ports, and host group IDs.
subscription threshold	In a thin provisioned storage system, the proportion (%) of total DP-VOL capacity associated with the pool versus the total capacity. You can set the percentage of DP-VOL capacity that can be created to the total capacity of the pool. This can help prevent DP-VOL blocking caused by a full pool. For example, when the subscription limit is set to 100%, the total DP-VOL capacity that can be created is obtained using this formula: total DP-VOL capacity <= pool capacity x 100% Using this setting protects the pool when doing the following: • Shrinking a pool • Creating DP-VOLs • Increasing DP-VOL capacity
tier boundary	The value of the reached maximum I/O counts that each tier can process.
tier relocation	A combination of determining the appropriate storage tier and migrating the pages to the appropriate tier.
tiered storage	A storage hierarchy of layered structures of data drives consisting of different performance levels, or tiers, that match data access requirements with the appropriate performance tiers.
VDEV	A virtual device in the storage system. A VDEV is a group of logical volumes (LDEVs or logical units) in a parity group. One parity group consists of multiple VDEVs. A VDEV usually includes some fixed volumes (FVs) and some free spaces. The number of FVs is determined by the emulation type.

Before you begin

Before you begin provisioning your VSP storage system, certain requirements must be met.

System requirements

- The VSP hardware, microcode, and Storage Navigator essential for operating the storage system be installed and configured for use.

- A VSP storage system.
- The storage system must have parity groups installed.
- A Storage Navigator client computer.

Shared memory requirements

If configuring thin provisioning, Dynamic Provisioning requires dedicated shared memory for the V-VOL management area.

The V-VOL management area, which is automatically created when shared memory is added, is an area used to store information for associating pool-VOLs and DP-VOLs.

If Dynamic Provisioning is used, at least 16 GB of shared memory consisting of two sections is required. The memory capacity allocated to each part is as follows:

- Basic part: 8 GB
- Dynamic Provisioning: 8 GB

If Dynamic Tiering is used, shared memory for Dynamic Provisioning and Dynamic Tiering is necessary. At least 24 GB of shared memory consisting of two sections is required. The memory capacity allocated to each part is as follows:

- Basic part: 8 GB
- Dynamic Provisioning: 8 GB
- Dynamic Tiering: 8 GB

If Dynamic Provisioning and Dynamic Tiering are used, a pool or V-VOL capacity can be created and the shared memory can be expanded depending on its status. If you use a pool or V-VOL which has a capacity greater than 1.1 PB, the shared memory must be installed. Before the shared memory is uninstalled, all Dynamic Provisioning and Dynamic Tiering pools must be deleted.

The required shared memory is installed by your Hitachi Vantara representative.

About cache management devices

Cache management devices are associated with volumes (LDEVs) and used to manage caches. One volume (LDEV) requires at least one cache management device. An entire system can manage up to 65,280 cache management devices. A DP-VOL may require more than one cache management device. This topic describes how to calculate the number of cache management devices.

Calculating the number of cache management devices required by a DP-VOL

The number of cache management devices that a DP-VOL requires depends on the capacity of the V-VOL (capacity of the user area) and the maximum capacity of cache management device. The maximum capacity of cache management device depends on the pool attribute (internal volume or external volume) associated with V-VOL. The following table explains the relationship between the pool attribute and the maximum capacity of cache management device.

Maximum capacity of cache management device

Pool attribute	Maximum capacity (in MB)	Maximum capacity (in blocks)
Internal volume	3,145,716 (2.99 TB)	6,442,426,368
External volume with **Mixable** set to Enabled	3,145,716 (2.99 TB)	6,442,426,368
External volume with **Mixable** set to Disabled	4,194,288 (3.99 TB)	8,589,901,824

Use the following formula to calculate the number of cache management devices that a DP-VOL requires. In this formula, the user-specified capacity is the user area capacity of a V-VOL.

ceil(*user-specified capacity* ÷ *max-capacity-of-cache-management-device*)

The calculated value must be rounded up to the nearest whole number.

Calculating the number of cache management devices required by a volume that is not a DP-VOL

One volume that is not a DP-VOL requires one cache management device.

Viewing the number of cache management devices

Click **Actions** and select **View Management Resource Usage** to display the number of cache management devices in the View Management Resource Usage window. For details, see About cache management devices on page 1-17 and View Management Resource Usage window on page C-58.

2

Configuring resource groups

The Storage Administrator can divide a provisioned storage system into resource groups that allow managing the storage system as multiple virtual private storage systems. Configuring resource groups involves creating resource groups, moving storage system resources into the resource groups, and assigning resource groups to user groups.

Resource groups can be set up on both open and mainframe systems. Resource Partition Manager software is required.

- ☐ System configuration using resource groups
- ☐ Resource groups examples
- ☐ Meta_resource
- ☐ Resource lock
- ☐ User groups
- ☐ Resource group assignments
- ☐ Resource group license requirements
- ☐ Resource group rules, restrictions, and guidelines
- ☐ Creating a resource group
- ☐ Adding resources to a resource group
- ☐ Removing resources from a resource group
- ☐ Managing Resource Groups

- Using Resource Partition Manager and other VSP products

System configuration using resource groups

Configuring resource groups prevents the risk of data leakage or data destruction by another Storage Administrator in another resource group. The Storage Administrator considers and plans which resource should be managed by which user, and then the Security Administrator creates resource groups and assigns each resource to the resource groups.

A resource group is assigned one or more storage system resources. The following resources can be assigned to resource groups.

- LDEV IDs*
- Parity groups
- External volumes (VDEVs)
- Ports
- Host group IDs*

* Before you create LDEVs, the LDEV IDs can be reserved and assigned to a resource group for future use. Host group numbers can also be reserved and assigned in advance because the number of host groups created on a single port is limited.

The following tasks provide instructions for configuring resource groups.

- Creating a resource group on page 2-9
- Adding resources to a resource group on page 2-10
- Removing resources from a resource group on page 2-11
- Changing the name of a resource group on page 2-11
- Deleting a resource group on page 2-12

Resource groups examples

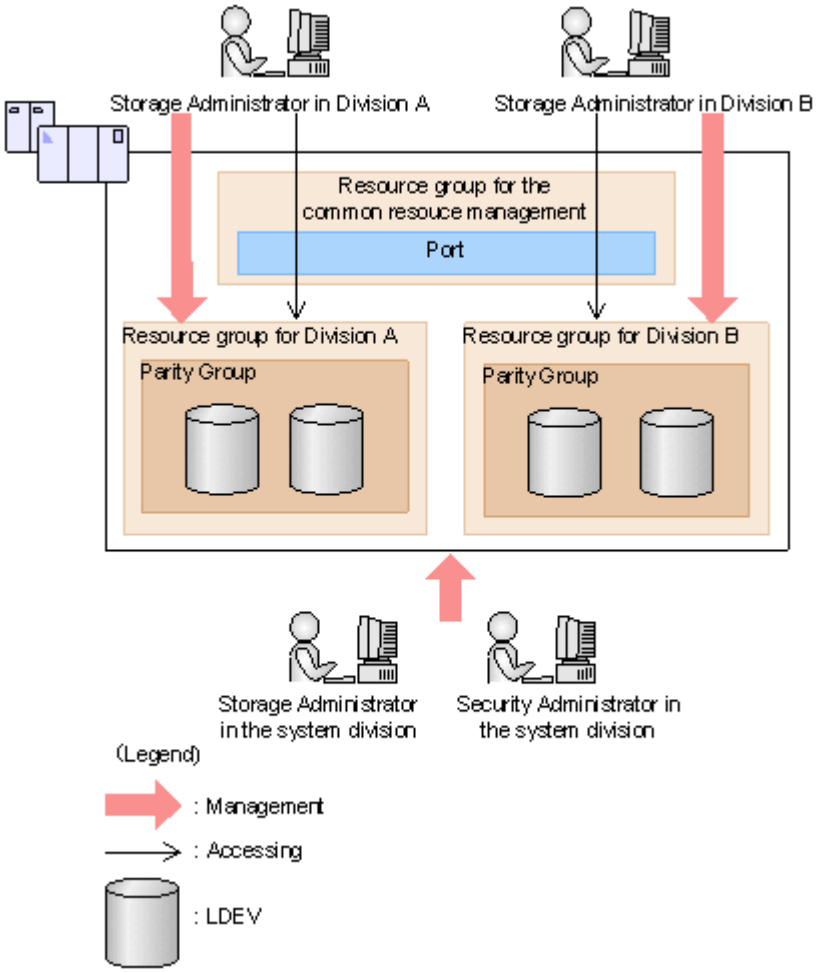
The following examples illustrate how you can configure resource groups on your storage system:

- Example of resource groups sharing a port on page 2-3
- Example of resource groups not sharing ports on page 2-5

Example of resource groups sharing a port

If you have a limited number of ports, you can still operate a storage system effectively by sharing ports using resource groups.

The following example shows the system configuration of an in-house division providing virtual private storage system for two divisions. Divisions A and B each use their own assigned parity group, but share a port between the two divisions. The shared port is managed by the system division.



The Security Administrator in the system division creates resource groups for each division in the storage system and assigns them to the respective divisions. The Storage Administrator in Division A can manage the resource groups for Division A, but cannot access the resource groups for Division B. In the same manner, the Storage Administrator in Division B can manage the resource groups for Division B, but cannot access the resource groups for Division A.

The Security Administrator creates a resource group for managing the common resources, and the Storage Administrator in the system division manages the port that is shared between Divisions A and B. The Storage Administrators in Divisions A and B cannot manage the shared port belonging to the resource group for common resources management.

Configuration workflow for resource groups sharing a port

1. The system division forms a plan about the resource group creation and assignment of the resources.
2. The Security Administrator creates resource groups.
   See Creating a resource group on page 2-9 for more information.
3. The Security Administrator creates user groups.

See *Hitachi Storage Navigator User Guide* for more information.

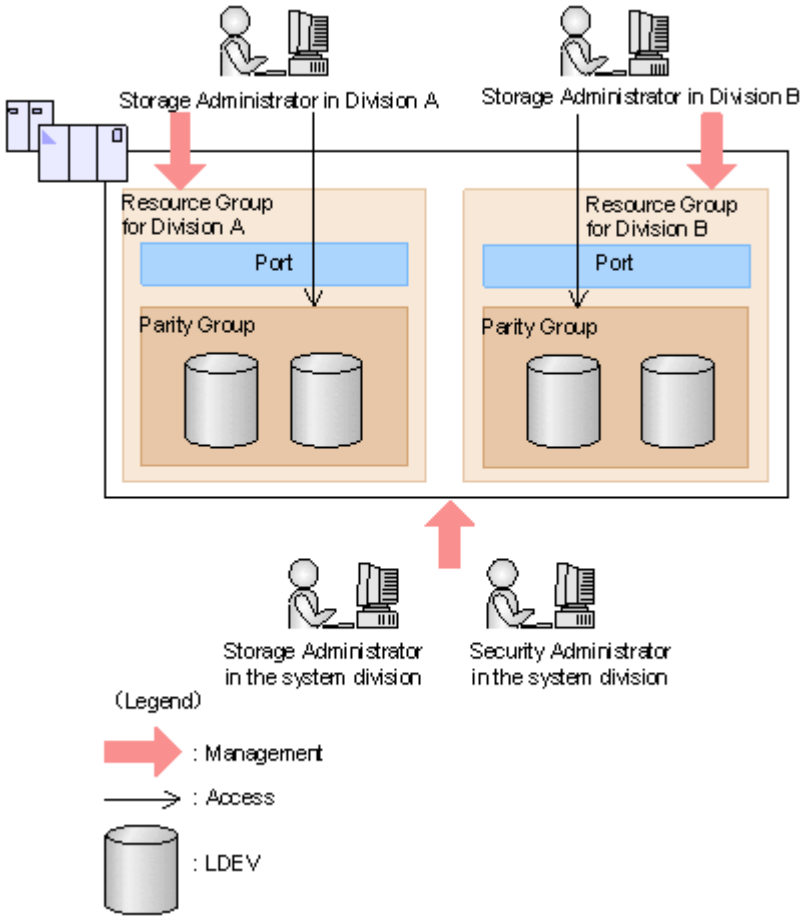
4. The Security Administrator assigns the resource groups to user groups.
   See *Hitachi Storage Navigator User Guide* for more information.
5. The Storage Administrator in the system division sets a port.
6. The Security Administrator assigns resources to the resource groups.
   See Adding resources to a resource group on page 2-10 for more information.
7. The Security Administrator assigns each Storage Administrator to each user group.
   See *Hitachi Storage Navigator User Guide* for more information.

After the above procedures, the Storage Administrators in A and B divisions can manage the resource groups assigned to their own division.

Example of resource groups not sharing ports

If you assign ports to each resource group without sharing, performance can be maintained on a different port even if the bulk of I/O is issued from one side port.

The following shows a system configuration example of an in-house system division providing the virtual private storage system for two divisions. Divisions A and B each use individual assigned ports and parity groups. In this example, they do not share a port.



The Security Administrator in the system division creates resource groups for each division in the storage system and assigns them to the respective divisions. The Storage Administrator in Division A can manage the resource groups for Division A, but cannot access the resource groups for Division B. In the same manner, the Storage Administrator in Division B can manage the resource groups for Division B, but cannot access the resource groups for Division A.

Configuration workflow for resource groups not sharing a port

1. The system division forms a plan about creating resource groups and the assigning resources to the groups.
2. The Security Administrator creates resource groups.
   See Creating a resource group on page 2-9) for more information.
3. The Security Administrator creates user groups.
   See *Hitachi Storage Navigator User Guide* for more information.
4. The Security Administrator assigns the resource groups to user groups.
   See *Hitachi Storage Navigator User Guide* for more information.
5. The Storage Administrator in the system division sets ports.
6. The Security Administrator assigns resources to the resource groups.

See Adding resources to a resource group on page 2-10 for more information.

7. The Security Administrator assigns each Storage Administrator to each user group.

   See *Hitachi Storage Navigator User Guide* for more information.

After the above procedures, the Storage Administrators in A and B divisions can access the resource groups allocated to their own division.

Meta_resource

The *meta_resource* is a resource group comprised of additional resources (other than external volumes) and the resources that exist on the storage system before the Resource Partition Manager is installed. By default, existing resources initially belong to the meta_resource group to ensure compatibility with older software when a system is upgraded to include Resource Partition Manager.

Resource lock

While processing a task on a resource, all of the resource groups assigned to the logged-on user are locked for exclusive access.

A secondary window (such as the Basic Information Display) or an operation from the service processor (SVP) locks all of the resource groups in the storage system.

When a resource is locked, a status indicator appears on the Storage Navigator status bar. Click the **Resource Locked** button to view information about the locked resource.

User groups

User groups and associated built-in roles are defined in the SVP. A user belongs to one or more user groups. Privileges allowed to a particular user are determined by the user group or groups to which the user belongs.

The Security Administrator assigns resource groups to user groups. A user group may already be configured, or a new user group may be required for certain resources.

See *Hitachi Storage Navigator User Guide* for more information about how to set up user groups.

Resource group assignments

All resource groups are normally assigned to the Security Administrator and the Audit Log Administrator.

Each resource group has a designated Storage Administrator who can access only their assigned resources and cannot access other resources.

All resource groups to which all resources in the storage system belong can be assigned to a user group. Configure this in Storage Navigator by setting **All Resource Groups Assigned** to **Yes**.

A user who has **All Resource Groups Assigned** set to **Yes** can access all resources in the storage system. For example, if a user is a Security Administrator (with View & Modify privileges) and a Storage Administrator (with View and Modify privileges) and **All Resource Groups Assigned** is **Yes** on that user account, the user can edit the storage for all the resources.

If allowing this access becomes a problem with security on the storage system, then register the following two user accounts in Storage Navigator and use these different accounts for different purposes.

- A user account for a Security Administrator where **All Resource Groups Assigned** is set to **Yes**.
- A user account for a Storage Administrator who does not have all resource groups assigned and has only some of the resource groups assigned.

Resource group license requirements

Use of Resource Partition Manager on the VSP storage system requires the following:

- A license key on the Storage Navigator computer for Resource Partition Manager software. For details about the license key or product installation, see the *Hitachi Storage Navigator User Guide*.

Resource group rules, restrictions, and guidelines

Rules

- The maximum number of resource groups that can be created on a storage system is 1023.
- A Storage Administrator with the Security Administrator (View & Modify) role can create resource groups and assign resources to resource groups.
- Resources removed from a resource group are returned to meta_resource.
- Only a Storage Administrator (View & Modify) can manage the resources in assigned resource groups.

Restrictions

- No new resources can be added to meta_resource.
- Resources cannot be deleted from meta_resource.
- An LDEV that has the same pool ID or the journal group ID cannot be added to multiple resource groups.

  In the case of adding LDEVs that are used as pool volumes or journal volumes, add all the LDEVs that have the same pool IDs or journal group IDs by using a function such as sort.
- Host groups that belong to the initiator port cannot be added to a resource group.

Guidelines

- If you are providing a virtual private storage system to different companies, you should not share parity groups, external volumes, or pools if you want to limit the capacity that can be used by each user. When parity groups, external volumes, or pools are shared between multiple users, and if one user uses too much capacity of the shared resource, the other users might not be able to create an LDEV.

Creating a resource group

When creating a resource group, observe the following:

- The maximum number of resource groups that can be created on a storage system is 1023.
- The name *meta_resource* cannot be set for a resource group name.
- Duplicate occurrences of the same name are not allowed.
- Resource group name can use alphanumeric characters, spaces, and the following symbols: ! # $ % & ' ( ) + - . = @ [ ] ^ _ ` { } ~
- Alphabets are case-sensitive.
- You must have Security Administrator (View & Modify) role to perform this task.

To create a resource group

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Administration**, and then **Resource Groups**.
2. Click **Create Resource Groups** in the **Resource Groups** tab.
3. Enter a resource group name in the **Create Resource Groups** window.

   Select resources to be assigned to the resource group.

   a. Click the appropriate buttons select parity groups, LDEVs, ports, or host groups.

   b. Select resources from the available parity groups, LDEVs, ports, or host groups table.

   c. Click **Add**.

The selected resources move to the selected parity groups, LDEVs, ports, or host groups table.

If the selected resource is removed, select the row and click **Remove**.

d. Click **OK**.

The **Create Resource Groups** window appears.

4. Click **Add**.

The resource group is added to **Selected Resource Groups** table. If you select a row and click **Detail**, the **Resource Group Properties** window appears. If you select a row and click **Remove**, a message appears asking whether you want to remove the **OK**.

5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

If you select a row and click **Detail**, the **Resource Group Properties** window appears.

If **Go to tasks window for status** is checked, the **Tasks** window opens.

Adding resources to a resource group

Before adding resources to a resource group, consider the following:

- You must have Security Administrator (View & Modify) role to perform this task.
- No resource can be added to meta_resource.
- Only resources allocated to meta_resource can be added to resource groups.
- An LDEV with the same pool ID or journal group ID cannot be added to multiple resource groups. For example, when two LDEVs belong to the same pool, you must allocate both to the same resource group. You cannot allocate them separately. Use the sort function to sort the LDEVs by pool ID or journal group ID, then select them and add them all at once.
- Host groups that belong to the initiator port cannot be added to a resource group.

To add resources to a resource group

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Administration**, and then **Resource Groups**.
2. Click a resource group to add in the **Resource Groups** tab.
3. Click **Add Resources**.
4. Select the type of resources to add in the resource group.
5. Select one or more resources to add to the resource group, and then click **Add**.
6. Click **OK**, and then click **Finish**.

7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Removing resources from a resource group

Before removing remove resources from a resource group, consider the following:

- The resources removed from a resource group are returned to meta_resource.
- Resources cannot be deleted from the meta_resource.
- An LDEV that has the same pool ID or journal group ID cannot be partially removed. For example, if two LDEVs belong to the same pool, you cannot remove only LDEV1 from the resource group and leave only LDEV2. Use the sort function to sort the LDEVs by pool ID or journal group ID, then select them and remove them all at once.
- You must have Security Administrator (View & Modify) role to perform this task.

To remove resources from a resource group

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Administration**, and then **Resource Groups**.
2. Click a resource group to remove in the **Resource Groups** tab.
3. Select one or more resources to remove from the resource group, and then click **Remove Resources**.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Managing Resource Groups

Changing the name of a resource group

When changing the name of a resource group, observe the following:

- The name *meta_resource* cannot be changed.
- Duplicate occurrences of the same name are not allowed.
- The name of *meta_resource* cannot be set for a resource group name.
- Resource group names can use alphanumeric characters, spaces, and the following symbols: ! # $ % & ' ( ) + - . = @ [ ] ^ _ ` { } ~
- Alphabets are case-sensitive.
- You must have Security Administrator (View & Modify) role to perform this task.

To change a resource group name

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Administration**, and then **Resource Groups**.
2. Click a resource group to change its name in the **Resource Groups** tab.
3. Click **Edit Resource Group**.
4. In the **Edit Resource Group** window, type a new resource group name, and then click Finish.
5. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If you select a row and click **Detail**, the **Resource Group Properties** window appears.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Deleting a resource group

You cannot delete the following:

- The meta_resource.
- A resource group that is assigned to a user group.
- A resource group that has resources assigned to it.

To delete a resource group

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Administration**, and then **Resource Groups**.
2. Click one or more resource groups to delete in the **Resource Groups** tab.
3. Click **Delete Resource Groups**.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Using Resource Partition Manager and other VSP products

To use Resource Partition Manager with other VSP products, the resources that are required for the operation must satisfy specific conditions. The following topics provide information about the specific resource conditions that are required for using each VSP product.

- Copy-on-Write Snapshot on page 2-13
- Dynamic Provisioning on page 2-13
- Encryption License Key on page 2-14
- High Availability Manager on page 2-14
- LUN Expansion on page 2-15
- LUN Manager on page 2-15
- Performance Monitor on page 2-17

- Thin Image on page 2-17
- TrueCopy on page 2-18
- Universal Replicator on page 2-19
- Universal Volume Manager on page 2-20
- Open Volume Management on page 2-21
- Virtual Partition Manager on page 2-22
- Volume Migration on page 2-22
- Volume Shredder on page 2-23
- Configuration File Loader on page 2-23
- CLI Spreadsheet for LUN Expansion on page 2-23
- Server Priority Manager on page 2-23

Copy-on-Write Snapshot

The following table provides information about specific Copy-on-Write Snapshot conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create LDEVs	The ID of the new LDEV for Copy-on-Write Snapshot must be assigned to the Storage Administrator group permitted to manage them.
Delete LDEVs	The LDEV to be deleted must be assigned to the Storage Administrator group permitted to manage them.
Create pools Expand pools	Volumes that are specified when creating or expanding a pool must be assigned to the Storage Administrator group permitted to manage them. All the volumes that are specified when creating a pool must belong to the same resource group.
Edit pools Delete pools	Pool-VOLs of the specified pool must be assigned to the Storage Administrator group permitted to manage them.
Create pairs	Both P-VOLs and S-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Split pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Suspend pairs	
Resynchronize pairs	
Delete pairs	

Dynamic Provisioning

The following table provides information about specific Dynamic Provisioning conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create LDEVs	The ID of the new LDEV for Dynamic Provisioning must be assigned to the Storage Administrator group permitted to manage them.
Delete LDEVs	Both the deleted LDEV and the pool VOLs of the pool where the LDEV belongs must be assigned to the Storage Administrator group permitted to manage them.
Create pools Expand pools	Volumes to be specified as pool-VOLS must be assigned to the Storage Administrator group permitted to manage them. All the volumes that are specified when creating a pool must belong to the same resource group.
Edit pools Delete pools	Pool-VOLs of the specified pool must be assigned to the Storage Administrator group permitted to manage them.
Expand V-VOLs	You can expand only the V-VOLs that are assigned to the Storage Administrator group permitted to manage them.
Reclaim zero pages Stop reclaiming zero pages	You can reclaim or stop reclaiming zero pages only for the DP-VOLs that are assigned to the Storage Administrator group permitted to manage them.

Encryption License Key

The following table provides information about specific Encryption License Key conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Edit encryption keys	When you specify a parity group and open the Edit Encryption window, the specified parity group and LDEVs belonging to the parity group must be assigned to the Storage Administrator group permitted to manage them. When you open the Edit Encryption window without specifying a parity group, more than one parity group and LDEVs belonging to the parity group must be assigned to the Storage Administrator group permitted to manage them.

High Availability Manager

The following table provides information about specific High Availability Manager conditions that must be observed when using Resource Partition Manager.

The system configuration for resource group settings should be the same for High Availability Manager in both the primary and secondary sites.

Operation name	Condition
Create pairs	P-VOLs and quorum disks must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
	Initiator ports for the logical paths that are configured between P-VOLs and the RCU must be assigned to the Storage Administrator group permitted to manage them.
Change pair options	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Split pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Resynchronize pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Release pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them. Quorum disks must be assigned to the Storage Administrator group permitted to manage them. When you specify P-VOLs, initiator ports for the logical paths that are configured between P-VOLs and RCU must be assigned to the Storage Administrator group permitted to manage them.
Add quorum disks Delete quorum disks	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.

LUN Expansion

The following table provides information about specific LUN Expansion conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create LUSE volumes	The LDEVs specified when creating a LUSE volume must all belong to the same resource group as the LUSE volume.

LUN Manager

The following table provides information about specific LUN Manager conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Add LUN paths	When you specify host groups and open the Add LUN Paths window, the specified host groups must be assigned to the Storage Administrator group permitted to manage them. When you specify LDEVs and open the Add LUN paths window, the specified LDEVs must be assigned to the Storage Administrator group permitted to manage them.
Delete LUN paths	When you specify a host group and open the Delete LUN Paths window, the specified host group must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
	When you specify LDEVs and open the Delete LUN Paths window, the specified LDEVs must be assigned to the Storage Administrator group permitted to manage them. When selecting the **Delete all defined LUN paths to above LDEVs** check box, the host groups of all the alternate paths in the LDEV displayed on the Selected LUNs table must be assigned to the Storage Administrator group permitted to manage them.
Edit host groups	The specified host groups and initiator ports must be assigned to the Storage Administrator group permitted to manage them.
Add hosts	The specified host groups must be assigned to the Storage Administrator group permitted to manage them.
Edit hosts	The specified host group must be assigned to the Storage Administrator group permitted to manage them. When you select the **Apply same settings to the HBA WWN of all ports** check box, all the host groups where the specified HBA WWNs are registered must be assigned to the Storage Administrator group permitted to manage them.
Remove hosts	When you select the **Remove hosts from all host groups containing the hosts in the storage system** check box, all the host groups where the HBA WWNs displayed in the Selected Hosts table are registered must be assigned to the Storage Administrator group permitted to manage them.
Edit ports	The specified port must be assigned to the Storage Administrator group permitted to manage them. If this port attribute is changed from Target or RCU Target to Initiator or to External, the host group of this port belongs to meta_resource. Therefore, the host group of this port is not displayed in windows.
Create alternative LUN paths	The specified host groups and all the LDEVs where the paths are set to the host groups must be assigned to the Storage Administrator group permitted to manage them.
Copy LUN paths	The specified host groups and the LDEVs where the paths are set must be assigned to the Storage Administrator group permitted to manage them.
Edit command devices	LDEVs where the specified paths are set must be assigned to the Storage Administrator group permitted to manage them.
Edit UUIDs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Delete UUIDs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Create host groups	When you open the Create Host Groups window by specifying host groups, the specified host groups must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
Delete host groups	The specified host groups and all the LDEVs where the paths are set to the host groups must be assigned to the Storage Administrator group permitted to manage them.
Release Host-Reserved LUNs	LDEVs where the specified paths are set must be assigned to you.

Performance Monitor

The following table provides information about specific Performance Monitor conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Add to ports	The specified ports must be assigned to the Storage Administrator group permitted to manage them.
Add new monitored WWNs	The specified ports must be assigned to the Storage Administrator group permitted to manage them.
Edit WWNs	The specified ports must be assigned to the Storage Administrator group permitted to manage them.

ShadowImage

The following table provides information about specific ShadowImage conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create pairs	Both P-VOLs and S-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Split pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Suspend pairs	
Resynchronize pairs	
Release pairs	
Set reserve attributes Remove reserve attributes	The specified LDEVs must be assigned to the Storage Administrator group permitted to manage them.

Thin Image

The following table provides information about specific Thin Image conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create LDEVs	When you create LDEVs for Copy-on-Write Snapshot, IDs of the LDEVs that you will create must be assigned to you.
Delete LDEVs	Deleted LDEVs must be assigned to you.
Create pools Expand Pool	Volumes that are specified when creating or expanding pools must be assigned to you. All the volumes that are specified when creating pools must belong to the same resource group.
Edit Pools Delete Pools	Pool-VOLs of the specified pools must be assigned to you.
Create pairs	Both P-VOLs and S-VOLs must be assigned to you.
Split pairs	P-VOLs must be assigned to you.
Suspend pairs	
Resynchronize pairs	
Release pairs	

TrueCopy

The following table provides information about specific TrueCopy conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them. Initiator ports for the logical paths that are configured between P-VOLs and RCU must be assigned to the Storage Administrator group permitted to manage them.
Change pair options	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Split pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Resynchronize pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Release pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them. When you specify P-VOLs, initiator ports for the logical paths that are configured between P-VOLs and RCU must be assigned to the Storage Administrator group permitted to manage them.
Define port attributes	The specified ports must be assigned to the Storage Administrator group permitted to manage them.
Add RCUs	The specified initiator ports must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
Delete RCUs Change RCU options	Initiator ports of logical paths to the specified RCUs must be assigned to the Storage Administrator group permitted to manage them.
Add logical paths Delete logical paths	The specified initiator ports must be assigned to the Storage Administrator group permitted to manage them.
Add SSIDs Delete SSIDs	Initiator ports of logical paths to the specified RCUs must be assigned to the Storage Administrator group permitted to manage them.

Universal Replicator

The following table provides information about specific Universal Replicator conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create journal volumes	All the LDEVs that are specified when creating a journal must belong to the same resource group.
Add journal volumes Delete journal volumes	All the specified LDEVs when adding journal volumes must belong to the same resource group where existing journal volumes belong.
Change journal options	All the data volumes in the specified journals must be assigned to the Storage Administrator group permitted to manage them.
Create pairs	Journal volumes for pair volumes and P-VOLs must be assigned to the Storage Administrator group permitted to manage them. Initiator ports of logical paths to remote storage systems must be assigned to the Storage Administrator group permitted to manage them.
Change pair options	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Split pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Restore pairs	P-VOLs must be assigned to the Storage Administrator group permitted to manage them.
Delete pairs	The specified P-VOLs or S-VOLs must be assigned to the Storage Administrator group permitted to manage them. Initiator ports of logical paths to remote storage systems must be assigned to the Storage Administrator group permitted to manage them.
Change mirror options	All the data volumes in the specified mirrors must be assigned to the Storage Administrator group permitted to manage them.
Define port attributes	The specified ports must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
Add remote DKCs	The specified initiator ports must be assigned to the Storage Administrator group permitted to manage them.
Delete remote DKCs	Initiator ports of logical paths to the specified remote storage systems must be assigned to the Storage Administrator group permitted to manage them.
Change remote DKC options	Initiator ports of logical paths to the specified remote storage systems must be assigned to the Storage Administrator group permitted to manage them.
Add logical paths	The specified initiator ports must be assigned to the Storage Administrator group permitted to manage them.
Delete logical paths	The specified initiator ports must be assigned to the Storage Administrator group permitted to manage them.
Move LDEVs to other resource groups	When you move LDEVs used for journal volumes to other resource groups, you must specify all the journal volumes of the journal where the LDEVs belong.

Universal Volume Manager

The following table provides information about specific Universal Volume Manager conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Add external volumes	When creating an external volume, a volume is created in the resource group where the external port belongs. When you specify a path group and open the Add External Volumes window, all the ports that compose the path group must be assigned to the Storage Administrator group permitted to manage them.
Delete external volumes	The specified external volume and all the LDEVs allocated to that external volume must be assigned to the Storage Administrator group permitted to manage them.
Disconnect external storage systems	All the external volumes belonging to the specified external storage system and all the LDEVs allocated to that external volumes must be assigned to the Storage Administrator group permitted to manage them.
Reconnect external storage systems	All the external volumes belonging to the specified external storage system and all the LDEVs allocated to that external volumes must be assigned to the Storage Administrator group permitted to manage them.
Disconnect external volumes	The specified external volume and all the LDEVs allocated to the external volumes must be assigned to the Storage Administrator group permitted to manage them.
Reconnect external volumes	The specified external volume and all the LDEVs allocated to the external volumes must be assigned to the Storage Administrator group permitted to manage them.

Operation name	Condition
Edit external volumes	The specified external volume must be assigned to the Storage Administrator group permitted to manage them.
Assign processor blades	The specified external volumes and all the ports of the external paths connecting the external volumes must be assigned to the Storage Administrator group permitted to manage them.
Disconnect external paths	Ports of the specified external paths and all the external volumes connecting with the external path must be assigned to the Storage Administrator group permitted to manage them. When you specify **By Ports**, all the external paths connecting with the specified ports and all the external volumes connecting with the external paths must be assigned to the Storage Administrator group permitted to manage them. When you specify **By External WWNs**, all the ports of the external paths connecting to the specified external WWN and all the external volumes connecting with those external paths must be assigned to the Storage Administrator group permitted to manage them.
Reconnect external paths	Ports of the specified external paths and all the external volumes connecting with those external paths must be assigned to the Storage Administrator group permitted to manage them. When you specify **By Ports**, all the external paths connecting with the specified ports and all the external volumes connecting with the external paths must be assigned to the Storage Administrator group permitted to manage them. When you specify **By External WWNs**, all the ports of the external paths connecting to the specified external WWN and all the external volumes connecting with those external paths must be assigned to the Storage Administrator group permitted to manage them.
Edit external WWNs	All the ports of the external paths connecting to the specified external WWN and all the external volumes connecting with the external paths must be assigned to the Storage Administrator group permitted to manage them.
Edit external path configuration	Ports of all the external paths composing the specified path group and all the external volumes that belong to the path group must be assigned to the Storage Administrator group permitted to manage them.

Open Volume Management

The following table provides information about specific Open Volume Management conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Create LDEVs	When you specify a parity group and open the Create LDEVs window, the parity group must be assigned to the Storage Administrator group permitted to manage them. When you create an internal or external volumes parity groups where the LDEV belongs and ID of the new LDEV must be assigned to the Storage Administrator group permitted to manage them.
Delete LDEVs	When deleting an internal or external volume, the deleted LDEV and parity groups where the LDEV belongs must be assigned to the Storage Administrator group permitted to manage them.
Edit LDEVs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Restore LDEVs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Block LDEVs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Format LDEVs	When you specify LDEV and open the Format LDEVs window, the specified LDEV must be assigned to the Storage Administrator group permitted to manage them. When you specify a parity group and open the Format LDEVs window, the specified parity group and all the LDEVs in the parity group must be assigned to the Storage Administrator group permitted to manage them.

Virtual Partition Manager

The following table provides information about specific Virtual Partition Manager conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Migrate parity groups	When you specify virtual volumes, the specified LDEV must be assigned to the Storage Administrator group permitted to manage them. When you specify a parity group, the specified parity group must be assigned to the Storage Administrator group permitted to manage them.

Volume Migration

The following table provides information about specific Volume Migration conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Migrate volumes	The specified source volume and target volume must be assigned to the Storage Administrator group permitted to manage them.
Reserve volumes	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.
Fix parity groups	The specified parity group must be assigned to the Storage Administrator group permitted to manage them.

Volume Shredder

The following table provides information about specific Volume Shredder conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Shred LDEVs	The specified LDEV must be assigned to the Storage Administrator group permitted to manage them.

Configuration File Loader

The following table provides information about specific Configuration File Loader conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Edit a spreadsheet	All the resource group IDs that are set in the storage system must be assigned to the user account that logs in to Storage Navigator.

CLI Spreadsheet for LUN Expansion

The following table provides information about specific CLI Spreadsheet for LUN Expansion conditions that must be observed when using Resource Partition Manager.

Operation name	Condition
Run the CFLSET command	All the resource group IDs that are set in the storage system must be assigned to the user account that logs in to Storage Navigator.

Server Priority Manager

The following table provides information about specific Server Priority Manager conditions that must be observed when using Resource Partition Manager.

Operation name	Conditions
Set priority of ports (attribute/threshold/ upper limit)	The specified ports must be assigned to the Storage Administrator group permitted to manage them.
Release settings on ports by the decrease of ports	
Set priority of WWNs (attribute/upper limit)	
Change WWNs and SPM names	
Add WWNs (add WWNs to SPM groups)	
Delete WWNs (delete WWNs from SPM groups)	
Add SPM groups and WWNs	
Delete SPM groups	
Set priority of SPM groups (attribute/upper limit)	
Rename SPM groups	
Add WWNs	
Delete WWNs	
Initialization	All ports must be assigned to the Storage Administrator group permitted to manage them.
Set threshold	

3

Configuring custom-sized provisioning

Configuring custom-sized provisioning involves creating and configuring a customized volume (CV). A CV is a fixed-sized volume that is divided into arbitrary sizes.

This provisioning strategy is suitable for use on both open and mainframe systems. Virtual LVI or Virtual LUN software is required to configure variable-sized provisioning.

- ☐ Virtual LVI/Virtual LUN functions
- ☐ VLL requirements
- ☐ VLL specifications
- ☐ SSID requirements
- ☐ VLL size calculations
- ☐ Configuration of interleaved parity groups
- ☐ Create LDEV function
- ☐ Blocking an LDEV
- ☐ Restoring a blocked LDEV
- ☐ Editing an LDEV name
- ☐ Deleting an LDEV (converting to free space)
- ☐ Formatting LDEVs

- Assigning a processor blade
- Using a system disk

Virtual LVI/Virtual LUN functions

Virtual LVI or Virtual LUN functions are used to create, configure, or delete a customized volume (LDEV).

The Virtual LUN and the Virtual LVI function are collectively referred to as *VLL*. The only difference between the two functions is that Virtual LUN is an open systems function available in Open Volume Management software, while Virtual LVI is a mainframe function available in Virtual LVI software.

A parity group usually consists of some fixed-sized volumes (FVs) and some free space. The number of FVs is determined by the emulation type. A VLL volume usually consists of at least one FV, one or more customized volumes (CVs), and some free space.

You can use VLL to configure variable-sized volumes that efficiently exploit the capacity of a disk. Variable-sized volumes are logical volumes that are divided into smaller than normal fixed-size volumes. This configuration is desirable when frequently accessed files are distributed across smaller multiple logical volumes. This generally improves the data accessing performance, though file access may be delayed in some instances.

VLL can also divide a logical volume into multiple smaller volumes to provide space efficiencies for small volumes such as command devices. Thus, VLL can efficiently exploit the capacity of a disk by not wasting capacity using larger volumes when the extra capacity is not needed.

VLL requirements

Use of Virtual LVI or Virtual LUN on the VSP storage system to configure variable-sized volumes requires the following:

- A license key on the Storage Navigator computer for Virtual LUN. This is available in Open Volume Management, software and is for open systems.

For details about the license key or product installation, see the *Hitachi Storage Navigator User Guide*.

VLL specifications

Virtual LUN specifications for open systems on page 3-3

CV capacity by emulation type for open systems on page 3-4

Virtual LUN specifications for open systems

Parameter	Open system	
Track format	OPEN-3, OPEN-8, OPEN-9, OPEN-E	OPEN-V
Emulation type	OPEN-3, OPEN-8,	OPEN-V

Parameter	Open system	
	OPEN-9, OPEN-E	
Ability to intermix emulation type	Depends on the track geometry	Depends on the track geometry
Maximum number of volumes (normal and Virtual LVI/LUN) per parity group	2,048 for RAID 5 (7D+1P), RAID 6 (6D+2P), or RAID 6 (14D+2P) 1,024 for other RAID levels	2,048 for RAID 5 (7D+1P), RAID 6 (6D+2P), or RAID 6 (14D+2P) 1,024 for other RAID levels
Maximum number of volumes (normal and Virtual LVI/LUN) per storage system	65,280	65,280
Minimum size for one Virtual LVI/LUN volume	36,000 KB (+ control cylinders)	48,000 KB (50 cylinders)
Maximum size for one Virtual LVI/LUN volume	See CV capacity by emulation type for open systems on page 3-4.	See CV capacity by emulation type for open systems on page 3-4.
Size increment	1 MB	1 MB (1 user cylinder)
Disk location for Virtual LVI/LUN volumes	Anywhere	Anywhere

CV capacity by emulation type for open systems

Emulation type*	Minimum CV capacity (CYL)	Maximum CV capacity	Number of control cylinders (cyl)
OPEN-V	48,000 KB	Internal volume: 3,221,159,680 KB (2.99 TB) External volume: 4,294,967,296 KB (4 TB)	None
OPEN-3	36,000 KB (50 cyl)	2,403,360 KB	5,760 KB (8 cyl)
OPEN-8	36,000 KB (50 cyl)	7,175,520 KB	19,440 KB (27 cyl)
OPEN-9	36,000 KB (50 cyl)	7,211,520 KB	19,440 KB (27 cyl)
OPEN-E	36,000 KB (50 cyl)	14,226,480 KB	13,680 KB (19 cyl)
*Virtual LUN operations are not available for OPEN-L volumes.			

SSID requirements

The storage system is configured with one SSID (Storage System ID) for each group of 64 or 256 devices, so there are one or four SSIDs per CU image. Each SSID must be unique to each connected host system. SSIDs are user-specified and are assigned during storage system installation in hexadecimal format, from 0004 to FEFF.

The following table shows the relationship between controller emulation types and SSIDs.

Controller emulation type	SSID requirement	Virtual LUN support
2105, 2105-F20 or 2107	0004 to FEFF	OPEN-3, OPEN-8, OPEN-9,OPEN-E, and OPEN-V volumes

VLL size calculations

When creating a CV, you can specify the capacity of each CV. However, rounding will produce different values for the user-specified CV capacity and the actual entire CV capacity. To estimate the actual capacity of a CV, use a mathematical formula. The following topics explain how to calculate the user area capacity and the entire capacity of a CV.

The capacity of a CV or an LDEV consists of two types of capacity. One type is the user area capacity that stores the user data. The second type is the capacities of all areas that are necessary for an LDEV implementation including control information. The sum of these two types of capacities is called the entire capacity.

Implemented LDEVs consume the entire capacity from the parity group capacity. Therefore, even if the sum of user areas of multiple CVs and the user area of one CV are the same size, the remaining free space generated when multiple CVs are created may be smaller than the free space in the parity group when one CV is created.

Additionally, if the data protection level is set to the Enhanced mode on a SATA drive parity group, you must calculate the entire capacity of all CVs in existence and the entire capacity of CVs in the Enhanced mode of the data protection level.

When using CCI, the specified size of CVs is created regardless of the capacity calculation. Therefore, even if the same capacity size (for example, 1 TB) appears, the actual capacity size might be different between the CVs created by CCI and the CVs created by Storage Navigator.

Calculating OPEN-V volume size (CV capacity unit is MB)

The methods for calculating the user area capacity and the entire capacity of a CV vary depending on the CV capacity unit that is specified when creating the CV.

To calculate the user area capacity of a CV whose capacity unit is defined as megabytes:

`ceil(ceil(`*`user-specified-CV-capacity`* `* 1024 / 64) / 15) * 64 * 15`

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.

- *user-specified-CV-capacity* is expressed in megabytes.
- The resulting *user area capacity* is expressed in kilobytes.

To calculate the entire capacity of a CV:

`ceil(`*user-area-capacity* `/` *boundary-value*`) *` *boundary-value* `/ 1024`

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-area-capacity* is expressed in kilobytes
- *boundary value* is expressed in kilobytes. The boundary value depends on volume emulation types and RAID levels (see Boundary values for RAID levels (other than Enhanced mode on SATA drives) on page 3-10). If the data protection level is set to the Enhanced mode on a SATA drive, the *boundary value* depends on volume emulation types and RAID levels (see Boundary values for RAID levels (Enhanced mode on SATA drives) on page 3-10).
- The resulting entire capacity is expressed in megabytes.

Calculating OPEN-V volume size (CV capacity unit is blocks)

To calculate the user area capacity of a CV whose capacity unit is defined as blocks:

`ceil(`*user-specified-CV-capacity* `/ 2)`

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-specified-CV-capacity* is expressed in blocks.
- The resulting *user area capacity* is expressed in kilobytes.

To calculate the entire capacity of a CV:

`ceil(`*user-specified-CV-capacity* `/ (`*boundary-value* `* 2)) * (`*boundary-value* `* 2)`

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-specified-CV-capacity* is expressed in blocks.
- *boundary-value* is expressed in kilobytes. The boundary value depends on volume emulation types and RAID levels (see Boundary values for RAID levels (Enhanced mode on SATA drives) on page 3-10). If the data protection level is set to the Enhanced mode on a SATA drive, the boundary value depends on volume emulation types and RAID levels (see Capacity of a slot on page 3-11)
- The resulting entire capacity is expressed in blocks. To convert the resulting entire capacity into megabytes, divide this capacity by 2,048.

Calculating fixed-size open-systems volume size (CV capacity unit is MB)

To calculate the user area capacity of a CV whose capacity unit is defined as megabytes:

```
ceil(ceil(user-specified-CV-capacity * 1024 /
capacity-of-a-slot) / 15) * capacity-of-a-slot * 15
```

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-specified-CV-capacity* is expressed in megabytes.
- *capacity-of-a-slot* is expressed in kilobytes. The capacity of a slot depends on volume emulation types (see Calculated management area capacities (SATA-E drive) on page 3-11).
- The resulting *user area capacity* is expressed in kilobytes.

To calculate the entire capacity of a CV:

```
ceil((user-area-capacity + management-area-capacity) /
boundary-value) * boundary-value / 1024
```

where

- The value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-area-capacity* is expressed in kilobytes.
- *management-area-capacity* is expressed in kilobytes. The management area capacity depends on volume emulation types (see Boundary values for RAID levels (other than Enhanced mode on SATA drives) on page 3-10).
- *boundary-value* is expressed in kilobytes. The boundary value depends on volume emulation types and RAID levels (see Boundary values for RAID levels (Enhanced mode on SATA drives) on page 3-10). If the data protection level is set to the Enhanced mode on a SATA drive, the boundary value depends on volume emulation types and RAID levels (see Capacity of a slot on page 3-11).
- The resulting entire capacity is expressed in megabytes.

Calculating fixed-size open-systems volume size (CV capacity unit is blocks)

To calculate the user area capacity of a CV whose capacity unit is defined as blocks:

```
user-specified-CV-capacity / 2
```

where

- *user-specified-CV-capacity* is expressed in blocks.
- The resulting *user area capacity* is expressed in kilobytes.

To calculate the entire capacity of a CV:

```
ceil((user-specified-CV-capacity + management-area-capacity * 2)
/ (boundary-value * 2)) * (boundary-value * 2)
```

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *user-specified-CV-capacity* is expressed in blocks.
- *management-area-capacity* is expressed in kilobytes. The management area capacity depends on volume emulation types (see Boundary values for RAID levels (other than Enhanced mode on SATA drives) on page 3-10).
- *boundary-value* is expressed in kilobytes. The boundary value depends on volume emulation types and RAID levels (see Boundary values for RAID levels (Enhanced mode on SATA drives) on page 3-10). If the data protection level is set to the Enhanced mode on a SATA drive, the *boundary value* depends on volume emulation types and RAID levels (see Capacity of a slot on page 3-11).
- The CV capacity recognized by hosts is the same as the CV capacity calculated by the above formula.
- If **block** is selected as the LDEV capacity unit in the Create LDEVs window and dialog boxes, the window and dialog boxes correctly show the calculated LDEV capacity. However, if **MB**, **GB**, or **TB** is selected as the LDEV capacity unit in the Create LDEVs window and dialog boxes, the capacity values shown might have a margin of error due to unit conversion reasons. If you need to know the exact LDEV capacity, select **block** as the capacity unit.
- The resulting entire capacity is expressed in blocks. To convert the resulting entire capacity into megabytes, divide this capacity by 2,048:

Calculating the size of a CV using Enhanced mode on SATA drives

If the data protection level is set to Enhanced mode on a SATA drive, the entire capacity of a CV must be calculated based on the previously calculated entire capacity of a CV. The calculation methods vary depending on the unit for the capacity specified when creating the CV. These are required to be OPEN-V.

If the CV capacity unit is MB (megabytes):

To calculate the entire capacity of a CV whose capacity unit is defined as MB:

```
entire-capacity-of-a-CV * 1024 / capacity-of-a-slot
```

where

- *capacity-of-a-slot* is expressed in kilobytes. The capacity of a slot depends on volume emulation types (see Capacity of a slot on page 3-11).
- The resulting entire capacity is expressed in slots.

To calculate the management area capacity:

```
ceil(entire-capacity-of-a-CV(slots) /
calculated-management-area-capacity) * boundary-value
```

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *calculated-management-area-capacity* depends on volume emulation types and RAID levels (see Management area capacity of an open-systems volume on page 3-10).
- The resulting entire capacity is expressed in slots.

To calculate the entire capacity of a CV if the data protection level is set to the Enhanced mode on the SATA drive:

```
ceil(entire-capacity-of-a-CV(slots) + calculated-management-area-
capacity)
```

To convert the resulting entire capacity into megabytes:

```
calculated-entire-capacity-of-a-CV(slots) /
1024 * capacity-of-a-slot
```

where

- *calculated-entire-capacity-of-a-CV(slots)* means the entire capacity of a CV if the data protection level is set to the Enhanced mode on the SATA drive.

If the CV capacity unit is block:

To calculate the entire capacity of a CV whose capacity unit is defined as block:

```
user-specified-a-CV-capacity / 2 / capacity-of-a-slot
```

where

- *capacity-of-a-slot* is expressed in kilobytes. The capacity of a slot depends on volume emulation types (see Capacity of a slot on page 3-11).
- The resulting entire capacity is expressed in slots.

To calculate the management area capacity:

```
ceil(entire-capacity-of-a-CV(slots) /
calculated-management-area-capacity) * boundary-value
```

where

- the value enclosed in `ceil( )` must be rounded up to the nearest whole number.
- *calculated-management-area-capacity* depends on volume emulation types and RAID levels (see Management area capacity of an open-systems volume on page 3-10).

To calculate the entire capacity of a CV if the data protection level is set to the Enhanced mode on the SATA drive:

```
ceil(entire-capacity-of-a-CV(slots) + calculated-management-area-
capacity)
```

To convert the resulting entire capacity into blocks:

*calculated-entire-capacity-of-a-CV(slots) * capacity-of-a-slot * 2*

where

- *calculated-entire-capacity-of-a-CV(slots)* means the entire capacity of a CV if the data protection level is set to the Enhanced mode on the SATA drive.

Management area capacity of an open-systems volume

Emulation type	Management area capacity (KB)
OPEN-V	None
OPEN-3	5,760
OPEN-8	19,440
OPEN-9	19,440
OPEN-E	13,680

Boundary values for RAID levels (Enhanced mode on SATA drives)

A SATA drive supports the OPEN-V emulation type for an open system.

Emulation type	Boundary value (KB)				
	RAID 1 (2D +2D)	RAID 5 (3D +1P)	RAID 5 (7D +1P)	RAID 6 (6D +2P)	RAID 6 (14D+2P)
OPEN-V	2,048	6,144	28,672	24,576	114,688

Notes:

- *xx* indicates one or more numbers or letters.
- Boundary values are expressed in kilobytes.
- A SATA drive supports the OPEN-V emulation type for open systems.

Boundary values for RAID levels (other than Enhanced mode on SATA drives)

Boundary values of external volumes are always one slot, regardless of RAID levels.

Emulation type*	Boundary value (KB)				
	RAID 1 (2D +2D)	RAID 5 (3D +1P)	RAID 5 (7D +1P)	RAID 6 (6D +2P)	RAID 6 (14D+2P)
OPEN-xx (except for OPEN-V)	768	1,152	2,688	2,304	-
OPEN-V	1,024	1,536	3,584	3,072	7,168

Notes:

- *xx* indicates one or more numbers or letters.
- Boundary values are expressed in kilobytes.

Emulation type*	Boundary value (KB)				
	RAID 1 (2D +2D)	RAID 5 (3D +1P)	RAID 5 (7D +1P)	RAID 6 (6D +2P)	RAID 6 (14D+2P)
• Boundary values of external volumes are always one kilobyte, regardless of RAID levels. • Hyphen (-) indicates that the combination is not supported.					

Capacity of a slot

Emulation type	Capacity (KB) of a slot
OPEN-xx (except for OPEN-V)	48
OPEN-V	256
Notes: • *xx* indicates one or more numbers or letters. • Slot capacity is expressed in kilobytes.	

Calculated management area capacities (SATA-E drive)

Emulation type	SATA-E (slots)				
	RAID 1 (2D +2D)	RAID 5 (3D +1P)	RAID 5 (7D +1P)	RAID 6 (6D +2P)	RAID 6 (14D+2P)
OPEN-V	122,880	552,960	3,010,560	2,211,840	12,042,240
Notes: • *xx* indicates one or more numbers or letters. • Calculated management area capacities are expressed in slots. • A SATA drive supports the OPEN-V emulation type for a open systems.					

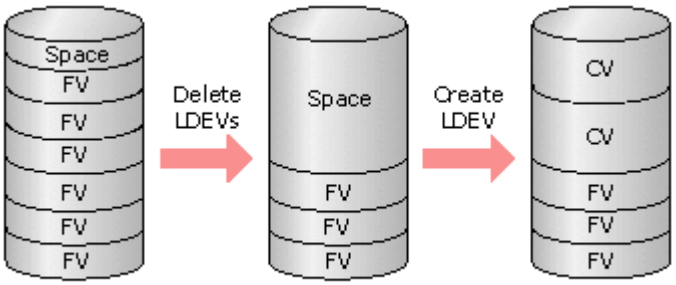
Configuring volumes in a parity group

For RAID 5 (7D+1P), RAID 6 (6D+2P), or RAID 6 (14D+2P) a maximum of 2,048 fixed-size volumes (FVs) and a certain amount of free space are available in one parity group. For other RAID levels, a maximum of 1,024 FVs and a certain amount of free space are available in one parity group. Each parity group has the same configuration, and is assigned the same FVs of the same size and RAID level.

The VLL functions of Delete LDEVs and Create LDEVs are performed on each parity group. Parity groups are also separated from each other by boundary limitations. Therefore, you cannot define a volume across two or more parity groups beyond these boundaries.

As the result of VLL operations, a parity group contains FVs, CVs, and free spaces that are delimited in logical cylinders. Sequential free spaces are combined into a single free space.

The following depicts an example of configuring volumes in a parity group:



Configuration of interleaved parity groups

If RAID configurations are RAID1 (2D+2D) or RAID5 (7D+1P), the interleaved parity group can be created by concatenating multiple of parity groups. The following table lists the RAID configurations and the number of parity groups that can be concatenated.

RAID configuration	2 concatenating	4 concatenating
RAID1 (2D+2D)	Available	Not Available
RAID5 (7D+1P)	Available	Available

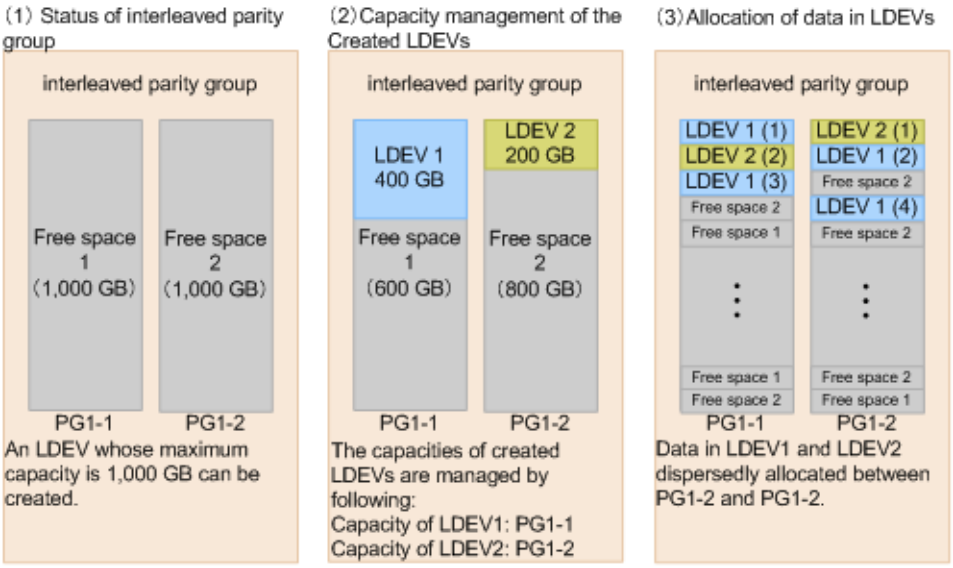
When concatenating parity groups, data in LDEVs is allocated between the interleaved parity groups. Therefore, loads are dispersed because of the parity group concatenation, and the LDEV performance is improved.

The capacity of the created LDEV is managed by each of the parity groups that are in the interleaved parity group. The maximum capacity of an LDEV is the same as the capacity of the interleaved parity group.

Note: Even if the parity groups are concatenated, they cannot be regarded as a large single parity group.

See the following example:

- Creating the interleaved parity group by concatenating parity groups PG1-1 and PG1-2.
- Creating LDEVs in each parity group that are in the interleaved parity group.
  - LDEV 1 in PG1-1
  - LDEV 2 in PG1-2

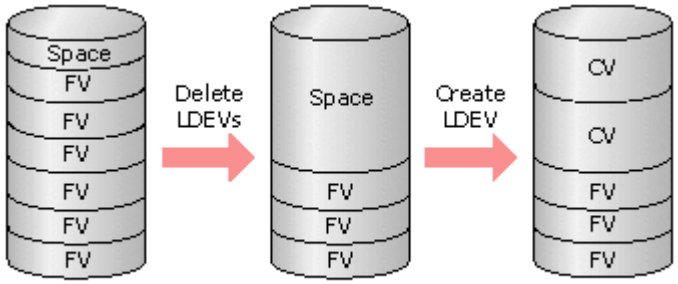


Create LDEV function

Use the Create LDEV function to create a customized variable-sized volume. Use Virtual LUN to create an open-systems volume.

You can also use the Create LDEV function to create a volume to be used as a system disk on either a mainframe or an open system. A system disk is not available to hosts, command devices, pool volumes, journal volumes, and so on. For more information, see Using a system disk on page 3-27.

The following depicts an example of creating customized volumes. First you delete FVs to create free space. Then you can create one or more customized volumes of any size in that free space.



Creating an LDEV

Use this procedure to create one or more internal or external logical volumes (LDEVs) in a selected storage system. You can create multiple LDEVs at once, for example, when you are setting up your storage system. After the storage system is set up, you can add LDEVs as needed.

Before creating an LDEV in a selected storage system, free space may need to be created. Before volumes are deleted to create free space, remove the LU paths to the open-system volumes. For instructions on removing LU paths, see Deleting LU paths on page 7-24.

You can create LDEVs using any of the following tabs in Storage Navigator:

- **Parity Groups** tab when selecting **Parity Groups**.
  You can create multiple LDEVs in the specified free space by setting the necessary items collectively. If multiple free spaces are in one parity group, the number of free spaces appears in **Total Selected Free Space** in the **Parity Group Selection** section on the **Create LDEVs** wizard. Confirm the number of free spaces, and then create the LDEVs accordingly.
  For example, if you are creating LDEVs in parity group PG1-1 and it contains two free spaces, **2** appears in **Total Selected Free Space**. In this case, if you specify **1** in **Number of LDEVs per Free Space**, and continue to create the LDEV, two LDEVs are created because one LDEV is created for each free space.
- **LDEVs** tab when selecting any parity group in **Parity Groups**.
- **LDEVs** tab when selecting **Logical Devices**.

To create an LDEV

1. In the Storage Navigator main window, in the **Storage Systems** tree, select the resource to view in the tab, and then click **Create LDEVs**.
2. In the **Create LDEVs** window, from the **Provisioning Type** list, select a provisioning type for the LDEV to be created.
   - If creating internal volumes, select **Basic**.
   - If creating external volumes, select **External**.
3. In **System Type**, select **Open** to create open system volumes.
4. From the **Emulation Type** list, select an emulation type for the selected system type.
5. If creating an internal volume, select the parity group, and then do the following:
   a. From the **Drive Type/RPM** list in **Parity Group Selection**, select the drive type and RPM.
   b. From the RAID level list in **Parity Group Selection**, select the RAID level.
   c. Click **Select Free Spaces**.
   d. In the **Select Free Spaces** window, in the **Available Free Spaces** table, select the free spaces to be assigned to the volumes.
      Do the following, if necessary:
      - To specify the conditions and show the free space, click **Filter**, specify the conditions, and then click **Apply**.
      - To specify the unit for capacity and the number of rows to view, click **Options**.
   e. Click **View Physical Location**.

f. In the **View Physical Location** window, confirm where the selected free space is physically located, and then click **Close**.

g. In the **Select Free Spaces** window, if the selected free spaces have no issues, click **OK**.

6. Otherwise, if creating an external volume, select the external volume, and then do the following:

   a. Click **Select Free Spaces**.

   b. In the **Select Free Spaces** window, in the **Available Free Spaces** table, select the free space to be assigned to the volumes.

      Do the following, if necessary:

      - To specify the conditions and show the free space, click **Filter**, specify the conditions, and then click **Apply**.

      - To specify the unit for capacity and the number of rows to view, click **Options**.

   c. Click **View Physical Location**.

   d. In the **View Physical Location** window, confirm where the selected free space is physically located, and then click **Close**.

   e. In the **Select Free Spaces** window, if the selected free spaces have no issues, click **OK**.

7. In **LDEV Capacity**, type the amount of LDEV capacity to be created and select a capacity unit from the list.

   You can enter the capacity within the range of figures displayed below the text box. You can enter the number with 2 digits after decimal point. You can change the capacity unit from the list.

8. In **Number of LDEVs**, type the number of LDEVs to be created.

   - For an internal volume, **Number of LDEVs per Free Space** appears.
   - For an external volume, **Number of LDEVs per External Volume** appears.

9. In **LDEV Name**, specify a name for this LDEV.

   a. In **Prefix**, type the characters that will become the fixed characters for the beginning of the LDEV name. The characters are case-sensitive.

   b. In **Initial Number**, type the initial number that will follow the prefix name.

10. In **Format Type**, select the format type for the LDEV from the list.

    - For an internal volume, you can select **Normal Format**, **Quick Format**, or **No Format**.

      If **No Format** is selected, format the volume after creating LDEVs.

    - For an external volume, if you create the LDEV whose emulation type is the open system, you can select **Normal Format** or **No Format**.

      If the external volume can be used as it is, select **No Format**. The created LDEV can be used without formatting.

If the external volume needs to be formatted, select **No Format** and then format the volume with the external storage system, or select **Normal Format**.

- If you select **Quick Format**, host I/Os might be affected when you perform the Quick Format operation. For details, see Quick Format function on page 3-22.

11. Click **Options** to show more options.
12. In **Initial LDEV ID**, make sure that an LDEV ID is set. To confirm the used number and unavailable number, click **View LDEV IDs** to open the **View LDEV IDs** window.
    a. In **Initial LDEV ID** in the **Create LDEVs** window, click **View LDEV IDs**.

       In the **View LDEV IDs** window, the matrix vertical scale represents the second-to-last digit of the LDEV number, and the horizontal scale represents the last digit of the LDEV number. The **LDEV IDs** table shows the available, used, and disabled LDEV IDs.

       In the table, used LDEV numbers appear in blue, unavailable numbers appear in gray, and unused numbers appear in white. LDEV numbers that are unavailable may be already in use, or already assigned to another emulation group (group by 32 LDEV numbers).
    b. Click **Close**.
13. In the **Create LDEVs** window, in **SSID**, type four digits, in hexadecimal format (0004 to FEFF), for the SSID.
14. To confirm the created SSID, click **View SSIDs** to open the **View SSIDs** dialog box.
    a. In the **Create LDEVs** window, in **Initial SSID**, click **View SSIDs**.

       In the **SSIDs** window, the **SSIDs** table shows the used SSIDs.
    b. Click **Close**.
15. In the **Create LDEVs** window, from the **Processor Blade** list, select a processor blade to be used by the LDEVs.
    - If you assign a specific processor blade, select the ID of the processor blade.
    - If you can assign any processor blade, click **Auto**.
16. If you are creating one more system disks, select **Create LDEVs as System Disk**.
17. Click **Add**.

    The created LDEVs are added to the **Selected LDEVs** table.

    The **Provisioning Type**, **System Type**, **Emulation Type**, **Parity Group Selection**, **LDEV Capacity**, and **Number of LDEVs per Free Space** or the **Number of LDEVs per External Volume** fields must be set. If these required items are not registered, you cannot click **Add**.
18. If necessary, change the following LDEV settings:

- Click **Edit SSIDs** to open the **SSIDs** window. If a new LDEV is to be created in the CU, you can change the SSID to be allocated to the LDEV. For details about how to edit an SSID, see Editing an LDEV SSID on page 3-18.
- Click **Change LDEV Settings** to open the **Change LDEV Settings** window. For details about how to change the LDEV settings, see Changing LDEV settings on page 3-18.

19. If necessary, delete an LDEV from the **Selected LDEVs** table.
    Select an LDEV to delete, and then click **Remove**. For details about how to remove an LDEV, see Removing an LDEV to be registered on page 3-19.
20. Click **Finish**.
    The **Confirm** window opens.
    To continue the operation for setting the LU path and defining a logical unit, click **Next**. For details about how to set the LU path, see Defining LU paths on page 7-20.
21. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
    If **Go to tasks window for status** is checked, the **Tasks** window opens.

Finding an LDEV ID

When creating volumes, the LDEV ID (LDKC: CU: LDEV) must be specified. Use this procedure to determine the LDEV IDs in use in the storage system so you can specify the correct LDEV.

1. In **Initial LDEV ID** in the **Create LDEVs** window, click **View LDEV IDs**.
2. In the **View LDEV IDs** window, review the list to confirm the LDEV IDs. The **LDEV IDs** table shows the available, used, and disabled LDEV IDs.
   The matrix vertical scale represents the second-to-last digit of the LDEV number, and the horizontal scale represents the last digit of the LDEV number.
   In the table, used LDEV numbers appear in blue, unavailable LDEV numbers appear in gray, and unused LDEV IDs appear in white. LDEV numbers that are unavailable may be already in use, or already assigned to another emulation group (group by 32 LDEV numbers).
3. Click **Close**.
   The **Create LDEVs** window opens.

Finding an LDEV SSID

When creating volumes, the LDEV SSIDs must be specified. Use this procedure to determine the SSIDs in use in the storage system so you can specify the correct SSID.

1. In the **Create LDEVs** window, beside **Initial SSID**, click **View SSIDs**.
2. In the **SSIDs** window, review the list to confirm the LDEV SSIDs. The **SSIDs** table shows the SSIDs in use in the system.

3. Click **Close**. The **Create LDEVs** window opens.

Editing an LDEV SSID

Before registering an LDEV, you may need to edit the LDEV SSID. If a CU is specified in which the first LDEV is created, the specified value of the SSID can be changed.

1. In the **Create LDEVs** window, in the **Selected LDEVs** table, click **Edit SSIDs**.
2. In the **Edit SSIDs** window, review the **SSIDs** table showing the existing SSIDs and ones to be added.
3. If you change the SSID, select the appropriate LDEV, and then click **Change SSIDs**.
4. In the **Change SSIDs** window, type the new SSID, and then click **OK**.
5. In the **Edit SSIDs** window, click **OK**.
6. In the **Create LDEVs** window, click **Finish**.
7. In the **Confirm** window, click **Apply**.
   The new SSID is registered.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing LDEV settings

Before registering an LDEV, you may need to change the LDEV settings.

1. In the **Create LDEVs** window, in the **Selected LDEVs** table, select an LDEV, and then click **Change LDEV Settings**.
2. In the **Change LDEV Settings** window, you can change the setting of **LDEV Name**, **Initial LDEV ID**, or **Processor Blade**.
   - If you change **LDEV Name**, specify the prefix characters and the initial number for this LDEV.
   - If you change **Initial LDEV ID**, specify the number of LDKC, CU, DEV, and Interval. To confirm used LDEV IDs, click **View LDEV IDs** to confirm the used LDEV IDs in the **View LDEV IDs** window.
   - If you change **Processor Blade**, click the list and specify the processor blade ID. If the specific processor blade is specified, select the processor blade ID. If any processor blade is specified, click **Auto**.
3. Click **OK**.
4. In the **Create LDEVs** window, click **Finish**.
5. In the **Confirm** window, verify the settings, and then click **Apply**.
   The settings are changed.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Removing an LDEV to be registered

If you do not want to register an LDEV that is scheduled to be registered, you can remove it from the registering task.

1. In the **Selected LDEVs** table in the **Create LDEVs** window, select an LDEV, and then click **Remove**.

   A message appears asking whether you want to remove the selected row or rows. If you want to remove the row, click **OK**.
2. Click **Finish**.
3. In the **Confirm** window, click **Apply**. The LDEV is removed from the registering task.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Blocking an LDEV

Before formatting or shredding a registered LDEV, the LDEV must be blocked. This procedure blocks both internal and external volumes.

You can block LDEVs from any of the following tabs:

- **LDEVs** tab when selecting any parity group in **Parity Groups**.
- **LDEVs** tab when selecting **Logical Devices**.
- **Virtual Volumes** tab when selecting any pool in **Pool**.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select the resource to view in the tab.
2. Find the target LDEV in the table and confirm the LDEV status in the **Status** column.
   - If **Blocked** appears, the LDEV is blocked. You can skip the remaining steps.
   - If **Blocked** does not appear, the LDEV is not blocked. Block the LDEV using the following steps.
3. Select an LDEV, click **More Actions**, and select **Block LDEVs**.

   You can select multiple LDEVs that are listed together or separately. For LDEVs that are listed together, select them while pressing the **Shift** key. For LDEVs that are listed separately, click each while pressing the **Ctrl** key.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Restoring a blocked LDEV

You can restore a blocked LDEV using any of the following tabs:

- **LDEVs** tab when selecting any parity group in **Parity Groups**.

- **LDEVs** tab when selecting **Logical Devices**.
- **Virtual Volumes** tab when selecting any pool in **Pool**.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select the resource to view in the tab.
2. Find the target LDEV in the table and confirm the LDEV status in the **Status** column.
   - If **Blocked** appears, the LDEV is blocked. Restore a blocked LDEV using the following steps.
   - If **Blocked** does not appear, the LDEV is not blocked.
3. Select the blocked LDEV, click **More Actions**, and select **Restore**.
   You can select multiple LDEVs that are listed together or separately. For LDEVs that are listed together, select them while pressing the **Shift** key. For LDEVs that are listed separately, click each while pressing the **Ctrl** key.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Editing an LDEV name

You can edit the name of a registered internal volume.

For information about editing a registered external volume, see *Hitachi Universal Volume Manager User Guide*.

1. Select the LDEV to be edited.
2. Click **Edit LDEVs**.
3. In **Edit LDEVs** window, edit **LDEV Name**.
4. Click **Finish**.
5. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Deleting an LDEV (converting to free space)

You can convert one or more of the LDEVs on a selected parity group into free space by deleting the LDEVs. That free space can be used to either create one or more variable-sized volumes (CVs) using the Create LDEVs function, or left as free space for future use. You can also delete a system disk if you no longer need it.

WARNING: Deleting LDEVs will erase your data. Back up your data before deleting LDEVs.

An LDEV cannot be deleted successfully if it is:

- In the defined path (including the pair volumes of TrueCopy and Universal Replicator).
- A configuration element of LUSE.
- A reserved volume of Volume Migration.
- A pool-VOL (including LUSE).
- A journal volume.
- A remote command device.
- A volume security volume.
- A quorum disk.
- An LDEV that has the Read/Write access attribute.
- Nondisruptive migration volume.
- An LDEV with the Volume Security setting.

When you delete an LDEV, the alias information contained in the LDEV is also deleted. Therefore, if you delete an LDEV related to an alias device, you should do one of the following:

- Allocate another LDEV to the alias device, and then delete the LDEV.
- Delete the LDEV first, and then allocate another LDEV to the alias device.

For information about how to delete a registered external volume, see the *Hitachi Universal Volume Manager User Guide*.

To delete an LDEV

1. Select one or more LDEVs to be deleted.
2. Click **More Actions** and select **Delete LDEVs**.
3. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   The LDEV is deleted.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Formatting LDEVs

If you initialize LDEVs that are being used, you will need to format the LDEVs. Read the following topics before formatting LDEVs:

- About formatting LDEVs on page 3-22
- Storage system operation when LDEVs are formatted on page 3-22
- Quick Format function on page 3-22

Formatting LDEVs includes the following tasks:

- Formatting a specific LDEV on page 3-24
- Formatting all LDEVs in a parity group on page 3-25

About formatting LDEVs

The LDEV Format function, which includes Normal Format, and Quick Format. These functions format volumes, including external volumes. Before formatting volumes, ensure that the volumes are in blocked status.

The following table lists which formatting functions can be used on which LDEV types.

Formatting function	Corresponding volume
Normal Format	Internal volume Virtual volume External volume
Quick Format	Internal volume

Storage system operation when LDEVs are formatted

The storage system acts in one of two ways immediately after an LDEV is added, depending on the default settings in the storage system.

- The storage system automatically formats the added LDEV. This is the default action.
- The storage system blocks the LDEV instead of automatically formatting it.

To confirm or change the default formatting settings on the storage system, contact the administrator. Users who have the Storage Administrator (Provisioning) role can change these default formatting settings using Storage Navigator.

Quick Format function

The Quick Format function formats internal volumes in the background. While Quick Format is running in the background, you can configure your system before the formatting is completed.

Before using Quick Format to format internal volumes, ensure that the internal volumes are in blocked status.

I/O operations from a host during Quick Format are allowed. Formatting in the background might affect performance.

Quick Format cannot be performed on the following volumes:

- Any volumes other than internal volumes
- Volumes assigned an access attribute other than read/write
- Pool volumes
- Journal volumes
- Quorum disks

Because shared resources such as MP blades or cache paths are used during quick format operations, all host I/Os in a storage system may be affected.

Particularly in the following cases, the I/O load concentrated on specific components may decrease performance during quick format operations.

- In a configuration that satisfies both of these conditions, many quick format operations are started at the same time.
  - The following comprise the minimum configuration of a module: CHA (CHannel Adapter) CPC (Cache Path Control adapter) DKA (DisK Adapter) ESW (PCI Express Path Switch)
  - The number of modules is one or two.
- In a configuration that satisfies either of these conditions, quick format operations are started.
  - If the number of CPCs, ESWs, DKAs, and CHAs is extremely unbalanced between modules in a configuration composed of multiple modules.

    For example, the configuration is unbalanced when many CPCs, ESWs, DKAs, and CHAs are installed in one module and the least number of CPCs, ESWs, DKAs, and CHAs are installed in another module.
  - If the number of CPCs, ESWs, DKAs, and CHAs in a module that connects to an ESW (Basic) or a ESW (Option) is extremely unbalanced between an ESW (Basic) or an ESW (Option).

    For example, an ESW(Basic) in one module may be connected by many CPCs, ESWs, DKAs, or CHAs and also connected by the least number of CPCs, ESWs, DKAs, or CHAs.

For configurations such as those described above, perform the quick format operation on one LDEV first to confirm that the I/O performance of the host does not decrease. After that, it is strongly recommended that the number of quick format operations you perform at the same time is increased one by one.

For configurations other than those described above, it is recommended that no more than eight quick format operations are started at the same time. After eight or fewer quick formats, it is recommended that four quick format operations are started in each increment while I/O performance is monitored on the host.

Quick Format specifications

Item	Description
Preparation for executing the Quick Format feature	The internal volume must be in blocked status. However, you do not need to create a system disk.
The number of parity groups that can undergo Quick Format	Up to 36 parity groups can concurrently undergo Quick Format. There is no limit on the number of volumes that can undergo Quick Format.

Item	Description
Concurrent Quick Format operations	While one Quick Format operation is in progress, another Quick Format operation can be performed. A maximum of 36 parity groups can concurrently undergo Quick Format.
Preliminary processing	At the beginning of the Quick Format operation, Storage Navigator performs preliminary processing to generate management information. If a volume is undergoing preliminary processing, the Storage Navigator main window shows the status of the volume as **Preparing Quick Format**. While preliminary processing is in progress, hosts cannot perform I/O access to the volume.
Blocking and restoring of volumes	If a volume undergoing Quick Format is blocked, the storage system recognizes that the volume is undergoing Quick Format. After the volume is restored, the status of the volume changes to **Normal (Quick Format)**. If all volumes in one or more parity groups undergoing Quick Format are blocked, the displayed number of parity groups undergoing Quick Format decreases by the number of blocked parity groups. However, the number of parity groups that have not undergone and can undergo Quick Format does not increase. To calculate the number of parity groups that have not undergone but can undergo Quick Format, use the following formula: 36 - *X* - *Y* Where: *X* indicates the number of parity groups on which Quick Format is being performed. *Y* indicates the number of parity groups where all volumes are blocked during the Quick Format.
Storage system is powered off and back on	The Quick Format operation resumes when power is turned back on.
Restrictions	• Quick Format cannot be executed on external volumes, virtual volumes, system disks, the journal volumes of Universal Replicator and quorum disks. • The volume migration feature or the QuickRestore feature cannot be applied to volumes undergoing Quick Format. When you use Command Control Interface to execute the volume migration operation or the QuickRestore operation on volumes undergoing Quick Format, **EX_CMDRJE** will be reported to Command Control Interface. In this case, check the volume status with Storage Navigator. • The prestaging feature of Cache Residency Manager cannot be applied to volumes undergoing Quick Format.

Formatting a specific LDEV

This procedure performs Normal formatting on the volume.

1. Select and block the LDEV to be formatted.

See Blocking an LDEV on page 3-19 for blocking an internal volume. See the *Hitachi Universal Volume Manager User Guide* for blocking an external volume.

2. To open the **Format LDEVs** window, click **More Actions**, then **Format LDEVs** from one of these tabs:
   - **LDEVs tab**, selected from the **Logical Devices** node of the Storage Systems tree.
   - **Virtual Volumes tab**, selected from a pool in the **Pools** node of the Storage Systems tree.
3. In the **Format LDEVs** window, select the format type from the **Format Type** list, and then click **Finish**.
4. In the **Confirm** window, click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Formatting all LDEVs in a parity group

This procedure performs Normal formatting on the volume.

When formatting all LDEVs in a parity group, you will need to:

- Specify a parity group.
- Format the LDEV.

Before formatting all LDEVs in a parity group, make sure that all LDEVs under this parity group have been blocked.

See Blocking an LDEV on page 3-19 for blocking an internal volume. See the *Hitachi Universal Volume Manager User Guide* for blocking an external volume.

1. Select the parity group containing the LDEV to be formatted.
2. Click **Format LDEVs**.
3. In the **Format LDEVs** window, select the format type from the **Format Type** list, and then click **Finish**.
   In the **Confirm** window, click **Next** to go to the next operation.
4. Click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Assigning a processor blade

Assigning a processor blade to a resource

You can assign a processor blade to resources (logical devices, external volumes, and journal volumes).

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Components**.

2. In **Components**, select the name of the DKC for which you want to assign a processor blade.
   Processor blades can be viewed in the **Processor Blades** tab.
3. Select a processor blade for which you want to change the settings, and then click **Edit MP Blades**.
4. In the **Edit Processor Blades** window, disable or enable **Auto Assignment**.
   - Select **Enable** if the processor blade can be automatically assigned. This is the default.
   - Select **Disable** if the processor blade cannot be automatically assigned.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing the processor blade assigned to an LDEV

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.
   LDEVs are shown in the **LDEVs** tab.
2. Select the LDEV for which you want to change the processor blade.
3. Click **More Actions**, and then select **Assign MP Blade**.
4. In the **Assign Processor Blade** window, specify the processor blade in **Processor Blade**.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Caution:

- Changes to the processor blade ID of an LDEV should be made during off-peak hours when the I/O load is as low as possible. 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 processor blade ID when the I/O load is high -- for example during an initial copy operation of ShadowImage, TrueCopy, or Universal Replicator.
- When you change the processor blade ID of an LDEV, you should use Performance Monitor before and after the change to check the load status of devices. Do not change several LDEV processor blade IDs during a short period of time. As a guideline, you can change 10% or less of the total number or the full workload of LDEV processor blade IDs assigned to the same processor blade ID at the same time.
- After you change the processor blade ID of an LDEV, wait more than 30 minutes before you try to change the ID again for the same LDEV.

Using a system disk

A system disk is a special LDEV used in the storage system for specific purposes. A system disk is not required in a storage system, but is recommended for buffering of the audit log. A system disk should not be used for storing user data. After a system disk is created, the system knows what types of information the system disk is used for and all appropriate information is automatically sent to the system disk.

For example, when the system disk is used as an audit log buffer, you set parameters to enable the audit log buffer. The Audit Log feature recognizes the LDEV number of the system disk and then accesses it as a buffer. The system disk must have sufficient capacity to accommodate the audit log buffer. See the *Hitachi Audit Log User Guide* for more information about how to enable the audit log buffer.

To designate the system disk as the buffer area for audit logs, do one of the following:

- In the **Audit Log Setting** window, set **Audit Log buffer** to **Enable**.
- Set system option mode (SOM) 676 to ON.

You can create a system disk on either a mainframe or an open system. To create a system disk, you create an LDEV and then designate it as a system disk in the Create LDEVs wizard (see Creating an LDEV on page 3-13). The system disk designation prevents other storage system structures from accessing it. It is not available to hosts, or a command device, pool volume, journal, and so on. The system disk is part of one parity group. When an LDEV is defined as a system disk, the LDEV cannot be allocated to a port.

The buffering area capacity for the audit log buffer is: 130 MB. Therefore, before using the audit log, make sure to prepare the system disk to have at minimum the above mentioned free capacity in the volume. The size of the system disk could be 1 GB if you want some spare capacity, or as large as 15 GB to accommodate the amount of system information that could be stored on it.

If you find you do not need a system disk, you can delete the system disk and convert the volume to free space (see Deleting an LDEV (converting to free space) on page 3-20).

System disk rules, restrictions, and guidelines

Rules

- The minimum size of the system disk should be 130 MB in order to accommodate audit log buffer information.
- The LDKC:CU:LDEV number assigned to the system disk should be distinguishable from the one for a normal volume.
- Use the Delete LDEVs function to delete the system disk.

Restrictions

- The system disk cannot be created on a DP-VOL.
- A system disk cannot be used for any other function or connected to a port.
- Normal data cannot be stored on the system disk.
- The bind mode of Cache Residency Manager must not be set to the system disk.
- I/O cannot be issued from the host of the open system because the system disk cannot be defined SCSI path.
- The system disk should not be deleted or blocked while it is being used. Delete or block the system disk when it is not being used.

Guidelines

- Although the system disk can be created in an external volume, it is best to use only internal volumes.
- Although there can be up to 16 volumes of system disks created throughout the entire storage system, best practice is to have only one system disk per storage system.
- In a mixed configuration of open and mainframe system volumes in a storage system, it is best to select open volumes for the system disk.
- If you have more than one system disk on your storage system, and one of them is blocked, the unblocked system disks may not be usable. In this case, delete the blocked system disk, and then use the other normal system disks.

4

Configuring expanded LU provisioning

Configuring expanded LU provisioning involves combining several smaller LDEVs into an expanded logical unit volume to make a LUSE (logical unit size expansion) volume that is larger than the standard 2.8 TB. A LUSE volume is a set of LDEVs defined to one or more hosts as a single data storage unit. A LUSE volume is a concatenation of two to 36 LDEVs (up to 60-TB limit) that are presented to a host as a single LU.

This provisioning strategy is for use on open systems. LUN Expansion software is required to use the LUSE feature to configure expanded LU provisioning.

- ☐ About LUSE
- ☐ LUN Expansion license requirements
- ☐ LUSE configuration example
- ☐ LUSE configuration rules, restrictions, and guidelines
- ☐ LUSE operations using a path-defined LDEV
- ☐ LUSE provisioning workflow
- ☐ Opening the LUN Expansion (LUSE) window
- ☐ Viewing a concatenated parity group
- ☐ Creating a LUSE volume
- ☐ Resetting an unregistered LUSE volume
- ☐ Maintaining LUSE volumes

About LUSE

The LUSE feature is for open-system logical volumes and allows you to configure one large logical volume by combining several smaller LDEVs. To use this feature, you need the software called Open Volume Management, which includes LUN Expansion software.

The LUSE feature allows hosts that can use only a limited number of LUs per fibre interface to have access to larger amounts of data by using expanded LUs. To create an open-systems volume (LU) larger than 2.8 TB, you must use the LUSE feature to combine open-systems volumes.

Up to 36 LDEVs can be combined to create one large logical volume, called a LUSE volume. The ID of the logical volume defined as the large logical volume is represented by the smallest LDEV ID (assigned to the top LDEV). The host recognizes the expanded logical volume as one representative LDEV. As long as the number of LDEVs combined into one large logical volume does not exceed 36, you can arbitrarily select any LDEVs as the volumes to combine, regardless of their size (or capacity) or whether they are on the same control unit (CU).

Using the LUSE feature, you can also combine several LDEVs and a LUSE volume (combined LDEVs) into one LUSE volume, or combine LUSE volumes together into one LUSE volume. The host also recognizes this type of LUSE volume as one LDEV.

The host cannot access the individual LDEVs or LUSE volumes that make up an expanded LU (LUSE volume). If you want to access the individual volumes, you must release the expanded LU.

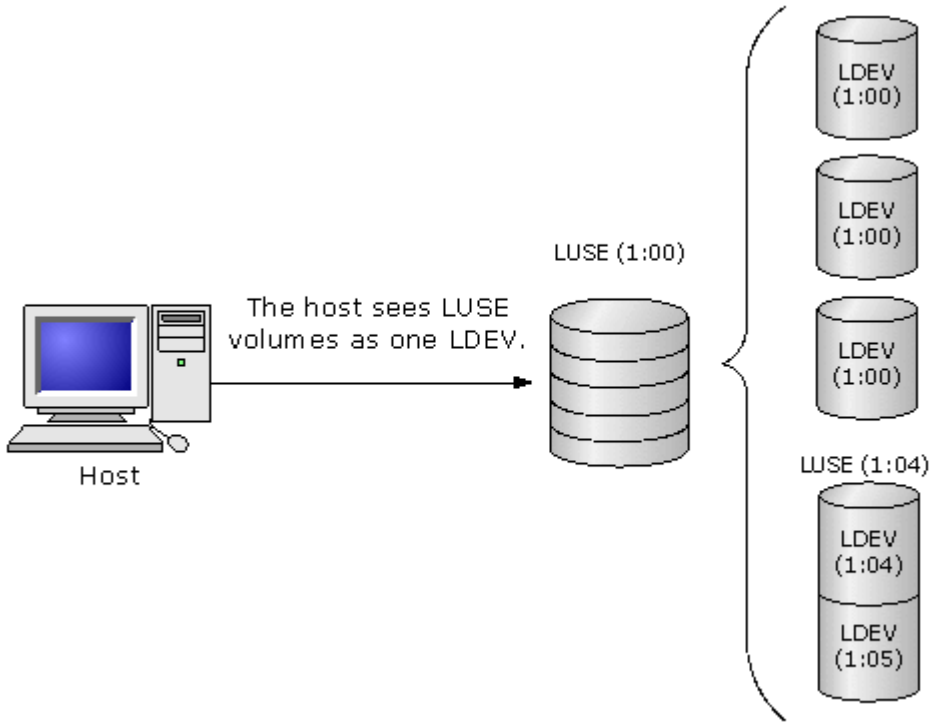
For information about the maximum LU capacity supported by your operating system, contact the vendor of your operating system.

LUN Expansion license requirements

Use of LUN Expansion on the VSP storage system requires license key on the Storage Navigator computer for Open Volume Management software. For details about the license key or product installation, see the *Hitachi Storage Navigator User Guide*.

LUSE configuration example

The following figure shows an example of a LUSE configuration. The host sees the LUSE volume as one LDEV. The LUSE volume ID is the smallest LDEV ID.



LUSE configuration rules, restrictions, and guidelines

Rules

- Open volumes (OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, and OPEN-V) are supported.
- The number of LDEVs combined into a LUSE volume must be within the range 2 to 36. The number of expanded LUs (LDEVs) should not exceed 36, even if the LUSE volume contains another LUSE volume.
- The emulation type of the LDEVs combined into a LUSE volume must be the same.
- LDEVs that are to be combined into LUSE volumes must not be reserved for Volume Migration. For more information on Volume Migration, contact the customer support.
- The maximum capacity of a LUSE volume is 60 TB. Any LUSE volume contains up to 4 MB of disk area to be used for controlling the volume, and this disk area cannot contain user data. Therefore, the maximum capacity for user data in a LUSE volume is smaller than 60 TB.
- The access attribute must be set to Read/Write.
- The cache mode settings of the LDEVs combined into a LUSE volume must be the same.
- The drive type of all LDEVs combined into a LUSE volume must be the same.
- When releasing an LDEV from a LUSE volume:

- The LUSE volume must not have any defined path.
- The access attribute must be set to read/write.

Restrictions

- LDEVs or LUSE volumes that are to be combined must have no assigned path definitions. For this reason, the volumes used by TrueCopy, ShadowImage, Thin Image, Copy-on-Write Snapshot, and, Universal Replicator, and High Availability Manager cannot be targets of LUSE operations (see LUSE operations using a path-defined LDEV on page 4-5).
- When combining a LUSE volume with another LUSE volume, the range of LDEVs should not be overlapped. For example, if you combine LDEV00, LDEV03 and LDEV05 into *LUSE 1*, LDEV02 and LDEV04 into *LUSE 2*, and LDEV06 and LDEV07 into *LUSE3*, you can also combine *LUSE 1* and *LUSE3*. However, you cannot combine *LUSE 1* and *LUSE 2*, because the LDEV range in *LUSE 1* and *LUSE 2* is overlapped.
- Combining command devices into a LUSE volume is not supported.
- Combining internal volumes, external volumes, and virtual volumes (V-VOLs) is not supported.
- The host mode must be neither 0C[Windows] or 01[VMware].
- LDEVs are not pool-VOLs.
- LDEVs are not JNL VOLs.
- LDEVs are not system volumes.
- LDEVs are not virtual volumes of Dynamic Provisioning (V-VOLs).
- LDEVs are not quorum disks.

Guidelines

- Move or back up your data, or both, before creating a LUSE volume.
- The RAID level of the LDEVs that are to be combined into LUSE volumes should be the same (recommended). Combining RAID 1 and RAID 5 volumes into the same LUSE volume is supported, but not recommended.
- If the top volume in the LUSE volume is an LDEV, the LDEV number of the LDEV that is combined should be larger than the top LDEV number.
- If the top volume in the LUSE volume is a LUSE volume, the LDEV number of the LDEV that is combined should be larger than the last LDEV number of the LUSE volume.
- The protection levels of LDEVs used to configure a LUSE volume should be the same.
- The resource group of all LDEVS used to configure a LUSE volume should be the same.
- LDEVS are not nondisruptive migration VOLs.

LUSE operations using a path-defined LDEV

When creating a LUSE volume, the top LUSE volume is either an LDEV or a LUSE volume that has one or more paths defined to it. Only the top volume in the LUSE volume to be created can have paths. The other volumes in the LUSE volume to be created must not have any paths.

You can perform a LUSE operation using a path-defined LDEV regardless of how many paths are defined to the LDEV. You cannot combine a path-defined LDEV or LUSE volume with another path-defined LDEV or LUSE volume.

When performing a LUSE operation using a path-defined LDEV, specify the host mode according to the host operating system, as follows.

Table 4-1 Host mode for defined paths by operating system

Operating system	Host mode
Windows Server 2003	2C
Windows Server 2008	2C
VMware	21
AIX5.2	Not applicable
AIX5.3	Not applicable

An LDEV can be used for LUSE operations using a path-defined LDEV with the following considerations:

- For hosts other than Windows Server 2003, Windows Server 2008, VMware, AIX5.2 and AIX5.3, an LDEV cannot be used for LUSE operations using a path-defined LDEV.
- Before performing LUSE operation to an LDEV with a path defined from a Windows Server 2003 or Windows Server 2008 host, ensure that the host mode of the Windows operating system is 2C (Windows Extension). If the host mode is not 2C, change the host mode to 2C before performing the LUSE operation.
- Before performing a LUSE operation on an LDEV with a path defined from a VMware host, ensure that the host mode of the VMware host is 21 (VMware Extension). If the host mode is not 21, change the host mode to 21 before performing the LUSE operation.
- When you combine LDEVs, they must be already formatted and their status must be normal.
- If you use the VMware host, and the Windows virtual host on the VMware is connected with the Raw Device Mapping (RDM) method, the host mode 2C Windows Extension must be set. If the host mode 2C Windows extension is not set, change the host mode to 2C. Before you change the host mode, back up the LUSE volume. After you change the mode, restore the LUSE volume.

LUSE provisioning workflow

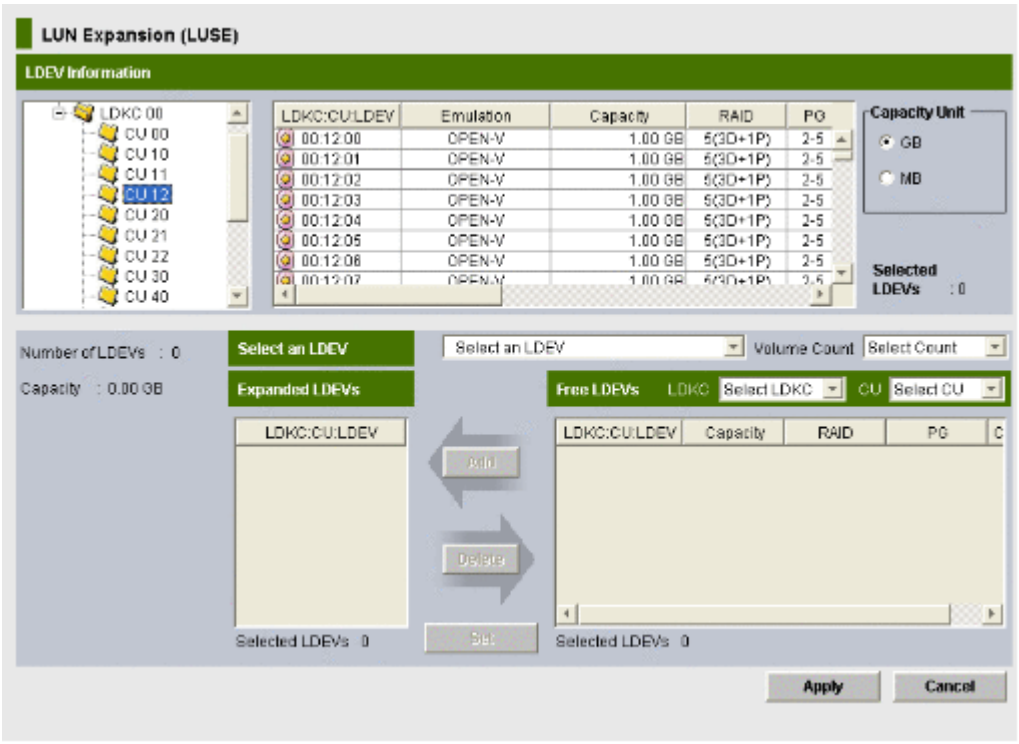
Expanded LU provisioning workflow includes the following steps.

1. Opening the LUN Expansion (LUSE) window on page 4-6
2. Viewing a concatenated parity group on page 4-7
3. Creating a LUSE volume on page 4-8
4. Resetting an unregistered LUSE volume on page 4-11

Opening the LUN Expansion (LUSE) window

The starting place for setting up expanded LU provisioning is the LUN Expansion window.

1. In the Storage Navigator main window, click **Actions**> **Logical Device** > **LUN Expansion**. The **LUN Expansion (LUSE)** window opens, where you can perform LUSE operations.



To exit LUSE, click **Close** button on the upper right corner of the Storage Navigator main window, or close the Web browser.

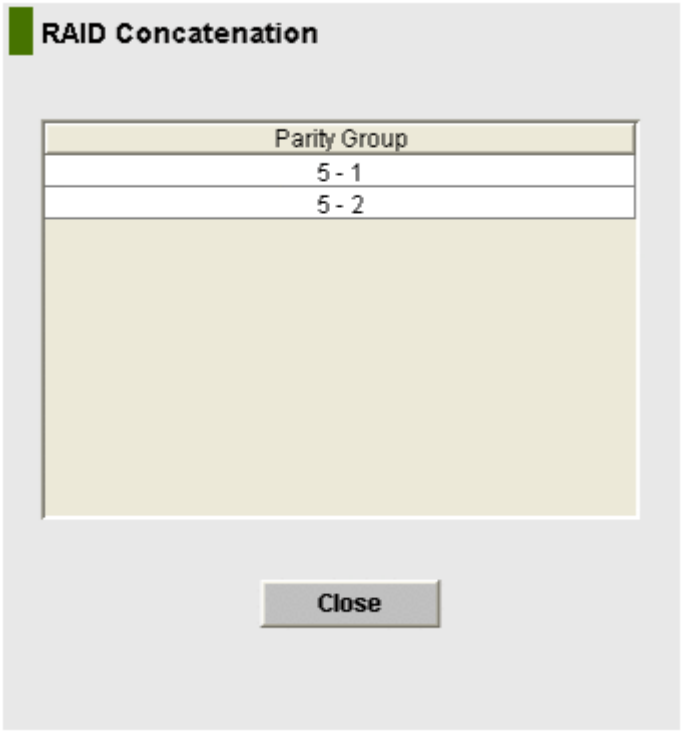
2. You can view the current LUSE configuration in the LUSE window:
   - The LDEV Information tree on the left provides an outline view of the CU numbers in a hierarchical structure.
   - The LDEV Detail table on the right provides detailed information for all open-system LDEVs in the selected CU.

Viewing a concatenated parity group

In the VSP storage system, data can be written to an LDEV that extends across concatenated parity groups. Concatenation of parity groups provides faster access to data.

1. In the Storage Navigator main window, click to change to **Modify** mode.
2. In the **LUN Expansion** (LUSE) window, select a CU number from the **LDEV Information** tree. The **LDEV Detail** table lists all LDEVs in the selected CU.
3. In the **LDEV Detail** table, right-click the free LDEVs that you want to form the LUSE volume. If parity groups are concatenated, the **RAID Concatenation** menu appears.

   The **RAID Concatenation** command does not appear if the selected LDEV does not extend across concatenated parity groups.
4. Select **Concatenation List** to open the **RAID Concatenation** dialog box. A parity group number starting with **E** (for example, E1-1) indicates that the parity group consists of one or more external LUs.



5. When you are finished viewing the list, select **Close** to return to the **LUN Expansion** window.

Creating a LUSE volume

If performing a LUSE operation on a volume that has a defined path, the integrity of the data on the LU that is expanded is guaranteed. However, performing a LUSE operation on a volume having no defined path is a destructive operation. In this case, the data on the LU that is expanded will be lost.

WARNING: Move or back up your data, or both, before creating a LUSE volume.

Use one of these methods to create a LUSE volume in the **LUN Expansion** (LUSE) window:

- Using the **LDEV Detail** table.
- Using **Select an LDEV** list box in the **LDEV Operation** detail.
- Using the **Volume Count** list box in the **LDEV Operation** detail. This way is recommended.

To create a LUSE volume using the Volume Count list box

1. In the Storage Navigator main window, click to change to **Modify** mode.
2. In the **LUN Expansion** (LUSE) window, in the LDEV information tree, select a CU number to use to create a LUSE volume.
3. In the **Select an LDEV** list, select a top LDEV for the LUSE volume.
   The selected top volume appears in the **Expanded LDEVs** list. Normal LDEVs and LUSE volumes that can be used for a LUSE volume appear the **Free LDEVs** list.
   Use the lists in the upper right of the **Free LDEVs** list to narrow entries in this table. If you select an LDKC and a CU from the **LDKC** and **CU** lists, the **Free LDEVs** table lists only the LDEVs belonging to the selected LDKC and CU.
4. In **Volume Count**, specify the number of LDEVs needed to form the LUSE volume.
   Expanded LDEVs lists the number of LDEVs specified in the **Volume Count** box. For example, if you specified 3 in **Volume Count**, three LDEVs appear in **Expanded LDEVs**.
5. Add LDEVs to the LUSE volume until you reach the number specified in **Volume Count**.
   - To add more LDEVs to the **Expanded LDEVs** list, select normal LDEVs or LUSE volumes from **Free LDEVs**, and then click **Add**.
   - You cannot select LUSE volumes from **Volume Count**. To select LUSE volumes, select LDEVs from **Free LDEVs**, and then click **Add**.
   - To remove LDEVs from the LUSE volume you are creating, select the LDEVs in **Expanded LDEVs**, and then click **Delete**.
6. Click **Set**. A dialog box asks what you want to do next.

Different messages appear depending on the LUSE settings you choose. Confirm each message that appears.

7. To create the LUSE volume using the specified settings, select **OK**. The selected top LDEV appears (in blue bold italics) as a LUSE volume in the LDEV list.

   The created LUSE volumes that are not yet registered to the storage system (shown in blue bold italics) can be reset to the state before they were created.

8. Click **Apply**, and then click **OK**. The LUSE volume is registered in the storage system.

To create a LUSE volume from the LDEV detail table

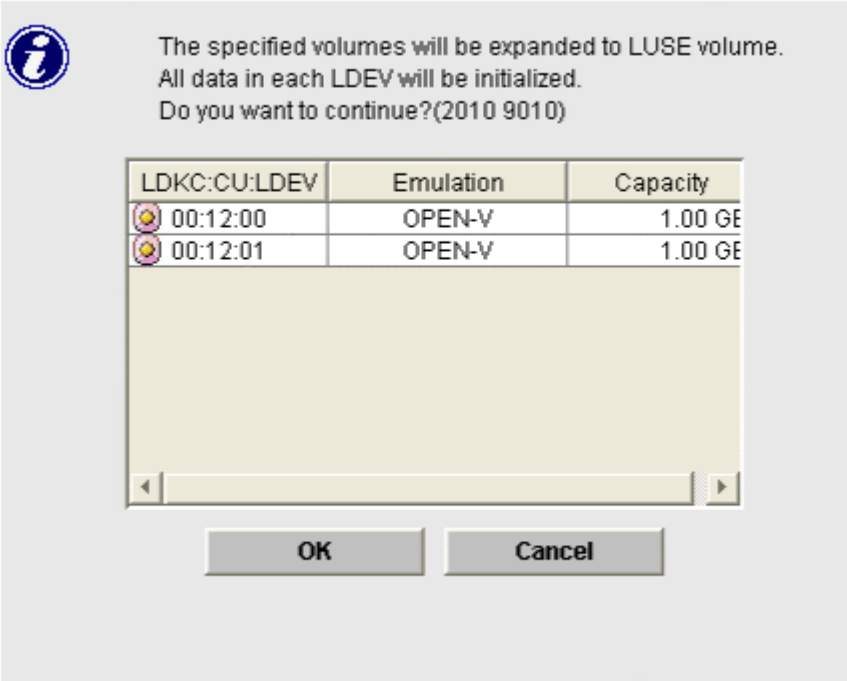
1. In the Storage Navigator main window, click to change to **Modify** mode.
2. In the **LUN Expansion** (LUSE) window, select a CU number from the **LDEV Information** tree. The **LDEV Detail** table shows all LDEVs in the selected CU.
3. In the **LDEV Detail** table, right-click the normal LDEVs or LUSE volumes that you want to form the LUSE volume.
4. Select **Set LUSE Volume**. The **Set LUSE Confirmation** dialog box opens asking what you want to do next. Verify that the LDEVs listed in the confirmation dialog box are the ones you want to use to create a LUSE volume:

   a. To perform a LUSE operation on a volume that has a path definition, click **OK**. If a message appears asking whether to perform a LUSE operation that will affect more than one cache logical partition (CLPR), go to step b. If the message does not appear, go to step 5.

      For detailed information about CLPRs, see the *Performance Guide*.

   b. To perform a LUSE operation that will affect more than one CLPR, click **OK**. A confirmation dialog box opens. Then, go to step 5.

   c. If the **Set LUSE Confirmation** dialog box opens, go to step 5.



5. Click **OK** to create the LUSE volume. The new settings that appear on the window in blue bold italics are not yet registered to the storage system until you click **Apply**. The LUSE volumes that have been created but not yet registered to the storage system can be reset to the state before they were created (see Resetting an unregistered LUSE volume on page 4-11).
6. Click **Apply**, and then click **OK**.

To create a LUSE volume from the LDEV operation detail

1. In the Storage Navigator main window, click to change to **Modify** mode.
2. In the **LUN Expansion** (LUSE) window, select a CU number from the **LDEV Information** tree.
3. Click **arrow** in the **Select an LDEV** box. For the LUSE, select the first LDEV from the **Free LDEVs** list that shows the available LDEVs.

   Use the lists on the upper right of the **Free LDEVs** list to narrow entries in this table. If you select an LDKC and a CU from the **LDKC** and **CU** lists, the **Free LDEVs** table lists only the LDEVs belonging to the selected LDKC and CU.
4. Select one or more additional normal LDEVs or LUSE volumes for the LUSE volume. Click **Add** to move the selected LDEVs from the **Free LDEVs** list to the **Expanded LDEVs** list.
5. To remove an LDEV from the **Expanded LDEVs** list, and move it back to the **Free LDEVs** list, select one or more volumes. Click **Delete**.
6. Click **Set**. A dialog box opens asking what you want to do next.

a. To perform a LUSE operation on a volume that has a path definition, click **OK**. If a message appears asking whether you want to perform a LUSE operation that will affect more than one CLPR, go to step b. If this message does not appear, go to step 7.

   For detailed information about CLPRs, see the *Performance Guide*.

b. To perform a LUSE operation that will affect more than one CLPR, click **OK**. A confirmation dialog box opens. Then, go to step 7.

c. If the **Set LUSE Confirmation** dialog box opens, go to step 7.

7. Click **OK** (or **Cancel**). The new settings that appear in the window in blue bold italics are LUSE volumes that have been created but not yet registered to the storage system until you click **Apply**. These LUSE volumes can be reset to the state before they were created (see Resetting an unregistered LUSE volume on page 4-11).
8. Click **Apply**, and then click **OK**.

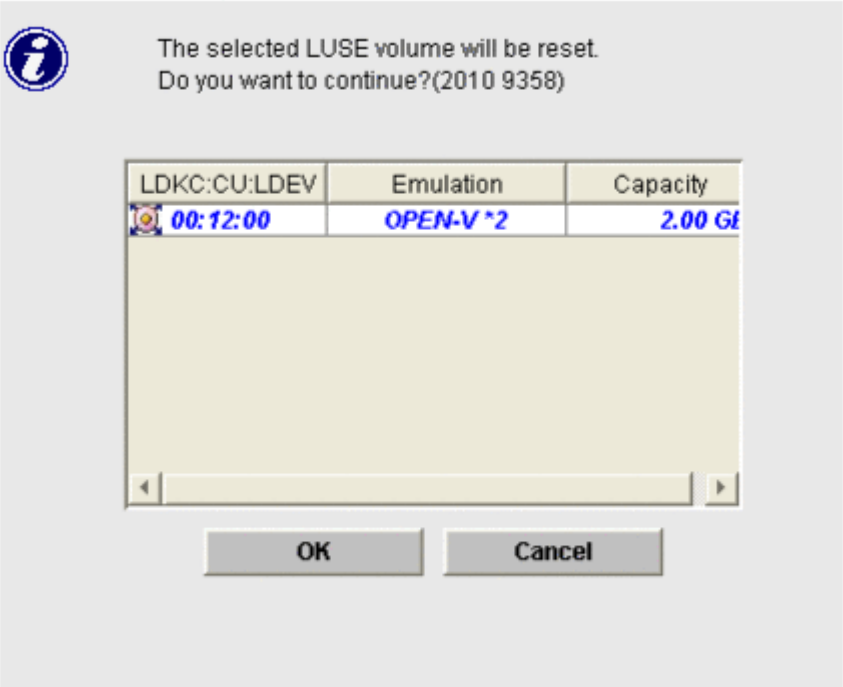
Resetting an unregistered LUSE volume

When you create a LUSE volume, it is not registered in the storage system until you click **Apply**. Until that time, an unregistered LUSE volume appears in blue bold italics, and can be reset to its initial state before it was created.

This procedure does not recover any LUSE volumes that have been released to the state they were in when they were first created. Therefore, if the LUSE volume that you have created contains any LDEVs (those in blue bold italics) that have been released from a different LUSE volume, your LUSE volume can be reset only to the state when the constituting LDEV was released from that different LUSE volume.

To reset an unregistered LUSE volume

1. In the Storage Navigator main window, click to change to **Modify** mode.
2. In the **LUN Expansion** window, select a CU number from the **LDEV Information** tree. The **LDEV Detail** table shows all LDEVs in the selected CU.
3. Select an unregistered LUSE volume (shown in blue bold italics) in the **LDEV Detail** table.
4. Right-click the selected LUSE volume, and then select **Reset Selected Volume**.
5. In the **Reset LUSE Confirmation** dialog box, click **OK** to confirm the LUSE volume reset operation.



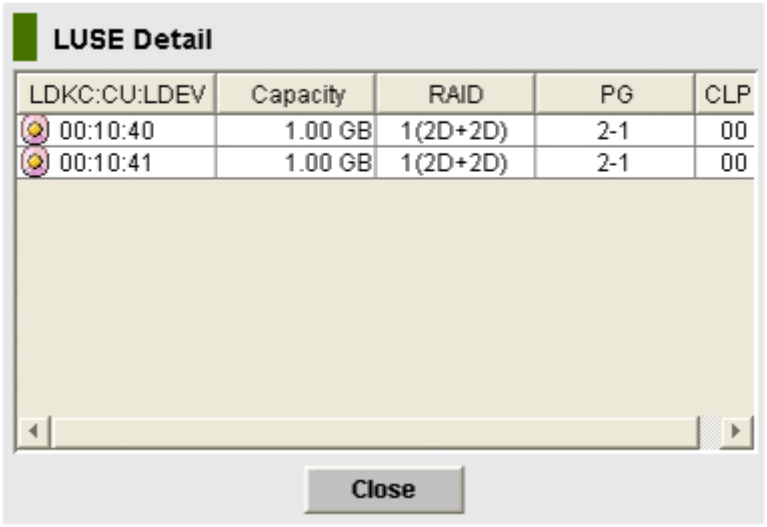
The unregistered LUSE volume is reset to the state before it was created, and the LUSE volumes or the LDEVs constituting the reset LUSE volume appear in the **LUN Expansion** window in the **LDEV Detail** table.

Maintaining LUSE volumes

Viewing LUSE volume details

A LUSE volume is made up of multiple volumes (LDEVs). Use this procedure to view the details of the individual LDEVs that make up a LUSE volume.

1. In the Storage Navigator Main window, click **Actions** > **Logical Device** > **LUN Expansion**.
2. Click to change to **Modify** mode.
3. In the **LUN Expansion** window, select a LUSE volume in the **LDEV Detail** table.
4. Right-click the selected LUSE volume, and then select **LUSE Detail**.
5. In the **LUSE Detail** dialog box, review the details. After viewing this list, click **Close**.



Changing capacity on a LUSE volume

You can change the capacity of a LUSE volume using one of these methods:

- Expand LUSE capacity
  To expand the capacity of a LUSE volume, select a LUSE volume that you want to expand, and then add LDEVs or LUSE volumes. Or first select LDEVs or LUSE volumes that you want to add, and then select a LUSE volume to be expanded.
- Reduce LUSE capacity
  You may not reduce the capacity of an existing LUSE volume. If you want to reduce the capacity of a LUSE volume, you must first release the LUSE volume and then redefine the LUSE volume (see Releasing a LUSE volume on page 4-13). Then select LDEVs of the desired size and create the LUSE volume again (see Creating a LUSE volume on page 4-8).

WARNING: Move or back up your data, or both, before releasing a LUSE volume.

Releasing a LUSE volume

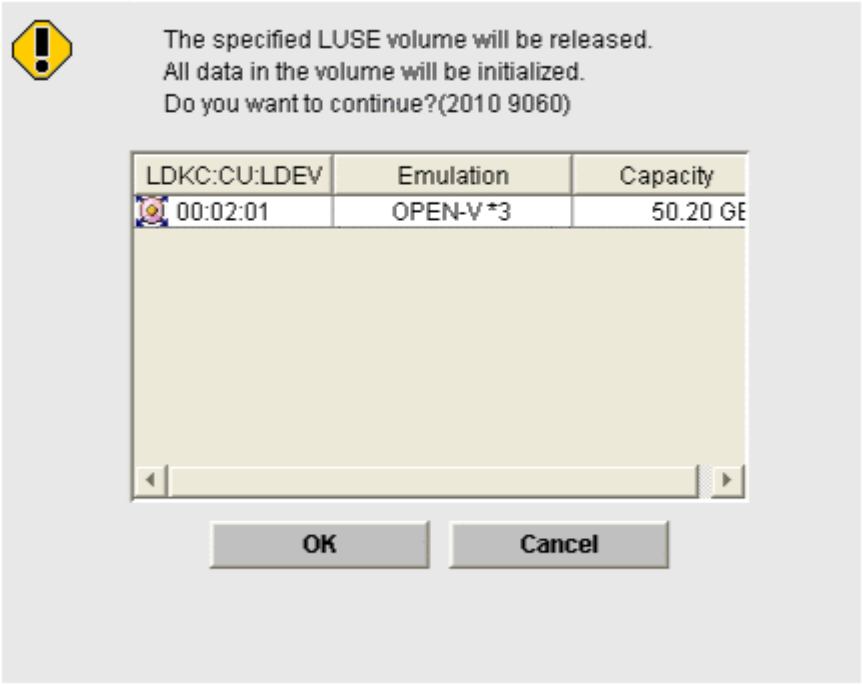
You must release a LUSE volume before you can reduce capacity in an existing LUSE volume.

WARNING: Move or back up your data, or both, before releasing a LUSE volume. After releasing a LUSE volume, data will be erased.

To release a LUSE volume

1. In the Storage Navigator Main window, click **Actions** > **Logical Device** >**LUN Expansion**.
2. Click to change to **Modify** mode.

3. Select a CU number from the **LDEV Information** tree. The **LDEV Detail** table lists all LDEVs in the selected CU.
4. In the **LUN Expansion** window, select a LUSE volume in the LDEV Detail table.
5. Right-click the selected LUSE volume, and then select **Release LUSE Volume**.
6. In the **Release LUSE Volume Confirmation** dialog box, verify that the LUSE volumes listed are the ones that you want released.



7. Click **OK**. The new settings appear on the **LDEV Detail** table in blue bold italics but are not yet implemented.
8. In the **LUN Expansion** window, click **Apply**.
9. Click **OK**.

5

Configuring thin provisioning

Thin provisioning technology allows you to allocate *virtual storage capacity* based on anticipated future capacity needs, using *virtual volumes* instead of physical disks.

Thin provisioning is an optional provisioning strategy for both open and mainframe systems. Thin provisioning is implemented with Dynamic Provisioning by creating one or more Dynamic Provisioning pools (DP pools) of physical storage space.

- ☐ Dynamic Provisioning overview
- ☐ Dynamic Tiering overview
- ☐ Thin provisioning requirements
- ☐ Using Dynamic Provisioning or Dynamic Tiering with other VSP products
- ☐ Dynamic Provisioning workflow
- ☐ Dynamic Tiering
- ☐ Changing a pool for Dynamic Tiering to a pool for Dynamic Provisioning
- ☐ Working with pools
- ☐ Notes on pools created with the previous versions
- ☐ Working with DP-VOLs
- ☐ Monitoring capacity and performance
- ☐ Thresholds

- Working with SIMs
- Managing pools and DP-VOLs

Dynamic Provisioning overview

Dynamic Provisioning is an advanced thin-provisioning software product that allows you to save money on storage purchases and reduce storage management expenses.

You can operate Dynamic Provisioning using both Storage Navigator software and the Command Control Interface.

Dynamic Tiering overview

Dynamic Tiering is a software product that helps you reduce storage costs and increase storage performance by supporting a volume configured with different storage media of different cost and performance capabilities. This support allows you to allocate data areas with heavy I/O loads to higher-speed media and to allocate data areas with low I/O loads to lower-speed media. In this way, you can make the best use of the capabilities of installed storage media. Up to three storage tiers consisting of different types of data drives are supported in a single pool of storage.

Thin provisioning requirements

License requirements

Before you operate Dynamic Provisioning, the Dynamic Provisioning program product must have been installed on the PC on which Storage Navigator has been installed. For this, you will need to purchase the Hitachi Basic Operating System Software (BOS) license.

You will need the Dynamic Tiering license for the total capacity of the pool for which the tier function is enabled.

If the V-VOL of Dynamic Provisioning or Dynamic Tiering are used for the P-VOLs and S-VOLs of ShadowImage, TrueCopy, Universal Replicator, or High Availability Manager, you will need the ShadowImage, TrueCopy, Universal Replicator, and High Availability Manager license for the total pool capacity in use.

If the DP-VOLs of Dynamic Provisioning or Dynamic Tiering are used for the P-VOLs and S-VOLs of ShadowImage, TrueCopy, Universal Replicator, or High Availability Manager, you will need the ShadowImage, TrueCopy, Universal Replicator, and High Availability Manager license for the total pool capacity in use.

If you exceed the licensed capacity, you will be able to use the additional unlicensed capacity for 30 days. After 30 days, you will not be able to perform ShadowImage operations except for deleting pairs. After 30 days, you will not be able to perform TrueCopy, Universal Replicator, and High Availability Manager operations except for suspending copy operations or deleting pairs. For more information about temporary license capacity, see the *Hitachi Storage Navigator User Guide*.

Pool requirements

A pool is a set of volumes reserved for storing Dynamic Provisioning write data.

Items	Requirements

Pool capacity	Calculate pool capacity using the following formula:
	`The capacity of the pool (MB) = Total number of pages × 42 - 4200.`
	4200 in the formula is the management area size of the pool-VOL with System Area.
	`Total Number of pages = Σ(floor(floor(pool-VOL number of blocks ÷ 512) ÷ 168)) for each pool-VOL.`
	floor( ): Truncates the value calculated from the formula in parentheses after the decimal point.
	However, the upper limit of total capacity of all pools is 5.0 PB if the shared memory is installed.

Max number of pool-VOLs	From 1 to 1,024 volumes (per pool). A volume can be registered as a pool-VOL to one pool only.
Maximum number of pools	Up to a total of 128 pools per storage system. This is the total number of Dynamic Provisioning (including Dynamic Tiering) pools, Thin Image, and Copy-on-Write Snapshot pools. Pool IDs (0 to 127) are assigned as pool identifiers.
Increasing capacity	You can increase pool capacity dynamically. Increasing capacity by one or more parity groups is recommended by adding pool-VOLs.
Reducing capacity	You can reduce pool capacity by removing pool-VOLs.
Deleting	You can delete pools that are not associated with any DP-VOLs.
Subscription limit	You can set the percentage of the total relative DP-VOL capacity that can be created to prevent the DP-VOL from becoming unwritable when the pool is full. When the subscription limit is, for example, set to 100%, the formula of DP-VOL capacity that can be created is calculated as follows. `The total DP-VOL capacity <= Pool capacity × 100%.` Reaching the subscription limit will restrict the ability to shrink the pool, create a new DP-VOL, or expand a DP-VOL.
Thresholds	• Warning Threshold: You can set the value between 1% and 100%, in 1% increments. The default is 70%. • Depletion Threshold: You can set the value between the warning threshold and 100%, in 1% increments. The default is 80%. Pool usage over either threshold will cause a warning to be issued via a SIM reported to Storage Navigator.
Data allocation unit	42 MB The 42-MB page corresponds to a 42-MB continuous area of the DP-VOL. Pages are allocated for the pool only when data has been written to the area of the DP-VOL.

Items	Requirements
Tier (Dynamic Tiering)	Defined based on the media type (see Drive type for a Dynamic Tiering tier, below). Maximum 3 tiers.
Maximum capacity of each tier (Dynamic Tiering)	4.0 PB (Total capacity of the tiers must be within 4.0 PB. The shared memory must be installed.)

Pool-VOL requirements

Pool-VOLs make up a DP-pool.

Items	Requirements
Volume type	Logical volume (LDEV) While pool-VOLs can coexist with other volumes in the same parity group, for best performance: • pool-VOLs for a pool should not share a parity group with other volumes. • pool-VOLs should not be located on concatenated parity groups. Pool-VOLs cannot be used for any other purpose. For instance, you cannot specify the following volumes as Dynamic Provisioning and Dynamic Tiering pool-VOLs: • Volumes used by ShadowImage, Volume Migration, TrueCopy, High Availability Manager, or Universal Replicator • LUSE volumes • Volumes defined by Cache Residency Manager • Volumes already registered in Thin Image, Copy-on-Write Snapshot, Dynamic Provisioning, or Dynamic Tiering pools • Volumes used as Thin Image, Copy-on-Write Snapshot P-VOLs or S-VOLs • Data Retention Utility volumes with a Protect, Read Only, or S-VOL Disable attribute • Volumes whose LDEV status is other than Normal or Normal (Quick Format) You cannot specify volumes in blocked status or volumes in copying process. • System disks • Command devices • Quorum disks
Emulation type	OPEN-V
RAID level for a Dynamic Provisioning pool	All RAID levels of pool-VOLs can be added. Pool-VOLs of RAID 5, RAID 6, RAID 1, and the external volume can coexist in the same pool. For pool-VOLs in the same pool:

Items	Requirements

	• RAID 6 is the recommended RAID level for pool-VOLs, especially for a pool where the recovery time of a pool failure due to a drive failure is not acceptable.
	• RAID 1 pool-VOLs with SATA-E drive types cannot be registered in a pool.
	• Pool-VOLs of the same drive type with different RAID levels can coexist in the same pool. Note that we recommend that you use the following configuration:
	  ◦ If there are pool-VOLs of the same hard disk drive type in a pool, unify the RAID levels.
	  ◦ Although you can set four or more of hard disk drive types for pool-VOLs in the same pool, you should use three or fewer types.
	• Pool-VOLs on external volumes cannot have a mix of cache modes set to enable and disable.
	• For internal and external pool-VOLs to coexist, the cache mode of the external volume must be set to enable.
	• If **Enabled** is displayed for **Mixable** in the Storage Navigator window, the volumes of RAID 1, RAID 5, RAID 6 and external volumes can coexist in the same pool. If **Disabled** is displayed for **Mixable** in the Storage Navigator window, the volumes of RAID 1, RAID 5, RAID 6 and external volumes cannot coexist in the same pool.

RAID level for a Dynamic Tiering pool	All RAID levels of pool-VOLs can be added. Pool-VOLs of RAID 5, RAID 6, RAID 1, and the external volume can coexist in the same pool.
	For pool-VOLs in a pool:
	• RAID 6 is the recommended RAID level for pool-VOLs, especially for a pool where the recovery time of a pool failure due to a drive failure is not acceptable.
	• RAID 1 pool-VOLs with SATA-E drive types cannot be registered in a pool.
	• Pool-VOLs of the same drive type with different RAID levels can coexist in the same pool. Note that we recommend that you use the following configuration:
	  ◦ If there are pool-VOLs of the same in a tier, unify the RAID levels.
	  ◦ Although you can set four or more of hard disk drive types for pool-VOLs in the same pool, you should use three or fewer types.
	  ◦ Because the speed of RAID 6 is slower than other RAID levels, tiers that use other RAID levels should not be placed under a tier that uses RAID 6.
	• Pool-VOLs of an external volume must have cache mode enabled.
	• If **Enabled** is displayed for **Mixable** in the Storage Navigator window, the internal volume and external volume can coexist. If **Disabled** is displayed for **Mixable** in the Storage Navigator window, the external volume and the RAID 1 pool-VOLs cannot be used.

Items	Requirements
Hard disk drive for a Dynamic Provisioning pool	SSD*, SAS15K, SAS10K, SAS7.2K, SATA-E, SATA-W/V, and the external volume can be used as the hard disk drive type. These hard disk drive types can coexist in the same pool. **Cautions**: • If multiple pool-VOLs with different drive types are registered in the same pool, the I/O performance depends on the drive type of the pool-VOL to which the page is assigned. Therefore, if different drive types are registered in the same pool, ensure that the required I/O performance is not degraded by using less desirable drive types. • Unless intentionally transitioning between SATA drive types, a SATA-E volume and a SATA-W/V volume should not coexist in a pool. • RAID 1 pool-VOLs with SATA-E drive types cannot be registered in a pool.
Hard disk drive type for a Dynamic Tiering pool	SSD*, SAS15K, SAS10K, SAS7.2K, SATA-E, SATA-W/V, and the external volume can be used as the hard disk drive type. These hard disk drive types can coexist in the same pool. **Cautions:** • It is recommended that the SATA-E volume and SATA-W/V volume do not coexist in one pool. • RAID 1 pool-VOLs with SATA-E drive types cannot be registered in a pool.
Volume capacity	Internal volume: From 8 GB to 2.9 TB External volume: From 8 GB to 4 TB
LDEV format	You must format the LDEV before the volume is registered in a pool. You cannot format an LDEV once it is a pool-VOL.
Path definition	You cannot specify a volume with a path definition as a pool-VOL.
* Includes SLC/MLC for SSD, and FMD.	

DP-VOL requirements

Items	Requirements
Volume type	DP-VOL (V-VOL) The LDEV number is handled in the same way as for normal volumes.
Emulation type	OPEN-V
Maximum number of DP-VOLs	Up to 63,232 per system. Any number of available DP-VOLs can be associated with a pool. Up to 63,232 volume groups per system. If external volumes and V-VOLs are used, the total number of external volumes and V-VOLs must be 63,232 or less.
Volume capacity	Volume capacity from 46.87 MB to 59.9 TB per volume. • TB: 0.01 to 59.99 • GB: 0.04 to 61,439.99 • MB: 46.87 to 62,914,556.25

Items	Requirements
	• Blocks: 96,000 to 128,849,011,200 However, if you use the volume as a P-VOL or S-VOL of ShadowImage, Volume Migration, TrueCopy, Universal Replicator, or High Availability Manager, the volume capacity must be 4 TB or less. Total maximum volume capacity of 5.0 PB per storage system.
Path definition	Available.
LDEV format	Available (Quick Format is not available.) System Option Mode 867 OFF When you format an LDEV on the DP-VOLs, the storage system initializes data only in the consumed pool pages of the DP-VOLs. However, after you format an LDEV, the free space in the pool does not increase because the pages are not released.

Note: System Option Mode 867 ON: When you format an LDEV on a DP-VOL, the capacity mapped to the DP-VOL is released to the pool as free space.

Requirements for increasing DP-VOL capacity

You can increase DP-VOL capacity up to 59.9 TB. To notify the host that the DP-VOL capacity has been increased, make sure host mode option 40 is enabled. Processing differs as follows, depending on the value of host mode option 40:

- When host mode option 40 is not enabled, the host will not be notified that the DP-VOL capacity has been increased. Therefore, the DP-VOL data has to be read again by your storage system after the capacity is increased.
- When host mode option 40 is enabled, the host is notified that the DP-VOL capacity has increased. If the operating system cannot recognize the value of capacity that was increased, the DP-VOL data has to be read again by your storage system.

The following requirements are important when increasing the DP-VOL capacity:

- The DP-VOL to be increased is not shared with a VSP product that does not allow increasing the DP-VOL (See Increasing DP-VOL capacity on page 5-109).
- The DP-VOL is not undergoing LDEV formatting.
- The capacity to be added to the DP-VOL must be specified within the range indicated below **LDEV Capacity** in the **Expand V-VOLs** window.
- You cannot add capacity to the DP-VOL while the pool related to the target DP-VOL is in any one of the following statuses:
  - Exceeding the subscription limit threshold
  - In progress of pool capacity shrinking

Caution: When increasing DP-VOL capacity, do not perform the following operations. When you perform these operations, do not increase DP-VOL capacity.

- Operations using Virtual LUN
- Operations using Cache Residency Manager
- Creating DP-VOLs
- Restoring pools
- Deleting DP-VOLs
- Operations to increase the DP-VOL capacity in another instance of CCI
- Maintenance of your storage system

After increasing DP-VOL capacity, click **Refresh** in Storage Navigator, and then confirm that the DP-VOL is increased. If the DP-VOL capacity is not increased, wait a while, click **Refresh** again, and confirm that the DP-VOL is increased. If you perform a Storage Navigator operation without making sure that the DP-VOL is increased, operations from Storage Navigator may fail.

If either of the following operations is being performed, the DP-VOL capacity might not be increased:

- Volume Migration
- Quick Restore by ShadowImage

Operating system and file system capacity

Operating systems and file systems when initializing a P-VOL will consume some Dynamic Provisioning pool space. Some combinations will initially take up little pool space, while other combinations will take as much pool space as the virtual capacity of the DP-VOL.

The following table shows the effects of some combinations of operating system and file system capacity. For more information, contact your Hitachi Vantara representative.

OS	File System	Metadata Writing	Pool Capacity Consumed
Windows Server 2003 and Windows Server 2008*	NTFS	Writes metadata to first block.	Small (one page) If file update is repeated, allocated capacity increases when files are updated (overwritten). Therefore, the effectiveness of reducing the pool capacity consumption decreases.[1]
Linux	XFS	Writes metadata in Allocation Group Size intervals.	Depends upon allocation group size. The amount of pool space consumed will be approximately [DP-VOL Size]*[42 MB/Allocation Group Size][1]

OS	File System	Metadata Writing	Pool Capacity Consumed
	Ext2 Ext3	Writes metadata in 128-MB increments.	About 33% of the size of the DP-VOL. The default block size for these file systems is 4 KB. This results in 33% of the DP-VOL acquiring HDP pool pages. If the file system block size is changed to 2 KB or less then the DP-VOL Page consumption becomes 100%.[1]
Solaris	UFS	Writes metadata in 52-MB increments.	Size of DP-VOL.[2]
	VxFS	Writes metadata to the first block.	Small (one page).[1]
AIX	JFS	Writes metadata in 8-MB increments.	Size of DP-VOL. If you change the Allocation Group Size settings when you create the file system, the metadata can be written to a maximum interval of 64 MB. Approximately 65% of the pool is used at the higher group size setting.[2]
	JFS2	Writes metadata to the first block.	Small (one page).[1]
	VxFS	Writes metadata to the first block.	Small (one page).[1]
HP-UX	JFS (VxFs)	Writes metadata to the first block.	Small (one page).[1]
	HFS	Writes metadata in 10-MB increments.	Size of DP-VOL.[2]

1. There is an effective reduction of pool capacity.

2. There is no effective reduction of pool capacity.

*See Formatting LDEVs in a Windows environment on page 5-88

Using Dynamic Provisioning or Dynamic Tiering with other VSP products

Interoperability of DP-VOLs and pool-VOLs

DP-VOLs and pool-VOLs can be used in conjunction with other VSP products. The following table lists the operations that are permitted and not permitted.

Product name (Guide name)	Permitted	Not permitted
Cache Residency Manager (*Performance Guide*)	Not applicable	Performing operations on DP pool-VOLs or DP-VOLs.
Copy-on-Write Snapshot (*Hitachi Copy-on-Write Snapshot User Guide*)	Using a DP-VOL as a Copy-on-Write Snapshot P-VOL. The maximum total number of pools per storage system is 128. Copy-on-Write Snapshot pool limits are reduced by the number of Dynamic Provisioning, Dynamic Tiering, and Thin Image pools.	• Using a DP-VOL as a Copy-on-Write Snapshot S-VOL or pool-VOL. • Using a Dynamic Provisioning, Dynamic Tiering or Thin Image pool-VOL as a Copy-on-Write Snapshot P-VOL, S-VOL or pool-VOL. • Increasing the capacity of a DP-VOL using Copy-on-Write Snapshot. • Reclaiming zero pages of V-VOL used by Copy-on-Write Snapshot. • Executing **`Writesame`** or **`Unmap`** commands to reclaim zero pages of a DP-VOL which is being used by a Copy-on-Write Snapshot operation.
Thin Image (*Hitachi Thin Image User Guide*)	Using a V-VOL as a Thin Image P-VOL. The maximum total number of pools per storage system is 128. Thin Image pool limits are reduced by the number of Dynamic Provisioning pools, Dynamic Tiering for Mainframe pools and Copy-on-Write Snapshot.	• Using a DP-VOL as a Thin Image S-VOL or pool-VOL. • Using a Dynamic Provisioning, Dynamic Tiering, or Copy-on-Write Snapshot pool-VOL as a Thin Image P-VOL, S-VOL or pool-VOL. • Increasing the capacity of a DP-VOL using Thin Image. • Reclaiming zero pages of a V-VOL used by Thin Image. • Executing **`Writesame`** or **`Unmap`** commands to reclaim zero pages of a DP-VOL which is being used by a Thin Image operation.
Data Retention Utility (*Provisioning Guide for Open Systems*)	Performing operations on DP-VOLs.	Performing operations on DP pool-VOLs.

Product name (Guide name)	Permitted	Not permitted
High Availability Manager (*Hitachi High Availability Manager User Guide*)	Using a DP-VOL as a High Availability Manager P-VOL or S-VOL.	• Using a DP-VOL as a quorum disk. • Using a pool-VOL as a High Availability Manager P-VOL or S-VOL. • Increasing the capacity of DP-VOL used by High Availability Manager.
LUN Expansion (*Provisioning Guide for Open Systems*)	Not applicable	Performing operations on DP-VOLs or DP pool-VOLs.
LUN Manager (*Provisioning Guide for Open Systems*) LUN Security (*Provisioning Guide for Open Systems*)	Performing operations on DP-VOLs.	Performing operations on DP pool-VOLs.
ShadowImage (*Hitachi ShadowImage® User Guide*)	Using a DP-VOL as a ShadowImage P-VOL or S-VOL.	• Using a pool-VOL as a ShadowImage P-VOL or S-VOL. • Increasing the capacity of a DP-VOL used by ShadowImage. • Reclaiming zero pages of a DP-VOL is determined by the pair status. For more information, see ShadowImage pair status for reclaiming zero pages on page 5-13. • Executing **`Writesame`** or **`Unmap`** commands to reclaim zero pages of a DP-VOL which is being used by a ShadowImage operation.
TrueCopy (*Hitachi TrueCopy® User Guide*)	Using a DP-VOL as a TrueCopy P-VOL or S-VOL.	• Using a pool-VOL as a TrueCopy P-VOL or S-VOL. • Increasing the capacity of DP-VOL used by TrueCopy.
Universal Replicator (*Hitachi Universal Replicator User Guide*)	Using a DP-VOL as a Universal Replicator P-VOL or S-VOL.	• Using a DP-VOL as a journal volume of Universal Replicator. • Using a DP pool-VOL as a Universal Replicator journal volume, S-VOL, or P-VOL.

Product name (Guide name)	Permitted	Not permitted
		• Increasing the capacity of a DP-VOL used by Universal Replicator.
Universal Volume Manager (*Hitachi Universal Volume Manager User Guide*)	Enabling volumes created by Universal Volume Manager to be used as pool-VOLs.	Increasing the capacity of a volume mapped to the Universal Volume Manager. If you try to increase the capacity of the external volume, the capacity of the volume will not change in the Universal Volume Manager. Volumes used as pool volumes would need to be deleted (shrunk) from the pool before being expanded.
Virtual LUN (Provisioning Guide for Open Systems)	Registering Virtual LUN volumes in Dynamic Provisioning pools.	Performing Virtual LUN operations on volumes that are already registered in a DP pool.
Virtual Partition Manager (*Performance Guide*)	Performing operations on DP-VOLs and pool-VOLs.	Not applicable
Volume Migration (For details, contact the customer support.)	Using a DP-VOL as a migration source or a migration target.	• Using on pool-VOLs. • Increasing the capacity of DP-VOL used by Volume Migration. • Reclaiming zero pages of V-VOL used by Volume Migration. • Executing **`Writesame`** or **`Unmap`** commands to reclaim zero pages of a DP-VOL which is being used by a Volume Migration operation.
Volume Shredder (*Hitachi Volume Shredder User Guide*)	Use on DP-VOLs.	• Using on pool-VOLs. • Increasing the capacity of DP-VOL used by Volume Shredder. • Reclaiming zero pages of V-VOL used by Volume Shredder.

ShadowImage pair status for reclaiming zero pages

You can use this table to determine whether reclaiming zero pages is possible for a particular pair status

Pair status	Reclaim zero pages from Storage Navigator	Reclaim zero pages from Command Control Interface
SMPL	Enabled	Enabled
COPY(PD)/COPY	Disabled	Disabled
PAIR	Disabled	Disabled
COPY(SP)	Disabled	Disabled
PSUS(SP)/PSUS	Disabled	Disabled
PSUS	Enabled	Enabled
COPY(RS)/COPY	Disabled	Disabled
COPY(RS-R)/RCPY	Disabled	Disabled
PSUE	Disabled	Disabled

TrueCopy

You can use Dynamic Provisioning or Dynamic Tiering in combination with TrueCopy to replicate V-VOLs. The following figure illustrates the interaction when the TrueCopy P-VOL and S-VOL are also V-VOLs.

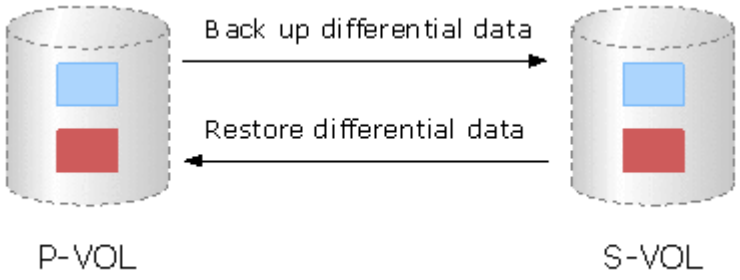


Figure 5-1 Dynamic Provisioning or Dynamic Tiering and TrueCopy

This table shows the supported TrueCopy and Dynamic Provisioning or Dynamic Tiering combinations.

TrueCopy P-VOL	TrueCopy S-VOL	Explanation
DP-VOLs	DP-VOLs	Supported
DP-VOLs	Normal (ordinary) volumes	Supported
Normal (ordinary) volumes	DP-VOLs	Supported Note, however, that this combination consumes the same amount of pool capacity as the original normal volume (P-VOL).

You cannot specify a Dynamic Provisioning or Dynamic Tiering pool-VOL as a TrueCopy P-VOL and S-VOL.

Universal Replicator

You can use Dynamic Provisioning or Dynamic Tiering in combination with Universal Replicator to replicate DP-VOLs.

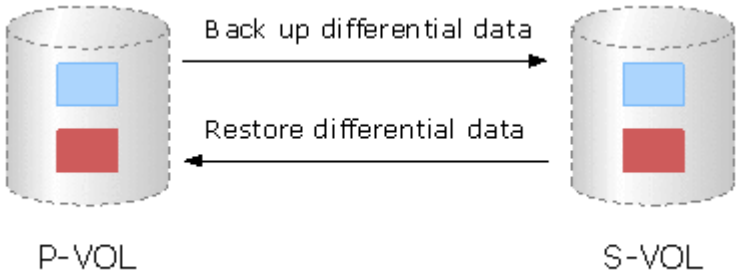


Figure 5-2 Using Dynamic Provisioning or Dynamic Tiering and Universal Replicator

The following table lists the supported Universal Replicator and Dynamic Provisioning or Dynamic Tiering volume combinations.

Universal Replicator P-VOL	Universal Replicator S-VOL	Explanation
DP-VOLs	DP-VOLs	Supported
DP-VOLs	Normal (ordinary) volumes	Supported
Normal (ordinary) volumes	DP-VOLs	Supported Note, however, that this combination consumes the same amount of pool capacity as the original normal volume (P-VOL).

You cannot specify a Dynamic Provisioning or Dynamic Tiering pool-VOL as a Universal Replicator P-VOL or S-VOL.

ShadowImage

You can use Dynamic Provisioning or Dynamic Tiering in combination with ShadowImage to replicate DP-VOLs.

The following table lists the interaction when the ShadowImage P-VOL and S-VOL are also DP-VOLs.

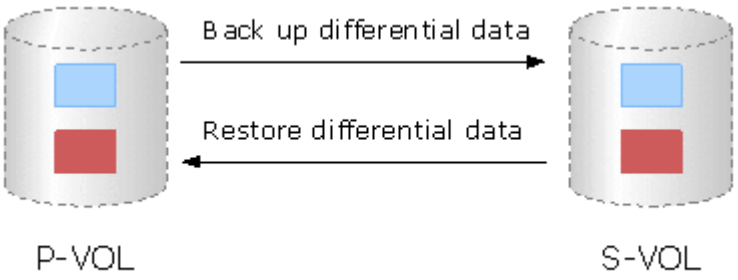


Figure 5-3 Using Dynamic Provisioning or Dynamic Tiering and ShadowImage

ShadowImage P-VOL	ShadowImage S-VOL	Explanation
DP-VOLs	DP-VOLs	Supported.
DP-VOLs	Normal (ordinary) volumes	Supported. The Quick Restore function is unavailable.
Normal (ordinary) volumes	DP-VOLs	Supported. Note, however, that this combination consumes the same amount of pool capacity as the normal volume. The Quick Restore function is unavailable.

Normal volumes include the internal volumes and external volumes that are mapped to the volumes of the external storage system using Universal Volume Manager. For more information on external volumes, see *Hitachi Universal Volume Manager User Guide*.

You cannot specify a Dynamic Provisioning or Dynamic Tiering pool-VOL as a ShadowImage P-VOL or S-VOL

Copy-on-Write Snapshot

You can use Dynamic Provisioning, Dynamic Provisioning for Mainframe, or Thin Image pools in combination with Copy-on-Write Snapshot to replicate V-VOLs.

- The pool for Copy-on-Write Snapshot cannot be the same pool used for Dynamic Provisioning, Dynamic Provisioning for Mainframe, or Thin Image pools
- Up to 128 pools in total can be used for Dynamic Provisioning (including Dynamic Tiering), Dynamic Provisioning for Mainframe (including Dynamic Tiering for Mainframe), Copy-on-Write Snapshot and Thin Image.
- A pool-VOL cannot be shared among Dynamic Provisioning (including Dynamic Tiering), Dynamic Provisioning for Mainframe, Thin Image. and Copy-on-Write Snapshot.

Thin Image

When using Dynamic Provisioning, Dynamic Provisioning for Mainframe, Thin Image, and Copy-on-Write Snapshot in a storage system, note the following:

- The pool for Dynamic Provisioning (including Dynamic Tiering), the pool for Dynamic Provisioning for Mainframe (including Dynamic Tiering for Mainframe), and the pool for Copy-on-Write Snapshot cannot be used in conjunction with Thin Image. The pool for Thin Image cannot be used in conjunction with Dynamic Provisioning, Dynamic Provisioning for Mainframe or Copy-on-Write Snapshot.
- Up to 128 pools in total can be used for Dynamic Provisioning (including Dynamic Tiering), the pool for Dynamic Provisioning for Mainframe (including Dynamic Tiering for Mainframe), Thin Image, and Copy-on-Write Snapshot.
- A pool-VOL cannot be shared with Dynamic Provisioning (including Dynamic Tiering), Dynamic Provisioning for Mainframe (including Dynamic Tiering for Mainframe), Thin Image, and Copy-on-Write Snapshot.

Virtual Partition Manager CLPR setting

Hitachi Vantara recommends assigning DP-VOL and pool-VOLs that are related to one pool to the same CLPR.

For detailed information about CLPRs, see the *Performance Guide*.

Volume Migration

For more information, see the *Hitachi Volume Migration User Guide*.

Resource Partition Manager

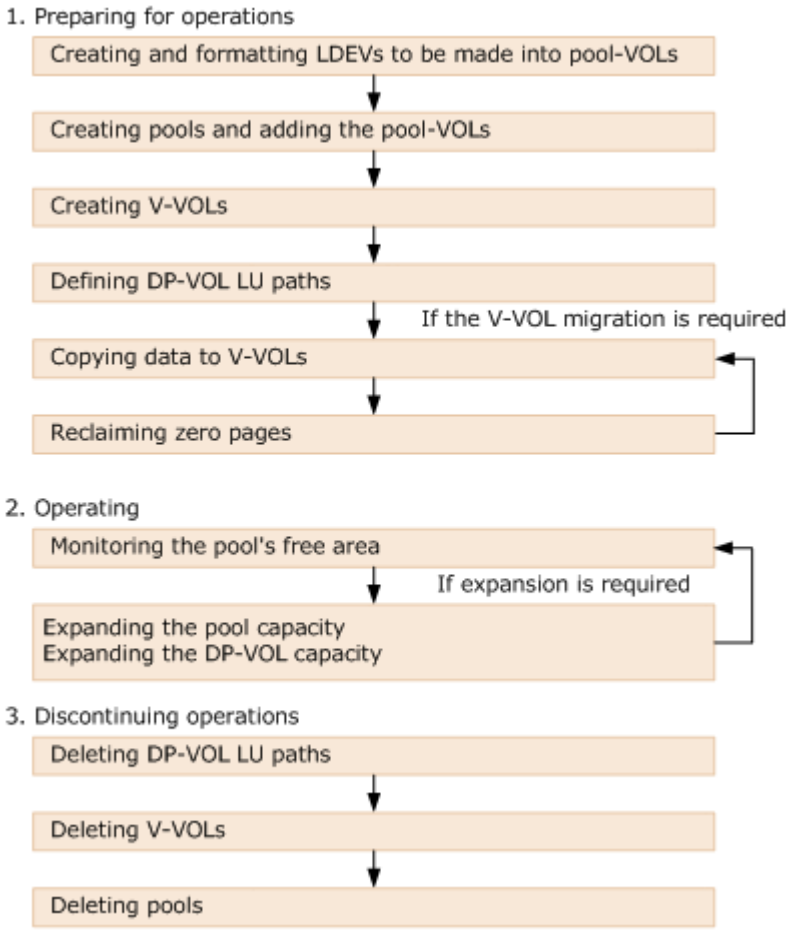
See Resource group rules, restrictions, and guidelines on page 2-8 for the conditions of resources that are necessary in the operation of other Hitachi Vantara software and the precautions required when using Resource Partition Manager.

Dynamic Provisioning workflow

Before you create a pool, you must create the V-VOL management area in shared memory. For information on adding shared memory, contact your Hitachi Vantara representative.

The following diagram shows the steps for a Storage Administrator to follow in setting up Dynamic Provisioning on a storage system.

Use Storage Navigator to create pools and DP-VOLs.



Caution: If you delete a pool, its pool-VOLs (LDEVs) will be blocked. Blocked volumes should be formatted before use.

Caution: If the V-VOL data is migrated through the host, unallocated areas of the volume may be copied as well. The used capacity of the pool increases after the data migration because the areas that were unallocated before the data migration have become allocated areas due to migration.

To migrate the V-VOL data:

1. Copy all data of V-VOLs from the source to the target.
2. Perform the operation to reclaim zero pages.

Perform this procedure for each V-VOL. When data migration is done on a file-by-file basis, perform the operation to reclaim zero pages if necessary.

To restore the backup data:

1. Restore the V-VOL data.
2. Perform the operation to reclaim zero pages.

Perform the above procedure for each V-VOL.

Dynamic Tiering

About tiered storage

In a tiered storage environment, storage tiers can be configured to accommodate different categories of data. A tier is a group of storage media (pool volumes) in a DP pool. Tiers are determined by a single storage media type. A storage tier can be one type of data drive, including SSD, SAS, SATA, or external volumes. Media of high-speed performance make up the upper tiers. Media of low-speed response become the lower tiers. Up to a maximum of three tiers can coexist in each Dynamic Tiering pool.

Categories of data may be based on levels of protection needed, performance requirements, frequency of use, and other considerations. Using different types of storage tiers helps reduce storage costs and improve performance.

Because assigning data to particular media may be an ongoing and complex activity, Dynamic Tiering software automatically manages the process based on user-defined policies.

As an example of the additional implementation of tiered storage, tier 1 data (such as mission-critical or recently accessed data) might be stored on expensive and high-quality media such as double-parity RAIDs (redundant arrays of independent disks). Tier 2 data (such as financial or seldom-used data) might be stored on less expensive storage media.

Tier monitoring and data relocation

Dynamic Tiering uses tiers to manage data storage. It classifies the specified drives in the pool into tiers (storage hierarchy). Up to three tiers can be defined in a pool depending on the processing capacity of the data drives. Tiering allocates more frequently accessed data to the upper tier and less frequently accessed data, stored for a long period of time, to the lower tier.

Multi-tier pool

With Dynamic Tiering, you can enable the Multi-Tier pool option for an existing pool. The default is to allow tier relocation for each DP-VOL. Only the DP-VOLs for which tier relocation is enabled are subject to calculation of the tier range value, and tier relocation will be performed on them. If tier relocation is disabled for all DP-VOLs in a pool, tier relocation is not performed.

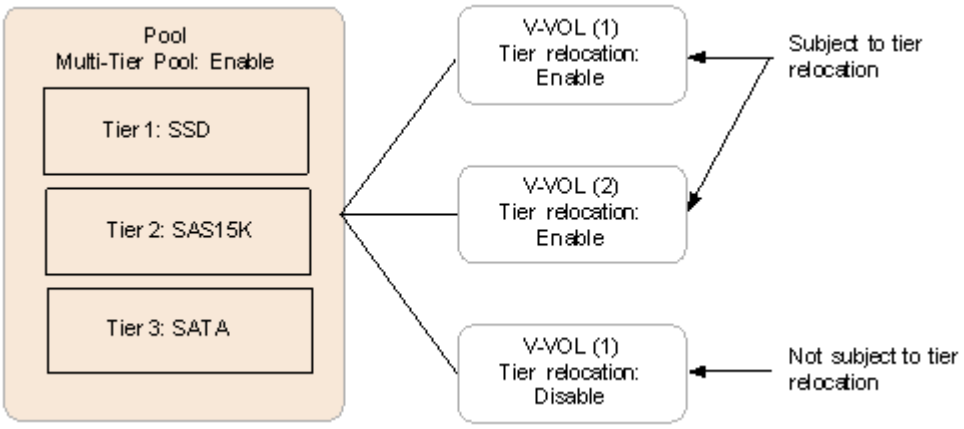


Figure 5-4 Relationship between multi-tier pool and tier relocation

Tier monitoring and relocation cycles

Performance monitoring and tier relocation can be set to execute in one of two execution modes: Auto and Manual. You can set up execution modes, or switch between modes by using either Hitachi Storage Navigator or Command Control Interface.

In Auto execution mode, monitoring and relocation are continuous and automatically scheduled. In Manual execution mode, the following operations are initiated manually.

- Start monitoring
- Stop monitoring and recalculate tier range values
- Start relocation
- Stop relocation

In both execution modes, relocation of data is automatically determined based on monitoring results. The settings for these execution modes can be changed nondisruptively while the pool is in use.

- **Auto execution mode**

  Auto execution mode performs monitoring and tier relocation based on information collected by monitoring at a specified constant frequency: from 0.5, 1, 2, 4, or 8 hours. All Auto execution mode cycle frequencies have a starting point at midnight (00:00). For example, if you select a 1 hour monitoring period, the starting times would be 00:00, 01:00, 02:00, 03:00, and so on.

  As shown in the following table, the 24-hour monitoring cycle allows you to specify the times of day to start and stop performance monitoring. The 24-hour monitoring cycle does not have to start at midnight. Tier relocation begins at the end of each cycle. For more information, see Edit Pools window on page E-33.

Monitoring cycle (hours)	Start Times	Finish Times
0.5	0.5 hours from 00:00 AM. For example 00:00, 00:30, and 01:00	0.5 hours after the start time
1	1 hour from 00:00 AM. For example 00:00, 01:00, and 02:00	1 hour after the start time
2	2 hours from 00:00 AM. For example 00:00, 02:00, and 04:00	2 hours after the start time
4	4 hours from 00:00 AM. For example 00:00, 04:00, and 08:00	4 hours after the start time
8	8 hours from 00:00 AM. For example 00:00, 08:00, and 16:00	8 hours after the start time
24 (monitoring time period can be specified)	Specified time	Specified time

If the setting of the monitoring cycle is changed, performance monitoring begins at the new start time. The collection of monitoring information and tier relocation operations already in progress are not interrupted when the setting is changed. The next operations are initiated at the new start time.

For example. if the monitoring cycle is changed from 1 hour to 4 hours at 01:30 AM, the collection of monitoring information and tier relocation in progress at 01:30 AM continues. At 02:00 AM and 03:00 AM, however, monitoring information is not collected and tier relocation is not performed. In this example, operations could begin again at 04:00 AM, the start time of the next monitoring cycle.

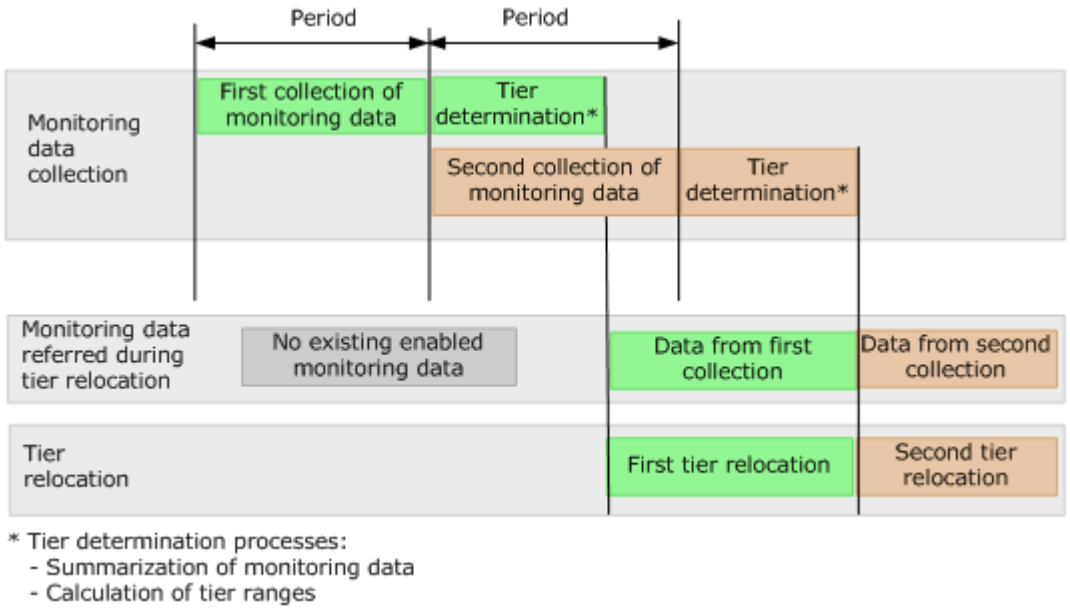


Figure 5-5 Collection of monitoring data to tier relocation workflow in auto execution mode

In auto execution mode, the collection of monitoring data and tier relocation operations are performed in parallel in the next cycle. Data from these parallel processes are stored in two separate fields.

- Data while monitoring is in progress in the next cycle.
- Fixed monitoring information used in tier reliocation.

- **Manual execution mode**

  You can start and stop performance monitoring and tier relocation at any time. You should keep the duration of performance monitoring to less than 7 days (168 hours). If performance monitoring exceeds 7 days, then monitoring stops automatically.

  Manual execution mode starts and ends monitoring and relocation at the time the command is issued from Storage Navigator or CCI. You can use scripts, which provide flexibility to control monitoring and relocation tasks based on a schedule for each day of the week.

  In manual execution mode, the next monitoring cycle can be started with the collection of monitoring data and tier relocation operations performed in parallel. Data from these parallel processes are stored in two separate fields.

  - Data while monitoring is in progress in the next cycle.
  - Fixed monitoring information used in tier reliocation.

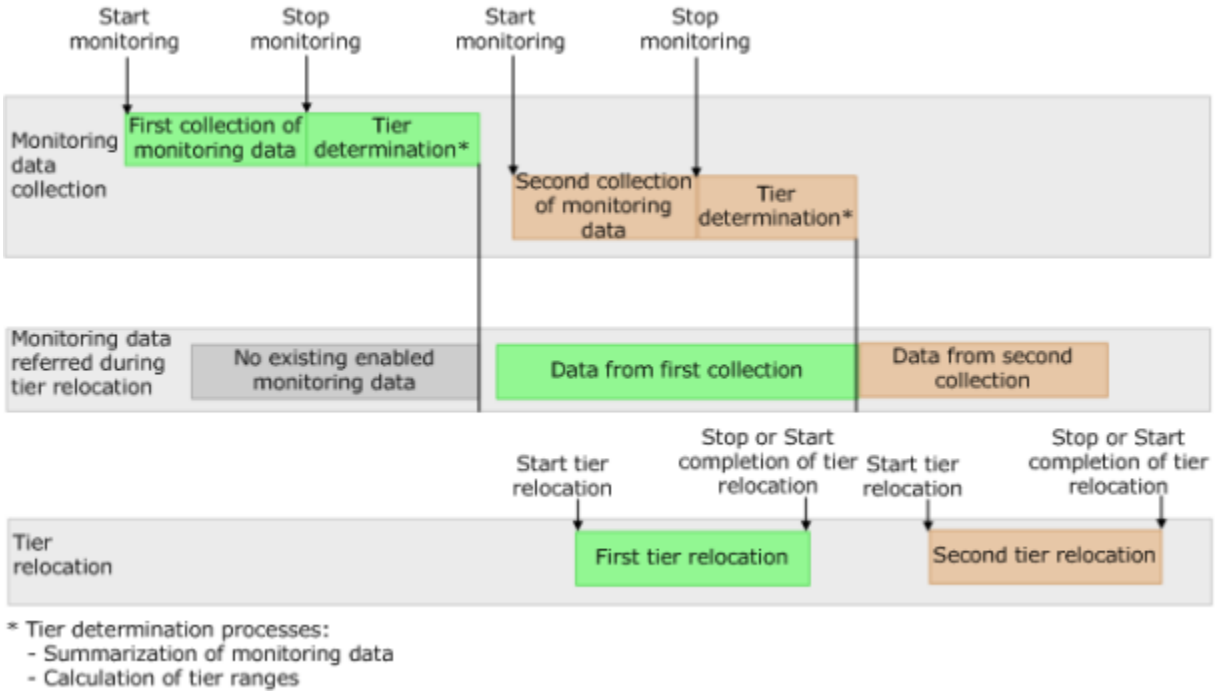


Figure 5-6 Collection of monitoring data to tier relocation workflow in manual execution mode

Case 1: If the second collection of the monitoring information is finished during the first tier relocation, the latest monitoring information is the second collection. In that case, the first collection of monitoring information is referenced only after the first tier relocation has completed.

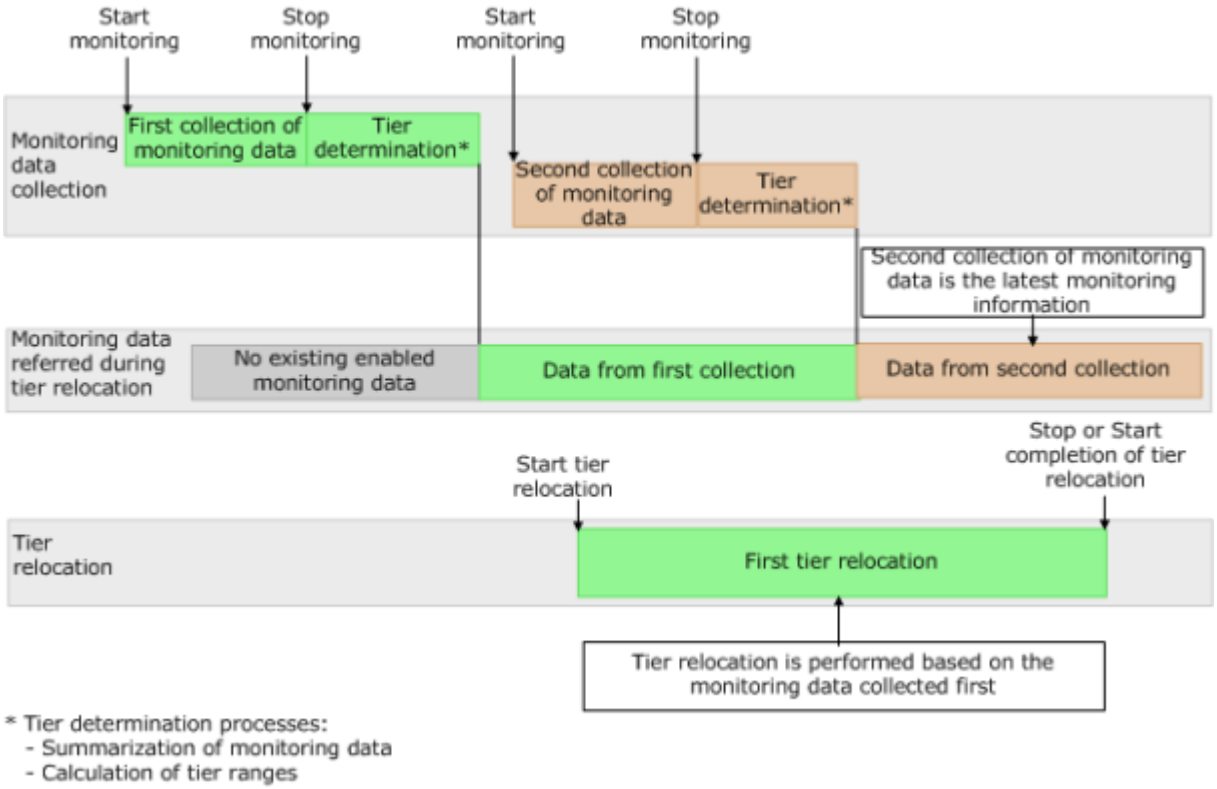


Figure 5-7 Second collection of monitoring information finishes before the first tier relocation is complete

Case 2: When tier relocation is performed with the first collection of monitoring information, the second collection of monitoring information can be performed. However, the third collection cannot be started. Because only two fields are used store collected monitoring information, the third collection cannot be overwritten.

In that case, the third collection of the monitoring information is started after the first tier relocation is stopped or tier relocation has completed.

The collection of the monitoring information is not started under these conditions as well:

- When the second tier relocation is performed, the fourth collection of monitoring information cannot be started.
- When the third tier relocation is performed, the fifth collection of monitoring information cannot be started.

If such conditions exist, two cycles of monitoring information cannot be collected continuously while tier relocation is performed.

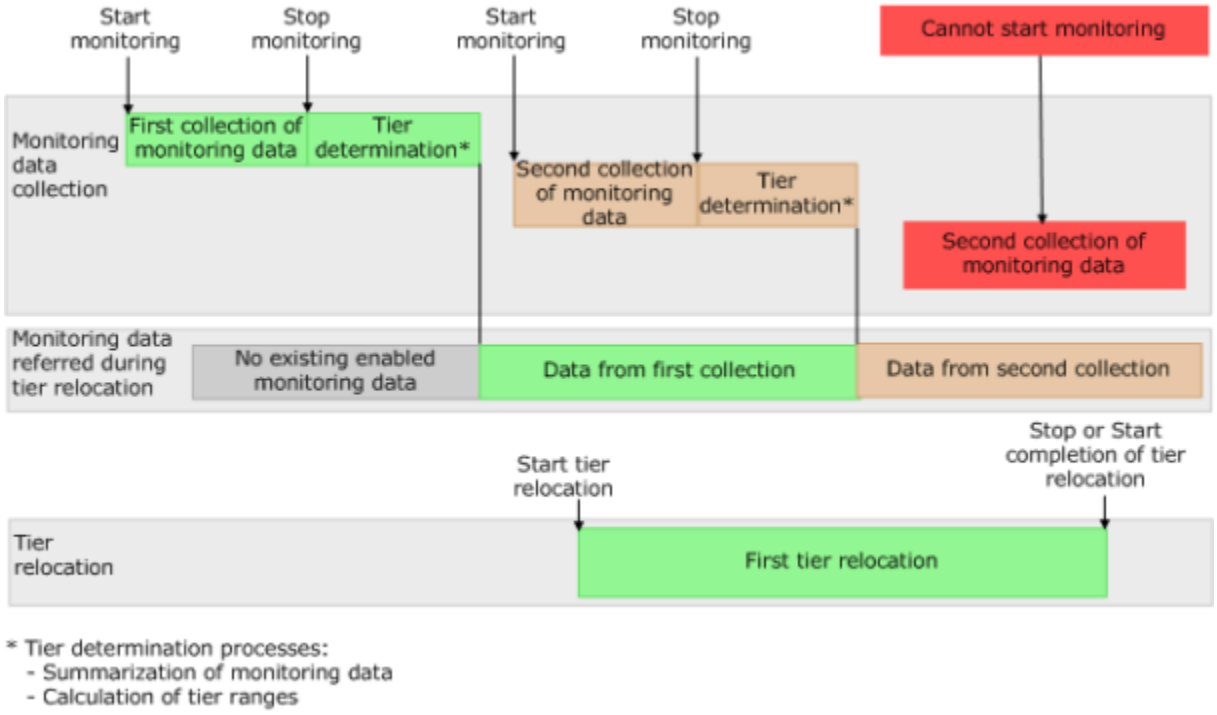
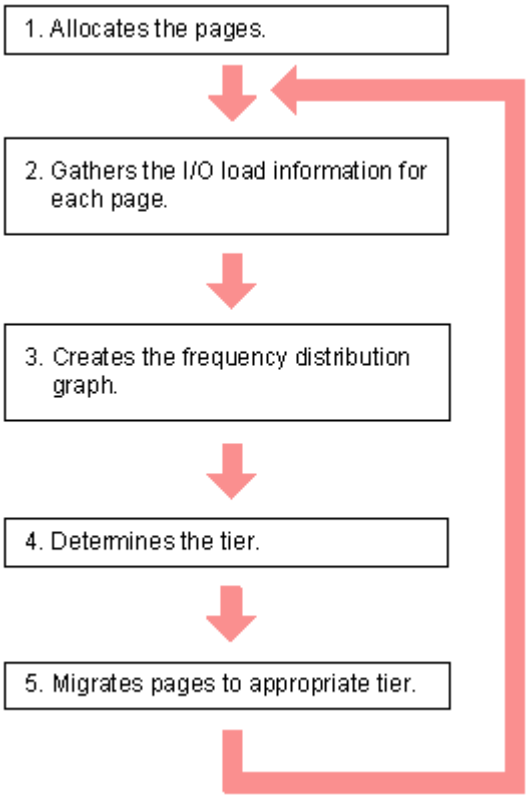


Figure 5-8 Third collection of monitoring information while tier relocation is performed

When Dynamic Tiering is configured for automatic operations, the monitoring feature will be enabled and the time period for monitoring is set for all or part of a 24-hour period. At the end of each monitoring period, the relocation task is performed automatically.

Tier relocation flow

The following shows the flow of allocating new pages and migrating them to the appropriate tier. The combination of determining the appropriate storage tier and migrating the pages to the appropriate tier is referred to as tier relocation.



Explanation of the relocation flow:

1. **Allocate pages and map them to DP-VOLs**
   Pages are allocated and mapped to DP-VOLs on an on-demand basis. Page allocation occurs when a write is performed to an area of any DP-VOL that does not already have a page mapped to that location. Normally, a free page is selected for allocation from an upper tier with a free page. If the capacity of the upper tier is insufficient for the allocation, the pages are allocated to the nearest lower tier. A DP-VOL set to a tier policy is assigned a new page that is based on the tier policy setting. The relative tier for new page allocations can be specified during operations to create and edit LDEVs. If the capacity of all the tiers is insufficient, an error message is sent to the host.
2. **Gather I/O load information of each page**
   Performance monitoring gathers monitoring information of each page in a pool to determine the physical I/O load per page in a pool. I/Os associated with page relocation, however, are not counted.
3. **Create frequency distribution graph**
   The frequency distribution graph, which shows the relationship between I/O counts (I/O load) and capacity (total number of pages), is created. You can use the **View Tier Properties** window in Storage Navigator to view this graph. The vertical scale of the graph indicates ranges of I/Os per hour and the horizontal scale indicates a capacity that received the I/O level. Note that the horizontal scale is accumulative.

Caution: When the number of I/Os is counted, the number of I/Os satisfied by cache hits are not counted. Therefore, the number of I/Os counted by Performance Monitoring is different from the number of I/Os from the host. The number of I/Os per hour is shown in the graph. If the monitoring time is less than an hour, the number of I/Os shown in the graph might be higher than the actual number of I/Os.

The following is an example of a frequency distribution graph.

Monitoring mode settings (see Monitoring modes on page 5-39) of Period or Continuous influences the values shown on the performance graph. Period mode will report the most recent completed monitor cycle I/O data on the performance graph. Continuous mode will report a weighted average of I/O data that uses recent monitor cycle data, along with historical data on the performance graph.

4. **Determine the tier range values**

   The page is allocated to the appropriate tier according to performance monitoring information. The tier is determined as follows.

   a. Determine the tier boundary

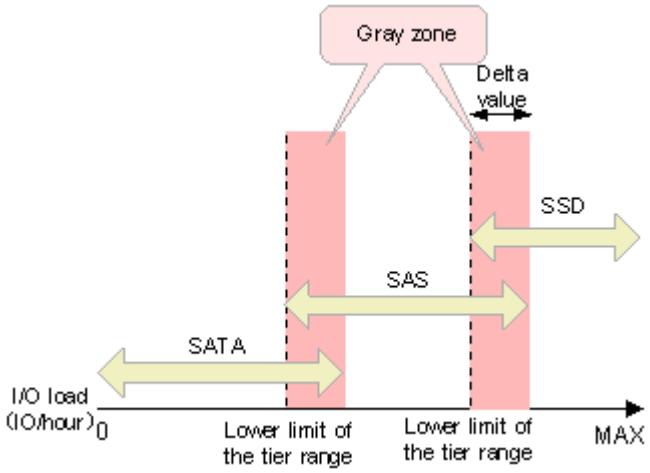
      The tier range value of a tier is calculated using the frequency distribution graph. This acts as a boundary value that separates tiers

      The pages of higher I/O load are allocated to the upper tier in sequence. Tier range is defined as the lowest I/Os per hour (IOPH) value at which the total number of stored pages matches the capacity of the target tier (less some buffer percentage) or the IOPH value that will reach the maximum I/O load that the tier should process. The maximum I/O load that should be targeted to a tier is the limit performance value, and the rate of I/O to the limit performance value of a tier is called the performance utilization percent. If the performance utilization percent shows 100%, this indicates that the target I/O load to a tier is beyond the forecasted limit performance value.

   Caution: The limit performance value is proportional to the capacity of the pool volumes used in the tier. The total capacity of the parity group should be used for a pool to further improve the limit performance.

   b. Determine the tier delta values

      The tier range values are set as the lower limit boundary of each tier. The delta values are set above and below the tier boundaries (+10 to 20%) to prevent pages from being migrated unnecessarily. If all pages subject to tier relocation can be contained in the upper tier, both the tier range value (lower limit) and the delta value will be zero.



c. Determine the target tier of a page for relocation.
   The IOPH recorded for the page is compared against the tier range value to determine the tier to which the page moves.

5. **Migrate the pages**
   The pages move to the appropriate tier. After migration, the page usage rates are averaged out in all tiers. I/Os which occur in the page migration are not monitored.

Tier relocation rules, restrictions, and guidelines

Rules

- Performance monitoring, using both Auto and Manual execution modes, observes the pages that were allocated to DP-VOLs prior to the start of the monitoring cycle and the new pages allocated during the monitoring cycle. Pages that are not allocated during performance monitoring are not candidates for tier relocation.
- Tier relocation can be performed concurrently on up to eight pools. If more than eight pools are specified, relocation of the ninth pool starts after relocation of any of the first eight pools has completed.
- If Auto execution mode is specified, performance monitoring may stop about one minute before to one minute after the beginning of the next monitor cycle start time.
- The amount of relocation varies per cycle. In some cases, the cycle may end before all relocation can be handled. If tier relocation doesn't finish completely within the cycle, relocation to appropriate pages is executed in the next cycle.
- Calculating the tier range values will be influenced by the capacity allocated to DP-VOLs with relocation disabled and the buffer reserve percentages.
- While a pool-VOL is being deleted, tier relocation is not performed. After the pool-VOL deletion is completed, tier relocation starts.

- Frequency distribution is unavailable when there is no data provided by performance monitoring.
- While the frequency distribution graph is being created or the tier range values are being calculated, the frequency distribution graph is not available. The time required for determining the tier range values varies depending on the number of DP-VOLs and total capacity. The maximum time is about 20 minutes.
- To balance the usage levels of all pool-VOLs, rebalancing may be performed after several tier relocation operations. If rebalancing is in progress, the next cycle of tier relocation might be delayed.

  For details on rebalancing, see Rebalancing the usage level among pool-VOLs on page 5-57.

  The status of data collection, fixed monitoring, and tier relocation operations are described in the following table. The latest fixed monitoring information is referenced when tiers are relocated.

Monitoring information or execution conditions	Status of data collection in progress	Status of fixed monitoring information used in tier relocation	Tier relocation operations	Solutions
Unallocated pages.	Pages are not monitored.	No monitoring information on pages.	Tiers of the pages are not relocated.	Unnecessary. After the pages are allocated, monitoring and relocation are performed automatically.
Zero data is discarded during data monitoring.	Monitoring on pages is reset.	Only monitoring information on pages is invalid.	Tiers of the pages are not relocated.	Unnecessary. After the pages are allocated, monitoring and relocation are performed automatically.
V-VOL settings do not allow tier relocation.	Volume is monitored.	Monitoring information on the volume is valid.	Tiers of the pages are not relocated.	N/A
When V-VOLs are deleted	Volume is not monitored.	Only monitoring information on the volume is invalid.	Tier relocation of the volume is suspended.	N/A
When execution mode is changed to **Manual** from **Auto** or vice versa.	Suspended.	Monitoring information collected before suspension is valid.	Suspended.[1]	Collect the monitoring information again if necessary.[2]

Monitoring information or execution conditions	Status of data collection in progress	Status of fixed monitoring information used in tier relocation	Tier relocation operations	Solutions
When the power switch is power ON or OFF.	Monitoring is suspended by powering OFF and is not resumed even after powering ON.[2]	Monitoring information collected during the previous cycle is continuously valid.	Tier relocation is suspended by powering OFF and is resumed after powering ON.	Collect the monitoring information again if necessary.[2]
• When Volume Migration is performed. • When Quick Restore of ShadowImage is performed.	The volume is not monitored.[3]	Monitoring information is invalid and the volumes need to be monitored.	Tiers of the pages are not relocated.	Collect the monitoring information again if necessary.[2]
S-VOLs used when initial copies of TrueCopy or Universal Replicator are performed.	Monitoring information is continuously collected continuously, but the monitoring of the volumes is reset.[4]	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Continued.	Collect the monitoring information again if necessary.[2]
• When the number of tiers increases by adding pool-VOLs.[4] • When the pool-VOLs of the tiers are switched by adding pool-VOLs.[5] • When pool-VOLs are deleted.	Continued.	Fixed monitoring information is invalid and is discarded.[6]	Suspended.	Relocate tiers again.[2]

Monitoring information or execution conditions	Status of data collection in progress	Status of fixed monitoring information used in tier relocation	Tier relocation operations	Solutions
• When tier rank of the external LDEV is changed.				
When a cache is blocked.	Continued.	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Suspended.	After recovering the faulty area, relocate tiers again.[2]
When an LDEV is blocked. (Pool-VOL or V-VOL)	Continued.	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Suspended.	After recovering the faulty area, relocate tiers again.[2]
When the depletion threshold of the pool is nearly exceeded during relocation.	Continued.	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Suspended.	Add pool-VOLs, then collect monitoring information and relocate tiers again.[2]
When execution mode is **Auto** and the execution cycle ends during tier relocation.	At the end time of execution cycle, data monitoring stops.	The monitoring information collected before monitoring performance stops is valid.	Suspended.	Unnecessary. The relocation is performed automatically in the next cycle.
When execution mode is **Manual** and and 7 days elapse after monitoring starts.	Suspended.	The monitoring information collected before suspension is valid.	Continued.	Collect the monitoring information again if necessary.[2]
Notes:				

Monitoring information or execution conditions	Status of data collection in progress	Status of fixed monitoring information used in tier relocation	Tier relocation operations	Solutions
1. If the version of the DKCMAIN program is earlier than 70-06-0X-XX/XX, tier relocation continues. 2. The execution mode is Auto or the script is written in manual execution mode, information is monitored again and tiers are relocated automatically. 3. The volume is monitored at the time of the next execution cycle. 4. All pages of the S-VOLs are not allocated, and the monitoring information of the volume is reset. After the page is allocated to the new page, the monitoring information is collected. 5. Example: Pool-VOLs of SAS15K are added to the following configuration 1 ∘ Configuration 1 (before change): Tier 1 is SSD, Tier 2 is SAS10K, and Tier 3 is SATA. ∘ Configuration 2 (after change): Tier 1 is SSD, Tier 2 is SAS15K, and Tier 3 is SAS10K and SATA. 6. The monitor information statuses are valid (VAL), invalid (INV), and calculating (PND). See Execution modes when using Command Control Interface on page 5-38. In this case, the monitor information is invalid (INV). If monitoring is in continue mode, the information of the mode is discarded.				

Buffer area of a tier

Dynamic Tiering uses buffer percentages to reserve pages for new page assignments and allow the tier relocation process. Areas necessary for processing these operations are distributed corresponding to settings used by Dynamic Tiering. The following describes how processing takes place to handle the buffer percentages.

Buffer space: The following table shows the default rates (rate to capacity of a tier) of buffer space used for tier relocation and new page assignments, listed by drive type. The default values can be changed, if needed, using Storage Navigator or CCI.

Drive type	buffer area for tier relocation	buffer area for new page assignment	Total
SSD	2%	0%	2%
Non-SSD	2%	8%	10%

Setting external volumes for each tier

If you use external volumes as pool-VOLs, you can put the external volumes in tiers by setting the **External LDEV Tier Rank** for the external volumes. The **External LDEV Tier Rank** consists of the following three types: **High**, **Middle**, and **Low**. The following examples describe how tiers may be configured:

Example 1: When configuring tiers by using external volumes only

Tier 1: External volumes (**High**)

Tier 2: External volumes (**Middle**)

Tier 3: External volumes (**Low**)

Example 2: When configuring tiers by combining internal volumes and external volumes

Tier 1: Internal volumes (SSD)

Tier 2: External volumes (**High**)

Tier 3: External volumes (**Low**)

You can set the **External LDEV Tier Rank** when creating the pool, changing the pool capacity, or setting the **Edit External LDEV Tier Rank** window. The following table explains the performance priority (from the top) of hard disk drives.

Priority	Hard disk drive type
1	SSD
2	SAS 15K rpm
3	SAS 10K rpm
4	SAS 7.2K rpm
5	SATA
6	External volume* (**High**)
7	External volume* (**Middle**)
8	External volume* (**Low**)
*Displays as **External Storage** in the **Drive Type/RPM**.	

Reserved pages for relocation operation: A small percentage of pages, normally 2, are reserved per tier to allow relocation to operate. These are the buffer spaces for tier relocation.

New page assignment: New pages are assigned based on a number of optional settings. Pages are then assigned to the next lower tier, leaving a buffer area (2% per tier by default) for tier relocation. Once 98% of capacity of all tiers is assigned, the remaining 2% of the buffer space is assigned from the upper tier. The buffer space for tier relocation is 2% in all tiers. The following illustrates the workflow of new page assignment.

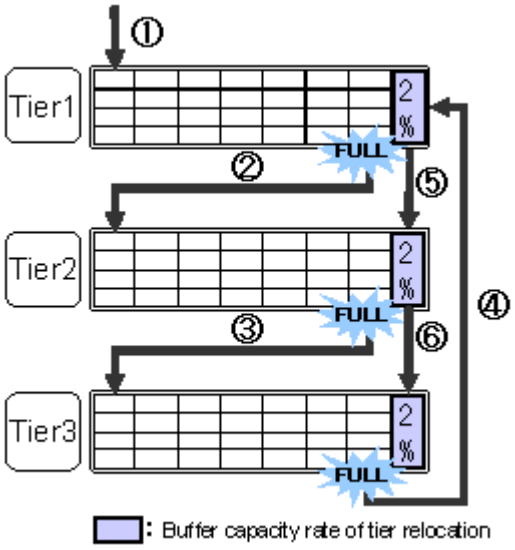


Figure 5-9 Workflow of a new page assignment

Tier relocation workflow: Tier relocation is performed taking advantage of the buffer space allocated for tier relocation, as mentioned above. Tier relocation is also performed to secure the space reserved in each tier for new page assignment. The area is called the buffer space for new page assignments. When tier relocation is performed, Dynamic Tiering reserves buffer spaces for relocation and new page assignment.

During relocation, a tier may temporarily be assigned over 98% of capacity as well, or well under the allowance for the buffer areas.

Further influence on tier relocation and tier occupancy: The buffer area for tier relocation and new page assignment will influence the amount that a tier's capacity is used.

If the relocation cycle's duration is not long enough for the allocation moves to all complete, then the amount of tier capacity used may not fully represent the desired target levels. Subsequent relocations should eventually reach the target levels.

Dynamic Tiering cache specifications and requirements

The following cache capacity is required when the total capacity is 128 TB:

- Recommended capacity of cache memory for data: 28 GB
- Required capacity of cache memory for control information for using Dynamic Provisioning: 8 GB
- Required capacity of cache memory for Dynamic Tiering: 4 GB
- Therefore, in this example 40 GB of capacity of cache memory is required.

Note that cache memory is installed in pairs. Therefore, actual capacity is twice the cache memory capacity. For example, if required controlling information is 8 GB, then actual installed capacity is 16 GB.

To decrease the capacity of the cache memory for Dynamic Tiering, you have to remove Dynamic Tiering.

Execution modes for tier relocation

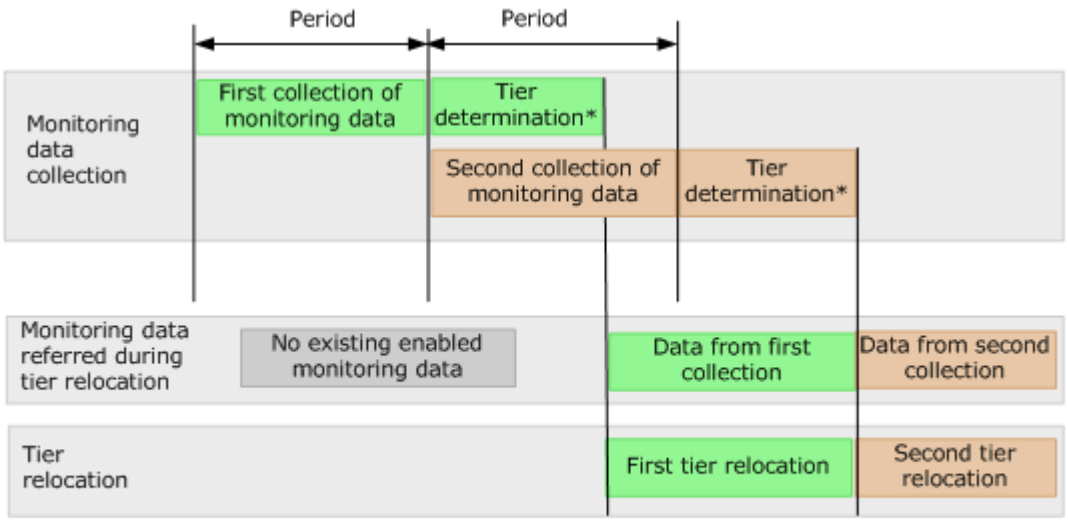
Execution modes when using Hitachi Storage Navigator

Dynamic Tiering performs tier relocations using one of two execution modes: Auto and Manual. You can switch between modes by using Hitachi Storage Navigator.

Auto execution mode

In Auto execution mode, the system automatically and periodically collects monitoring data and performs tier relocation. You can select an Auto execution cycle of 0.5, 1, 2, 4, or 8 hours, or a specified time. You can specify the settings for the auto execution mode with Hitachi Storage Navigator.

The following illustrates tier relocation processing in a 2-hour Auto execution mode:



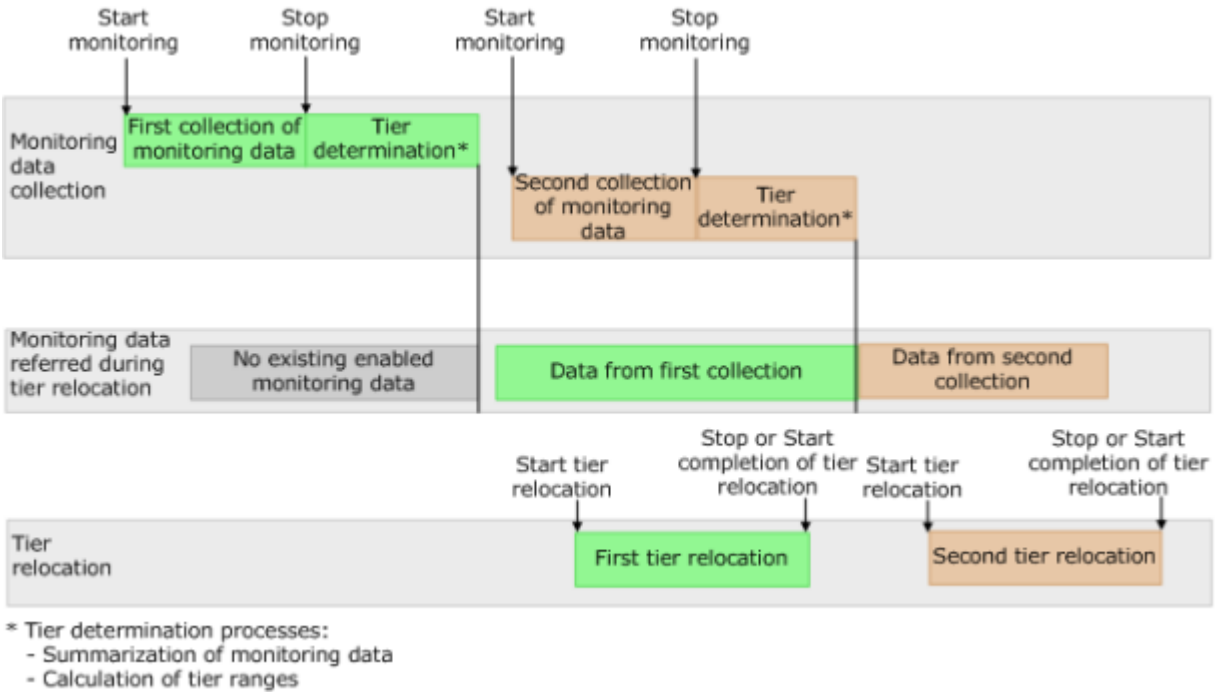
* Tier determination processes:
- Summarization of monitoring data
- Calculation of tier ranges

Manual execution mode

In Manual execution mode, you can manually collect monitoring data and relocate a tier. You can issue commands to manually:

1. Start monitoring.
2. Stop monitoring.
3. Perform tier relocation.

The following illustrates tier relocation processing in Manual execution mode:



Notes on performing monitoring

- You can collect the monitoring data even while performing the relocation.
- After stopping the monitoring, the tier range is automatically calculated.
- The latest available monitoring information, which is collected just before the relocation is performed, is used for the relocation processing.
- When the relocation is performed, the status of the monitor information must be valid.

Viewing monitor and tier relocation information:

Information is displayed on the following items in the GUI windows:

- **Monitoring Status** on Pools window after selecting pool (Pools window) on page E-3, Top window when selecting a pool under Pools on page E-10, and View Pool Management Status window on page E-72.
  Displays the status of pool monitoring.
  - In Progress: The monitoring is being performed.
  - During Computation: The calculating is being processed.

  Other than these cases, a hyphen (-) is displayed.
- **Recent Monitor Data** on Pools window after selecting pool (Pools window) on page E-3 and Top window when selecting a pool under Pools on page E-10
  Displays the latest monitoring data.
  - If the monitoring data exists, the monitoring period of time is displayed.

Example: 2010/11/15 00:00 - 2010/11/15 23:59

- If the monitoring data is being obtained, only the starting time is displayed.

  Example: 2010/11/15 00:00 -
- If the latest monitoring data does not exist, a hyphen (-) is displayed.

- **Pool Management Task** on Pools window after selecting pool (Pools window) on page E-3 and Top window when selecting a pool under Pools on page E-10

  Displays the pool management task being performed to the pool.

  - **Waiting for Relocation**: The tier relocation process is being waited.
  - **Relocating**: The tier relocation process is being performed.

  For details about the relocation progress rate, check the tier relocation log. For more information about the table item for the tier relocation log file, see Tier relocation log file contents on page 5-42.
- **Pool Management Task (Status/Progress)** on View Pool Management Status window on page E-72.

  Displays the status of the pool management task being performed, each V-VOL progress ratio in the pool and its average.

  - **Waiting for Relocation**: The tier relocation process is being waited.
  - **Relocating**: The tier relocation process is being performed.

  For details about the relocation progress rate, check the tier relocation log. For more information about the table item for the tier relocation log file, see Tier relocation log file contents on page 5-42.
- **Relocation Result** on Pools window after selecting pool (Pools window) on page E-3, Top window when selecting a pool under Pools on page E-10, and View Pool Management Status window on page E-72.

  Displays the status of the tier relocation processing.

  - In Progress: The status of **Pool Management Task** is **Waiting for Relocation** or **Relocating**.
  - Completed: The tier relocation operation is not in progress, or the tier relocation is complete.
  - Uncompleted (n% relocated): The tier relocation is suspended at the indicated percentage progression.
  - -: The pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.
- **Relocation Priority** on Top window when selecting a pool under Pools on page E-10 and View Pool Management Status window on page E-72.

  Displays the relocation priority.

  - **Prioritized**: The priority is set to V-VOL.
  - Blank: The priority is not set to V-VOL.
  - -: V-VOL is not the Dynamic Tiering V-VOL or the tier relocation function is disabled.
- **Performance Graph** on View Tier Properties window on page E-59.

The performance graph for the available monitor information is displayed in the **View Tier Properties** window.

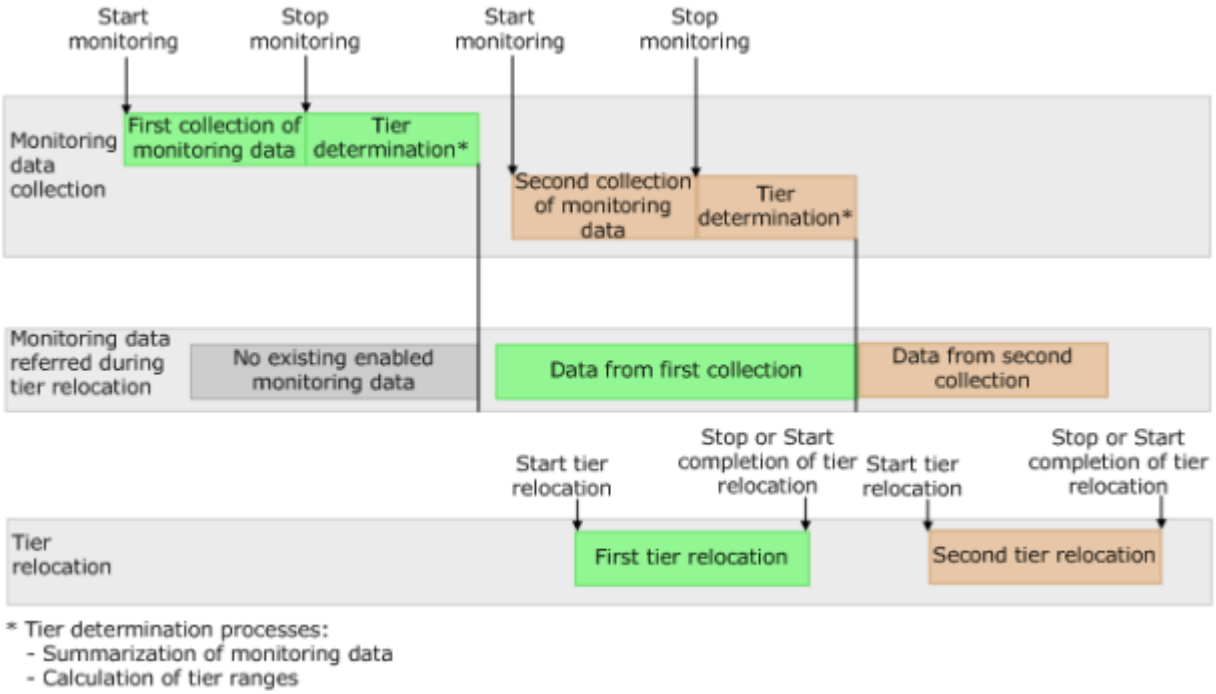
Execution modes when using Command Control Interface

Manual execution mode

In Manual execution mode, you can manually collect monitoring data and relocate a tier. You can execute commands to do the following:

1. Start monitoring.
2. Stop monitoring.
3. Perform tier relocation.

The following illustrates tier relocation processing when in Manual execution mode:



* Tier determination processes:
- Summarization of monitoring data
- Calculation of tier ranges

Notes on performing monitoring

- You can collect the monitoring data even while performing the relocation.
- After stopping the monitoring, the tier range is automatically calculated.
- The latest available monitoring information, which is collected just before the relocation is performed, is used for the relocation processing.
- When the relocation is performed, the status of the monitor information must be valid.

Viewing monitor and tier relocation information:

If the **raidcom get dp_pool** command is executed with the **-key opt** option specified, the monitoring information and tier relocation information are displayed. For details about the **raidcom get dp_pool** command, see *Command Control Interface Command Reference*. Items are displayed as follows:

- STS

  This item displays the operational status of the performance monitor and the tier relocation.

  - STP: The performance monitor and the tier relocation are stopped.
  - RLC: The performance monitor is stopped. The tier relocation is operating.
  - MON: The performance monitor is operating. The tier relocation is stopped.
  - RLM: The performance monitor and the tier relocation are operating.
- DAT

  This item displays the status of the monitor information.

  - VAL: Valid.
  - INV: Invalid.
  - PND: Being calculated.
- R(%)

  This item displays the progress percentage of tier relocation.

  0 to 99: Shows one of the following statuses.

  - When the value of STS is RLC or RLM: Relocation is in progress.
  - When the value of STS is STP or MON: Relocation is suspended at the indicated percentage progression.

  100: Shows if the relocation operation is not in progress, or the relocation is complete.

Monitoring modes

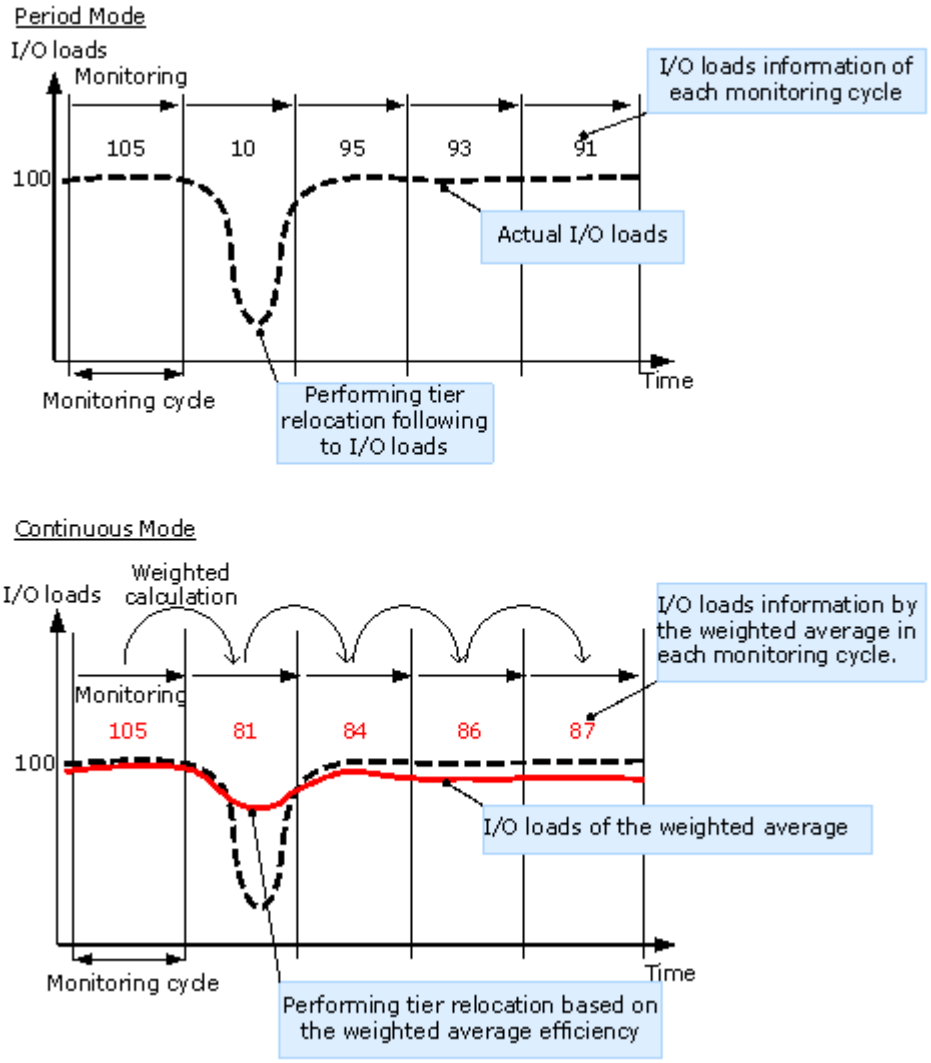
When you create or edit a pool, specify the Dynamic Tiering monitoring mode. The monitoring mode is either the period mode or the continuous mode. If you change the mode from the one to the other while performing the monitoring, the changed setting becomes effective when the next monitoring will starts.

Period mode

Period mode is the default setting. If Period mode is enabled, tier range values and page relocations are determined based solely on the monitoring data from the last complete cycle. Relocation is performed according to any changes in I/O loads. However, if the I/O loads vary greatly, relocation may not finish in one cycle.

Continuous mode

If Continuous Mode is enabled, by weighting the latest monitoring information and the collected monitoring information in the past cycles, the weighted average efficiency is calculated. By performing the tier relocation based on the weighted average efficiency, even if a temporary decrease or an increase of the I/O load occurs, unnecessary relocation can be avoided.



Cautions when using monitoring modes

- If Continuous mode is used, best practice is to collect monitoring information using the following execution modes:
  - Auto execution mode
  - Manual execution mode with collecting the periodic monitoring information by defining a script using CCI

If the Manual execution mode is used without scripts, the Continuous monitoring mode can be set. However, in this case, unexpected results may be calculated because the weighted average efficiency is calculated based on very different duration (short and long) periods information obtained in the past cycles.

- When the monitoring mode is set to Continuous, the Storage Navigator window and in CCI display the frequency distributions of each pool and V-VOL calculated by using the monitor value on which the weighted calculation is done.

  These calculated values are the predictive values for the next cycle after successfully relocating all pages. Therefore, these values may differ from an actual monitoring result when they appear.

  In **Performance Utilization** of each tier, regardless of the type of the monitoring mode setting, the Storage Navigator window and CCI display the monitor values which were already collected in the current cycle.

  If you switch the monitoring mode from Period to Continuous or from Continuous to Period, the current cycle's monitoring data that is being collected is not discarded. However, the data calculated by using past monitor cycle information on which the weighted calculation is done will be reset.

Notes on performing monitoring

- You can collect a new cycle of monitoring data while performing relocation.
- After monitoring stops, the tier range is automatically calculated.
- The latest available monitoring information, collected just before the relocation is performed, is used for relocation processing.
- When relocation is performed, the status of the monitor information must be valid (VAL).

Downloading the tier relocation log file

You can download the log file that contains the results of past tier relocations. See Tier relocation log file contents on page 5-42 for information about the contents of the log.

1. Using Storage Navigator, in the **Storage Systems** tree select **Pool**.
2. In the **Pool** window, click **More Actions > Tier Relocation Log**.
3. In the progress dialog box, click **OK**.
4. A dialog box opens allowing you to select where to download the file. Specify the folder in which to download the file, and then click **Save**.

   If you change the file name from the default, make sure the file name contains the .tsv extension before saving a renamed file.

Tier relocation log file contents

The tier relocation log file is a tab-delimited file and contains the following information:

Item	Description
Pool ID	Displays the pool ID.
Start Relocation Time	Displays the time and date when the performing the relocation function starts.
End Relocation Time	Displays the time and date when the performing the relocation function ends.
Result	Displays the section where the relocation result is shown.
Status	Displays the execution results that are **Normal** or **Cancel**.
Detail	Displays the following causes of cancellation. A hyphen (-) is displayed when the execution status is **Normal**. • It was interrupted by annulling the monitor data. Monitoring information with a status of valid or calculating is discarded under certain conditions. • It was interrupted by not completing within the cycle of relocation. • The tier relocation was interrupted because the threshold reached the vicinity of the upper limit. The information appears when the pool usage level reaches the depletion threshold of the pool. • It was interrupted by a user instruction.
Move Page Num	Displays the number of pages that are moved between tiers.
Tier1->Tier2	Displays the number of pages that are moved from tier1 to tier2.
Tier1->Tier3	Displays the number of pages that are moved from tier1 to tier3.
Tier2->Tier1	Displays the number of pages that are moved from tier2 to tier1.
Tier2->Tier3	Displays the number of pages that are moved from tier2 to tier3.
Tier3->Tier1	Displays the number of pages that are moved from tier3 to tier1.
Tier3->Tier2	Displays the number of pages that are moved from tier3 to tier2.

Tiering policy

The tiering policy function is used to assign a specific storage tier to a specific DP-VOL. A tiering policy specifies subset of tiers that is available to a given set of DP-VOLs.

Tier relocation changes the location of previously stored data. It is performed in conformance to the tiering policy. If a DP-VOL is initially allocated to a low-speed tier and the tiering policy is changed to a high-speed tier, relocation is performed in the next cycle.

For example, if you set the tiering policy level on a V-VOL(DP-VOL) to a tier with a high I/O speed, the data is always stored on the high-speed tier when relocating tiers. When you use that V-VOL(DP-VOL), regardless of the actual size of the I/O load, you can always get high-speed responses. See Tiering policy expansion on page 5-43.

When you create the DP-VOL, you can designate one of six existing tiering policies and define up to 26 new tiering policies. See Tiering policy expansion on page 5-43 and Setting tiering policy on a DP-VOL on page 5-45.

Use the **Edit LDEVs** window to change the tiering policy settings. When tier relocation occurs, the related tiering policy set for the DP-VOL is used to relocate data to the desired tier or tiers.

The tiering policy does not own pool capacity. Rather, pool capacity is shared among tiers. Pages are allocated in order of priority from upper to lower tiers in a tiering policy. When you specify a new allocation tier, pages are allocated starting from the tier that you specify.

The tier range, frequency distribution, and used capacity are displayed per tiering policy: existing tier level All(0), Level1(1) through Level5(5) and Level6(6) to Level31(31).

Tiering policy expansion

In the current release, the tiering policy concept has been expanded to provide new options:

- Custom policies. You can define up to 26 new policies (Level6(6) - Level31(31)) in addition to the existing six (All(0), Level1(1), Level2(2), Level3(3), Level4(4), and Level5(5)). See Setting tiering policy on a DP-VOL on page 5-45.

  A custom policy can be set for a DP-VOL when it is created and changed, if necessary, after creation.

Note: Custom policies cannot be renamed.

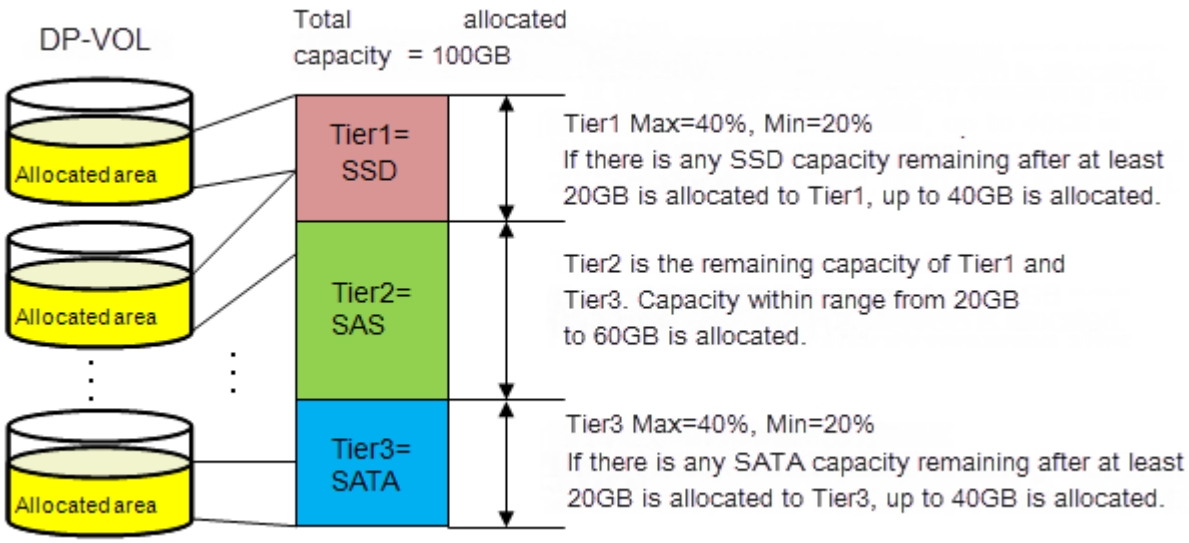
- Dynamic Tiering performs relocation while calculating page allocation based on the tiering policy setting of all DP-VOLs that have the same tiering policy in each pool.
- Max(%) and Min(%) parameters. When a tiering policy is created, 4 types of parameters can be set: Tier1 Max and Tier 1 Min, Tier 3 Max and Tier 3 Min. Each parameter setting is a ratio that corresponds to the total capacity of the allocated area of DP-VOLs that have the same tiering policy set for a pool. See Tiering policy examples on page 5-44.

Tier1 and Tier3 parameter settings can also limit the capacity for all volumes in a configuration that contain multiple DP-VOLs that have the same intended use. These settings can prevent conditions such as the following from occurring.

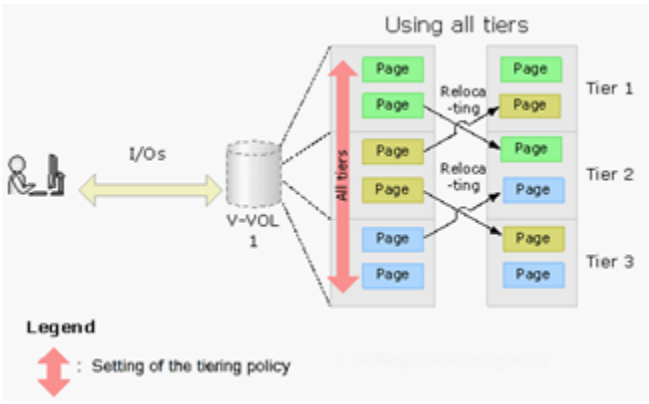
- Excess allocation of SSD capacity for unimportant applications.
- Degradation in average response time for high performance operations.

Tiering policy examples

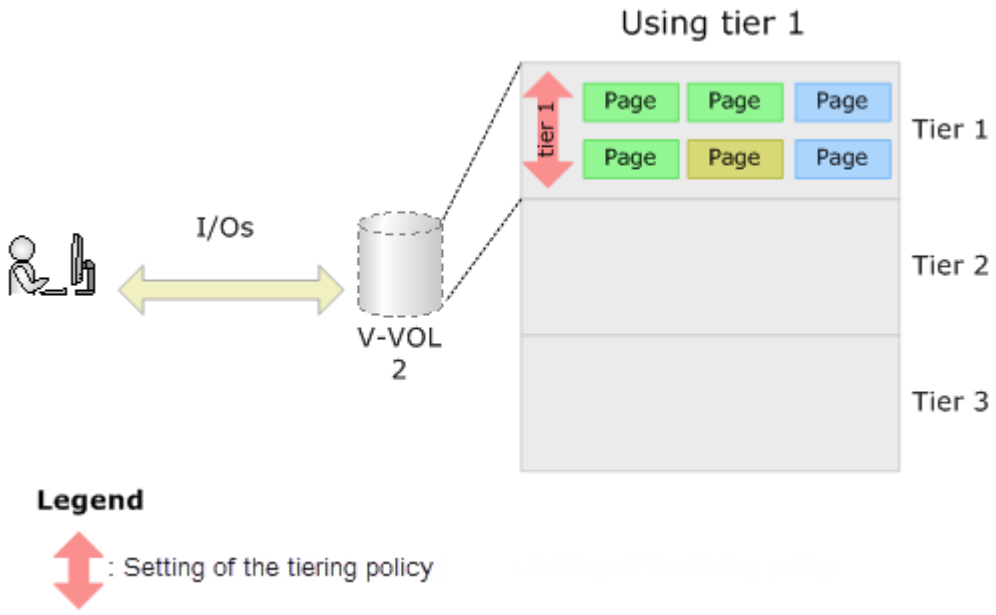
The following figure shows the parameter settings Tier1 Max=40%, Tier1 Min=20%, Tier3 Max=40%, and Tier3 Min=20% for a DP-VOL with a Level6(6) setting when the initial allocated capacity of is 100GB.



The following figure shows an example of data allocation when the default tiering policy level All(0) is specified. Pages in the DP-VOL are relocated to any tier.



The following figure shows an example of data allocation when setting the tiering policy to Level1(1) (see Level1(1) in Tiering policy levels on page 5-46). In this case, pages in the DP-VOL are relocated to tier 1, and are not relocated to other tiers.



Setting tiering policy on a DP-VOL

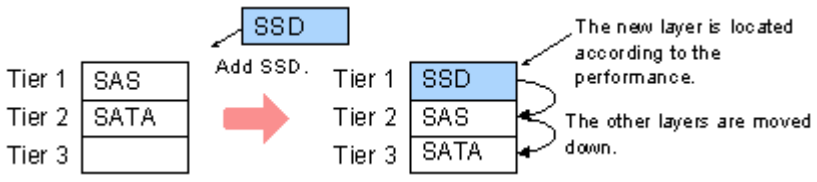
The setting of a tiering policy for a DP-VOL is optional. If one is not selected, the default is the All(0) tiering policy level. The available levels are listed in Tiering policy levels on page 5-46). DP-VOLs of different tiering policies can coexist in one pool. If you specify the level of the tiering policy, DP-VOLs with the policy are grouped together.

- All(0) is the default policy. In this case, data is stored to all of the tiers.
- When a tier is added to the pool after setting the tiering policy on a DP-VOL, the DP-VOL is relocated according to the new tier lineup.

  For example, if you set the tiering policy to level 5, the data is always allocated to the tier of the low I/O speed. If the pool has two tiers, data is stored in tier 2. If a new tier is added, the number of tiers becomes three and if the new tier is the lowest tier, relocation will be performed to move data into tier 3.

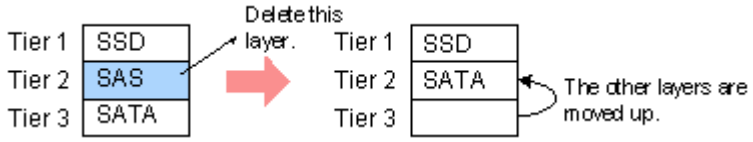
Example of adding a tier

If the added pool-VOLs is a different media type, then a new tier is created in the pool. The tier is added to the appropriate position according to its performance. The following figure illustrates adding a tier.



Example of deleting a tier

If a tier no longer has any pool-VOLs when you delete them, the tier is deleted from the pool. The following figure illustrates deleting a tier.



For more information about tiering policy and groups, see Tiering policy levels on page 5-46.

Tiering policy levels

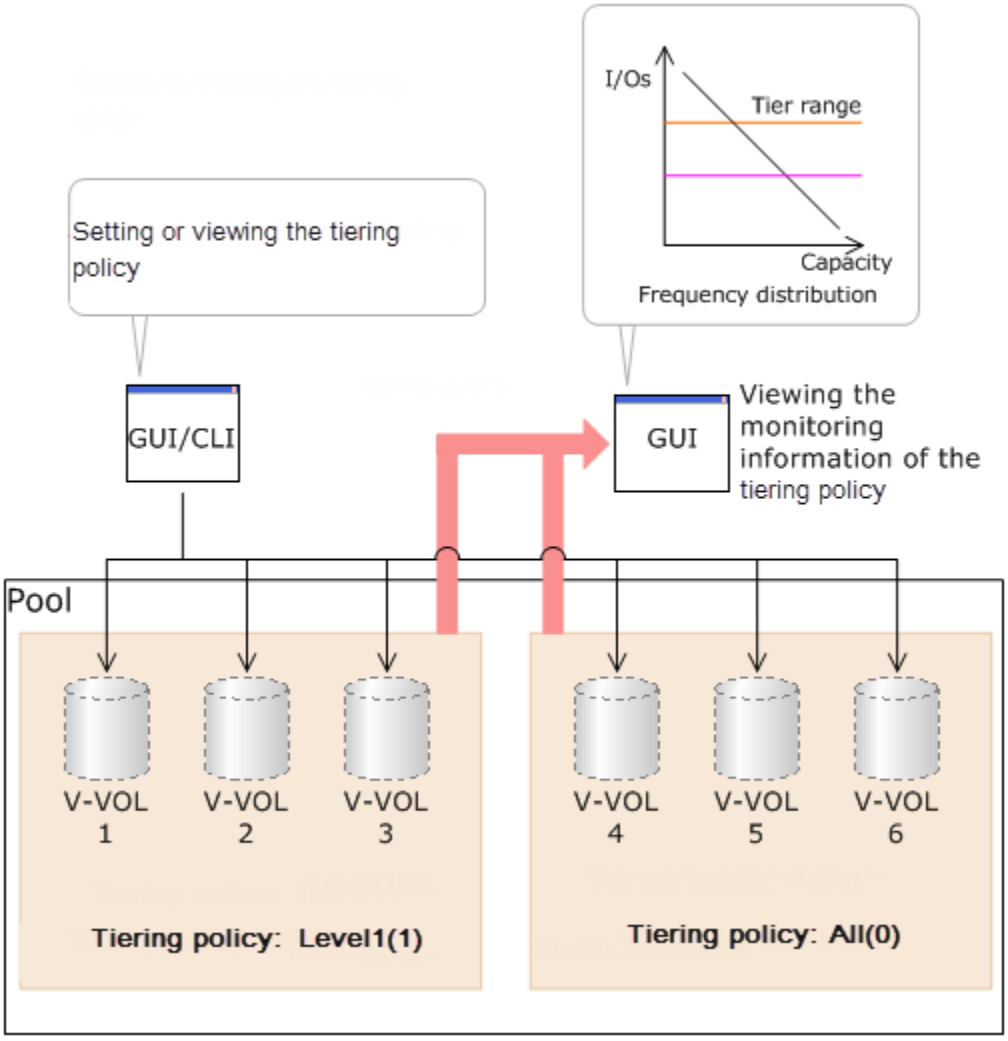
Tiering policy	1 tier pool	2 tier pool	3 tier pool	Note
All(0)	Single Tier	Both tiers	All 3 tiers	Default Tiering Policy
Level1(1)	Same as All(0)	Tier 1	Tier 1	Data is located to the Top Tier. Any overflow moves to the next lower tier.
Level2(2)	Same as All(0)	Same as All(0)	Tier 1 and Tier 2 See note	Data is located to the Top Tier after Level1(1) assignments are processed. Any overflow moves to the next lower tier.
Level3(3)	Same as All(0)	Same as All(0)	Tier 2 See note	Data is located to the Middle Tier. Any overflow moves to the top tier.
Level4(4)	Same as All(0)	Same as All(0)	Tier 2 and Tier 3 See note	Data is located to the Middle Tier after Level3(3) assignments are processed. Any overflow moves to the next lower tier.
Level5(5)	Same as All(0)	Tier 2	Tier 3 See note	Data is located to the bottom tier. Any overflow moves to the next higher tier.
From Level6(6) to Level31(31)	Same as All(0)	Depends on user setting	Depends on user setting	
For example: If additional capacity is added to the pool and the capacity defines a new Tier 1 or new Tier 2, then the DP VOLs with a Level 5(5) assignment will not physically move but Level 5(5) will be associated with Tier 3. If additional capacity is added to the pool and the capacity defines a new Tier 3, the DP VOLs with a Level 5(5) assignment will physically move to the new Tier 3 and Level 5(5) will be associated with Tier 3.				

Viewing the tiering policy in the performance graph

You can view the frequency distribution graph of the pool by selecting either the level of the tiering policy or the entire pool on the performance graph in the **View Tier Properties** window.

The following table shows how tiering policy is shown in the performance graph. How the graph appears depends on the number of tiers set in a pool and tiering policy level selected when viewing the performance graph.

Tiering policy selected with performance graph	V-VOL displayed in the performance graph
All(0)	In the performance graph, you can display a frequency distribution of a DP-VOL, set to all tiers.
Level 1(1)	In the performance graph, you can display the frequency distribution of a DP-VOL set to level 1.
Level 2(2)	In the performance graph, you can display the frequency distribution of a DP-VOL set to level 2.
Level 3(3)	In the performance graph, you can display the frequency distribution of a DP-VOL set to level 3.
Level 4(4)	In the performance graph, you can display the frequency distribution of a DP-VOL set to level 4.
Level 5(5)	In the performance graph, you can display the frequency distribution of a DP-VOL set to level 5.
From Level6(6) to Level31(31)	In the performance graph, you can display the frequency distribution of a DP-VOL set to custom policy.

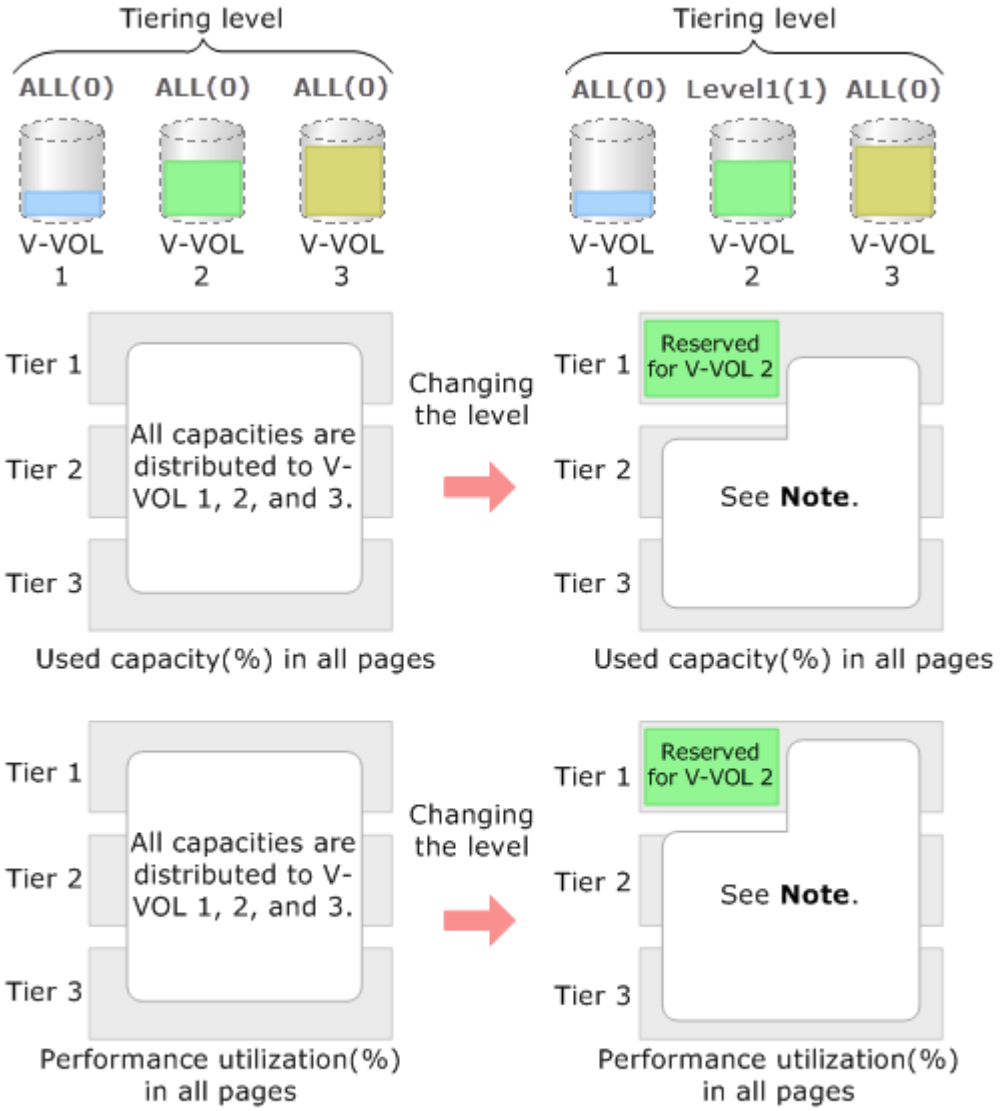


Reserving tier capacity when setting a tiering policy

If you set the tiering policy of a DP-VOL, the DP-VOL used capacity and the I/O performance limitation are reserved from the tier. The reserved limit performance per page is calculated as follows:

The reserved limit performance per page = *(The performance limit of the tier)* ÷ *(The number of pages in the tier)*.

A DP-VOL without a tiering policy setting uses the unreserved area in the pool.

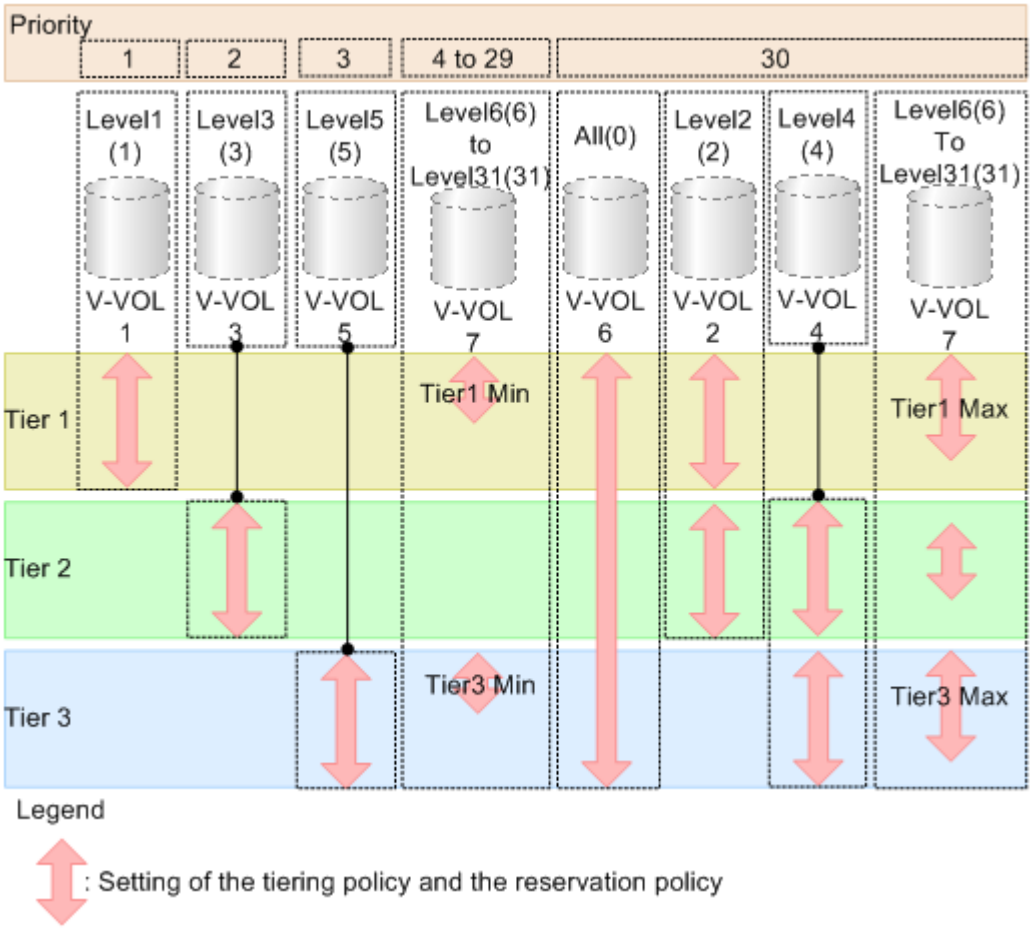


Note: The remaining capacity to which the reserved capacity is deducted is distributed to V-VOL 1 and 3.

Example of reserving tier capacity

The reservation priority depends on the level of tiering policy. The following figure illustrates the reservation priority. Tiers are reserved in order of priority from (1) to (7) in the figure. If the pool-VOL capacity is deficient when you reserve a tier, the nearest tier of your specified tier is allocated. If you specify two tiers like level 2 or level 4 of the tiering policy, first of all the upper tier is reserved. At this time, if the capacity of the pool-VOL assigned to the upper tier is deficient, the lower tier defined by the tiering policy is reserved automatically. For example, in case of level 2 in the diagram below, tier 1 is reserved first. If the capacity of tier 1 is deficient at this point, tier 2 is reserved automatically. For details, see Notes on tiering policy settings on page 5-51.

Tier reservation priority	Tiering policy	Reserved tier
1	Level1(1)	Tier 1
2	Level3(3)	Tier 2
3	Level5(5)	Tier 3
From 4 to 29	From Level6(6) to Level31(31)	The custom policy whose number is small is prioritized. Tier 1: From Level6(6) to Level31(31), each of the Tier1 Min values are reserved. Tier 2: From Level6(6) to Level31(31), each of values that deducted the total value of Tier1 Max and Tier3 Max from 100(%) are reserved. Tier 3: From Level6(6) to Level31(31), each of the Tier3 Min values are reserved.
30	All(0)	All tiers
	Level2(2)	Tier 1 and Tier 2
	Level4(4)	Tier 2 and Tier 3
	From Level6(6) to Level31(31)	Tier 1: From Level6(6) to Level31(31), each of the Tier1 Max values are reserved. Tier 3: From Level6(6) to Level31(31), each of the Tier3 Max values are reserved.



Notes on tiering policy settings

- If Auto is set as the execution mode, tier relocation is performed based on the monitoring cycle. Therefore, when the tiering policy setting is changed, tier relocation will automatically implement the tiering policy at the end of the current monitoring cycle. See Example 1 in Execution mode settings and tiering policy on page 5-58.
- If Manual is set as the execution mode, you must manually perform monitoring, issue a monitor stop, and then start relocation (see Example 2, Case 1, in Execution mode settings and tiering policy on page 5-58). If you change the tiering policy settings while obtaining monitoring data, the monitoring data is used for the next tier relocation (see Example 2, Case 2, in Execution mode settings and tiering policy on page 5-58). Therefore, you do not need to perform new monitoring.
- If a capacity shortage exists in the tier being set, a message may appear in the **View Tier Property** window that the page allocation cannot be completed according to the tiering policy specified for the V-VOL. Should that occur, the page allocation in the entire pool -- including the tier that defines the tiering policy -- might not be optimized.

Note: The message that page allocation cannot be completed according to the tiering policy does not appear when these tiering policies are set:

- All(0)
- In a 2-tier configuration, Level2(2), Level3(3), or Level4(4) which is equivalent to All(0)

When a capacity shortage exists in a tier, you can revise the setting of the tiering policy or the configuration of tiers. If the capacity of one tier is fully exhausted, the migrating pages are assigned to the next tier according to the tiering policy.

  - Level1(1): When tier 1 is full, the remaining pages are allocated to tier 2. If tier 2 is full, the remaining pages are allocated to tier 3.
  - Level3(3): When tier 2 is full, the remaining pages are allocated to tier 1. If tier 1 is full, the remaining pages are allocated to tier 3.
  - Level5(5): When tier 3 is full, the remaining pages are allocated to tier 2. If tier 2 is full, the remaining pages are allocated to tier 1.
  - Level2(2), Level4(4), and from Level6(6) to Level31(31): When the specified tier is full, the unallocated pages are kept in the prior tier.

- If a performance shortage exists in the tier being set, pages may not be allocated in conformance to the tiering policy specified for the V-VOL. In that case, pages are allocated according to the performance ratio of each tier.

  As shown in the following table, allocation capacity considerations are based on the tiering policy.

Tiering Policy	Allocation capacity considerations
All(0), Level2(2), or Level4(4)	Tier range and I/O performance
Level1(1), Level3(3), or Level5(5)	Tier range
From Level6(6) to Level31(31)	First phase: Tier range. Allocation capacities in each tier. • Tier1: The setting value(%) in Tier1 Min. • Tier2: The value deducted Tier1 Max(%) and Tier3 Max(%) from 100(%). • Tier3: The setting value(%) in Tier3 Min.
	Second phase: Tier range and I/O performance. Capacities deducted from the allocated capacities of the first phase from the total used capacity, are allocated to each tier.

New page assignment tier

If you set the new page assignment tier value, when a new page is needed by a DP-VOL, the page is taken from the specified tier aligned with the new page assignment tier value. You can set this function only by using Storage Navigator when creating a DP-VOL. To change the new page assignment tier value for the created DP-VOL, you can use either Storage Navigator or CCI. In addition, this function becomes effective just after setting. The following table lists setting values:

Setting value	Description
High	The new page is assigned from the higher tier of tiers set in the tiering policy.
Middle	The new page is assigned from the middle tier of tiers set in the tiering policy.
Low	The new page is assigned from the lower tier of tiers set in the tiering policy.

The following tables show the tiers to which new pages are preferentially assigned.

Tiering Policy	When specifying High	When specifying Middle	When specifying Low	Note
All	From tier 1 to 2	From tier 1 to 2	From tier 2 to 1	If you set Low, tier 2 is given a priority over tier 1.
Level 1	From tier 1 to 2	From tier 1 to 2	From tier 1 to 2	Assignment sequences when High, Middle, and Low are same.
Level 2	From tier 1 to 2	From tier 1 to 2	From tier 2 to 1	Every assignment sequence is the same as when All is specified as the tiering policy.
Level 3	From tier 1 to 2	From tier 1 to 2	From tier 2 to 1	Every assignment sequence is the same as when All is specified as the tiering policy.
Level 4	From tier 1 to 2	From tier 1 to 2	From tier 2 to 1	Every assignment sequence is the same as when All is specified as the tiering policy.
Level 5	From tier 2 to 1	From tier 2 to 1	From tier 2 to 1	Assignment sequences when High, Middle, and Low are same.

Number	Condition	Order of new page allocation
1	T1 MIN = 100%	Same as Level1(1)
2	T1 MAX = 0%	Same as Level5(5)
3	T1 MAX > 0%	Same as All(0)

Tiering policy	When specifying High	When specifying Middle	When specifying Low	Note
All	From tier 1, 2, to 3.	From tier 2, 3, to 1.	From tier 3, 2, to 1.	Specifying High, Middle or Low to the assignment sequence is effective.
Level 1	From tier 1, 2, to 3.	From tier 1, 2, to 3.	From tier 1, 2, to 3.	Assignment sequences when High, Middle, and Low are same.
Level 2	From tier 1, 2, to 3.	From tier 1, 2, to 3.	From tier 2, 1, to 3.	If you set Low, tier 2 is given a priority over tier 1.
Level 3	From tier 2, 3, to 1	From tier 2, 3, to 1	From the 2, 3, to 1	Assignment sequences when High, Middle, and Low are same.
Level 4	From tier 2, 3, to 1	From tier 2, 3, to 1	From tier 3, 2, to 1	If you set Low, tier 3 is given priority over tier 2.
Level 5	From tier 3, 2, to 1	From tier 3, 2, to 1	From tier 3, 2, to 1	Assignment sequences when High, Middle, and Low are same.

Number	Condition	Order of new page allocation
1	T1 MIN = 100%	Same as Level1(1)
2	T3 MIN = 100%	Same as Level5(5)
3	T1 MAX > 0% and T3 MAX = 0%	Same as Level2(2)
4	T1 MAX = 0% and T3 MAX = 0%	Same as Level3(3)
5	T1 MAX = 0% and T3 MAX > 0%	Same as Level4(4)
6	T1 MAX > 0% and T3 MAX > 0%	Same as All(0)

Relocation priority

If you use the relocation priority function, you can set the selection priority of a DP-VOL when performing relocation. With this setting, a prioritized DP-VOL can be relocated earlier during a relocation cycle. You can set this function by using Storage Navigator. The function is activated after the monitoring data is collected.

- If no relocation priority is set for all DP-VOLs, the general order of DP-VOL selection is to select the next DP-VOL in LDEV number order after the last DP-VOL that fully performed relocation. This selection order persists across relocation cycles.
- If one or more DP-VOLs is assigned a relocation priority, the prioritized DP-VOLs are operated upon in the early portion of the relocation cycle, before others in the general order of DP-VOL selection.
- If V-VOL is not given priority for relocation:

  For example, if LDEVs of LDEV IDs with LDEV#1, LDEV#2, LDEV#3, LDEV#4, and LDEV#5 are not given priority for relocation, LDEVs are relocated with the following sequences. In this example, three LDEVs are relocated in each period, but the number of LDEVs to relocate may change by the relocation cycle or the data size.

Relocating cycle	Relocating sequence of LDEV#1 in each cycle	Relocating sequence of LDEV#2 in each cycle	Relocating sequence of LDEV#3 in each cycle	Relocating sequence of LDEV#4 in each cycle	Relocating sequence of LDEV#5 in each cycle
T1	1st	2nd	3rd	Unperformed	Unperformed
T2	3rd	Unperformed	Unperformed	1st	2nd
T3	Unperformed	1st	2nd	3rd	Unperformed
T4	2nd	3rd	Unperformed	Unperformed	1st

- If V-VOL is given priority for relocation:

  For example, if LDEVs of LDEV IDs with LDEV#3 and LDEV#4 are set priority for relocation from LDEV#1 to LDEV#5, LDEVs are relocated with the following sequences. In this example, three LDEVs are relocated in each period, but the number of LDEVs to relocate may change by the relocation cycle or data size.

Relocating cycle	Relocating sequence of LDEV#1 in each cycle	Relocating sequence of LDEV#2 in each cycle	Relocating sequence of LDEV#3 in each cycle	Relocating sequence of LDEV#4 in each cycle	Relocating sequence of LDEV#5 in each cycle
T1	3rd	Unperformed	1st	2nd	Unperformed

Relocating cycle	Relocating sequence of LDEV#1 in each cycle	Relocating sequence of LDEV#2 in each cycle	Relocating sequence of LDEV#3 in each cycle	Relocating sequence of LDEV#4 in each cycle	Relocating sequence of LDEV#5 in each cycle
T2	Unperformed	3rd	1st	2nd	Unperformed
T3	Unperformed	Unperformed	1st	2nd	3rd
T4	3rd	Unperformed	1st	2nd	Unperformed

Assignment tier when pool-VOLs are deleted

When you delete pool-VOLs, the pages allocated to the pool-VOLs are moved to other pool-VOLs. The following table shows the tier numbers to which pages are allocated before and after pool-VOLs are deleted. This operation does not depend on the tiering policy or the settings of newly assigned tiers. Relocate tiers after deleting pool-VOLs.

The following table describes page allocation in a 3-tier configuration.

Tier of deleted pool-VOLs	Order in which pages are allocated to tiers	Description
Tier 1	Tier 1, Tier 2, and Tier 3	If there is free space in Tier 1, pages are allocated to Tier 1. If there is no free space in Tier 1, pages are allocated to Tier 2. If there is no free space in Tier 1 and Tier 2, pages are allocated to Tier 3.
Tier 2	Tier 2, Tier 1, and Tier 3	If there is free space in Tier 2, the pages are allocated to Tier 2. If there is no free space in Tier 2, pages are allocated to Tier 1. If there is no free space in Tier 1 and Tier 2, pages are allocated to Tier 3.
Tier 3	Tier 3, Tier 2, and Tier 1	If there is free space in Tier 3, pages are allocated to Tier 3. If there is no free space in Tier 3, pages are allocated to Tier 2. If there is no free space in Tier 2 and Tier 3, pages are allocated to Tier 1.

The following table describes page allocation in a 2-tier configuration.

Tier of deleted pool-VOLs	Order in which pages are allocated to tiers	Description
Tier 1	Tier 1 and Tier 2	If there is free space in Tier 1, pages are allocated to Tier 1. If there is no free space in Tier 1, pages are allocated to Tier 2.
Tier 2	Tier 2 and Tier 1	If there is free space in Tier 2, pages are allocated to Tier 2. If there is no free space in Tier 2, pages are allocated to Tier 1.

Formatted pool capacity

The formatted pool capacity is the capacity of initialized free space in the pool, not the capacity of all the free space in the pool. The free space of the pool is monitored by a storage system. Space is formatted automatically if needed. You can confirm the formatted pool capacity in the **View Pool Management Status window** (see View Pool Management Status window on page E-72). Dependent on the load of the storage system, the format speed of the free space of the pool is adjusted.

New pages are allocated, then initialized, during data write operations to the V-VOL. If a significant number of new pages are allocated, initialization might be delayed as a result of conflicts between data write and new page initialization processes. Such conflicts could occur, for example, when you create a file system of new DP-VOLs from the host. You can initialize the free space of a pool in advance to prevent delays in data write operations.

If you want to change the method of performing the function to format the free space of a pool, contact the customer support.

Rebalancing the usage level among pool-VOLs

The usage level among pool-VOLs is rebalanced automatically so that the page usage ratio is averaged across pool-VOLs and pool-VOL loads are distributed. When rebalancing is done on jobs run for virtual volumes in the same pool, a page is reclaimed if all data on the page is zero.

The usage level among pool-VOLs is automatically rebalanced in the following cases:

- Expanding pool capacity
- Shrinking pool capacity
- Reclaiming zero pages
- Reclaiming zero pages by the page releasing request of a host. For example, when the Write Same command is performed.
- Performing tier relocations several times

Performance of the host I/O may decrease due to movement of the existing data. If you do not want to automate balancing of the usage level of pool-VOLs, call the customer support. You can see the rebalancing progress of the usage level among pool-VOLs in the **View Pool Management Status window** (see View Pool Management Status window on page E-72). Dynamic Provisioning automatically stops balancing the usage levels among pool-VOLs if the cache memory is not redundant or the pool usage rate reaches up to the threshold.

Note: If you expand the pool capacity, Dynamic Provisioning moves data to the added space on a per-page basis. The method for moving the data is determined by the setting of system option mode (SOM) 917 on the VSP storage system:

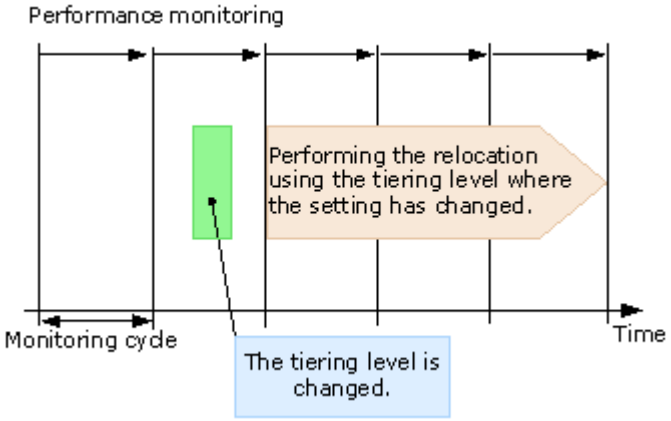
- SOM 917 **ON** (default): Rebalance the usage rate among parity groups for which pool-VOLs are defined.

  If there are multiple parity groups to which pool-VOLs are defined, Dynamic Provisioning rebalances the usage rate among the parity groups. If a parity group has multiple pool-VOLs, the parity group is assumed to be a pool-VOL and Dynamic Provisioning rebalances the usage rate. For this reason, the usage rate might not be averaged among pool-VOLs in a parity group. Compared to rebalancing the usage rate among pool-VOLs, this method reduces the seek time of the hard disk drive during data access.
- SOM 917 **OFF**: Rebalance the usage rate among pool-VOLs without considering parity groups.

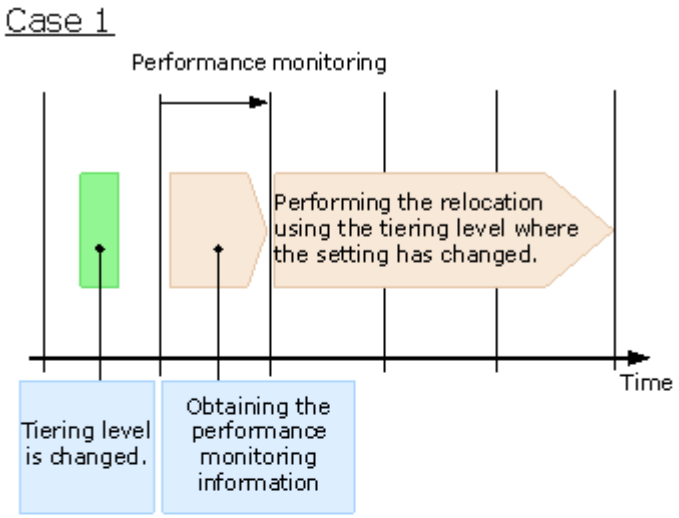
SOMs are set on the service processor (SVP) by your Hitachi Vantara representative. For a description of the SOMs for the VSP, see the *Hitachi Virtual Storage Platform User and Reference Guide*. To change the setting of SOM 917, contact the customer support.

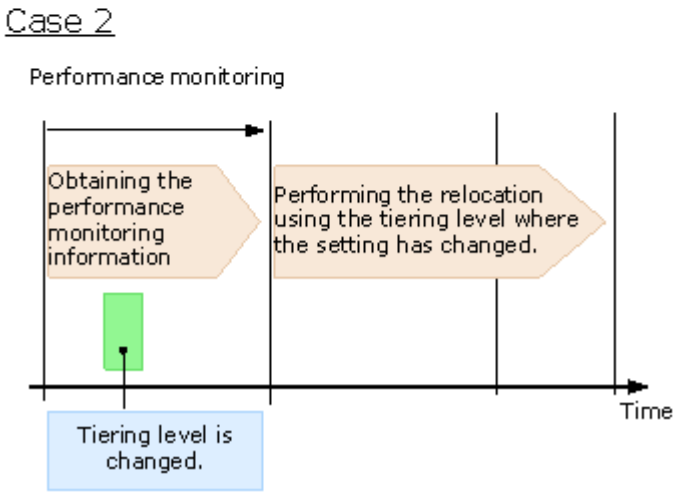
Execution mode settings and tiering policy

The follow depicts how tier relocation is performed after changing the tiering policy setting while Auto execution mode is used.



The following depicts two cases of how tier relocation is performed after changing the tiering policy setting while Manual execution mode is used.





Changing the tiering policy level on a DP-VOL

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

   b. Select the pool associated with the DP-VOL that has the tiering policy level you want to change.

   c. Click the **Virtual Volumes** tab.

2. From the table, select the row with the DP-VOL that has the tiering policy level you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row while pressing the **Ctrl** key.

3. Click **More Actions**, and then select **Edit LDEVs**.

4. In the **Edit LDEVs** window, select **Tiering Policy**, and select the tiering policy.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing new page assignment tier of a V-VOL

1. In the **Storage Systems** tree on the left pane of the top window, select **Logical Devices**.

   The following shows an example of the other operations to select LDEVs.

   a. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.

      The pool name appears below **Pool**.

   b. Click the pool associated with the V-VOL that has new page assignment tier you want to change.

   c. Click the **Virtual Volumes** tab on the right pane.
2. From the table, click the row that has the V-VOL with the new page assignment tier that you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row pressing the **Ctrl** key.
3. Click **More Actions** to select **Edit LDEVs**.

   The **Edit LDEVs** window appears.
4. Click the **New Page Assignment Tier** check box and select the new page assignment tier you want to use.
5. Click **Finish**.

   The **Confirm** window appears.
6. In the **Task Name** text box, type a unique name for the task or accept the default.

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

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

Opening the Edit Tiering Policies window

1. In the **Storage Systems** tree, select **Pool**.

   The pool information is displayed on the right pane of the window.
2. Click the **Edit Tiering Policies** button.

   The **Edit Tiering Policies** window appears.

Changing a tiering policy

You must have the Storage Administrator (system resource management) role to perform this task.

To change the tiering policy

1. In the **Storage Systems** tree, select **Pool**.
   The pool information is displayed on the right pane of the window.
2. Click the **Edit Tiering Policies** button.
   The **Edit Tiering Policies** window appears.
3. Select the tiering policy that you want to change and click the **Change** button.
   The **Change Tiering Policies** window appears. The policies which have an ID numbered 0 to 5 cannot be changed.
4. Change the tiering policy, and click **OK** .
   After clicking **OK**, the **Edit Tiering Policies** window appears again. Note that each tiering policy value is needed in order to meet the conditions described in the following table.

Item	Explanation
Tier1 Max	One of these conditions must be met: Equal to Tier1 Min Bigger than Tier1 Min
Tier1 Min*	One of these conditions must be met: Equal to Tier1 Max Smaller than Tier1 Max
Tier3 Max	One of these conditions must be met: Equal to Tier3 Min Bigger than Tier3 Min
Tier3 Min*	One of these conditions must be met: Equal to Tier3 Max Smaller than Tier3 Max
* The sum of Tier1 Min and Tier3 Min must be 100 (%) or less.	

5. Click **Finish**.
   The **Confirm** window appears.
6. In the **Task Name** text box, type a unique name for the task or accept the default.
7. Click **Apply**.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Changing relocation priority setting of a V-VOL

1. In the **Storage Systems** tree on the left pane of the top window, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.

      The pool name appears below **Pool**.

   b. Click the pool associated with the V-VOL that has the relocation priority you want to change.

   c. Click the **Virtual Volumes** tab on the right pane.

2. From the table, click the row that has the V-VOL with the relocation priority you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row pressing the **Ctrl** key.

3. Click **More Actions** to select **Edit LDEVs**.

   The **Edit LDEVs** window appears.

4. Select the **Relocation Priority** check box and click **Default** or **Prioritize**. If you choose **Prioritize**, LDEV is relocated preferentially.

5. Click **Finish**.

   The **Confirm** window appears.

6. In the **Task Name** text box, enter the task name.

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

7. Click **Apply**.

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

Dynamic Tiering workflow

The following diagram shows the flow of work for a Storage Administrator to set up Dynamic Tiering on the storage system.

As shown in the diagram, Storage Navigator and Command Control Interface have different workflows. The details about how to set up Dynamic Tiering using Storage Navigator are covered in subsequent topics. For details about how to set up Dynamic Tiering using Command Control Interface, see the *Command Control Interface Command Reference* and *Command Control Interface User and Reference Guide*. Use Storage Navigator to create pools and DP-VOLs.

1. Preparing for operations
GUI
CCI
Expand cache memory
Create pool-VOLs and format LDEVs
Create LDEVs wizard
Format LDEVs wizard
raidcom add ldev
raidcom initialize ldev
Create a pool and add the pool-VOLs (Tier reallocation: Disable) *1
Create Pools wizard
raidcom add dp_pool
Change multitier pool from Disable to Enable *2
raidcom modify pool
Create V-VOLs
Create LDEVs wizard
raidcom add ldev
Define V-VOL LU paths
Add LUN paths wizard
raidcom add lun
2. Operating
Monitor performance of the pool
Edit Pools wizard
View Tier Properties
raidcom monitor pool
Relocate tiers of the pool
raidcom relocate pool
Download relocation log file
Clear SIMs
Monitor the pool's free area
Pool window
raidcom get pool
raidcom get dp_pool
If expansion is required
Increase pool capacity (Add pool-VOLs)
Increase V-VOL capacity
Expand Pool wizard
Expand V-VOLs wizard
raidcom add dp_pool
raidcom extend ldev
3. Discontinuing operations
Delete V-VOL LU paths
Delete LUN paths wizard
raidcom delete lun
Delete V-VOLs
Delete LDEVs window
raidcom delete ldev
Delete the Dynamic Tiering pool
Delete Pools wizard
raidcom delete pool
Delete Dynamic Tiering pool-VOLs
Delete LDEVs window
raidcom delete ldev

- Before creating a pool, you need a DP-VOL management area in shared memory. When shared memory is added, the DP-VOL management area is automatically created. For adding shared memory, contact your Hitachi Vantara representative.
- In Command Control Interface, when creating a pool, you cannot enable Multi-Tier Pool and cannot register multiple media as pool-VOLs. Before making tiers, enable Multi-Tier Pool.
- Enabling Multi-Tier Pool from Command Control Interface automatically sets **Tier Management** to **Manual**. To change **Tier Management** to **Auto**, you must do this in Storage Navigator.
- If you delete a pool, its pool-VOLs (LDEVs) will be blocked. If they are blocked, format them before using them.

Dynamic Tiering tasks and parameters

The following topics list the Dynamic Tiering tasks and parameter settings and indicate whether the tasks can be performed or the parameters can be set in Storage Navigator (GUI) or Command Control Interface, or both.

- Task and parameter settings on page 5-64
- Display items: Setting parameters on page 5-66
- Display items: Capacity usage for each tier on page 5-67
- Display items: Performance monitor statistics on page 5-67
- Display items: Operation status of performance monitor/relocation on page 5-67

Task and parameter settings

No.	Item			GUI	Command Control Interface
1	DP pool	Create (Setting item)	Create	Y	Y
2			Pool Name	Y	Y
3			Threshold	Y	Y
4			Multi-Tier Pool: Enable/Disable	Y	N[1]
5			Tier Management: Auto mode	Y	N
6			Tier Management: Manual mode	Y	N
7			Rate of space for new page assignment	Y[3]	N
8			Buffer Space for Tier relocation	Y	N
9			Cycle Time	Y	N

No.	Item			GUI	Command Control Interface
10			Monitoring Period	Y	N
11			Monitoring Mode	Y	N
12			External LDEV Tier Rank	Y	N
13		Delete		Y	Y
14		Change Settings (Setting item)	Change Settings	Y	Y
15			Pool Name	Y	Y[2]
16			Threshold	Y	Y
17			Multi-Tier Pool: Enable/Disable	Y	Y
18			Tier Management: Auto to Manual	Y	Y
19			Tier Management: Manual to Auto	Y	N
20			Buffer Space for New page assignment	Y[3]	Y[3]
21			Buffer Space for Tier relocation	Y	Y
22			Cycle Time	Y	N
23			Monitoring Period	Y	N
24			Monitoring Mode	Y	N
25			External LDEV Tier Rank	Y	N
26	DP pool	Add pool-VOLs		Y	Y
27		Delete pool-VOLs		Y	N
28		Restore Pools		Y	Y
29		Monitoring start/end		Y	Y
30		Tier relocation start/stop		Y	Y
31	DP-VOL	Create (Setting item)	Create	Y	Y
32			DP-VOL Name	Y	Y
33			Multi-Tier Pool relocation: Disable	N	N
34			Tiering Policy	Y	N
35			New page assignment tier	Y	N
36			Relocation priority	Y	N
37		Expand		Y	Y
38		Reclaim zero pages		Y	Y

No.	Item			GUI	Command Control Interface
39		Delete		Y	Y
40		Change Settings (Setting item)	Change Settings	Y	Y
41			Tier relocation: Enable/Disable	Y	Y
42			Tiering Policy	Y	Y
43			New page assignment tier	Y	Y
44			Relocation priority	Y	N
45	Relocation log	Download relocation log		Y	N

Notes:

1. Set to **Disable** if the pool is created by Command Control Interface.
2. You can rename a pool when adding pool-VOLs to it.
3. We recommend that you specify 0% for SSD and 8% for other drives.

Display items: Setting parameters

No.	Category	Output information	GUI	Command Control Interface
1	DP pool	Multi-Tier Pool: Disable	Y	Y
2		Tier Management mode: Auto/ Manual	Y	Y
3		Rate of space for new page assignment	Y	Y
4		Cycle Time	Y*	N
5		Monitoring Period	Y*	N
6		Monitoring Mode	Y	N
7		External LDEV Tier Rank	Y	N
8	DP-VOL	Tier relocation: Enable/Disable	Y	Y
9		Tiering Policy	Y	Y
10		New page assignment tier	Y	Y
11		Relocation priority	Y	N

*You can view this item only in the Auto execution mode.

Display items: Capacity usage for each tier

No.	Category	Output information	GUI	Command Control Interface
1	DP pool	Capacity for each tier (Total)	Y	Y
2		Capacity for each tier (Usage)	Y	Y
3	DP-VOL	Capacity for each tier (Usage)	Y	Y

Display items: Performance monitor statistics

No.	Category	Output information	GUI	Command Control Interface
1	DP pool	Frequency distribution	Y[1]	N
2		Tier range	Y[1]	Y[2]
3		Performance utilization	Y	Y
4		Monitoring Period starting time	Y	N
5		Monitoring Period ending time	Y	N
6	DP-VOL	Frequency distribution	Y	N
7		Tier range	Y	N
8		Monitoring Period starting time	Y	N
9		Monitoring Period ending time	Y	N

Notes:

1. You can select either each level of the tiering policy or the entire pool. If you set other than All(0), the tier range is not displayed when you select the entire pool.
2. The tier range when the tiering policy All(0) is selected is displayed.

Display items: Operation status of performance monitor/relocation

No.	Category	Output information	GUI	Command Control Interface
1	DP pool	Monitor operation status: Stopped/ Operating	Y	Y
2		Performance monitor information: Valid/Invalid/Calculating	Y	Y
3		Relocation status: Relocating/ Stopped	Y	Y
4		Relocation progress: 0 to 100%	Y	Y

Managing Dynamic Tiering

Changing pool for Dynamic Provisioning to pool for Dynamic Tiering

To change a pool for Dynamic Provisioning to a pool for Dynamic Tiering:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on right, click the row of a pool you want to change to the Dynamic Tiering setting.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit Pools**.

   The **Edit Pools** window appears.
4. Check **Multi-Tier Pool**.
5. Select **Enable** from the **Multi-Tier Pool** field.
6. To configure Dynamic Tiering:

   a. Select the **Tier Management** check box.

   b. From the Tier Management field, select **Auto** or **Manual**.

   Normally **Auto** should be set.

   When you select **Auto**, monitoring and tier relocation can automatically executed.

   When you select **Manual**, monitoring and tier relocation can be executed with the Command Control Interface commands or the **Pools** window of Storage Navigator.

   When you change the setting of **Auto** to **Manual** while monitoring and tier relocation is executing, it is cancelled.

   c. From the **Cycle Time** list, select the cycle of performance monitoring and tier relocation.

Note:

- When you change the **Cycle Time** while performance monitoring and tier relocation are being executed, the setting becomes effective for the next cycle after the current cycle is complete.

  When you select **24 Hours** (default):

  Monitoring and tier relocation is performed once a day. In the **Monitoring Period** field, specify the time of starting and ending of monitoring in 00:00 to 23:59 (default value).

- If you specify the starting time later than the ending time, the monitoring continues until the time when you specify as the ending time on the next day. Anytime that is not in the specified range of the monitor period is not monitored.
- You can view the information gathered by monitoring with Storage Navigator and Command Control Interface.
- When you change the time range of performance monitoring, the setting becomes effective from the next cycle after the cycle that is executing is complete.

  When you select any of **0.5 Hours**, **1 Hour**, **2 Hours**, **4 Hours** or **8 Hours**:

  Performance monitoring is performed every duration you selected starting at 00:00.

  You cannot specify the monitoring period.

d. Select the **Monitoring Mode** check box.

e. From the **Monitoring Mode** option, select **Period Mode** or **Continuous Mode**.

   If you want to perform tier relocation using the monitor results from the prior cycle, select **Period Mode**. If you want to perform tier relocation weighted to the past period monitoring result, select **Continuous Mode**.

f. Select the **Buffer Space for New page assignment** check box.

g. In the **Buffer Space for New page assignment** text box, enter an integer value from 0 to 50 as the percentage (%) to set for each tier.

h. Select the **Buffer Space for Tier relocation** check box.

i. In the **Buffer Space for Tier relocation** text box, enter an integer value from 2 to 40 as the percentage (%) to set for each tier.

7. Click **Finish**.

   The **Confirm** window appears.

8. In the **Task Name** text box, enter the task name.

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

9. In the **Confirm** window, click **Apply** to register the setting in the task.

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

Changing monitoring and tier relocation settings

This topic describes how to change the following pool settings of Dynamic Tiering:

- Automatic or manual execution of monitoring and tier relocation
- Cycle time of monitoring and tier relocation
- Time period of monitoring

To change monitoring and tier relocation settings:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of the pool with the Dynamic Tiering setting you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row while pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit Pools**.

   The **Edit Pools** window appears.
4. Check **Tier Management**.
5. From the Tier Management field, select **Auto** or **Manual**.

   Normally **Auto** should be set.

   When you select **Auto**, monitoring and tier relocation can automatically executed.

   When you select **Manual**, monitoring and tier relocation can be executed with the Command Control Interface commands or the **Pools** window of Storage Navigator.

   When you change the setting of **Auto** to **Manual** while performance monitoring and tier relocation is executing, it is cancelled and is not performed since then.
6. If **Auto** is selected from the **Cycle Time** list, select the cycle of performance monitoring and tier relocation.
7. Click **Finish**.

   The **Confirm** window appears.
8. In the **Task Name** text box, enter the task name.

   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. The value "date-window name" is entered by default.
9. In the **Confirm** window, click **Apply** to register the setting in the task.

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

Changing monitoring mode setting

To change monitoring mode setting:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of the pool with the Dynamic Tiering setting you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row while pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit Pools**.

   The **Edit Pools** window appears.
4. Check **Monitoring Mode**.
5. From the **Monitoring Mode** option, select **Period Mode** or **Continuous Mode**.

   If you want to perform tier relocation using the monitor results from the prior cycle, select **Period Mode**. If you want to perform tier relocation weighted to the past period monitoring result, select **Continuous Mode**.
6. Click **Finish**.

   The **Confirm** window appears.
7. In the **Task Name** text box, enter the task name.

   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. The value "date-window name" is entered by default.
8. In the **Confirm** window, click **Apply** to register the setting in the task.

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

Changing buffer space for new page assignment setting

To change buffer space for new page assignment setting:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of a pool with the Dynamic Tiering setting you want to change.

   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row while pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit Pools**.

   The **Edit Pools** window appears.
4. Select the **Buffer Space for New page assignment** check box.
5. In the **Buffer Space for New page assignment** text box, enter an integer value from 0 to 50 as the percentage (%) to set for each tier.
6. Click **Finish**.

   The **Confirm** window appears.

7. In the **Task Name** text box, enter the task name.
   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. The value "date-window name" is entered by default.
8. In the **Confirm** window, click **Apply** to register the setting in the task.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Changing buffer space for tier relocation setting

To change buffer space for tier relocation setting:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of a pool with the Dynamic Tiering setting you want to change.
   To select consecutive rows, highlight all of the rows to be selected and press the **Shift** key. To select separate rows, click each row while pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit Pools**.
   The **Edit Pools** window appears.
4. Select the **Buffer Space for Tier relocation** check box.
5. In the **Buffer Space for Tier relocation** text box, enter an integer value from 2 to 40 as the percentage (%) to set for each tier.
6. Click **Finish**.
   The **Confirm** window appears.
7. In the **Task Name** text box, enter the task name.
   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. The value "date-window name" is entered by default.
8. In the **Confirm** window, click **Apply** to register the setting in the task.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Viewing pool tier information

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
2. From the **Pool** list, select a pool for which you want to view the information.
3. Click **More Actions**, and then select **View Tier Properties**.
   The **View Tier Properties** window opens.

Viewing DP-VOL tier information

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

2. From the **Pool** list, select a pool associated with the DP-VOL for which you want to view the information.
3. Click the **Virtual Volumes** tab.
4. From the **Virtual Volumes** table, select the DP-VOL for which you want to view the information.
5. Click **More Actions**, and then select **View Tier Properties**.
   The **View Tier Properties** window opens.

Changing a pool for Dynamic Tiering to a pool for Dynamic Provisioning

You can change a Dynamic Tiering pool to a Dynamic Provisioning pool. However, you cannot change the pool status of Dynamic Tiering to disable in the following cases:

- Tier relocation is being executed manually.
- Pool-VOLs are being deleted.
- Zero pages are being reclaimed.

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
   The pool name appears below Pool.
2. Select a pool that is changed from a pool for Dynamic Tiering to a pool for Dynamic Provisioning.
   The pool information appears.
3. Click **More Actions** to select **Edit Pool**.
   The **Edit Pool** window appears.
4. Check **Multi-Tier Pool** and select **Disable** from the **Multi-Tier Pool** option.
5. Click **Finish**.
   The **Confirm** window appears.
6. In the **Task Name** text box, enter the task name.
   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. The value "date-window name" is entered by default.
7. In the **Confirm** window, click **Apply** to register the setting in the task.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Working with pools

About pools

Dynamic Provisioning requires the use of pools. A pool consists of more than one pool-VOL. A storage system supports up to 128 pools, each of which can contain up to 1024 pool-VOLs and 63,232 DP-VOLs per pool. The pool for Dynamic Provisioning or Copy-on-Write Snapshot cannot be used in conjunction with other pools.

Copy-on-Write Snapshot also uses pools. The 128-pool maximum per storage system applies to the total number of both Copy-on-Write Snapshot pools, and Dynamic Provisioning pools, and Dynamic Tiering pools. The pool for Dynamic Provisioning or Copy-on-Write Snapshot or Dynamic Tiering cannot be used in conjunction with other pools. For more information, see the *Hitachi Copy-on-Write Snapshot User Guide*.

A pool number must be assigned to a pool. Multiple DP-VOLs can be related to one pool.

The total pool capacity combines the capacity of all the registered Dynamic Provisioning pool-VOLs assigned to the pool. Pool capacity is calculated using the following formulas:

- *capacity of the pool* (MB) = *total number of pages* × 42 - 4200
  4200 in the formula is the management area size of the pool-VOL with System Area.
- *total number of pages* = Σ(floor(floor(*pool-VOL number of blocks* ÷ 512) ÷ 168)) for each pool-VOL

where

- floor( ) means to truncate the part of the formula within the parentheses after the decimal point.

About pool-VOLs

Pool-VOLs are grouped together to create a pool. When a new pool is created, the available pool-VOLs are selected in the Select Pool VOLs window and added to the Selected Pool Volumes table. Every pool must have a pool-VOL with System Area.

During initial creation of a pool, designate a pool-VOL as the pool-VOL with System Area, select the pool-VOL, and click Change Top Pool VOL in the selected pool volumes table.

When adding a volume to the pool for which Multi-Tier Pool is enabled, note the following:

- Up to three different drives types/RPM are allowed between all the pool-VOLs to be added.
- Volumes to be added to the same pool must have the same RAID level across all the same drive type/RPM pool-VOLs.

For example, you cannot add a volume whose drive type/RPM is SAS/15k and whose RAID level is 5 (3D+1P) when a volume whose drive type/RPM is also SAS/15k but whose RAID level is 5 (7D+1P) is already in the pool

- Up to three values are allowed for Drive Type/RPM for the volume.

If you increase the pool capacity by adding a pool-VOL, a portion of the existing data in the pool automatically migrates from an older pool-VOL to the newly added pool-VOL, balancing the usage levels of all the pool-VOLs. If you do not want to automate balancing of the usage levels of pool-VOLs, call the customer support for assistance.

Dynamic Provisioning does not automatically balance the usage levels among pool-VOLs if the cache memory is not redundant or if the pool usage reaches up to the threshold.

The pool-VOLs contained in a pool can be added or deleted. Removing a pool-VOL does not delete the pool or any related DP-VOLs. You must delete all DP-VOLs related to the pool before the pool can be deleted. When the pool is deleted, all data in the pool is also deleted.

Pool status

The following table describes the pool status that appears in Storage Navigator. The status indicates that a SIM code may have been issued that needs to be resolved. See SIM reference codes on page 5-95for SIM code details.

The DP-VOL status remains normal even though the pool status may be something other than normal.

Status	Explanation	SIM code*
Normal	Normal status.	None
Warning	A pool-VOL in the pool is blocked.	If the pool-VOL is blocked, SIM code 627XXX is reported.
Exceeded Threshold	The pool usage level may exceed a pool threshold.	620XXX , 621XXX, or 626XXX
Shrinking	The pools is being shrunk and the pool-VOLs are being deleted.	None
Blocked	The pool is full or an error occurred in the pool, therefore the pool is blocked.	622XXX or 623XXX
*XXX in the SIM code indicates the hexadecimal pool number.		

Creating a pool

The following procedure tells how to create a pool using Storage Navigator. This procedure is for setting up Dynamic Provisioning, but optional steps are shown for setting up Dynamic Tiering if you chose to add tiers to your storage system.

Before creating a pool, you must install the proper amount of shared memory, and you must have a V-VOL management area in shared memory. When shared memory is added, the V-VOL management area is automatically created. To add shared memory, contact your Hitachi Vantara representative.

When the pool is created, a pool-VOL with system area is assigned the priority shown in the following table.

Priority	Hard disk drive type
1	SATA-W/V or SATA-E
2	SAS7.2K
3	SAS10K
4	SAS15K
5	SSD
6	External volume

If multiple pool-VOLs of the same hard disk drive type exist, the priority of each is determined by the internal index of the storage system.

For Dynamic Provisioning

To create pools using Storage Navigator:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
   The **Pool** window appears.
2. Click **Create Pools**.
   The **Create Pools** windows appears.
3. From the **Pool Type** list, select **Dynamic Provisioning**.
4. From the **System Type** list, select **Open**.
5. From the **Multi-Tier Pool** field, select **Disable**.
6. Follow the steps below to select pool-VOLs.
   a. From the **Drive Type/RPM** list, select hard disk drive type and RPM.
   b. From the **RAID Level** list, select RAID level.
      If you select **External Storage** from the **Drive Type/RPM** list, A hyphen (-) appears and you cannot select the RAID level.
   c. Click **Select Pool VOLs**.
      The **Select Pool VOLs** window appears.
   d. In the **Available Pool Volumes** table, select the pool-VOL row to be associated to a pool, and then click **Add**.
      The selected pool-VOL is registered into the **Selected Pool Volumes** table.
      When adding external volumes, **Cache Mode** of the volumes to be added must be all set to enable, or all set to disable.

Caution: Up to 1,024 volumes can be added to a pool.
When you add external volumes, note the following items:

- An external volume whose **Cache Mode** is set to **Enable** and an external volume whose **Cache Mode** is set to **Disable** cannot coexist.
- An internal volume and an external volume whose **Cache Mode** is set to **Disable** cannot coexist.

Note: Perform the following if necessary:

- Click **Filter** to open the menu, specify the filtering, and then **Apply**.
- Click **Select All Pages** to select all pool-VOLs in the table. To cancel the selection, click **Select All Pages** again.
- Click **Options** to specify the unit of volumes or the number of rows to be displayed.
- To set the tier rank of an external volume to a value other than **Middle**, select a tier rank from **External LDEV Tier Rank**, and click **Add**.

e. Click **OK**.
The information in the **Selected Pool Volumes** table is applied to **Total Selected Pool Volumes** and **Total Selected Capacity**.

7. In the **Pool Name** text box, enter the pool name as follows:
In the **Prefix** text box, enter the alphanumeric characters, which are fixed characters of the head of the pool name. The characters are case-sensitive.
In the **Initial Number** text box, type the initial number following the prefix name, which can be up to 9 digits.
You can enter up to 32 characters, including the initial number.
8. Click **Options**.
9. In the **Initial Pool ID** text box, type the number of the initial pool ID, from 0 to 127.
The smallest available number is displayed in the text box as a default. No number, however, appears in the text box, if no available pool ID exists. When the registered pool ID is entered, the smallest available pool ID is registered automatically among the subsequent pool IDs that were entered.
10. In the **Subscription Limit** text box, enter an integer value from 0 to 65534 as the subscription rate (%) for the pool.
If it is blank, the subscription rate is set to unlimited.
11. In the **Warning Threshold** text box, enter an integer value from 1 to 100 as the rate (%) for the pool. The default value is 70%.
12. In the **Depletion Threshold** text box, enter an integer value from 1 to 100 as the rate (%) for the pool. The default value is 80%.
Enter a value more than the value of **Warning Threshold**.

13. Click **Add**.

    The created pool is added to the right **Selected Pools** table. If the invalid values are set, an error message appears.

    If even one item that must be set is not entered or selected, you cannot click **Add**.

    The items that have to be set include **Pool Type**, **Pool Volume Selection**, and **Pool Name**.

    If you select a row and click **Detail**, the **Pool Properties** window appears. If you select a row and click **Remove**, a message appears asking whether you want to remove the selected row or rows. If you want to remove the row, click **OK**.

14. Click **Next**.

    The **Create LDEVs** window appears. Go to Creating V-VOLs on page 5-84 to create LDEVs.

    If **Subscription Limit** for all the created pool is set to 0%, the **Create LDEVs** window does not appear.

    To finish the wizard, click **Finish**. The **Confirm** window appears.

15. In the **Confirm** window, click **Apply** to register the setting in the task.

    If you select a row and click **Detail**, the **Pool Properties** window appears.

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

For Dynamic Tiering

To create pools using Storage Navigator:

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.

   The **Pool** window appears.

2. Click **Create Pools**.

   The **Create Pools** windows appears.

3. From the **Pool Type** list, select **Dynamic Provisioning**.
4. From the **System Type** list, select **Open**.
5. From the **Multi-Tier Pool** field, select **Enable**.

Caution: You cannot select **Enable** if the storage system has only external volumes with the **Cache Mode** set to **Disable**.

---

6. Follow these steps below to select pool-VOLs:

   a. In the **Drive Type/RPM** list, make sure that **Mixable** is selected.

   b. From the **RAID Level** list, make sure that **Mixable** is selected.

   c. Click **Select Pool VOLs**.

      The **Select Pool VOLs** window appears.

   d. In the **Available Pool Volumes** table, select the pool-VOL row to be associated to a pool, and then click **Add**.

The selected pool-VOL is registered into the **Selected Pool Volumes** table.

Caution: Up to 1,024 volumes can be added to a pool.

Note: Perform the following if necessary:

- Click **Filter** to open the menu, specify the filtering, and then **Apply**.
- Click **Select All Pages** to select all pool-VOLs in the table. To cancel the selection, click **Select All Pages** again.
- Click **Options** to specify the unit of volumes or the number of rows to be displayed.
- To set the tier rank of an external volume to a value other than **Middle**, select a tier rank from **External LDEV Tier Rank**, and then click **Add**.
- For a pool, you can add volumes whose **Drive Type/RPM** settings are the same and whose **RAID Level**s are different. For example, you can add the following volumes to the same pool:

  Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (3D+1P)

  Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (7D+1P)

e. Click **OK**.

   The information in the **Selected Pool Volumes** table is applied to **Total Selected Pool Volumes** and **Total Selected Capacity**.

7. In the **Pool Name** text box, enter the pool name as follows:

   In the **Prefix** text box, enter the alphanumeric characters, which are the fixed characters of the head of the pool name. The characters are case-sensitive.

   In the **Initial Number** text box, type the initial number following the prefix name, which can be up to 9 digits.

   You can enter up to 32 characters, including the initial number.

8. Click **Options**.

   The setting fields following **Initial Pool ID** appear.

9. In the **Initial Pool ID** text box, enter the number of the initial pool ID from 0 to 127.

   The smallest available number is displayed in the text box as a default. No number, however, appears in the text box, if no available pool ID exists. When the registered pool ID is entered, the smallest available pool ID is registered automatically among the subsequent pool IDs that were entered.

10. In the **Subscription Limit** text box, enter an integer value from 0 to 65534 as the subscription rate (%).

    If no figure is entered, the subscription is unlimitedly set.

11. In the **Warning Threshold** text box, enter an integer value from 1 to 100 as the rate (%) for the pool. The default value is 70%.
12. In the **Depletion Threshold** text box, enter an integer value from 1 to 100 as the rate (%) for the pool. The default value is 80%.

    Enter a value more than the value of **Warning Threshold**.
13. Configure Dynamic Tiering as follows:

    a. From the **Tier Management** option, select **Auto** or **Manual**.

    Normally you select **Auto**.

    If you select **Auto**, performance monitoring and tier relocation are automatically performed.

    If you select **Manual**, you can manually perform performance monitoring and tier relocation with the Command Control Interface commands or Storage Navigator.

    b. From **Cycle Time** list, select the cycle of performance monitoring and tier relocation.

    When you select **24 Hours** (default value):

    Performance monitoring and tier relocation is performed once a day.

    In the **Monitoring Period** field, specify the time of starting and ending of performance monitoring in 00:00 to 23:59 (default value).

    Take one or more hours between the starting time and the ending time. If you specify the starting time later than the ending time, the performance monitoring continues until the time when you specify as the ending time on the next day.

    You can view the information gathered by performance monitoring with Storage Navigator and Command Control Interface.

    When you select any of **0.5 Hours**, **1 Hour**, **2 Hours**, **4 Hours** or **8 Hours**:

    Performance monitoring is performed every hour you selected starting at 00:00.

    You cannot specify the time of performance monitoring.

    Caution: When **Auto** is set, all the V-VOL pages may not be completed migrating by one cycle. At the next cycle, the last processed V-VOL will start being migrated with the updated information. However, the performance monitoring information is switched.
14. From the **Monitoring Mode** option, select **Period Mode** or **Continuous Mode**.

    If you perform the tier relocation with the specified cycle or you do not need to specify the **Monitoring Mode** option, select **Period Mode**. If you perform the tier relocation weighted to the past period monitoring result, select **Continuous Mode**.
15. In the **Buffer Space for New page assignment** text box, enter an integer value from 0 to 50 as the percentage (%) to set for each tier.

    A default value depends on the hard disk drive type of pool-VOL in each tier. The default value of SSD is 0%. The default value of the type other than SSD is 8%.

16. In the **Buffer Space for Tier relocation** text box, enter an integer value from 2 to 40 as the percentage (%) to set for each tier.

    A default value is 2%.

17. Click **Add**.

    The created pool is added to the right **Selected Pools** table. If invalid values are set, an error message appears.

    The **Pool Type**, **Multi-Tier Pool**, **Pool Volume Selection** and **Pool Name** field must be set. If these required items are not registered, you cannot click **Add**.

    If you select a row and click **Detail**, the **Pool Properties** window appears. If you select a row and click **Remove**, a message appears asking whether you want to remove the selected row or rows. If you want to remove the row, click **OK**.

18. Click **Next**.

    The **Create LDEVs** window appears. Go to Creating V-VOLs on page 5-84 to create LDEVs.

    If **Subscription Limit** for all the created pool is set to 0%, the **Create LDEVs** window does not appear.

    To finish the wizard, click **Finish**. The **Confirm** window appears.

19. In the **Confirm** window, click **Apply** to register the setting in the task.

    If you select a row and click **Detail**, the **Pool Properties** window appears.

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

Notes on pools created with the previous versions

Pools created with the previous version of the Hitachi Virtual Storage Platform microcode may be subject to restrictions in the current version of the microcode.

Pool-VOLs of RAID 5 and RAID 6 coexisting in the Dynamic Provisioning pool

Using Hitachi Virtual Storage Platform microcode 70-02-0x or later, pool-VOLs of RAID 5 and RAID 6 can coexist in the Dynamic Provisioning pool. However, restrictions apply to the following cases.

Pool type	Version that pools were created	Updated version	What cannot be done
Dynamic Provisioning	Prior to 70-02-0x	70-02-0x or later	Pool-VOLs of RAID 5 and RAID 6 cannot coexist in this pool.
Dynamic Tiering	Prior to 70-02-0x	70-02-0x or later	This pool cannot be changed to the Dynamic Provisioning pool.

Pool type	Version that pools were created	Updated version	What cannot be done
• Pool-VOLs of RAID 5 and RAID 6 coexist in the same pool.			

Pool-VOLs to which external volumes are mapped assigned to the Dynamic Tiering pool

Using Hitachi Virtual Storage Platform microcode 70-02-0x or later, you can assign pool-VOLs to which external volumes are mapped to the Dynamic Tiering pool. However, restrictions apply to the following cases.

Pool type	Version that pools were created	Updated version	What cannot be done
Dynamic Tiering	Prior to 70-02-0x	70-02-0x or later	Pool-VOLs to which external volumes are mapped cannot be assigned to this pool.
Dynamic Provisioning • Pool-VOLs to which external volumes are assigned to the pool.	Prior to 70-02-0x	70-02-0x or later	This pool cannot be changed to the Dynamic Tiering pool.

Pool-VOLs of RAID 1 assigned to the Dynamic Tiering pool

Using Hitachi Virtual Storage Platform microcode 70-03-3x or later, you can assign pool-VOLs of RAID 1 to the Dynamic Tiering pool. However, restrictions apply to the following cases.

Pool type	Version that pools were created	Updated version	What cannot be done
Dynamic Tiering, including a pool that is changed from the Dynamic Provisioning pool.	Prior to 70-02-0x	70-03-3x or later	Pool-VOLs of RAID 1 cannot be assigned to this pool.
Dynamic Provisioning • Pool-VOLs of RAID 1 are assigned to the pool.	70-02-0x or later and prior to 70-03-3x	70-03-3x or later	This pool cannot be changed to the Dynamic Tiering pool.

Pool-VOLs of RAID 1 and RAID 5, or pool-VOLs of RAID 1 and RAID 6 coexisting in the same pool

Using Hitachi Virtual Storage Platform microcode 70-03-3x or later, pool-VOLs of RAID 1 and RAID 5, or pool-VOLs of RAID 1 and RAID 6 can coexist in the same pool. However, restrictions apply to the following cases.

Pool type	Version that pools were created	Updated version	What cannot be done
Dynamic Tiering, including a pool that is changed from the Dynamic Provisioning pool	Prior to 70-02-0x	70-03-3x or later	Pool-VOLs of RAID 1 and RAID 5, or pool-VOLs of RAID 1 and RAID 6 cannot coexist in this pool.
Dynamic Provisioning • Pool-VOLs of RAID 1 are assigned to the pool.	70-02-0x or later and prior to 70-03-3x	70-03-3x or later	Pool-VOLs of RAID 1 and RAID 5, or pool-VOLs of RAID 1 and RAID 6 cannot coexist in this pool.

Working with DP-VOLs

About DP-VOLs

Dynamic Provisioning requires the use of DP-VOLs, which are virtual volumes with no physical memory space. In Dynamic Provisioning, multiple DP-VOLs can be created.

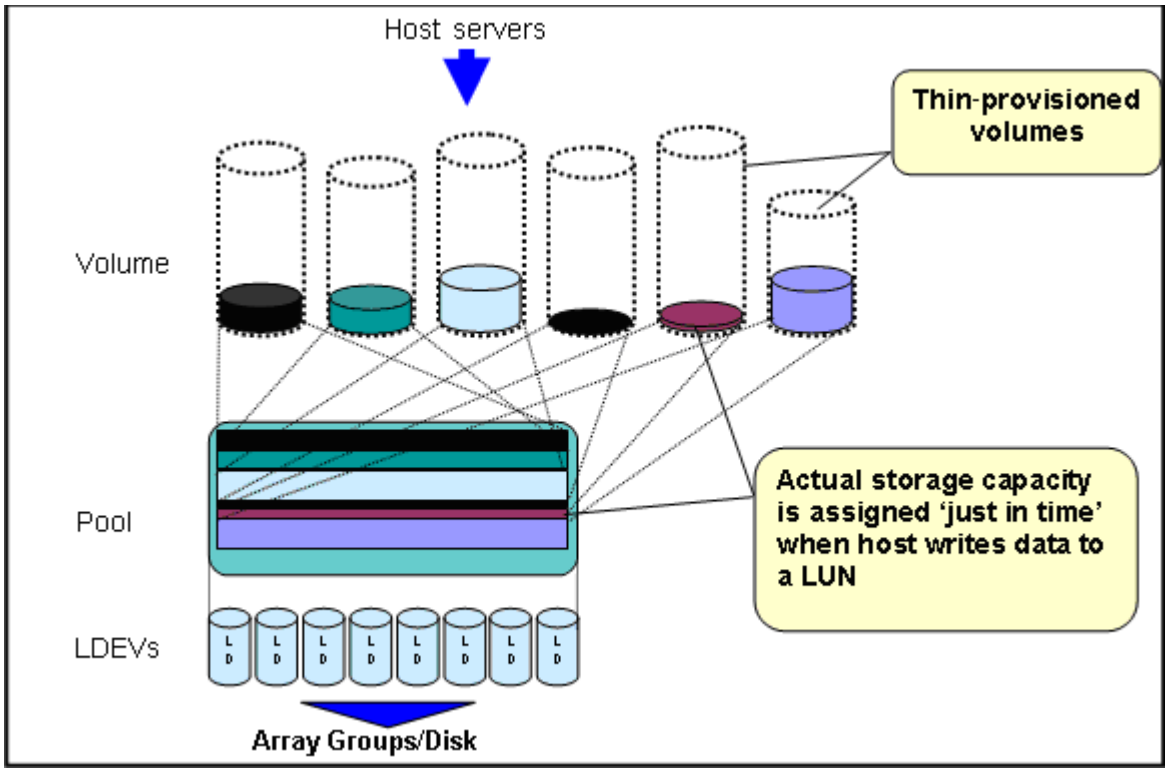
A DP-VOL is a volume in a thin provisioning storage system. It is the virtual volume from a DP pool. Data in the DP pool is used via a DP-VOL. A DP-VOL is a virtual LU to some hosts.

On open systems, OPEN-V is the only supported emulation type on a DP-VOL. You can define multiple DP-VOLs and assign them to a Dynamic Provisioning pool.

Relationship between a pool and DP-VOLs

Before you can use Dynamic Provisioning, a DP-VOL and a pool are required. Dynamic Provisioning uses the pool volumes in a pool through the DP-VOLs.

The following figure shows the relationship between a pool and DP-VOLs.



Creating V-VOLs

You can create a DP-VOL from any of the following tabs:

- The **LDEVs** tab, which appears when **Logical Devices** is selected.
- The **Pools** tab, which appears when **Pools** is selected.
- The **Virtual Volumes** tab, which appears when a pool in **Pools** is selected.

1. You can create LDEVs from the following tab windows:
   - The **LDEVs** tab, which appears when **Logical Devices** is selected.
   - The **Pools** tab, which appears when **Pools** is selected.
   - The **Virtual Volumes** tab, which appears when a pool in **Pools** is selected.
2. Click **Create LDEVs**.
   The **Create LDEVs** window appears.
3. From the **Provisioning Type** list, confirm **Dynamic Provisioning** is selected.
   If not, select **Dynamic Provisioning** from the list.
4. In the **System Type** option, select a system type.
   To create open system volumes, select **Open**.
5. From the **Emulation Type** list, confirm **OPEN-V** is selected.
6. From the **Multi-Tier Pool** field, select **Enable** when you create the V-VOL for Dynamic Tiering, and select **Disable** when you do not create one.

If no pool is set to **Enable** in Dynamic Tiering, **Disable** is fixed.

Note: You cannot specify the **TSE Attribute** option when selecting **Open** in the **System Type** option.

7. Select the pool according to the following steps.
   a. From the **Drive Type/RPM** list in **Pool Selection**, select the hard disk drive type and RPM.
   b. From the **RAID level** list, select the RAID level.
   c. Click **Select Pool**.
      The **Select Pool** window appears.
   d. In the **Available Pools** table, select a pool.

   Note: You can specify a pool when creating DP-VOLs if the pool has a status of one of the following:

   - Normal status
   - Exceeded Threshold status
   - In progress of pool capacity shrinking

   You can select only one pool. When **Enable** is selected in step 6, the Dynamic Tiering-pools appear, and when **Disable** is selected, only the non-Dynamic Tiering-pools appear.

   Perform the following if necessary:

   - Click **Filter** to open the menu, specify the filtering, and then **Apply**.
   - Click **Options** to specify the units of pools or the number of rows to be displayed.

   e. Click **OK**.
      The **Select Pool** window closes. The selected pool name appears in **Selected Pool Name (ID)**, and the total capacity of the selected pool appears in **Selected Pool Capacity**.
8. In the **LDEV Capacity** text box, enter the DP-VOL capacity to be created.
   You can enter the capacity within the range of figures displayed below the text box. You can enter the number with 2 digits after decimal point. You can change the capacity unit from the list.
9. In the **Number of LDEVs** text box, enter the number of LDEVs to be created.
   You can enter the number of LDEVs within a range of the figures displayed below the text box.
10. In the **LDEV Name** text box, enter the DP-VOL name.
    In the **Prefix** text box, enter the alphanumeric characters, which are fixed characters of the head of the DP-VOL name. The characters are case-sensitive.
    In the **Initial Number** text box, type the initial number following the prefix name, which can be up to 9 digits.
    You can enter up to 32 characters including the initial number.

11. Click **Options**.
12. In the **Initial LDEV ID** field, make sure that LDEV ID is set.
    To confirm the used number and unavailable number, click **View LDEV IDs** to display the **View LDEV IDs** window.
13. In the **Initial SSID** text box, type the 4-digit SSID of a hexadecimal number (0004 to FFFE).
    To confirm the created SSID, click **View SSID** to display the **View SSID** windows.
14. From the **Cache Partition** list, select CLPR.
15. From the **Processor Blade** list, select a processor blade.
    Select a processor blade to be used by the LDEVs. If you assign a specific processor blade, select the ID of the processor blade. If you can assign any processor blade, click **Auto**.
16. From the **Tiering Policy** field, select the tiering policy to be used by the LDEVs. If you assign a specific tiering policy, select any policy. All(0) is selected by default. You can change a level from Level1(1) to Level5(5) or from Level6(6) to Level31(31). You can specify the function when the **Multi-Tier Pool** is enabled.
17. From the **New Page Assignment Tier** list, select a new page assignment tier. You can select from levels **High**, **Middle**, and **Low**.
    You can specify the function when the **Multi-Tier Pool** is enabled.
18. In the **Relocation Priority** option, select a priority.
    To relocate the LDEV preferentially, set **Prioritize**. You can select **Default** or **Prioritize**. You can specify this function when the **Multi-Tier Pool** is enabled.
19. If necessary, change the settings of the V-VOLs.
    You can change the following settings:
    - Editing SSID
      Click **Edit SSIDs** to open the **Edit SSIDs** window.
    - Changing the LDEV settings
      Click **Change LDEV Settings** to open the **Change LDEV Settings** window.
20. If necessary, delete a row from the **Selected LDEVs** table.
    Select a row to be deleted, and then click **Remove**.
21. Click **Add**.
    The created V-VOLs are added to the right **Selected LDEVs** table. If invalid values are set, an error message appears.
    The **Provisioning Type**, **System Type**, **Emulation Type**, **Pool Selection**, **Drive Type/RPM**, **RAID Level**, **LDEV Capacity**, and **Number of LDEVs** field must be set. If these required items are not registered, you cannot click **Add**.
22. Click **Finish**.
    The **Confirm** window appears.

To continue the operation for setting the LU path and define LUN, click **Next**.

23. In the **Task Name** in the text box, enter the task name.
    You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. "yymmdd-window name" is entered as a default.
24. Click **Apply**.
    If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Editing a DP-VOL's SSID

Before registering a DP-VOL, you may need to edit the DP-VOL's SSID. The SSID is a hexadecimal value.

1. In the **Selected LDEVs** table in the **Create LDEVs** window, click **Edit SSIDs**.
   The **Edit SSIDs** window opens. The **SSIDs** table shows the SSID existing and to be added.
2. If you want to change the SSID, select the appropriate LDEV, and then click **Change SSIDs**.
3. In the **Change SSIDs** window, type the new SSID in hexadecimal format, and then click **OK**
4. In the **Edit SSIDs** window, click **OK**.
5. In the **Create LDEVs** window, click **Finish**.
6. In the **Confirm window**, confirm the settings, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing DP-VOL settings

Before registering a DP-VOL, you may need to change the DP-VOL settings.

1. In the **Selected LDEVs** table in the **Create LDEVs** window, select an LDEV, and then click **Change LDEV Settings**.
2. In the **Change LDEV Settings** window, you can change the setting of **LDEV Name**, **Initial LDEV ID**, or **Processor Blade**.
   - If you change **LDEV Name**, specify the prefix characters and the initial number for this LDEV.
   - If you change **Initial LDEV ID**, specify the number of LDKC, CU, DEV, and Interval. To check used LDEVs, click **View LDEV IDs** to confirm the used LDEVs. The **View LDEV IDs** window opens.
   - If you change **Processor Blade**, click the list and specify the processor blade ID. If the specific processor blade is specified, select the processor blade ID. If any processor blade is specified, click **Auto**.
3. Change the settings, and then click **OK**.
4. In the **Create LDEVs** window, click **Finish**.
5. In the **Confirm** window, click **Apply**.

The setting is changed.

If **Go to tasks window for status** is checked, the **Tasks** window opens.

Removing the DP-VOL to be registered

If you do not want to register the DP-VOL, you can remove it from the registering task.

1. In the **Selected LDEVs** table in the **Create LDEVs** window, select the LDEV, and then click **Remove**. A message appears asking whether you want to remove the selected row or rows. If you want to remove the row, click **OK**.
2. Click **Finish**.
3. In the **Confirm** window, click **Apply**.

   The LDEV is removed.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Formatting LDEVs in a Windows environment

In a Windows environment, both Normal Format or Quick Format are commonly used. In this environment, Quick Format consumes less thin provisioning pool capacities than Normal Format.

On Windows Server 2008, using Normal Format issues Write commands to the overall volume (for example, overall "D" drive). When Write commands are issued, pages corresponding to the overall volume are allocated, therefore, pool capacities corresponding to the ones of the overall volume are consumed. In this case, the thin provisioning advantage of reducing capacities is lost.

Quick Format issues Write commands only to management information (for example, index information). Therefore, pages corresponding to the management information areas are allocated, but the capacities are smaller than the ones consumed by Normal Format.

Monitoring capacity and performance

Monitoring pool capacity

The storage system monitors the pool's free capacity in accordance with threshold values defined when you create pools. If the pool capacity reaches the threshold values, warnings are issued as SIMs to Storage Navigator and SNMP traps to the open-systems host. See Monitoring pool usage levels on page 5-89 for more information.

You can provision a larger virtual capacity beyond the pool capacity by using DP-VOLs of Dynamic Provisioning or Dynamic Tiering. However, when the pool's free capacity is depleted, you can lose access to DP-VOLs that require more pool capacity. For example, if the pool usage rate is 100% due to increased write operations, then I/O is not accepted and I/O will be stopped for a DP-VOL that failed to receive needed pool capacity. Therefore, you should carefully monitor the pool usage or pool free capacity, as well as the level of provisioned virtual capacity.

Protecting data during pool shortages

To protect data from reading and writing to the DP-VOL when the pool is full, you can apply access attributes to a volume. To do this, you need to enable the use of the Hitachi Data Retention Utility, by insuring the license is installed and using system option mode 729. This protection method applies a Protect attribute to the DP-VOL to protect volumes against write operations when the pool is full. See Assigning an access attribute to a volume on page 6-4 for more details.

The Protect attribute is applied to the DP-VOL and is used in conjunction with other Hitachi software products. When the Protect attribute is applied to the DP-VOL, **Permitted** appears in the **S-VOL** field and **0 day** appears in the **Validation** field of the Hitachi Data Retention Utility window. However, when the Protect attribute is added to the DP-VOL with the S-VOL unacceptable attribute available in the Hitachi Data Retention Utility, **Not Permitted** appears in the **S-VOL** field in the Data Retention window.

Monitoring pool usage levels

Several tools are available that show both the current pool usage rates and the changes over time for those usage rates. These tools help you monitor the pool free space and estimate when you will need to increase the pool capacity by adding pool volumes.

In the Storage Navigator Pool window, use the Virtual Volumes tab to view DP-VOL usage rates and pool usage rates (see Pools window after selecting pool (Pools window) on page E-3 and (Top window when selecting a pool under Pools on page E-10.

If you have Hitachi Command Suite, you can monitor DP-VOL usage and pool usages rates using the time-variable graph.

Monitoring performance

You can monitor system performance using Performance Monitor (see the *Performance Guide*). You can monitor information on pools and DP-VOLs using Command Control Interface (CCI) (see Command Control Interface User and Reference Guide).

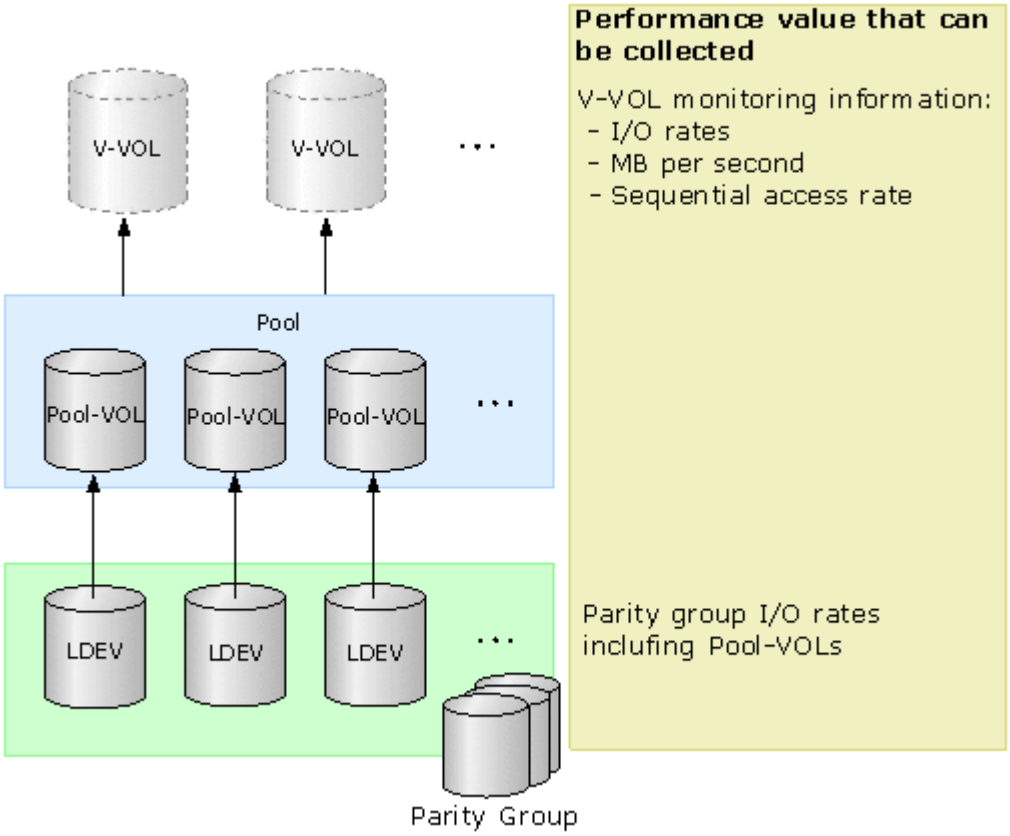
The following activities help you to monitor and control performance of the DP-VOL. Collecting monitor information and subsequent tuning may increase throughput and the operating rates.

- **Collecting monitor information.** Collecting the following monitor information helps you determine the pool load (including the access frequency, the trend of pool usage rates, and the access load upon data drives) and DP-VOL load (including the access frequency and the trend of pool allocation rates). You can then use this monitor information to tune the appropriate allocation.
  - Access frequency of DP-VOL, read hit rates, and write hit rates (using Performance Monitor)
  - Usage rates of property groups of pools (using Performance Monitor)
  - Pool usage and elapsed time of pool usage (using Hitachi Command Suite).
  - DP-VOL usage (stored data rates) and elapsed time of pool usage (using Hitachi Command Suite).
  - Dynamic Tiering performance monitoring of pool storage
- **Possible tuning actions (without Dynamic Tiering)**. The following techniques using ShadowImage or Hitachi Tiered Storage Manager will move a DP-VOL.
  - The DP-VOL is copied using ShadowImage from a pool with an I/O bottleneck. For more information, see *Hitachi ShadowImage® User Guide*.
  - When normal volumes exist in the same parity group as the pool-VOL, Hitachi Tiered Storage Manager can be used to move the normal volume to another parity group that is not shared with a pool-VOL. For more information, see Hitachi Hitachi Command Suite Software User Guide (MK-90HC172).
  - ShadowImage copies a DP-VOL with a high I/O load to a pool with a lower access level to adjust the pool load.

Managing I/O usage rates example

The following figure illustrates an example of managing I/O usage rates. To manage I/O and adjust the pool load, you can use:

- ShadowImage to copy a DP-VOL with a high load to an under-utilized pool.
- Hitachi Tiered Storage Manager to migrate the DP-VOL data with a higher load to a pool with extra performance capability.



Tuning with Dynamic Tiering

If Dynamic Tiering is active on your storage system, you can monitor access frequency and performance use, and while Dynamic Tiering automatically relocates data to the most suitable data drive (tier). You can configure monitoring to be automatic or manual. In both cases, relocation of the data is automatically determined based on monitoring results.

For details, see Dynamic Tiering on page 5-19

Thresholds

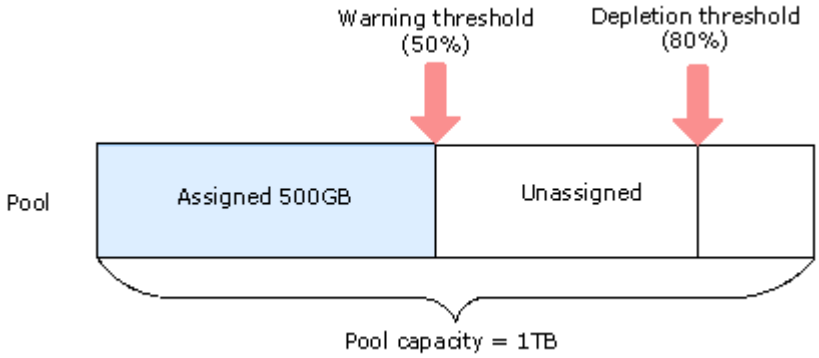
Pool utilization thresholds

Dynamic Provisioning monitors pool capacity using thresholds. A threshold is the proportion (%) of used capacity of the pool to the total pool capacity. Each pool has its own pool threshold values.

- Warning Threshold: Set the value between 1% and 100%, in 1% increments. The default is 70%.
- Depletion Threshold: Set the value between 1% and 100%, in 1% increments. The default is 80%. The depletion threshold must be higher than the Warning threshold

Pool usage that reaches or exceeds either threshold will cause a warning to be issued in the form of SIMs (Service Information Messages) to Storage Navigator and SNMP (Simple Network Management Protocol) traps to the open-systems host. For more information on SNMP traps and the SNMP Manager, see the *Hitachi SNMP Agent User Guide*. See Working with SIMs on page 5-95 for more information about SIMs.

The following figure illustrates a total pool capacity of 1 TB, Warning Threshold of 50%, and Depletion Threshold of 80%. If the used capacity of the pool is 50% (500 GB) or more of the total pool capacity, a SIM is reported to Storage Navigator and an SNMP trap is reported to the open-systems host. If the used capacity of the pool increases and reaches the Depletion Threshold (80 %) or more, a SIM and an SNMP trap are reported again.



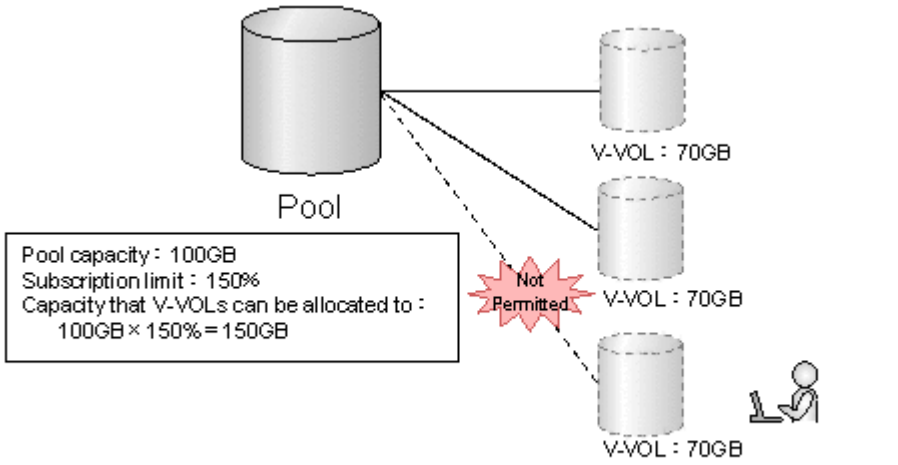
Pool subscription limit

The value of using subscription limit is to manage the maximum amount of over-provisioning that is acceptable for a pool. By managing the pool subscription limit, you can control the potential demand for storing data that might exceed the pool capacity.

The subscription limit is the ratio (%) of the total DP-VOL capacity that has been configured to the total capacity of the pool. When the subscription limit is set, you cannot configure another DP-VOL if the new DP-VOL capacity would cause the subscription limit to be exceeded.

For example, if the pool capacity is 100 GB and the subscription limit is 150%, you can configure up to a total of 150 GB of capacity to the DP-VOLs related to the pool.

The following figure depicts setting the subscription limit of pool capacity.



Cannot set V-VOL because the capacity exceeds 150%.

Monitoring total DP-VOL subscription for a pool

You can configure the Subscription Limit of total DP-VOL capacity to pool capacity. This prevents a new DP-VOL capacity that exceeds the configured subscription limit from being allocated and is associated to the pool. If you specify more than 100% as the Subscription Limit or the subscription limit is not set, you must monitor the free capacity of the pool because it is possible that writes to the DP-VOLs may exceed pool capacity. For details about the Subscription Limit, see Create Pools window on page E-19.

The used value displayed on the cell for **Current** in the **Subscription (%)** is truncated after the decimal point of the calculated value. Therefore, the actual percentage of DP-VOL assigned to the pool may be larger than the value displayed on the window. If you create a new DP-VOL of the same size as the existing DP-VOL, the larger size of capacity which is displayed on the **Current** cell is necessary.

For example, if 3 GB V-VOL is related to an 11.89 GB pool, the capacity (%) is calculated as follows:

```
(3÷11.89)×100 = 25.23....(%)
```

In this case, 25 (%) is displayed on the cell for **Current** in the **Subscription (%)**. If you create a new V-VOL of the same size as the existing V-VOL, 26 (%) or more remaining capacity is necessary.

Changing pool thresholds

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

   The pool name appears below **Pool**.
2. From the **Pools** table, select the pool with the threshold you want to change.

To select multiple pools that are consecutively listed, highlight all of the pools to be selected and press the **Shift** key. To select separate pools, click each pool while pressing the **Ctrl** key.

3. Click **More Actions**, and then select **Edit Pools**.
4. In the **Edit Pools** window, check **Warning Threshold** or **Depletion Threshold**.
5. Type the threshold values in the text box.

   The threshold value can be within the range of values indicated below the text box. The **Depletion Threshold** value can be equal to or greater than the **Warning Threshold**.

Note: For a pool where only one user-defined threshold is set, the system assigns the system threshold (fixed at 80%). The lower value of the single user-defined threshold and the fixed system threshold are set as the **Warning Threshold**; the higher value of the two is set as the **Depletion Threshold**. After one of the thresholds is changed, the system threshold cannot be enabled again.

A SIM code is reported when the pool usage capacity exceeds the threshold changes.

6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing the pool subscription limit

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
2. From the **Pools** table, select the pool with the subscription limit you want to change.

   To select multiple pools that are consecutively listed, highlight all of the pools to be selected and press the **Shift** key. To select separate pools, click each pool while pressing the **Ctrl** key.
3. Click **More Actions**, and then select **Edit Pools**.
4. In the **Edit Pools** window, check **Subscription Limit**, and then type the subscription limit percentage.

   If the subscription limit is blank, then it is disabled, and any amount of DP-VOLs can be created regardless of the pool free capacity.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Working with SIMs

About SIMs

Dynamic Provisioning and Dynamic Tiering provide Service Information Messages (SIMs) to report the status of the DP-VOLs and pools. The SIM level is Moderate. If an event associated with a pool occurs, a SIM is output to Storage Navigator to alert the user, and an SNMP trap is reported to the open-systems host.

SIM reference codes

The following table provides information about SIM reference codes associated with Dynamic Provisioning or Dynamic Tiering.

SIM Code (XXX = hexadecimal pool number)	Event	Thresholds or Values	Types of reports		
			Report to the host	Completion report to Storage Navigator	Information to the operator
620XXX	Pool usage level exceeded the Warning Threshold	1% to 100% (in 1% increments). Default: 70%	Yes	Yes	No
621XXX	Pool usage level exceeded the System Threshold	Default: 80%	Yes	Yes	No
622XXX	Pool is full	100%	Yes	Yes	No
623XXX	Error occurred in the pool	Not applicable	Yes	No	Yes
624000	No space in the shared memory	Not applicable	Yes	Yes	Yes
625000	Pool usage level continues to exceed the highest pool threshold. SOM 734 must be enabled.	Highest pool threshold	Yes	Yes	No
626XXX	Pool usage level exceeded the Depletion Threshold	1% to 100% (in 1% increments). Default: 80%	Yes	Yes	No
627XXX	Pool-VOL is blocked	Not applicable	Yes	No	Yes

SIM Code (XXX = hexadecimal pool number)	Event	Thresholds or Values	Types of reports		
			Report to the host	Completion report to Storage Navigator	Information to the operator
628000	The Protect attribute of Data Retention Utility is set.	Not applicable	Yes	Yes	Yes

Automatic completion of a SIM

Some SIMs are completed automatically when you resolve the problem that caused the SIM. SOM 734 must be enabled for automatic completion of a SIM. Automatic completion of a SIM removes it from the system with no additional manual intervention. After the SIM is automatically completed, the status of the SIM changes to **completed** in Storage Navigator in the Confirm window.

The following SIMs are automatically completed when you resolve the problem causing the SIM.

- SIMs 620XXX, 621XXX, 625000, and 626XXX are automatically completed if you increase pool capacity by adding pool-VOLs because the condition that caused the SIM removed.
- SIMs are automatically completed in the following cases:
  - SIM 620XXX

    If the DP pool number XXX usage level falls below both of two effective thresholds, SIM is automatically completed.
  - SIM 621XXX

    In the pool of the pool number XXX, if the DP pool usage level falls below both of two effective thresholds,SIM is automatically completed.
  - SIM 625000

    In all pools in the storage system, if every DP pool's usage level falls below the higher of two effective thresholds, SIM is automatically completed.
  - SIM 626XXX

    If the DP pool number XXX, usage level falls below both of the two effective thresholds, SIM is automatically completed.

Manually completing a SIM

Some SIMs must be manually completed to clear them from the system.

After the trouble that caused the SIM is solved, you can manually complete the SIM. After manually completing a SIM, the status of the SIM changes to **completed**. If you complete the SIM before the underlying cause is solved, the SIM may reoccur.

1. Perform the troubleshooting associated with the issued SIM. For information on troubleshooting, see Troubleshooting Dynamic Provisioning on page 8-2.
2. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

   The pool name appears below **Pool**.
3. Click **More Actions**, and then select **Complete SIMs**.

   OR

   From **Pool** in the **Actions** menu, select **Complete SIMs**.

   The **Complete SIMs** window opens.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   It takes time if many SIMs need to be completed.

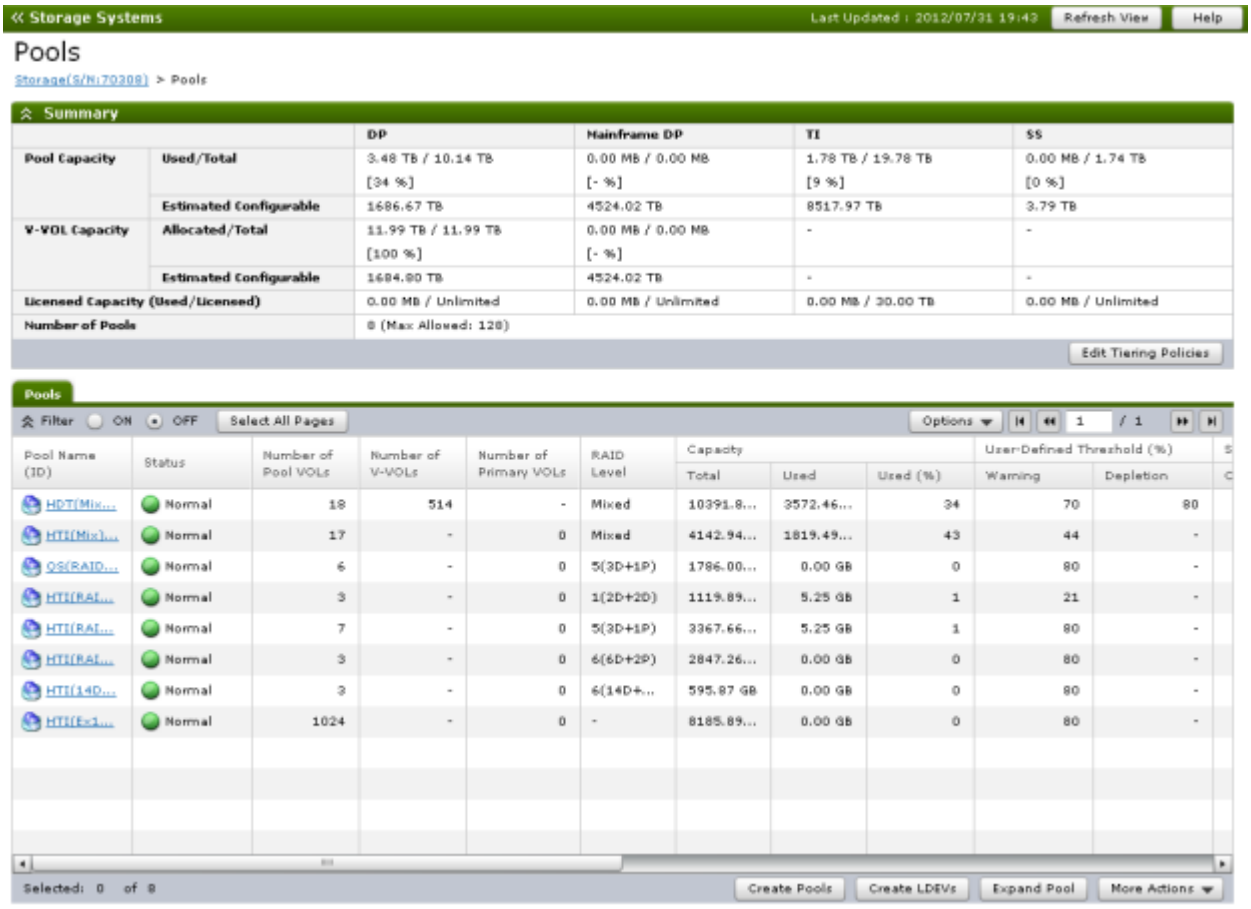
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

You can check whether a SIM completes successfully in the Storage Navigator main window. For details, see the *Hitachi Storage Navigator User Guide*.

Managing pools and DP-VOLs

Viewing pool information

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pools**.
2. View the pool information.



For details about the window for pool information, see Pools window after selecting pool (Pools window) on page E-3 and Top window when selecting a pool under Pools on page E-10.

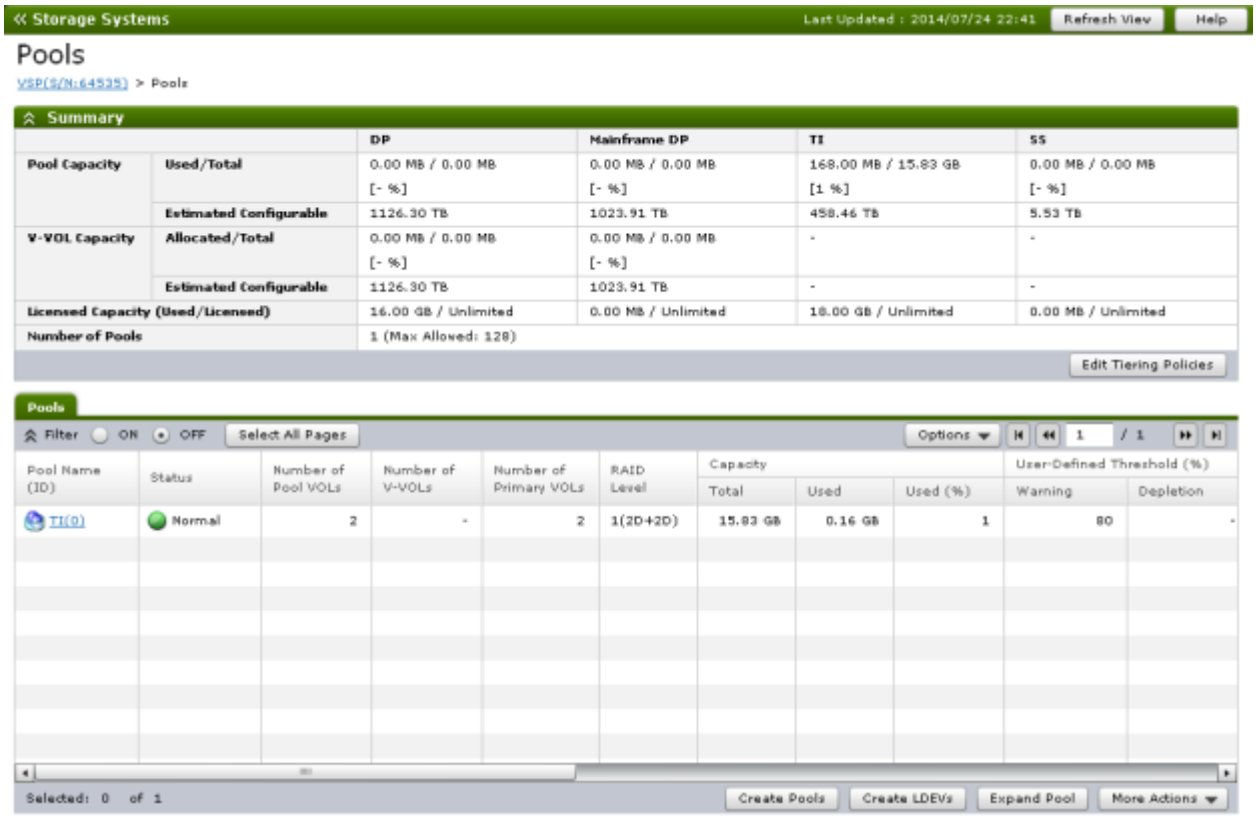
Viewing used pool capacity

The following procedures can be used to find the used capacity of a pool:

- Viewing the used capacity of each pool on page 5-98
- Viewing the used capacity of a Thin Image pool on page 5-99

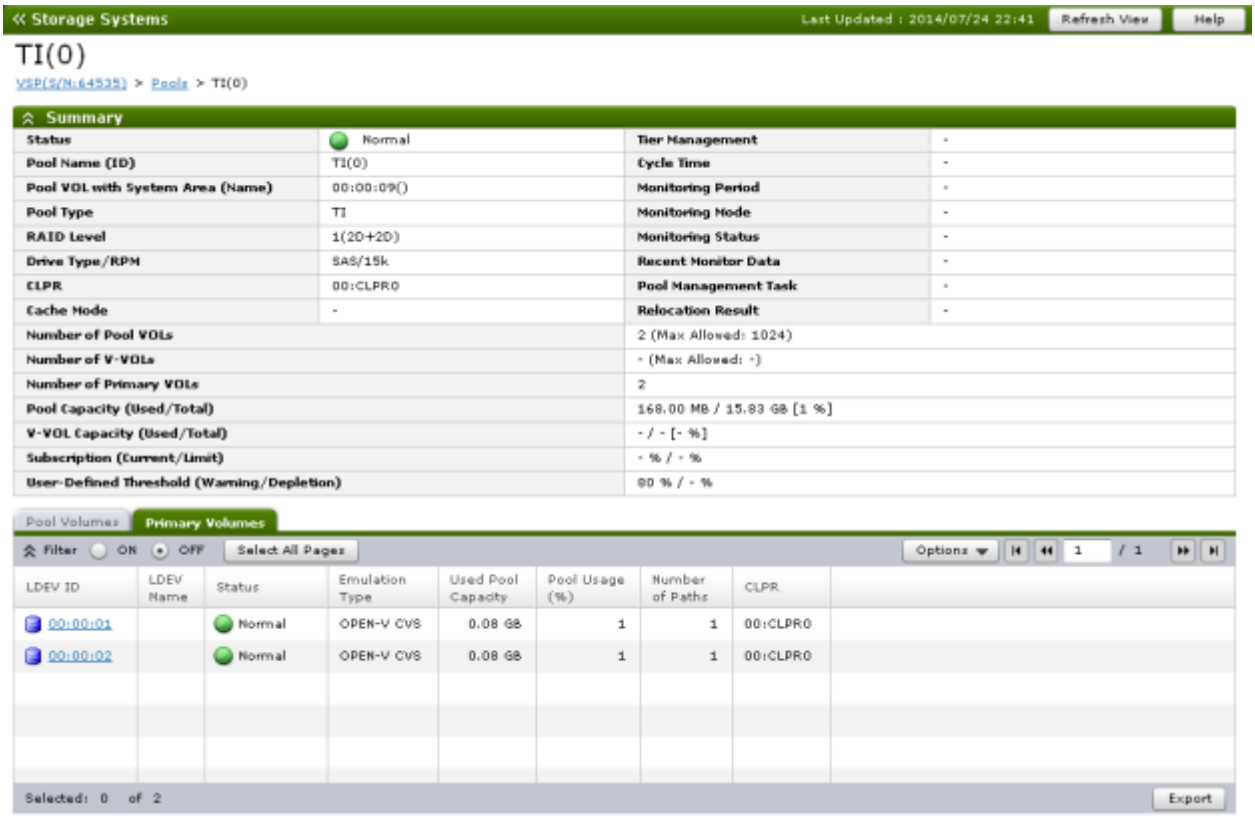
Viewing the used capacity of each pool

1. In the **Storage Systems** tree on the left pane of the top window, select **Pools**.
2. The used pool capacity of pools appears on the **Used** column in the **Pools** tab.



Viewing the used capacity of a Thin Image pool

1. In the **Storage Systems** tree on the left pane of the top window, select **Pools**.
2. From the **Pools** table on the right, click the pool name with the used capacity you want to see.
3. Click the **Primary Volumes** tab.
4. The used pool capacity of primary volumes appears in the **Used Pool Capacity** column.



For details about Thin Image pairs, see the *Hitachi Thin Image User Guide*.

Viewing formatted pool capacity

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of a pool you want to confirm the free pool capacity.
3. Click **More Actions** to select **View Pool Management Status**.
   The **View Pool Management Status** window appears.

Following are cases that the free space of the pool is not formatted. In those cases, the free space of the pool may not increase:

- Pools other than the selected pool are being formatted.
- The pool usage level reaches up to the warning threshold or the depletion threshold.
- The selected pool is blocked.
- I/O loads to the storage system are high.
- The cache memory is blocked.
- Pool-VOLs in the selected pool are blocked.
- Pool-VOLs which are external volumes in the selected pool are blocked.
- Correction access executes to the pool-VOL in the selected pool.

- The format function for the free space of a pool is not operating.

  If you want to change the method of performing the function to format the free space of a pool, contact the customer support.

Note: Following are cases that the formatted pool capacity may decrease:

- New pages are being allocated.
- LDEV format is being performed on the pool-VOL.
- Correction copy is being executed.

Viewing the progress of rebalancing the usage level among pool-VOLs

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, click the row of a pool you want to confirm the progress of rebalancing the usage level among pool-VOLs.
3. Click **More Actions** to select **View Pool Management Status**.

   The **View Pool Management Status** window appears.

Following are cases that the progress ratio may not increase:

- The usage level is being rebalanced among the pool-VOLs in pools other than the selected pool.
- Tier relocation is performed.

Increasing pool capacity

Adding the pool-VOL to the pool created for Dynamic Provisioning or Dynamic Tiering increases the pool capacity. The amount of pool capacity registered in the pool represents the pool capacity. You need to check the pool free capacity to determine if additional pool capacity is required. You cannot increase the pool capacity while it is being shrunk.

Notes on using Dynamic Provisioning

If **Mixable** is set to **Enabled**, notes on adding the pool-VOL to the pool are as follows:

- The internal volume, and the external volume whose **Cache Mode** is set to **Disable** cannot coexist.
- The external volume whose **Cache Mode** is set to **Enable**, and the external volume whose **Cache Mode** is set to **Disable** cannot coexist.

If **Mixable** is set to **Disabled**, notes on adding the pool-VOL to the pool as follows:

- Pool-VOLs of different RAID levels cannot coexist.
- The internal volume and external volume cannot coexist.

Notes on using Dynamic Tiering

- When pool-VOLs with the available monitoring information are added in a pool, tier relocation is performed. When pool-VOLs with no available monitoring information are added in a pool, the page usage rate is averaged out in a tier.
- If **Mixable** is set to **Enabled**, RAID 1 volume and an external volume can be registered in a pool. If **Mixable** is set to **Disabled**, a RAID 1 volume and an external volume cannot be registered in a pool.
- If the pool-VOL is the external volume, set **Enable** for **Cache Mode**.
- If the pool-VOLs are added, the tier relocation being performed stops.

To increase pool capacity

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
2. From the **Pools** table, select the pool for which you want to increase the capacity. You cannot increase pool capacity for multiple pools.
3. Click **Expand Pool**.
4. In the **Expand Pool** window, select the pool-VOL.
   a. Click **Select Pool VOLs**.
   b. In the **Select Pool VOLs** window, from the **Available Pool Volumes** table, select the pool-VOL you want to assign, and then click **Add**.
      The selected pool-VOLs are registered in the **Selected Pool Volumes** table.
      Up to 1024 volumes can be added including the volumes already in the pool.

Note: If necessary, perform the following steps:

- From **Filter** option, select **ON** to filter the rows.
- Click **Select All Pages** to select pool-VOLs in the table. To cancel the selection, click **Select All Pages** again.
- Click **Options** to specify the unit of volumes or the number of rows to be viewed.
- To set the tier rank of an external volume to a value other than **Middle**, select a tier rank from **External LDEV Tier Rank**, and then click **Add**.
- For a pool, you can add volumes whose **Drive Type/RPM** settings are the same and whose **RAID Level**s are different. For example, you can add the following volumes to the same pool:
  Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (3D+1P)
  Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (7D+1P)

   c. Click **OK**.

The **Select Pool VOLs** window closes. The number of the selected pool volumes appears in **Total Selected Pool Volumes**, and the total capacity of the selected pool-VOL appears in **Total Selected Capacity**.

5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing a pool name

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
2. From the **Pools** table, select the pool with the name you want to change.

   To select multiple pools that are consecutively listed, highlight all of the pools to be selected and press the **Shift** key. To select separate pools, click each pool while pressing the **Ctrl** key.
3. Click **More Actions**, and then select **Edit Pools**.
4. In the **Edit Pools** window, in **Pool Name**, specify a name for this pool.
   a. In **Prefix**, type the characters that will become the fixed characters for the beginning of the pool name. The characters are case-sensitive.
   b. In **Initial Number**, type the initial number that will follow the prefix name.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Recovering a blocked pool

This procedure is for failure recovery of a blocked pool. Ordinarily, you should not need to use this procedure. A recovered pool can be used, but the former data is lost.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

   The pool name appears below **Pool**.
2. From the **Pool** table, select the pool to be recovered.

   To select multiple pools that are consecutively listed, highlight all of the pools to be selected and press the **Shift** key. To select separate pools, click each pool while pressing the **Ctrl** key.
3. Click **More Actions**, and then select **Restore Pools**.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

The recovery time for pools varies depending on pool usage or DP-VOL usage. Allow roughly 20 minutes of recovery time for every 100 TB of pool or DP-VOL usage. Recovery time may vary depending on the workload of the storage system at the time of recovery.

Decrease pool capacity

About decreasing pool capacity

You can decrease pool capacity by deleting pool-VOLs.

When a pool-VOL is removed from a pool, all the used pages in the pool-VOL are moved to other pool-VOLs.

When you delete a pool or decrease the pool capacity, the released pool-VOLs (LDEVs) will be blocked. If they are blocked, format them before using them. If the blocked pool-VOL is an external volume, use Normal Format when formatting the volume.

You can decrease pool capacity for up to eight tasks at the same time. Do not execute a Command Control Interface command to also decrease the capacity of the pool whose capacity is already in the process of being decreased.

You cannot decrease pool capacity while doing any of the following to a pool.

- Creating the pool.
- Deleting the pool.
- Increasing the pool.
- Decreasing the pool.
- Recovering the pool.
- Stopping decreasing the pool.
- Changing the threshold.
- Reclaiming zero pages.
- Creating DP-VOLs.
- Increasing DP-VOL capacity.

If the shrink pool operation has abnormally ended, it may be caused by one or more of the following:

- Maintenance of a cache memory is performed while the pool capacity is being decreased.
- Errors occur on a cache memory while the pool capacity is being decreased.
- The I/Os load to DP-VOLs related to the pool is high.
- DP-VOLs related to the pool are being blocked.

If the shrink pool operation has abnormally ended, perform one or more of the following operations:

- Restore a cache memory, and then perform the shrink pool operation again.
- When the I/Os load to DP-VOLs related to the pool is low, perform the shrink pool operation again.
- Delete or format DP-VOLs related to the pool, and then perform the shrink pool operation again.

Note: You cannot perform the following operations on a pool while the pool volume capacity is in the process of shrinking. Wait until shrinking completes or stop the shrinking process.

- Expand Pool
- Shrink Pools
- Edit Pools
- Restore Pools

If you delete the pool-VOL with the pool's system area, the used capacity and the management area will move to other pool volumes. If you delete the pool-VOL with system area, a different system area pool-VOL will be assigned automatically according to the priority shown in the following table. A pool must include one or more pool-VOLs.

Priority	Hard disk drive type
1	SATA-W/V or SATA-E
2	SAS7.2K
3	SAS10K
4	SAS15K
5	SSD
6	External volume

If multiple pool-VOLs of the same hard disk drive type exist, the priority of each is determined by internal index of the storage system.

If pool capacity is decreased soon after creating a pool or adding a pool-VOL, processing may take a while to complete.

Notes on using Dynamic Provisioning

You cannot delete a pool-VOL under these conditions.

- If the pool-VOL is deleted, the used capacity of the pool-VOL exceeds the pool threshold.
- If the pool-VOL is deleted, the subscription rate of the total V-VOL capacity exceeds the subscription limit.
- If the pool-VOL with system area is deleted, more than 4.2 GB of free space is necessary in the pool.

Notes on using Dynamic Tiering

You cannot delete a pool-VOL under these conditions.

- If the pool-VOL is deleted, the used capacity of the pool-VOL exceeds the pool threshold.
- If the pool-VOL is deleted, the subscription rate of the total V-VOL capacity exceeds the subscription limit.
- If the pool-VOL with system area is deleted, more than 4.2 GB of free space is necessary in the pool.

When the pool-VOL is deleted, the pages contained in the deleted pool-VOL transfer to another pool-VOL in the same tier. If the used capacity in the tier exceeds **Rate of Free Space Newly Allocated to**, the overflowing pages transfer to another tier.

When pool-VOLs in the pool are empty, the appropriate tier is deleted.

Deleting the pool-VOL stops tier relocation. The process resumes after the pool-VOL is deleted.

Decreasing pool capacity

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
   The pool name appears below **Pool**.
2. Select the pool that contains the pool-VOLs to be deleted.
3. From the **Pool volumes**, select the pool-VOL to be deleted.
   To select multiple pool-VOLs that are consecutively listed, highlight all of the pool-VOLs to be selected and press the **Shift** key. To select separate pool-VOLs, click each pool-VOL while pressing the **Ctrl** key.
   You cannot delete pool-VOLs unless **Shrinkable** is applied.
4. Click **Shrink Pool**.
   The **Shrink Pool** window opens.
   The details of **Before Shrinking** and **After Shrinking**, including the pool capacity, the used pool capacity and the free pool capacity, appears in **Prediction Result of Shrinking**.
5. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Stopping the decrease of pool capacity

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
2. From the **Pools**, select the pool for which you want to stop decreasing pool capacity.
   To select multiple pools that are consecutively listed, highlight all of the pools to be selected and press the **Shift** key. To select separate pools, click each pool while pressing the **Ctrl** key.

3. Click **Stop Shrinking Pools**.
   The **Stop Shrinking Pools** window opens.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Deleting a tier in a pool

To delete a tier in a pool, you must delete all the pool-VOLs in the tier to be deleted.

If you delete a pool, its pool-VOLs (LDEVs) will be blocked. If they are blocked, format them before using them.

You cannot delete the pool-VOL when:

- Creating the pool.
- Deleting the pool.
- Increasing the pool capacity.
- Decreasing the pool capacity.
- Restoring the pool.
- Stopping decreasing the pool capacity.
- Changing the threshold.
- Initializing the pool capacity.
- Changing the external LDEV tier rank

Notes on deleting a tier in a pool

You cannot delete a pool-VOL under these conditions.

- If the pool-VOL is deleted, the used capacity of the pool-VOL exceeds the pool threshold.
- If the pool-VOL is deleted, the subscription rate of the total V-VOL capacity exceeds the subscription limit.
- If the pool-VOL with system area has less than 4.2 GB of free space. There must be 4.2 GB of free space in the pool in order to delete the pool-VOL with system area.

Deleting the pool-VOL stops the tier relocation. The process resumes after the pool-VOL is deleted.

To delete a tier in a pool

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
   The pool name appears below **Pool**.
2. Select the pool that contains the pool-VOLs to be deleted.
   The pool information appears on the right.

3. Select the **Pool volumes** tab and select all the pool-VOLs contained in the tier to be deleted.

   To select multiple pool-VOLs that are consecutively listed, highlight all of the pool-VOLs to be selected and press the **Shift** key. To select separate pool-VOLs, click each pool-VOL while pressing the **Ctrl** key.

   You cannot delete a pool-VOL unless **Shrinkable** has been applied.
4. Click **Shrink Pool**.
5. In the **Shrink Pool** window, verify the changes.

   The details of **Before Shrinking** and **After Shrinking**, including the pool capacity, the used pool capacity and the free pool capacity, appears in **Prediction Result of Shrinking**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Deleting a pool

When you delete a pool, its pool-VOLs (LDEVs) are blocked. If the pool-VOLs are blocked, they must be formatted before they can be reused. If the blocked pool-VOL is an external volume, select **Normal Format** when formatting the volume. You can delete a pool only when all of the DP-VOLs have been deleted.

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
2. From the **Pools** table on the right, select the pool to be deleted.

   You can select multiple pools with the **Shift** key if the LDEV IDs are listed consecutively. If the pools are not in consecutive order, click the LDEV ID of each pool that you want to delete while pressing the **Ctrl** key.
3. Click **More Actions**, and then select **Delete Pools**.

   The **Delete Pools** window opens.

   You cannot delete a pool whose usage is not 0%, or a pool for which DP-VOLs are assigned.
4. Click **Finish**.

   The **Confirm** window opens.

   To continue with the shredding operation and delete volume data, click **Next**. For details about the shredding operation, see *Hitachi Volume Shredder User Guide*.

   If the pool is blocked, you might not be able to perform shredding operations.
5. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Note: When the pool-VOLs of a pool are empty, the appropriate tier is deleted.

Changing external LDEV tier rank

Note: When using Dynamic Tiering, if all pool-VOLs are deleted, the tier is also deleted.

1. In the **Storage Systems** tree on the left pane of the top window, select **Pool**.
   The pool name appears below **Pool**.
2. From the **Pool volumes** table in the right pane, select the pool-VOL that has the external LDEV tier rank you want to change.
   You cannot change the external LDEV tier rank of a pool-VOL if **External Volume** is not displayed in the **Drive Type/RPM** column.
   To select multiple pool-VOLs that are consecutively listed, highlight all of the pool-VOLs to be selected and press the **Shift** key. To select separate pool-VOLs, click each pool-VOL while pressing the **Ctrl** key.
3. Click **More Actions** and select **Edit External LDEV Tier Rank**.
   The **Edit External LDEV Tier Rank** window appears.
4. From the **Selected Pool volumes** table, select the pool-VOL with the external LDEV tier rank you want to change.
   To select multiple pool-VOLs that are consecutively listed, highlight all of the pool-VOLs to be selected and press the **Shift** key. To select separate pool-VOLs, click each pool-VOL while pressing the **Ctrl** key.
5. Click **Change** and select the tier rank.
6. Click **Finish**.
   The **Confirm** window appears.
7. In the **Task Name** text box, enter the task name.
   You can enter up to 32 ASCII characters and symbols in all, except for \ / : , ; * ? " < > |. "date-window name" is entered by default.
8. In the **Confirm** window, click **Apply** to register the setting in the task.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.

Increasing DP-VOL capacity

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.
   The following is another way to select LDEVs.
   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.
      The pool name appears below **Pool**.
   b. Select the pool associated with the DP-VOL that has the capacity that you want to increase.
   c. Select the **Virtual Volumes** tab.
2. From the table, select the DP-VOL with the capacity you want to increase.

To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.

3. Click **Expand V-VOLs**.

   The **Expand V-VOLs** window opens. If the DP-VOL is selected from the LDEV table in the Logical Devices window, click **More Actions**, and then click **Expand V-VOLs**.

4. In **Capacity**, type the capacity amount.

   You can enter the LDEV capacity to two decimal places within the range of values indicated below the text box.

5. Click **Finish**.

   The **Confirm** window opens.

6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing the name of a DP-VOL

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

      The pool name appears below **Pool**.

   b. Select the pool associated with the DP-VOL you want to rename.

   c. Select the **Virtual Volumes** tab.

2. From the table, select the DP-VOL you want to rename.

   To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.

3. Click **Edit LDEVs**.

   When you selected DP-VOLs from the **Virtual Volumes** table, click **More Actions**, and then Edit LDEVs.

   The **Edit LDEVs** window opens.

4. Check **LDEV Name** and change the LDEV name, if necessary.

   a. In **Prefix**, type the characters that will become the fixed characters for the beginning of the LDEV name. The characters are case-sensitive.

   b. In **Initial Number**, type the initial number that will follow the prefix name.

5. Click **Finish**.

6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

About releasing pages in a DP-VOL

Releasing pages in a DP-VOL frees up pool capacity. When a page in the DP-VOL contains zero data, the free capacity of a pool increases after the pages are released. You can perform the operation to reclaim zero pages on each V-VOL and monitor progress in Storage Navigator. For details, see View Pool Management Status window on page E-72. If you stop the operation to reclaim zero pages, the zero pages that have been reclaimed cannot be restored.

Logically, there is no difference between a page with just zero data and the area of a DP-VOL without a page allotted. Both are effectively identical. However, the former uses pool capacity and the latter does not.

Zero pages can be reclaimed when all the following conditions are satisfied:

- The DP-VOL is not used in conjunction with another VSP product which does not support reclaiming zero pages.

  See Using Dynamic Provisioning or Dynamic Tiering with other VSP products on page 5-10.
- LDEV formatting is not being performed on the DP-VOL.
- The DP-VOL is not blocked.
- The DP-VOL is associated with a pool.
- The pool associated with the DP-VOL is not blocked, or is full and blocked.

Pages that include file system metadata cannot be reclaimed. Refer to the Operating system and file system capacity on page 5-9 for a table with the pool capacity consumed by the file system.

While releasing pages from a DP-VOL, performance of the host I/O to the DP-VOL may temporarily decrease due to scanning for non-zero data.

If you stop an operation to reclaim zero pages in mid-stream, the pages that have been released will remain as free pool capacity.

After an operation to reclaim zero pages, Dynamic Provisioning automatically balances usage levels among pool-VOLs in the pool. This rebalancing is performed on all of the DP-VOLs and pool-VOLs in the pool. If you do not want automatic balancing of the usage levels of pool-VOLs, call the customer support to change your configuration.

Dynamic Provisioning does not automatically balance the usage levels among pool-VOLs if the cache memory is not redundant or if the pool usage reaches up to the threshold.

If all the tracks that belong to a page assigned to a DP-VOL have no records written, you can reclaim the page and return it to the pool's available capacity.

If you have started an operation to reclaim zero pages, and the storage system loses power, the shared memory is disrupted. The operation does not automatically continue after the storage system restarts.

In the following cases, an operation reclaim zero pages stops and DP-VOL pages are not released.

- LDEV formatting is performed while the operation to reclaim zero pages is in progress.
- The pool-VOL accessed by the target DP-VOL is blocked.
- The pool associated with the target DP-VOL is blocked while the operation to reclaim zero pages is in progress.
- Cache memory failure occurs the operation to reclaim zero pages is in progress.
- The DP-VOL is released when the operation to reclaim zero pages is in progress.
- The initial copy operation between TrueCopy pair, Universal Replicator, ShadowImage pair is performed on the DP-VOL in which the zero pages are reclaimed.

Releasing pages in a DP-VOL

You can reclaim pages in a DP-VOL to free pool capacity. If a page assigned to a DP-VOL contains only zero binary data, you can reclaim the page. Before releasing pages in a DP-VOL, see About releasing pages in a DP-VOL on page 5-111).

To release pages in a DP-VOL

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

      The pool name appears below **Pool**.

   b. Select the pool associated with the DP-VOL that has pages you want to release.

   c. Select the **Virtual Volumes** tab.
2. From the table, select the DP-VOL that has pages you want to release.

   To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.
3. Click **More Actions**, and then select **Reclaim Zero Pages**.

   The **Reclaim Zero Pages** window opens.

   You cannot release pages in a DP-VOL when the DP-VOL is not in a normal status or the DP-VOL is in the process of reclaiming zero pages.
4. In **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

After the operation to reclaim zero pages is complete, click **Refresh** in Storage Navigator to update the **Page Status**. If the **Page Status** is not immediately updated, wait a while, and then click **Refresh** again. **Completed** status is displayed when no pages can be reclaimed.

If you have started the reclaiming zero pages operation, and the storage system is powered off the reclaiming zero pages operation will not automatically continue after the storage system restarts.

In any of the following cases, the reclaiming zero pages will stop, and DP-VOL pages will not be released:

- LDEV formatting was performed while reclaiming zero pages.
- The pool-VOL that is being accessed by the target DP-VOL was blocked.
- The pool associated with the target DP-VOL was blocked while reclaiming zero pages.
- Cache memory failure occurred while reclaiming zero pages.
- The DP-VOL was deleted when zero pages were reclaimed.
- The initial copy operation between the TrueCopy pair or the Universal Replicator pair was performed on the DP-VOL in which zero pages were being reclaimed.

Stopping the release of pages in a DP-VOL

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

      The pool name appears below **Pool**.

   b. Select the pool associated with the DP-VOL that has pages you want to release.

   c. Select the **Virtual Volumes** tab.

2. From the table, select the DP-VOL that you want to stop from releasing pages.

   To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.

3. Click **More Actions**, and then select **Stop Reclaiming Zero Pages**.

   The **Stop Reclaiming Zero Pages** window opens.

   You cannot stop releasing the pages in a DP-VOL where zero pages are not being reclaimed.

4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Enabling/disabling tier relocation of a DP-VOL

You can enable or disable tier relocation of individual DP-VOLs or on all DP-VOLs.

DP-VOLs on which tier relocation is disabled are excluded from the targets for the tier range calculation, and are not reflected in the performance information of pools. If tier relocation is disabled on all DP-VOLs in a pool, performance information of a pool is unavailable in the **View Tier Properties** window.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**.

   b. Select the pool associated with the DP-VOL for which tier relocation is to be enabled or disabled.

   c. Click the **Virtual Volumes** tab.

2. From the table, select the DP-VOL for which tier relocation is to be enabled or disabled.

   To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.

   Select multiple DP-VOLs using the **Shift** key (if the DP-VOLs are adjacent), or using the **Ctrl** key (if the DP-VOLs are not adjacent).

3. Click **More Actions**, and then select **Edit LDEVs**.

4. In the **Edit LDEVs** window, check **tier relocation** and select **Enable** or **Disable**.

   Enable allows tier relocation to be performed to the DP-VOL.

   Disable do not allow tier relocation to be performed on the DP-VOL in the case of both automatic and manual tier relocation.

5. Click **Finish**.

6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Deleting a DP-VOL

You cannot delete a DP-VOL if the status is *online*.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Logical Devices**.

   The following is another way to select LDEVs.

   a. In the Storage Navigator main window, in the **Storage Systems** tree, select **Pool**. The pool name appears below **Pool**.

   b. Select the pool associated with the DP-VOLs to be deleted.

   c. Click the **Virtual Volumes** tab.

2. From the table, select the DP-VOL to be deleted.

To select multiple DP-VOLs that are consecutively listed, highlight all of the DP-VOLs to be selected and press the **Shift** key. To select separate DP-VOLs, click each DP-VOL while pressing the **Ctrl** key.

Do the following, if necessary.

- In the **Filter** option, select **ON** to filter the rows.
- Click **Select All Pages** to select all DP-VOLs in the list.
- Click **Options** to specify the unit of volumes or the number of rows to view.

3. Click **More Actions**, and then select **Delete LDEVs**.

   The **Delete LDEVs** window opens.

4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

6

Configuring access attributes

After provisioning your system, you can assign access attributes to open-system volumes to protect the volume against read, write, and copy operations and to prevent users from configuring LU paths and command devices.

Data Retention Utility software is required to assign access attributes to volumes.

- ☐ About access attributes
- ☐ Access attribute requirements
- ☐ Access attributes and permitted operations
- ☐ Access attribute restrictions
- ☐ Access attributes work flow
- ☐ Assigning an access attribute to a volume
- ☐ Changing an access attribute to read-only or protect
- ☐ Changing an access attribute to read/write
- ☐ Enabling or disabling the expiration lock
- ☐ Disabling an S-VOL
- ☐ Reserving volumes

About access attributes

Open-systems volumes, by default, are subject to read and write operations by open-systems hosts. With open-system volumes in this default condition, data might be damaged or lost if an open-systems host performs erroneous write operations. In addition, confidential data on open-systems volumes might be stolen if a malicious operator performs read operations on open-systems hosts.

Therefore, it is recommended that you change the default read and write conditions by assigning an access attribute to each logical volume. Access attributes can be set to read/write, read-only, or protect.

By assigning access attributes, you can:

- Protect a volume against both read and write operations of all hosts.
- Protect a volume against write operations of all hosts, but allow read operations.
- Protect a volume against erroneous copy operations, but allow other write operations.
- Prevent other Storage Navigator users from configuring LU paths and command devices.

One of the following access attributes can be assigned to each logical volume:

- Read/write

  If a logical volume has the read/write attribute, open-systems hosts can perform both read and write operations on the logical volume.

  You can use replication software to copy data to logical volumes that have read/write attribute. However, if necessary, you can prevent copying data to logical volumes that have read/write attribute.

  All open-systems volumes have the read/write attribute by default.
- Read-only

  If a logical volume has the read-only access attribute, open-systems hosts can perform read operations but cannot perform write operations on the logical volume.
- Protect

  If a logical volume has the protect access attribute, open-systems hosts cannot access the logical volume. Open-systems hosts cannot perform either read nor write operations on the logical volume.

Access attribute requirements

To assign access attributes, you need Hitachi Data Retention Utility software installed on the Storage Navigator computer.

Access attributes and permitted operations

Access Attribute	Read Operations from Hosts	Write Operations from Hosts	Specified as P-VOL	Specified as S-VOL
Read/Write	Yes	Yes	Yes	Yes
Read-only	Yes	No	Depends on the replication software	No
Protect	No	No	Depends on the replication software	No
Read/Write and S-VOL disable	Yes	Yes	Yes	No

Access attribute restrictions

Some restrictions apply when you use the following VSP products or functions on a volume that has an access attribute assigned to it.

LUN Expansion (LUSE)

- When creating a LUSE volume, you cannot combine volumes that do not have the read/write access attribute. You can, however, assign an access attribute other than read/write to the resulting LUSE volume.
- You cannot release a LUSE volume that does not have the read/write access attribute.

Virtual LUN

- You cannot convert into spaces volumes that do not have the read/write attribute.
- You cannot initialize customized volumes that do not have the read/write attribute.

Command Control Interface

- You can use Command Control Interface to make some Data Retention Utility settings. You can view some of the CCI settings in the Data Retention Utility user interface.

- When viewing the Data Retention window, another user might be using CCI to change an access attribute of a volume. If the CCI user changes an access attribute of a volume when you are viewing the Data Retention window, you will be unable to change the access attribute of the volume by using Data Retention Utility. If you attempt to change the access attribute of the volume by using the Data Retention Utility, an error occurs. If the error occurs, click **File > Refresh All** on the menu bar of the Storage Navigator main window, and then retry changing the access attribute of the volume.

Automatic starting products

If any software that can start automatically is enabled, you must do one of the following:

- Perform Data Retention Utility operations when the program is not running.
- Cancel the setting of the program start time.

Some software is likely to start automatically at the time specified by the user. For example, if a Volume Migration user or a Performance Monitoring user specifies the time for starting the monitor, the monitor will automatically start at the specified time.

Access attributes work flow

Access attribute workflow includes the following steps:

1. Changing an access attribute to read-only or protect on page 6-5
2. Changing an access attribute to read/write on page 6-7
3. Enabling or disabling the expiration lock on page 6-8
4. Disabling an S-VOL on page 6-8
5. Reserving volumes on page 6-9

Assigning an access attribute to a volume

If you want to protect volumes against both read and write operations from hosts, change the access attribute to protect. To protect volumes against write operations from hosts and allow read operations, change the access attribute to read-only. In both ways, if you set the attribute to a volume by Storage Navigator, S-VOL Disable is automatically set to prevent data in a volume from being overwritten by replication software. If you use Command Control Interface to set the attribute to a volume, you can select whether the S-VOL Disable is set or not. If you set the Protect attribute to the volume when the Dynamic Provisioning pool is full, the S-VOL Disable is not set to the volume.

After you change an access attribute to read-only or protect, the access attribute cannot be changed to read/write for a certain period of time. You can specify the length of this period (called Retention Term) when changing the access attribute to read-only or protect. The retention term can be extended but cannot be shortened.

During the retention term

- Read-only access can be changed to protect or protect can be changed to read-only.
- If you need to change an access attribute to read/write, you must ask the maintenance personnel to do so.

After the retention term is over

- The access attribute can be changed to read/write.
- The access attribute remains read-only or protect until changed back to read/write.

Changing an access attribute to read-only or protect

When changing an access attribute to read-only or protect, observe the following:

- Do not assign an access attribute to a volume if any job is manipulating data on the volume. If you assign an access attribute to such a volume, the job will possibly end abnormally.
- The emulation type of the volume must be one of the following:
  OPEN-3, *OPEN-8*, *OPEN-9*, *OPEN-E*, *OPEN-K*, *OPEN-L*, *OPEN-V*
- The volume must *not* be one of the following:
  - Volumes that do not exist
  - Volumes that are configured as command devices
  - TrueCopy S-VOLs (*)
  - Universal Replicator S-VOLs (*) or journal volumes
  - ShadowImage S-VOLs (*)
  - Thin Image S-VOLs (*)
  - Copy-on-Write Snapshot S-VOL (*)
  - Reserved volumes for Volume Migration
  - Pool volume
  - Thin Image virtual volume
  - Copy-on-Write Snapshot virtual volume

    *Note: The access attribute of S-VOLs may be changed depending on the pair status.

To change an access attribute to read-only or protect

1. Log on to Storage Navigator as a user with the Storage Administrator (Provisioning) role.

2. In the Storage Navigator main window, click **Actions** > **Other Function** > **Data Retention** to open the Data Retention window.

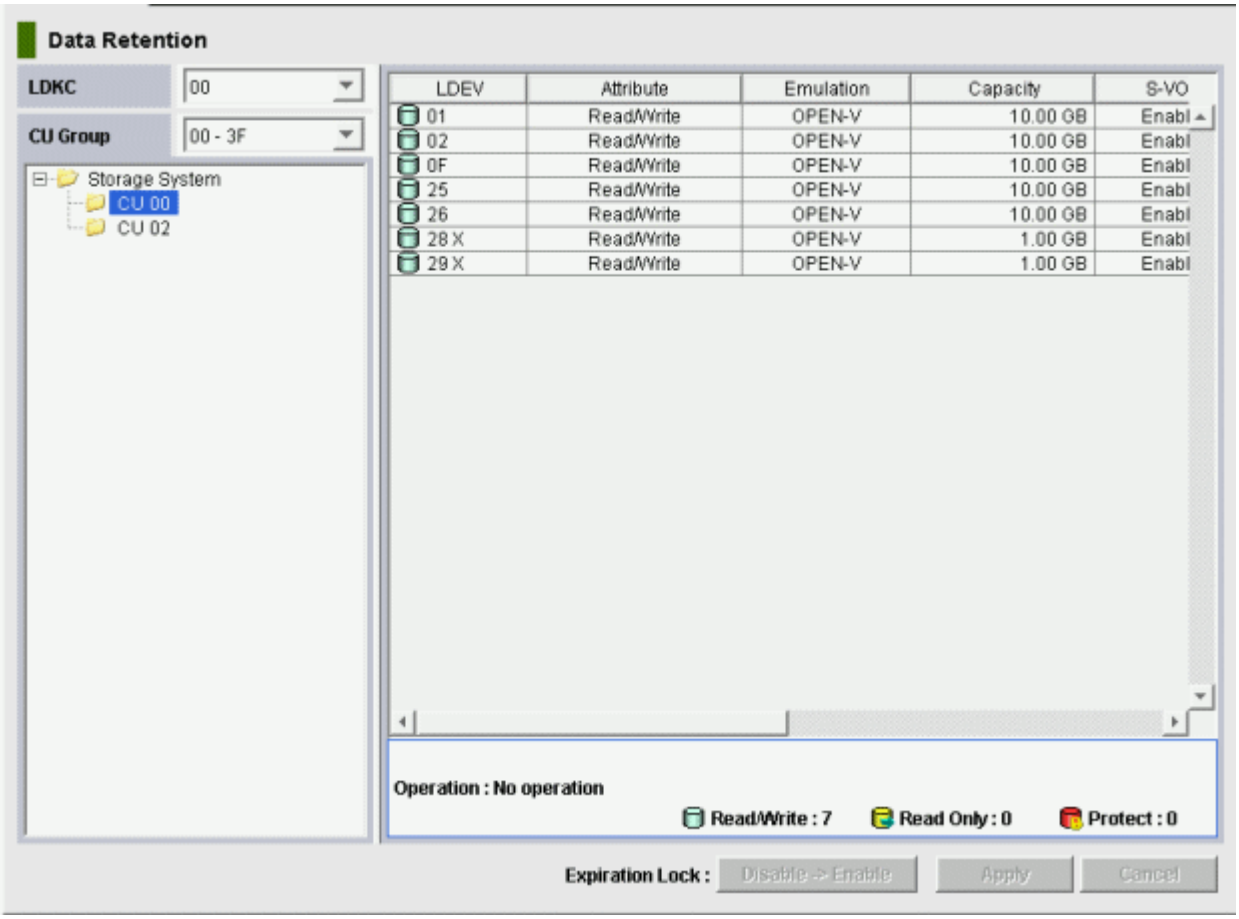


Figure 6-1 Data Retention window

3. Click to change to **Modify** mode.
4. Select an LDKC number in the **LDKC** list, select a group that the CU belongs in the **CU Group** list, and then click a CU in the tree.
5. Right-click a volume whose access attribute you want to change. You may select multiple volumes.
6. Select **Attribute**, and then select **Read Only** or **Protect**.

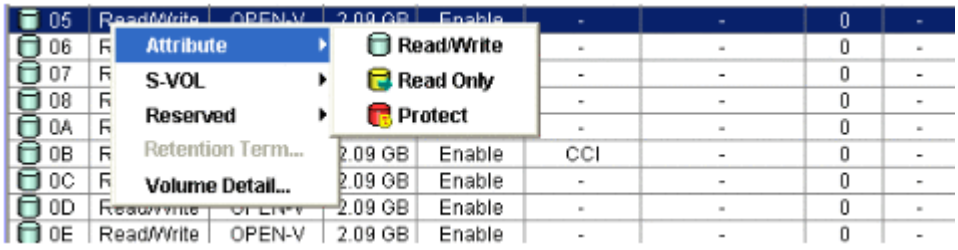


Figure 6-2 Selecting Access Attribute

7. In the **Term Setting** dialog box, specify the retention term. During this period, the access attribute cannot be changed to read/write. You can enter the number of years and days, or select Unlimited. The retention term can be extended but cannot be shortened.
   - years: Specify the number of years within the range of 0 to 60. One year is counted as 365 days, whether the year is a leap year.
   - days: Specify the number of days within the range of 0 to 21900.

   For example, if 10 years 5 days or 0 years 3655 days is specified, the access attribute of the volume cannot be changed to read/write in the next 3,655 days.
8. Click **OK** to close the dialog box.
9. In the Data Retention window, click **Apply** to apply the setting.

To extend the retention term later, open the **Data Retention** window, right-click the volume, and then select **Retention Term**.

Changing an access attribute to read/write

Before changing the access attribute from read-only or protect to read/write, considering the following:

- Do not assign an access attribute to a volume if any job is manipulating data on the volume. If you assign an access attribute to such a volume, the job will possibly end abnormally.
- Make sure that the retention term is expired. If expired, the **Retention Term** column in the **Data Retention** window shows 0. To change the access attribute to read/write within the retention term, contact the customer support.
- Make sure that **Expiration Lock** indicates **Disable -> Enable**. If it indicates **Enable -> Disable**, changing to read/write is restricted by an administrator for some reason. Contact the administrator of your system to ask if you can change the access attribute. (See Enabling or disabling the expiration lock on page 6-8)

To change an access attribute to read/write

1. Log on to Storage Navigator as a user assigned to the Storage Administrator (Provisioning) role.
2. In the Storage Navigator main window, click **Actions** > **Other Function** > **Data Retention** to open the Data Retention window.
3. Click to change to **Modify** mode.
4. Select an LDKC number in the **LDKC** list, select a group in which the CU belongs in the **CU Group** list, and then click a CU in the tree.
5. Right-click a volume for which you want to change access attributes. You may select multiple volumes, select **Attribute**, and then click **Read/ Write**.
6. Click **Apply** to apply the setting.

Enabling or disabling the expiration lock

The expiration lock provides enhanced volume protection. Enabling the expiration lock ensures that read-only volumes and protect volumes cannot be changed to read/write volumes, even after the retention term ends. Disabling the expiration lock changes the access attribute to read/write after the retention term ends.

This setting applies to all volumes in the storage system with the read-only and protect attribute.

To enable the expiration lock

1. Log on to Storage Navigator as a user assigned to the Storage Administrator (Provisioning) role.
2. In the Storage Navigator main window, click **Actions** > **Other Function** > **Data Retention** to open the Data Retention window.
3. Click to change to **Modify** mode.
4. In the **Data Retention** window, verify which button appears beside **Expiration Lock**.
   - If **Disable -> Enable** appears, go to the next step.
   - If **Enable -> Disable** appears, expiration lock is already enabled. You do not need to follow the rest of this procedure because attempts to change access attribute to read/write are already prohibited.
5. Click **Disable -> Enable**. A confirmation message appears.
6. Click **OK**. The button changes to **Enable -> Disable**, and then expiration lock is enabled. When expiration lock is enabled, access attributes of volumes cannot be changed to read/write even after the retention term ends.

To disable the expiration lock, click **Enable -> Disable**. The access attribute can be changed to read/write after the retention term ends.

Disabling an S-VOL

Assigning a read-only or protect attribute is one of the ways to prevent data in a volume from being overwritten by replication software. Volumes having the read-only or protect attribute are not only protected against these copy operations, but are also protected against any other form of write operations.

To protect a volume only from copy operations, you must ensure that the volume has the read/write attribute and then assign the S-VOL Disable attribute to the volume. This setting prohibits the volume from being used as a secondary volume for copy operations.

To disable an S-VOL

1. Log on to Storage Navigator as a user assigned to the Storage Administrator (Provisioning) role.

2. In the Storage Navigator main window, click **Actions** > **Other Function** > **Data Retention** to open the Data Retention window.
3. Click to change to **Modify** mode.
4. Select an LDKC number in the **LDKC** list, select a group that the CU belongs in the **CU Group** list, and then click a CU in the tree.
5. Right-click a volume for which the **S-VOL** column shows **Enable**. You may select multiple volumes.
6. Select **S-VOL** > **Disable**.
7. Click **Apply** to apply the setting.

To use a volume as an S-VOL, ensure that the volume has the read/write attribute and then assign the S-VOL Enable attribute to the volume.

Reserving volumes

By default, all Storage Navigator users with proper permissions can make LU path settings and command device settings. If you perform the following procedure in Storage Navigator, all users, including yourself, will not be allowed to make LU path settings and command device settings on the specified volume. Command Control Interface users can still make LU path settings and command device settings on the volume.

To reserve volumes

1. Log on to Storage Navigator as a user assigned to the Storage Administrator (Provisioning) role.
2. In the Storage Navigator main window, click **Actions** > **Other Function** > **Data Retention**.
3. Click to change to **Modify** mode.
4. In the Data Retention window, select an LDKC number in the **LDKC** list, select a group that the CU belongs in the **CU Group** list, and then click a CU in the tree.
5. Select a volume where the **Reserved** column contains a hyphen. You may select multiple volumes.
6. Right-click the selected volume or volumes, and then select **Reserved** > **Set**.
7. Click **Apply** to apply the setting.

To permit Storage Navigator users to make LU path settings and command device settings on a volume, follow the steps above and select **Reserved** > **Release**. Then call the customer support to ask for SVP settings.

7

Managing logical volumes

After provisioning your system, you can begin to manage open-system logical volumes. Managing logical volumes includes tasks such as configuring hosts and ports, configuring LU paths, setting LUN security on ports, and setting up fibre channel authentication.

LUN Manager is required to manage logical volumes.

- ☐ LUN Manager overview
- ☐ Managing logical units workflow
- ☐ Configuring hosts and fibre channel ports
- ☐ Configuring fibre channel ports
- ☐ Configuring hosts
- ☐ Configuring LU paths
- ☐ Releasing LUN reservation by host
- ☐ LUN security on ports
- ☐ Setting fibre channel authentication
- ☐ Managing hosts

LUN Manager overview

LUN Manager operations

The VSP storage system can be connected to open-system server hosts of different platforms (for example, UNIX servers and PC servers). To configure a system that includes open-system hosts and a VSP storage system, use LUN Manager to configure logical volumes and ports.

One of the important tasks when configuring logical volumes is to define I/O paths from hosts to logical volumes. When paths are defined, the hosts can send commands and data to the logical volumes and also can receive data from the logical volumes.

After the system begins operating, you might need to modify the system configuration. For example, if hosts or disks are added, you will need to add new I/O paths. You can modify the system configuration with LUN Manager when the system is running. You do not need to restart the system when modifying the system configuration.

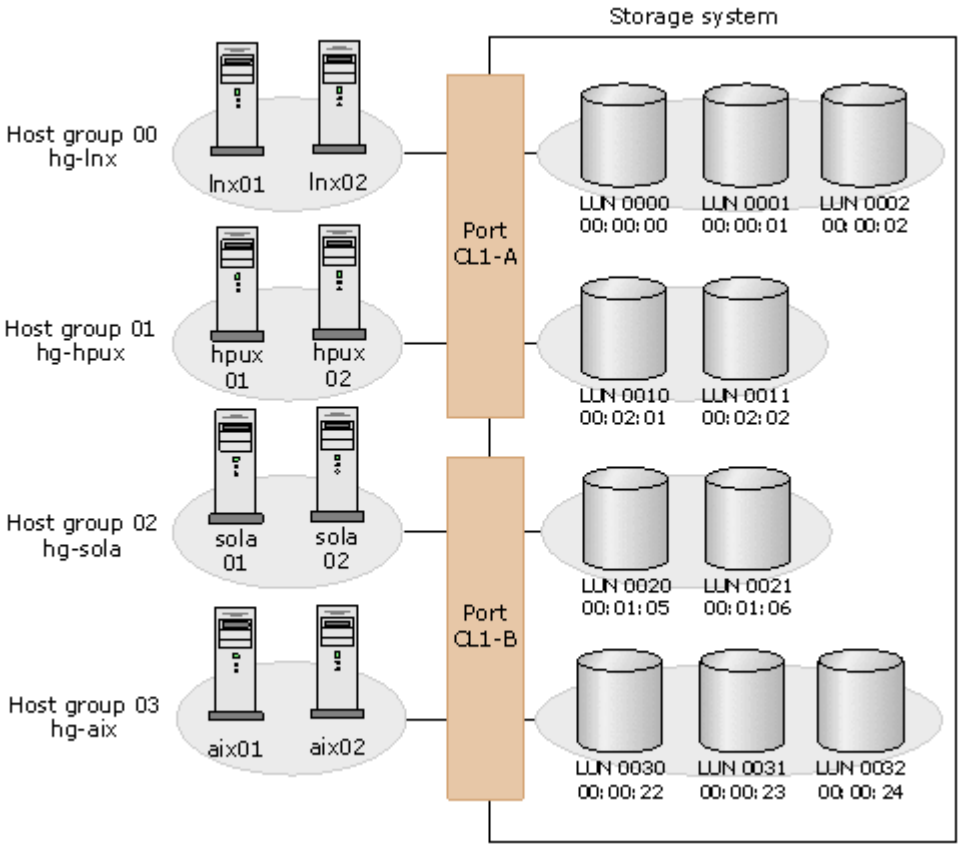
Fibre channel operations

After open-system hosts and the storage system are physically connected by cables, hubs, and so on, use LUN Manager to establish I/O paths between the hosts and the logical volumes. This defines which host can access which logical volume. Logical volumes that can be accessed by open-system hosts are referred to as *logical units* (*LUs*). The paths between the open-system hosts and the LUs are referred to as *LU paths*.

Before defining LU paths, you must classify server hosts by *host groups*. For example, if Linux hosts and Windows hosts are connected to the storage system, you must create one host group for the Linux hosts and another host group for the Windows hosts. Then, you must register the host bus adapters of the Linux hosts in the Linux host group. You must also register the host bus adapters of the Windows hosts in the `windows` host group.

A host group can contain only those hosts that are connected to the same port, and cannot contain hosts that are connected to different ports. For example, if two Windows hosts are connected to port 1A and three Windows hosts are connected to port 1B, you cannot register all five Windows hosts in one host group. You must register the first two Windows hosts in one host group, and then register the remaining three Windows hosts in another host group.

After server hosts are classified into host groups, you associate the host groups with logical volumes. The following figure illustrates LU paths configuration in a fibre channel environment. The figure shows host group `hg-lnx` associated with three logical volumes (00:00:00, 00:00:01, and 00:00:02). LU paths are defined between the two hosts in the `hg-lnx` group and the three logical volumes.



You can define paths between a single server host and multiple LUs. The figure shows that each of the two hosts in the host group `hg-lnx` can access the three LUs.

You can also define paths between multiple server hosts and a single LU. The figure shows that the LU identified by the LDKC:CU:LDEV number 00:00:00 is accessible from the two hosts that belong to the `hg-lnx` host group.

The figure also shows that the LUs associated with the `hg-lnx` host group are addressed by numbers 0000 to 0002. The address number of an LU is referred to as a *LUN* (*logical unit number*). When TrueCopy and other software manipulates LUs, the software use LUNs to specify the LUs to be manipulated.

You can add, change, and delete LU paths when the system is in operation. For example, if new disks or server hosts are added to your storage system, you can add new LU paths. If an existing server host is to be replaced, you can delete the LU paths that correspond to the host before replacing the host. You do not need to restart the system when you add, change, or delete LU paths.

If a hardware failure (such as a CHA failure) occurs, there is a chance that some LU paths are disabled and some I/O operations are stopped. To avoid such a situation, you can define *alternate LU paths*; if one LU path fails, the alternate path takes over the host I/O. For information, see Defining LU paths on page 7-20 and Defining alternate LU paths on page 7-23.

LUN Manager license requirements

Use of LUN Manager on the VSP storage system requires the following:

- A license key on the Storage Navigator computer for LUN Manager software. For details about the license key or product installation, see the *Hitachi Storage Navigator User Guide*.

LUN Manager rules, restrictions, and guidelines

Rules

- In a fibre channel environment, up to 2,048 LU paths can be defined for one host group and up to 2,048 LU paths can be defined for one port.
- Up to 255 host groups can be created for one fibre channel port.

Restrictions

- You cannot define an LU path to volumes reserved by Volume Migration. For more information on Volume Migration, contact the customer support.
- You cannot define an LU path to journal volumes.
- You cannot define an LU path to pool volumes.
- You cannot define an LU path to system disk volumes.
- When defining LU paths, you must not use Command Control Interface and Storage Navigator at the same time.

Guidelines

- If you attempt to apply many settings in the LUN Manager windows, the SVP might be unable to continue processing. Therefore, you should make nor more than approximately 1,000 settings. Note that many settings are likely to be made when defining alternate paths (see Defining alternate LU paths on page 7-23), even though only two commands are required for defining alternate paths.
- Do not perform the following when host I/O is in progress and hosts are in reserved status (mounted):
  - Remove LU paths (see Deleting LU paths on page 7-24)
  - Disable LUN security on a port (see Disabling LUN security on a port on page 7-29)
  - Change the data transfer speed for Fibre channel ports
  - Change AL-PAs or loop IDs
  - Change settings of fabric switches
  - Change the topology
  - Change the host modes
  - Remove host groups
  - Setting command devices

Managing logical units workflow

1. Configure fibre channel ports
2. Configure hosts
3. Configure LU paths
4. Enable LUN security
5. Set fibre channel authentication
6. Manage hosts

Configuring hosts and fibre channel ports

When provisioning your system, configure hosts and fibre channel ports using LUN Manager. You can manage hosts, modify the host configuration, and modify the port configuration when the system is in operation.

- Configuring fibre channel ports on page 7-5
- Configuring hosts on page 7-9

Configuring fibre channel ports

Setting the data transfer speed on a fibre channel port

As system operation continues, you might notice that a large amount of data is transferred at some ports, but a small amount of data is transferred at other ports. You can optimize system performance on a fibre channel port by setting a faster data transfer speed on ports where a larger amount of data is transferred, and setting a slower data transfer speed on ports where a smaller amount of data is transferred.

In Fibre Channel over Ethernet (FCoE) networks, the port speed is fixed at 10 Gbps and cannot be changed.

To set the data transfer speed on a fibre channel port

1. In the **Storage Systems** tree, click **Ports/Host Groups**.
2. In the **Ports/Host Groups** window, select the **Ports** tab.
3. Select the desired port.
4. Click **Edit Ports**.
5. In the **Edit Ports** window, select the **Port Speed** check box, and then select the desired port speed.

   Select the speed of the fibre channel port in the unit of Gbps (Gigabit per second). If Auto is selected, the storage system automatically sets the speed to 1, 2, 4, or 8 Gbps.

Caution: Observe the following cautions when setting speed on a fibre channel port:

- If the HBAs (host bus adapters) and switches support 2 Gbps, use the fixed speed of 2 Gbps for the CHF (channel adapter for fibre channel) port speed. If they support 1, 4, or 8 Gbps, use 1, 4, or 8 Gbps for the CHF port speed, respectively. However, if the CHF supports 8 Gbps, the CHF does not support 1 Gbps port speed, so HBAs and switches that support 1 Gbps cannot be connected.
- If the Auto Negotiation setting is required, some links might not be up when the server is restarted. Check the channel lamp. If it is flashing, disconnect the cable, and then reconnect it to recover from the link-down state.
- If the CHF port speed is set to Auto, some equipment might not be able to transfer data at the maximum speed.
- When you start a storage system, HBA, or switch, check the host speed appearing in the Port list. If the transfer speed is different from the maximum speed, select the maximum speed from the list on the right, or disconnect, and then reconnect the cable.

6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Setting the fibre channel port address

When configuring your storage system, set addresses for fibre channel ports. When addressing fibre channel ports, use AL-PA (arbitrated-loop physical address) or loop IDs as the addresses. See Addresses for fibre channel ports on page 7-6 for information about available addresses.

In Fibre Channel over Ethernet networks, you do not need to set the address of a fibre channel port.

1. In the **Storage Systems** tree, click **Ports/Host Groups**.
2. In the **Ports/Host Groups** window, select the **Ports** tab.
3. Select the desired port.
4. Select **Edit Ports**.
5. In the **Edit Ports** window, select the **Address (Loop ID)** check box, and then select the address.
6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Addresses for fibre channel ports

The following addresses are available for setting fibre channel ports.

AL-PA	Loop ID (0~29)	AL-PA	Loop ID (30~59	AL-PA	Loop ID (60~89)	AL-PA	Loop ID (90~119)	AL-PA	Loop ID (120~125)
EF	0	B4	30	76	60	49	90	10	120
E8	1	B3	31	75	61	47	91	0F	121
E4	2	B2	32	74	62	46	92	08	122
E2	3	B1	33	73	63	45	93	04	123
E1	4	AE	34	72	64	43	94	02	124
E0	5	AD	35	71	65	3C	95	01	125
DC	6	AC	36	6E	66	3A	96	-	-
DA	7	AB	37	6D	67	39	97	-	-
D9	8	AA	38	6C	68	36	98	-	-
D6	9	A9	39	6B	69	35	99	-	-
D5	10	A7	40	6A	70	34	100	-	-
D4	11	A6	41	69	71	33	101	-	-
D3	12	A5	42	67	72	32	102	-	-
D2	13	A3	43	66	73	31	103	-	-
D1	14	9F	44	65	74	2E	104	-	-
CE	15	9E	45	63	75	2D	105	-	-
CD	16	9D	46	5C	76	2C	106	-	-
CC	17	9B	47	5A	77	2B	107	-	-
CB	18	98	48	59	78	2A	108	-	-
CA	19	97	49	56	79	29	109	-	-
C9	20	90	50	55	80	27	110	-	-
C7	21	8F	51	54	81	26	111	-	-
C6	22	88	52	53	82	25	112	-	-
C5	23	84	53	52	83	23	113	-	-
C3	24	82	54	51	84	1F	114	-	-
BC	25	81	55	4E	85	1E	115	-	-
BA	26	80	56	4D	86	1D	116	-	-
B9	27	7C	57	4C	87	1B	117	-	-
B6	28	7A	58	4B	88	18	118	-	-
B5	29	79	59	4A	89	17	119	-	-

Setting the fabric switch

When you configure your storage system, specify whether the hosts and the storage system are connected via a fabric switch.

In Fibre Channel over Ethernet networks, **FC Switch** is fixed to **Enable**. Therefore, you do not need to set **FC Switch**.

1. In the **Storage Systems** tree, click **Ports/Host Groups**.
2. In the **Ports/Host Groups** window, select the **Ports** tab.
3. Select the desired port.
4. Click **Edit Ports**.
5. Select a check box of **Fabric**, and select **ON** if you set the fabric switch. If you do not set the fabric switch, select **OFF**.
6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Fibre channel topology

The term *fibre channel topology* indicates how devices are connected to each other. Fibre channel provides the following types of topology:

- **Fabric:** Uses a fabric switch to connect a large number of devices (up to 16 million) together. Each device will have the full bandwidth of 100 MBps.
- **FC-AL (Fibre Channel-Arbitrated Loop):** A shared interface that can connect up to 126 devices (AL-ports) together. The full-duplex data transfer rate of 100-MBps bandwidth is shared among the devices connected to each other.
- **Point-to-point:** The simplest fibre topology connects two devices directly together.

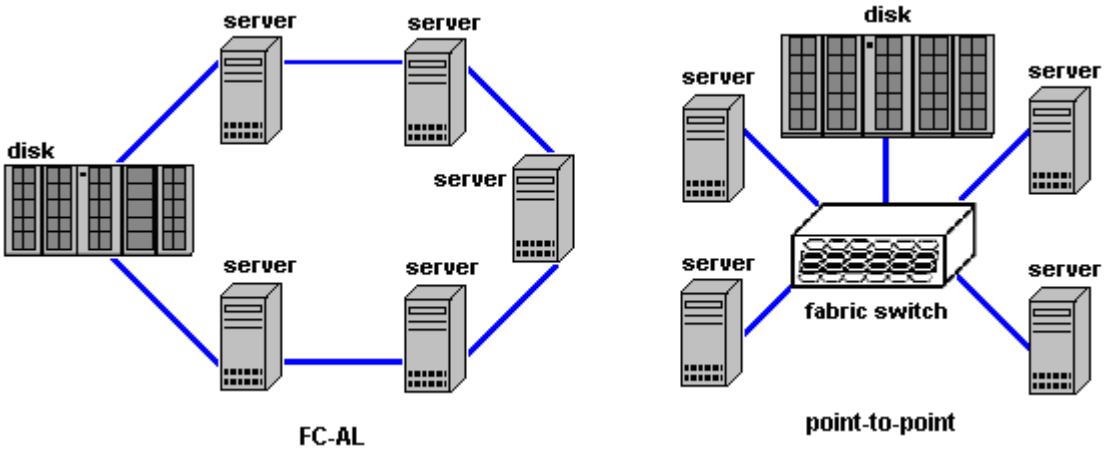
When configuring your storage system, use the LUN Manager window to specify whether the hosts and the storage system are connected using a fabric switch (see Example of FC-AL and point-to-point topology on page 7-9).

If a fabric switch is used, specify FC-AL or point-to-point in the LUN Manager window. FC-AL is the default. If a fabric switch is used, consult the documentation for the fabric switch to learn whether FC-AL or point-to-point should be used. Some fabric switches require you to specify point-to-point to get the system running.

If no fabric switch is used, specify FC-AL.

In Fibre Channel over Ethernet networks, **Connection Type** is fixed to **P-to-P**. Therefore, you do not need to set **Connection Type**.

Example of FC-AL and point-to-point topology



Configuring hosts

You can configure hosts in your storage system. You can also modify the host configuration with LUN Manager when the system is in operation.

Read the following topics concerning host modes before configuring hosts:

- Host modes for host groups on page 7-9
- Host mode options on page 7-11

Configuring hosts includes the following tasks:

- Find WWN of the host bus adapter on page 7-15)
- Creating a host group and registering hosts in the host group (in a Fibre Channel environment) on page 7-18)

Configure hosts workflow

1. Determine the host modes and host mode options you will use
2. Determine the WWN of the host bus adapters that you will use.
3. Create host groups
4. Register host groups

Host modes for host groups

The following table lists the host modes that are available for use on the VSP storage system. Carefully review and determine which host modes you will need to use when configuring your system and observe the cautions concerning using certain host modes. Host modes and host mode options must be set on the port before the host is connected. If you change host modes or host mode options after the host is connected, the host (server) will not recognize it.

Host mode	When to select this mode
00 Standard	When registering Red Hat Linux server hosts or IRIX server hosts in the host group
01 VMware	When registering VMware server hosts in the host group (See *Note*)
03 HP	When registering HP-UX server hosts in the host group
05 OpenVMS	When registering OpenVMS server hosts in the host group
07 Tru64	When registering Tru64 server hosts in the host group
09 Solaris	When registering Solaris server hosts in the host group
0A NetWare	When registering NetWare server hosts in the host group
0C Windows	When registering Windows server hosts in the host group (See *Note*)
0F AIX	When registering AIX server hosts in the host group
21 VMware Extension	When registering VMware server hosts in the host group (See *Note*)
2C Windows Extension	When registering Windows server hosts in the host group (See *Note*)
4C UVM	When registering another VSP storage system in the host group for mapping by using Universal Volume Manager. If this mode is used when the VSP storage system is being used as an external storage system of another VSP storage system, the data of the MF-VOL in the VSP storage system can be transferred. Refer to emulation types below for the MF-VOL. The data of the MF-VOL cannot be transferred when the storage systems are connected with the host mode other than 4C UVM, and a message requiring formatting appears after the mapping. In this case, cancel the message requiring formatting, and set the host mode to **4C UVM** when you want to transfer data. The volume data of the following emulation type can be transferred: 3390-3A, 3380-3A, 3390-9A, 3390-LA.

Caution: Note the following when setting the host mode.

- If Windows server hosts are registered in a host group, ensure that the host mode of the host group is 0C Windows or 2C Windows Extension.

  If you connect a new Windows server host, the preferable host mode option is the 2C Windows Extension because the 2C Windows Extension includes 0C Windows.

  If the host mode of a host group is 0C Windows and an LU path is defined between the host group and a logical volume, the logical volume cannot be combined with other logical volumes to form a LUSE volume (that is, an expanded LU).

  If the host mode of a host group is 2C Windows Extension and an LU path is defined between the host group and a logical volume, the logical volume can be combined with other logical volumes to form a LUSE volume (that is, an expanded LU). If you plan to expand LUs by using LUSE in the future, set the host mode 2C Windows Extension.
- If VMware server hosts are registered in a host group, ensure that the host mode of the host group is 01 VMware or 21 VMware Extension.

  If you connect a new VMware server host, the preferable host mode option is the 21 VMware Extension because the 21 VMware Extension includes the 01 VMware.

  If the host mode of a host group is 01 VMware and an LU path is defined between the host group and a logical volume, the logical volume cannot be combined with other logical volumes to form a LUSE volume (that is, an expanded LU).

  If the host mode of a host group is 21 VMware Extension and an LU path is defined between the host group and a logical volume, the logical volume can be combined with other logical volumes to form a LUSE volume (that is, an expanded LU). If you plan to expand LUs by using LUSE in the future, set the host mode 21 VMware Extension.
- If the virtual host on VMware recognizes LUs by the Raw Device Mapping (RDM) method, set the host mode related to the OS of the virtual host.
- If you plan to expand LUs by using LUSE in case of Windows virtual host on VMware recognizing LU by Raw Device Mapping (RDM) method, set the host mode 2C Windows Extension. If the host mode 2C Windows Extension is not set, change the host mode to 2C. Before you change the host mode, back up the LUSE volume. After you change the mode, restore the LUSE volume.

Host mode options

The following table lists host mode options that are available to use for configuring hosts on a VSP storage system.

No.	Host mode options	When to select this option
2	VERITAS Database Edition/ Advanced Cluster	When VERITAS Database Edition/Advanced Cluster for Real Application Clusters or VERITAS Cluster Server 4.0 or later (I/O fencing function) is used.

No.	Host mode options	When to select this option
6	TPRLO	When all of the following conditions are satisfied: • The host mode **0C Windows** or **2C Windows Extension** is used. • The Emulex host bus adapter is used. • The mini-port driver is used. • TPRLO=2 is specified for the mini-port driver parameter of the host bus adapter.
7	Automatic recognition function of LUN	When all of the following conditions are satisfied: • The host mode **00 Standard** or **09 Solaris** is used. • SUN StorEdge SAN Foundation Software Version 4.2 or higher is used. • You want to automate recognition of increase and decrease of devices when genuine SUN HBA is connected.
12	No display for ghost LUN	When all of the following conditions are satisfied: • The host mode **03 HP** is used. • You want to suppress creation of device files for devices to which paths are not defined.
13	SIM report at link failure[1]	When you want to be informed by SIM (service information message) that the number of link failures detected between ports exceeds the threshold.
14	HP TruCluster with TrueCopy function	When all of the following conditions are satisfied: • The host mode **07 Tru64** is used. • You want to use TruCluster to set a cluster to each of P-VOL and S-VOL for TrueCopy or Universal Replicator.
15	HACMP	When all of the following conditions are satisfied: • The host mode **0F AIX** is used. • HACMP 5.1 Version 5.1.0.4 or later, HACMP4.5 Version 4.5.0.13 or later, or HACMP5.2 or later is used.
22	Veritas Cluster Server	When Veritas Cluster Server is used.
23	REC Command Support [1]	When you want to shorten the recovery time on the host side if the data transfer failed
25	Change the nexus specified in the SCSI Logical Unit Reset	Support SPC-3 behavior on Persistent Reservation, when one of the following conditions are satisfied: • Windows Server Failover Clustering (WSFC) is used. • Microsoft Failover Cluster (MSFC) is used. • Symantec Cluster Server, which is called Veritas Cluster Server (VCS), is used.

No.	Host mode options	When to select this option
		• Configurations other than above. By using the PERSISTENT RESERVE OUT (Service Action=REGISTER AND IGNORE EXISTING KEY) command, you can change the status response from **Reservation-Conflict** to **Good-Status** when there is no registered key to be deleted.
33	Set/Report Device Identifier enable	When all of the following conditions are satisfied: • Host mode **03 HP** or **05 OpenVMS**[2] is used. • You want to enable commands to assign a nickname of the device. • You want to set UUID to identify a logical volume from the host.
39	Change the nexus specified in the SCSI Target Reset	When you want to control the following ranges per host group when receiving Target Reset: • Range of job resetting. • Range of UAs (Unit Attentions) defined.
40	V-VOL expansion	When all of the following conditions are satisfied: • The host mode **0C Windows** or **2C Windows Extension** is used. • You want to automate recognition of the DP-VOL capacity after increasing the DP-VOL capacity.
41	Prioritized device recognition command	When you want to execute commands to recognize the device preferentially.
43	Queue Full Response	When the command queue is full in the VSP storage system connecting with the HP-UX host, and if you want to respond **Queue Full**, instead of **Busy**, from the storage system to the host.
48	HAM Svol Read Option	When you do not want to generate the failover from MCU to RCU, and when the applications that issue the Read commands more than the threshold to S-VOL of the pair made with High Availability Manager are performed.
49	BB Credit Set Up Option1[3]	When you want to adjust the number of buffer-to-buffer credits (BBCs) to control the transfer data size by the fibre channel, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. Use the combination of this host mode option and the host mode option 50.
50	BB Credit Set Up Option2[3]	When you want to adjust the number of buffer-to-buffer credits (BBCs) to control the transfer data size by the fibre channel, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. Use the combination of this host mode option and the host mode option 49.

No.	Host mode options	When to select this option
51	Round Trip Set Up Option[3, 4]	If you want to adjust the response time of the host I/O, for example when the distance between MCU and RCU of the TrueCopy pair is long (approximately 100 kilometers) and the Point-to-Point topology is used. Use the combination of this host mode option and the host mode option 65.
52	HAM and Cluster software for SCSI-2 Reserve	When a cluster software using the SCSI-2 reserve is used in the High Availability Manager environment.
54	(VAAI) Support Option for the EXTENDED COPY command	When the VAAI (vStorage API for Array Integration) function of VMware ESX/ESXi 4.1 is used.
57	HAM response change	When you use **0C Windows**, **2C Windows Extension**, **01 VMware**, or **21 VMware Extention** as the host mode in the High Availability Manager environment.
60	LUN0 Change Guard	When HP-UX 11.31 is used, and when you want to prevent adding or deleting of LUN0.
61	Expanded Persistent Reserve Key	Use this Host Mode Option when 128 keys are insufficient for the host.
63	(VAAI) Support Option for vStorage APIs based on T10 standards	When you connect the storage system to VMware ESXi 5.0 and use the VAAI function for T10.
65	Round Trip extended set up option[3]	If you want to adjust the response time of the host I/O when you use the host mode option 51 and the host connects the TrueCopy pair. For example, when the configuration using the maximum number of processor blades is used. Use the combination of this host mode option and the host mode option 51.
67	Change of the ED_TOV value	When the OPEN fibre channel port configuration applies to following: • The topology is the Fibre Channel direct connection. • The port type is **Target** or **RCU Target**.
68	Support Page Reclamation for Linux	When using the Page Reclamation function from the environment which is being connected to the Linux host.
69	Online LUSE expansion	When you want the host to be notified of expansion of LUSE volume capacity.
71	Change the Unit Attention for Blocked Pool-VOLs	When you want to change the unit attention (UA) from **NOT READY** to **MEDIUM ERROR** during the pool-VOLs blockade.
72	AIX GPFS Support	When using General Parallel File System (GPFS) in the VSP storage system connecting to the AIX host.
73	Support Option for WS2012	When using the following functions provided by Windows Server 2012 (WS2012) from an environment which is being connected to the WS2012:

No.	Host mode options	When to select this option
		- Thin Provisioning function - Offload Data Transfer (ODX) function
95	Change the nexus specified in the SCSI Logical Unit Reset	You can select this option, when you want to control the following ranges per host group while receiving LU Reset: • Range of job resetting. • Range of UAs (Unit Attentions) defined.

Notes:

1. Configure these host mode options only when requested to do so.
2. Set the UUID when you set host mode option 33 and host mode **05 openvms** is used.
3. Host mode options 49, 50, 51, and 65 are enabled only for the 8UFC/16UFC package.
4. Set host mode option 51 for both ports on MCU and RCU.

Find WWN of the host bus adapter

Before physically attaching the storage system to hosts, some preparation work needs to be performed. When configuring a fibre channel environment, first verify that the fibre adapters and the fibre channel device drivers are installed on the open-system hosts. Next, find the *World Wide Name* (*WWN*) of the host bus adapter that is used in each open-system host.

The WWN is a unique identifier for a host bus adapter in an open-system host, consisting of 16 hexadecimal digits. The following topics describe how to find the WWN of a host on different operating systems. It is best to make a record of the WWNs of the hosts in your storage system, because you will need to enter these WWNs in LUN Manager dialog boxes to specify the hosts used in your storage system.

- Finding a WWN on Windows on page 7-15
- Finding a WWN on Oracle® Solaris on page 7-16
- Finding a WWN on AIX, IRIX, or Sequent on page 7-17
- Finding WWN for HP-UX on page 7-17

Finding a WWN on Windows

Hitachi Vantara supports the Emulex fibre channel adapter in a Windows environment, and will support other adapters in the future. For further information on fibre channel adapter support, or when using a fibre channel adapter other than Emulex, contact the customer support for instructions on finding the WWN.

Before attempting to acquire the WWN of the Emulex adapter, confirm whether the driver installed in the Windows 2000 or Windows Server 2003 environment is an Emulex port driver or an Emulex mini-port driver, and then follow the driver instructions.

To find a WWN on Windows environment with an Emulex mini-port driver

1. Verify that the fibre channel adapters and the fibre channel device drivers are installed.
2. Log on to the Windows 2000 host with administrator access.
3. Go to the **LightPulse Utility** to open the **LightPulse Utility** window. If you do not have a shortcut to the utility:
   a. Go to the **Start** menu, select **Find** and choose the **Files and Folders** option.
   b. On the **Find** dialog box, in **Named** type lputilnt.exe, and from the **Look in** list, choose the hard drive that contains the Emulex mini-port driver.
   c. Choose **Find Now** to search for the LightPulse utility.
      If you still cannot find the LightPulse utility, contact Emulex technical support.
   d. Select **lputilnt.exe** from the **Find: Files named** list, then press **Enter**.
4. On the **LightPulse Utility** window, verify that any installed adapters appear in the tree.
5. In the **Category** list, choose the **Configuration Data** option. In the **Region** list, choose the **16 World-Wide Name** option. The WWN of the selected adapter appears in the list on the right of the window.

Finding a WWN on Oracle® Solaris

Hitachi Vantara supports the JNI fibre channel adapter in an Oracle Solaris environment. This document will be updated as needed to cover future adapter-specific information as those adapters are supported. For further information on fibre channel adapter support, or if using a fibre channel adapter other than JNI, contact the customer support for instructions for finding the WWN.

To find a WWN on Oracle Solaris

1. Verify that the fibre channel adapters and the fibre channel device drivers are installed.
2. Log on to the Oracle Solaris host with root access.
3. Type **`dmesg |grep Fibre`** to list the installed fibre channel devices and their WWNs.
4. Verify that the fibre channel adapters listed are correct, and record the listed WWNs.

The following is an example of finding a WWN on Oracle Solaris.

```
# dmesg |grep Fibre          <- Enter the dmesg command.
 :
fcaw1: JNI Fibre Channel Adapter model FCW
fcaw1: Fibre Channel WWN: 200000e0694011a4      <- Record the WWN.
fcaw2: JNI Fibre Channel Adapter model FCW
```

```
fcaw2: Fibre Channel WWN: 200000e06940121e     <- Record the WWN.
#
```

Finding a WWN on AIX, IRIX, or Sequent

To find the WWN in an IBM AIX, SGI Irix, or Sequent environment, use the fabric switch that is connected to the host. The method of finding the WWN of the connected server on each port using the fabric switch depends on the type of switch. For instructions on finding the WWN, see the manual of the corresponding switch.

Finding WWN for HP-UX

To find the WWN in an HP-UX environment:

1. Verify that the Fibre Channel adapters and the Fibre Channel device drivers are installed.
2. Log in to the HP-UX host with root access.
3. At the command line prompt, type:

   `/usr/sbin/ioscan -fnC lan`

   This will list the attached Fibre Channel devices and their device file names. Record the Fibre Channel device file name (for example, /dev/fcms0).

Note: When the A5158 Fibre Channel adapter is used, at the command line prompt, enter **`/usr/sbin/ioscan -fnC fc`** for the device name.

4. Use the **`fcmsutil`** command along with the Fibre Channel device name to list the WWN for that Fibre Channel device. For example, to list the WWN for the device with the device file name **`/dev/fcms0`**, type:

   `/opt/fcms/bin/fcmsutil /dev/fcms0`

   Record the Fibre Channel device file name (for example, **`/dev/td0`**).

Note: When using the A5158 Fibre Channel adapter, list the WWN for the device with the device file name as follows:

`/opt/fcms/bin/fcmsutil <device file name>`

5. Record the WWN and repeat the above steps for each Fibre Channel device that you want to use.

```
# /usr/sbin/ioscan -fnC lan  <- 1
Class     I  H/W Path  Driver      S/W State   H/W Type
Description
===============================================================
lan         0  8/0.5     fcT1_cntl   CLAIMED     INTERFACE    HP
Fibre Channel Mass Storage Cntl
                         /dev/fcms0  <-2
lan         4  8/4.5     fcT1_cntl   CLAIMED     INTERFACE    HP
Fibre Channel Mass Storage Cntl
                         /dev/fcms4  <-2
lan         5  8/8.5     fcT1_cntl   CLAIMED     INTERFACE    HP
Fibre Channel Mass Storage Cntl
                         /dev/fcms5  <-2
```

```
lan        6  8/12.5    fcT1_cntl   CLAIMED    INTERFACE    HP
Fibre Channel Mass Storage Cntl
                          /dev/fcms6  <-2
lan        1  10/8/1/0  btlan4      CLAIMED    INTERFACE
PCI(10110009) -- Built-in #1
lan        2  10/8/2/0  btlan4      CLAIMED    INTERFACE
PCI(10110009) -- Built-in #2
lan        3  10/12/6   lan2        CLAIMED    INTERFACE
Built-in LAN
                          /dev/diag/lan3  /dev/ether3     /dev
/lan3
#
# fcmsutil /dev/fcms0 <-3
                Local N_Port_ID is = 0x000001
       N_Port Node World Wide Name = 0x10000060B0C08294
          N_Port Port World Wide Name = 0x10000060B0C08294 <- 4
                          Topology = IN_LOOP
                             Speed = 1062500000 (bps)
                         HPA of card = 0xFFB40000
                         EIM of card = 0xFFFA000D
                        Driver state = READY
             Number of EDB's in use = 0
             Number of OIB's in use = 0
Number of Active Outbound Exchanges = 1
   Number of Active Login Sessions = 2
#
1: Enter the ioscan.
2: Device name
3: Enter the fcmsutil command.
4: Record the WWN.
```

Creating a host group and registering hosts in the host group (in a Fibre Channel environment)

After discovering the WWNs of the host bus adapters, create a host group and register hosts in the host groups in a fibre channel environment.

You can connect multiple server hosts of different platforms to one port of your VSP storage system. When configuring your storage system, you should group server hosts connected to the storage system by *host groups*. For example, if HP-UX hosts and Windows hosts are connected to a port, create one host group for HP-UX hosts and create another host group for Windows hosts. Then register HP-UX hosts to the corresponding host group and register Windows hosts to the other host group.

Note: The above example relates to configurations in which all HP-UX hosts are on the same cluster.

Before you can set LU paths, you must register the hosts in host groups. For example, if HP-UX hosts and Windows hosts are connected to a port, register HP-UX hosts and Windows hosts separately in two different host groups.

When registering a host, you must also specify the WWN of the host bus adapters.

When registering hosts in multiple host groups, set the security switch (LUN security) to enabled, and then specify the WWN of the host bus adapter.

When registering a host, you can assign a nickname to the host bus adapter. If you assign a nickname, you can easily identify each host bus adapter in the LUN Manager window. Although WWNs are also used to identify each host bus adapter, the nickname that you assign will be more helpful because you can name host bus adapters after the host installation site or for the host owners.

1. Display the **Create Host Groups** window by performing one of the following:
   - In Storage Navigator, select **Create Host Groups** from the **General Tasks** menu and display the **Create Host Groups** window.
   - From the **Actions** menu, choose **Ports/Host Groups**, and then **Create Host Groups**.
   - From the **Storage Systems** tree, click the **Ports/Hosts Groups**. In the **Host Groups** page of the displayed window, click **Create Host Groups**.
   - From the **Storage Systems** tree, expand the **Ports/Hosts Groups** node, and then click the relevant port. In the **Host Groups** page of the displayed window, click **Create Host Groups**.
2. Enter the host group name in the **Host Group Name** box.
   - It is convenient if you name each host group after the host platform.
   - A host group name can consist of up to 32 ASCII characters (letters, numerals, and symbols). However, you cannot use the following symbols for host group names: \ / : , ; * ? " < > |
   - You cannot use space characters for the first and the last characters in host group names.
   - Host group names are case-sensitive. For example, the host group names **wnt** and **Wnt** represent different host groups.
3. Select the resource group in which a host group is created.

   If you select **Any**, ports to which you may add host groups within all ports assigned to a user are displayed in the **Available Ports** list. If you select other than **Any**, ports to which you may add host groups within the ports assigned to the selected resource group are displayed in the **Available Ports** list.
4. Select a host mode from the **Host Mode** list. When selecting a host mode, you must consider the platform and some other factors.
5. Select hosts to be registered in a host group.

   If the desired host has ever been connected via a cable to another port in the storage system, select the desired host bus adapter from the **Available Hosts** list.

   If the desired host has never been connected via a cable to any port in the storage system, perform the following steps:

   a. Click **Add New Host** under the **Available Hosts** list.

      The **Add New Host** dialog box opens.

   b. Enter the desired WWN in the **HBA WWN** box.

   c. If necessary, enter a nickname for the host bus adapter in the **Host Name** box.

d. Click **OK** to close the **Add New Host** dialog box.

e. Select the desired host bus adapter from the **Available Hosts** list.

6. Select the port to which you want to add the host group. For details about host modes, see Host modes for host groups on page 7-9.

   If you select multiple ports, you may add the same host group to multiple ports by one operation.

7. If necessary, click **Options** and select host mode options. For details about host mode options, see Host mode options on page 7-11.

Note: When you click **Options**, the dialog box expands to display the list of host mode options. The **Mode No.** column indicates option numbers. Select an option you want to specify and click **Enable**.

8. Click **Add** to add the host group.

   By repeating steps from 2 to 8, you can create multiple host groups.

   If you select a row and click **Detail**, the **Host Group Properties** window appears. If you select a row and click **Remove**, a message appears asking whether you want to remove the selected row or rows. If you want to remove the row, click **OK**.

9. Click **Finish** to display the **Confirm** window.

   To continue to add LUN paths, click **Next**.

10. Confirm the settings and enter the task name in the **Task Name** box.

    A task name can consist of up to 32 ASCII characters (letters, numerals, and symbols). Task names are case-sensitive. (date) - (task name) is input by default.

    If you select a row and click **Detail**, the **Host Group Properties** window appears.

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

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

Configuring LU paths

When provisioning your storage system, and after configuring ports, hosts, and host groups, you must configure fibre channel LU paths. LUN Manager is required for these tasks. You can also modify the LU paths configuration when the system is in operation.

Defining LU paths

In a fibre channel environment, you must define LU paths and associate host groups with logical volumes. For example, if you associate a host group consisting of three hosts with logical volumes, LU paths are defined between the three hosts and the logical volumes.

To define LU paths

1. From the **Storage Systems** tree, click **Ports/Hosts Groups**. From the **Actions** menu, select **Logical Device**, and then **Add LUN Paths**.
2. Select the desired LDEVs from the **Available LDEVs** table, and then click **Add**.
   Selected LDEVs are listed in the **Selected LDEVs** table.
3. Click **Next**.
4. Select the desired host groups from the **Available Host Groups** table, and then click **Add**.
   Selected host groups are listed in the **Selected Host Groups** table.
5. Click **Next**.
6. Confirm the defined LU paths.
   - To change the LU path settings, click **Change LUN IDs** and type the LUN ID that you want to change.
   - To change the LDEV name, click **Change LDEV Settings**. In the **Change LDEV Settings** window, change the LDEV name.
7. Click **Finish**.
8. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Setting a UUID

You can set an arbitrary ID to identify a logical volume from the host using LUN Manager when host mode option 33 is set to on. The ID is referred to as the UUID (user-definable LUN identifier) and is typically composed of a Prefix and an Initial Number.

Note the following when setting a UUID:

- If host mode **05 OpenVMS** is used, the host mode option 33 is set to ON, LUs that do not have UUID settings are inaccessible.
- If host mode **05 OpenVMS** is used with host mode option 33 set to OFF, LUs that have UUID settings are inaccessible.

The following rules apply to setting a UUID:

- These characters cannot be used for UUID: `\ / : , ; * ? " < > |`
- A space character cannot be used as the first or the last character of a UUID.
- UUID is case-sensitive. For example, **Abc** and **abc** are different UUIDs.

To keep track of device information, create a correspondence table similar to the example in Correspondence table for defining devices on page 7-23.

To set a UUID

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Ports/Host Groups**.

The list of available ports appears in the tree.

2. In the tree, select a port.

   The host groups that correspond to the port appear in the tree.

3. In the tree, select a host group.

   Information about the selected host group appears on the right side of the window.

4. Select the **LUNs** tab.

   Information about LU paths associated with the selected host group appears.

5. Select one or more logical units to which volumes are assigned (if a volume is assigned to a LU, the columns on the right of the LUN column are not empty).

   When multiple LUs are selected, the same UUID is set to all selected LUs.

6. Click **More Actions**, and then select **Edit UUIDs**.

7. In the **Edit UUIDs** window, in **Prefix**, type the UUID.

   If a UUID is already specified, you can change it. The UUID before changing appears in **UUID** in the **Edit UUIDs** window. However, if multiple LUs, or **N/A**s are selected, the **Prefix** box is blank.

   For an OpenVMS server host, you can enter a UUID composed of a **Prefix** and an **Initial Number**. The **Prefix** may include up to 5 digits, from 1 to 32767, and the **Initial Number** may include up to 5 digits, from 0 to 32767.

   For a server host other than OpenVMS, you can enter a UUID composed of a **Prefix** and an **Initial Number**. The Prefix may include up to 64 ASCII characters (letters, numerals and symbols) and the Initial Number may include up to 9 digits.

   When changing the server host OS from HP-UX to Open VMS, or from Open VMS to HP-UX, the same UUID cannot be used continuously. Clear the UUID setting (see Clearing a UUID setting on page 7-25), and then set the proper UUID for a server host.

8. To sequentially number the UUIDs, type the first digit in the **Initial Number** box. The following rules apply to the Initial Number:

   ```
   1: Up to 9 numbers are added (1, 2, 3, ... 9).
   08: Up to 92 numbers are added (08, 09, 10, ... 99).
   If the host mode is set to OpenVMS, the numbers are as follows:
   8, 9, 10, ... 99
   23: Up to 77 numbers are added (23, 24, 25, ... 99).
   ```

9. Click **Finish**.

10. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

    If **Go to tasks window for status** is checked, the **Tasks** window opens.

Correspondence table for defining devices

When configuring the storage system, you will need definition information about devices set by LUN Manager, for example, LUs, LDKC:CU:LDEV, or UUID. A correspondence table similar to the example below is useful and recommended when collecting this information.

Port	LU	LDKC:CU:LDEV	UUID	OpenVMS device file name
BR	0000	00:00:30	148	1dga148
BR	0001	00:00:31	149	1dga149
. . .	. . .	. . .	. . .	. . .

Defining alternate LU paths

You may want to define alternate LU paths so that if one LU path fails, you will be able to switch to its alternate path.

To create an alternate LU path, copy the original LU path from one port to another. For example, if you want to define an alternate for the LU path from the CL1-A port to logical volume 00:00:01, copy the LU path from the CL1-A port to another port.

Use one of these methods to copy LU paths:

- Copy all the LU paths defined in a host group
- Copy one or more (but not all) LU paths defined in a host group

Before taking the following steps:

- See LUN Manager rules, restrictions, and guidelines on page 7-4 for important information.
- To define alternate paths when LUN security is disabled, you must redefine the LU path.

To copy all the LU paths defined in a host group

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Ports/Host Groups**.
   The list of available ports appears in the tree.
2. Select the **Host Groups** tab, or select a port from the tree and then select the **Host Groups** tab.
3. Select a host group.
4. Select **Create Alternative LUN**.
5. In the **Create Alternative LUN Paths** window, select the copy destination port from the **Available Ports** table, and then click **Add**.
   The selected ports appear in the **Selected Ports** table.

6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

To copy one or more (but not all) LU paths defined in a host group

1. In the Storage Navigator main window, in the **Storage Systems** tree, select **Ports/Host Groups**.
   The list of available ports appears in the tree.
2. In the tree, select a port.
   The host groups corresponding to the port appear.
3. In the tree, select a host group.
   Information about the selected host group appears on the right side of the window.
4. Select the **LUNs** tab.
   Information about LU paths associated with the selected host group appears.
5. Select one or more logical units to which volumes are assigned (if a volume is assigned to a logical unit, the columns on the right of the LUN column are not empty).
6. Select **Copy LUN Paths**.
7. In the **Copy LUN Paths** window, select the host group to which you want to paste paths from the **Available Host Groups** table, and then click **Add**.
   The selected host groups appear in the **Selected Host Groups** table.
8. Click **Finish**.
9. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Managing LU paths

You can modify the LU paths configuration with LUN Manager when the system is in operation, but not when host I/O is in progress. Managing LU paths includes the following tasks:

- Deleting LU paths on page 7-24
- Clearing a UUID setting on page 7-25
- Viewing LU path settings on page 7-25

Deleting LU paths

Caution: Do not delete LU paths when host I/O is in progress.

1. In the Storage Navigator main window, in the **Storage Systems** tree, select LDEVs using either of the following methods.
   - Select **Logical Devices**, and then select the **LDEVs** tab.
   - Select **Pools**, select a pool, and then select the **Virtual Volumes** tab.

   Or, select logical units using the following method.
   - Select **Ports/Host Groups**, select a port, select a host group, and then select the **LUNs** tab.

Caution: When an LDEV is selected and **Delete LUN Paths** is performed, all LUN paths of the selected LDEV are deleted by default.

2. Click **More Actions** and select **Delete LUN Paths**.
3. In the **Delete LUN Paths** window, confirm that the LU paths that you want to delete are listed in **Selected LUN Paths**.

   If LU paths that you do not want to delete are listed, select the LU path you do not want to delete, and then click **Remove from Delete process**.
4. If necessary, check the **Delete all defined LUN paths to above LDEVs** check box. When checked, all additional LU paths on the selected LDEVs will be deleted.
5. Click **Finish** to open the **Confirm** window.

   If you want to start shredding operations to delete the data of the volume, click **Next**. For detailed information about shredding operations, see the *Hitachi Volume Shredder User Guide*.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

If you delete many paths at one time, the deletion process may take time and the dialog box may seem to hang temporarily.

Clearing a UUID setting

You can clear the UUID setting that has been set to identify a logical volume from the host.

1. In the Storage Navigator main window, in the **Storage Systems** tree, click **Logical Devices**, and then select the **LDEVs** tab.
2. Select the LDEVs for which you want to clear the UUID setting.
3. Select **Delete UUIDs**. The **Delete UUIDs** window opens.
4. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Viewing LU path settings

1. In the **Storage Systems** tree, click **Ports/Host Groups**.

   The list of available ports appears in the tree.
2. In the tree, select a port.

The host groups corresponding to the port appear.

3. In the tree, select a host group.
   Information about the selected host group appears on the right side of the window.
4. Select the **LUNs** tab.
   Information about LU paths associated with the selected host group appear.
5. In the **LUN ID** column, click the LUN to open the **LUN Properties** window.

Releasing LUN reservation by host

The following explains how to release forcibly a LUN reservation by a host.

Prerequisites

- You must have the Storage Administrator (system resource management) role to perform this task.

Caution: If you perform the releasing a LUN reservation by a host, the host which is connected to LDEV by LUN path is affected.

To release a LUN reservation by a host:

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
   The list of available ports appears in the tree.
2. In the tree, select a port.
   The host groups corresponding to the port appear.
3. In the tree, select a host group.
   Information about the selected host group appears on the right side of the window.
4. Select the **LUNs** tab on the right side of the window.
   Information about LU paths associated with the selected host group appears.
5. On the menu bar, click **Actions**, **Ports/Hosts Groups**, and then **View Host-Reserved LUNs**. Or, select **View Host-Reserved LUNs** from the lower right of the window. The **Host-Reserved LUNs** window opens.
6. In the **Host-Reserved LUNs** window, select LUN to release the reservation by the host, and then select **Release Host-Reserved LUNs**. The **Release Host-Reserved LUNs** window opens.
7. Confirm the settings and enter the task name in the **Task Name** box.
   A task name can consist of up to 32 ASCII characters (letters, numerals, and symbols). Task names are case-sensitive. (date) - (task name) is input by default.
8. Click **Apply** in the **Release Host-Reserved LUNs** window.

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

LUN security on ports

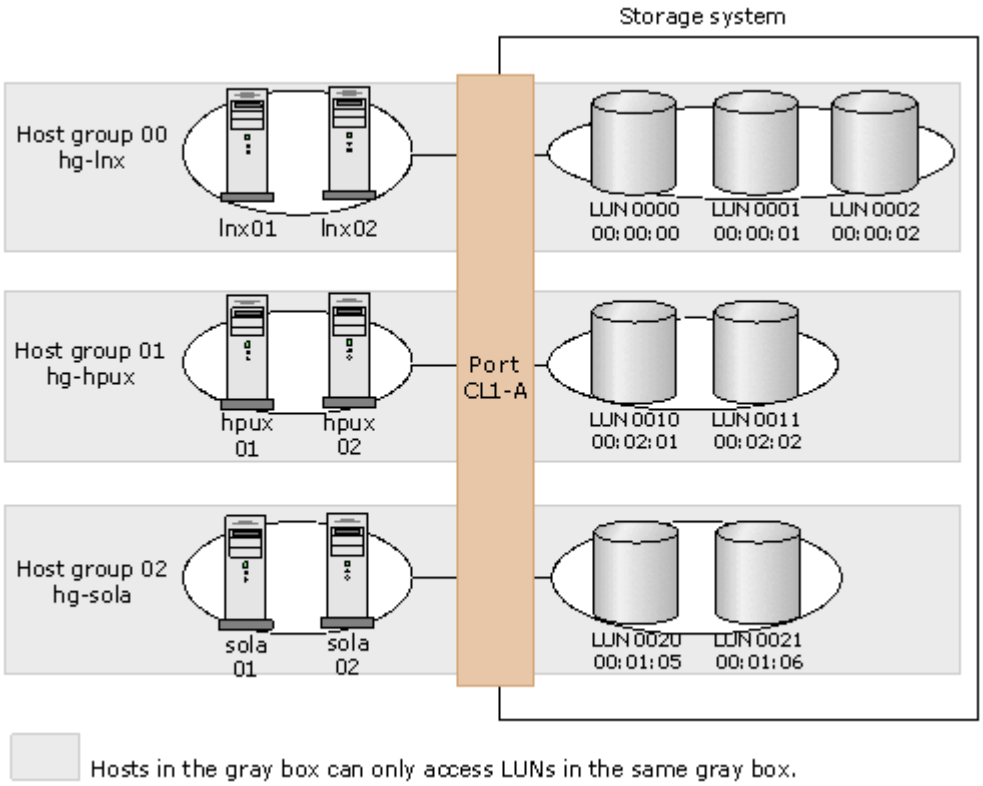
To protect mission-critical data in your storage system from illegal access, apply security policies to logical volumes. Use LUN Manager to enable LUN security on ports to safeguard LUs from illegal access.

If LUN security is enabled on ports, host groups affect which host can access which LUs. Hosts can access only the LUs associated with the host group to which the hosts belong. Hosts cannot access LUs associated with other host groups. For example, hosts in the *hp-ux* host group cannot access LUs associated with the *windows* host group. Also, hosts in the *windows* host group cannot access LUs associated with the *hp-ux* host group.

Examples of enabling and disabling LUN security on ports

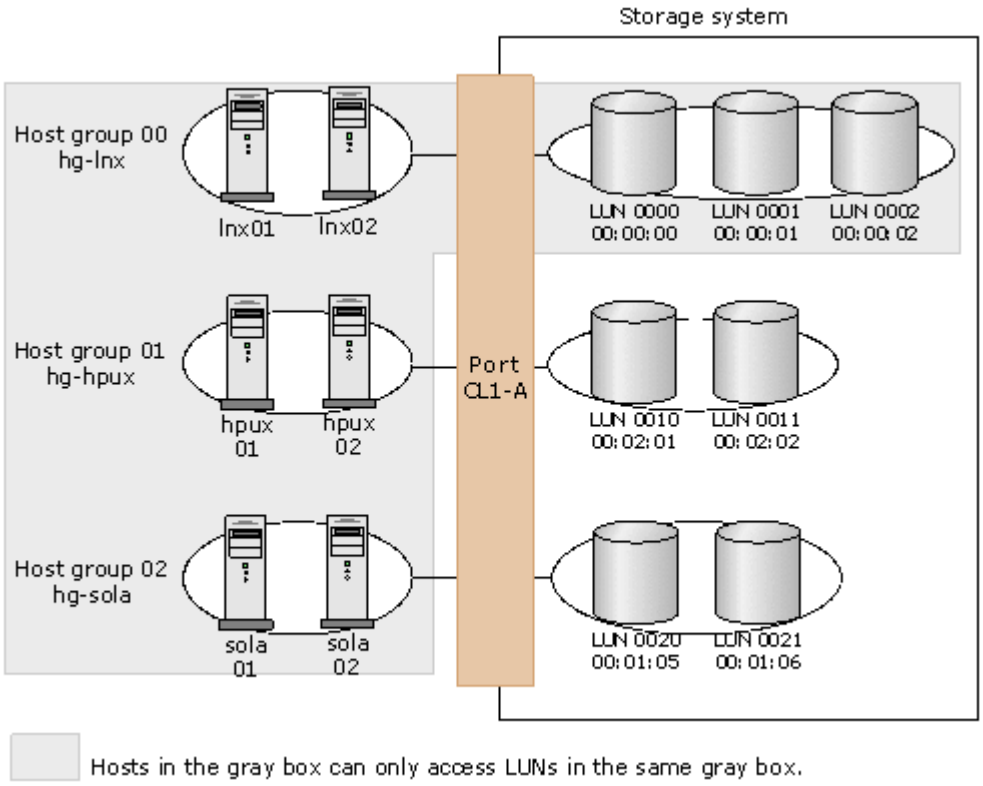
Enabling LUN security

In the following example, LUN security is enabled on port CL1-A. The two hosts in the `hg-lnx` host group can access only three LUs (00:00:00, 00:00:01, and 00:00:02). The two hosts in the `hg-hpux` host group can access only two LUs (00:02:01 and 00:02:02). The two hosts in the `hg-solar` host group can access only two LUs (00:01:05 and 00:01:06).



Disabling LUN security

Typically, you do not need to disable LUN security on ports. For example, if LUN security is disabled on a port, the connected hosts can access only the LUs associated with *host group 0*, and cannot access LUs associated with any other host group.



Host group 0 is the only host group reserved, by default, for each port. If you use the LUN Manager window to view a list of host groups in a port, host group 0, indicated by *00*, usually appears at the top of the list.

The default name of host group 0 consists of the port name, a hyphen, and the number *00*. For example, the default name of host group 0 for port 1A is 1A-G00. However, you can change the default name of the host group 0.

LUN security is disabled, by default, on each port. When you configure your storage system, you must enable LUN security on each port to which hosts are connected.

Enabling LUN security on a port

To protect mission-critical data in your storage system from illegal access, secure the logical volumes in the storage system. Use LUN Manager to secure LUs from illegal access by enabling LUN security on ports.

By default, LUN security is disabled on each port. When registering hosts in multiple host groups, you must enable LUN security (set the switch to enabled). When you change LUN security from disabled to enabled, you must specify the WWN of the host bus adapter.

Caution: It is best to enable LUN security on each port when configuring your storage system. Although you can enable LUN security on a port when host I/O is in progress, I/O is rejected with a security guard after enabling.

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
2. Select the **Ports** tab.
3. Select the desired port.
4. Select **Edit Ports**. The **Edit Ports** window opens.
5. Select the **Port Security** check box, and then select **Enable**.
6. Click **Finish**. A message appears, confirming whether to switch the LUN security. Clicking **OK** opens the **Confirm** window.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Disabling LUN security on a port

Caution: Do not disable LUN security on a port when host I/O is in progress.

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
2. Select the **Ports** tab.
3. Select the desired port.
4. Select **Edit Ports** The **Edit Ports** window opens.
5. Select the **Port Security** check box, and then select **Disable**.
6. Click **Finish**. If disabling LUN security, a message appears, indicating that only host group 0 (the group whose number is 00) is to be enabled. Clicking **OK** opens the **Confirm** window.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Setting fibre channel authentication

When configuring a fibre channel environment, use the **Authentication** window to set user authentication on host groups, fibre channel ports, and fabric switches of the storage system.

In Fibre Channel over Ethernet networks, user authentication is not supported.

The hosts to be connected must be configured for authentication by host groups (and for authentication of host groups by the host, if required). For details on how to configure the host for CHAP authentication, see the documentation of the operating system and fibre channel driver in your environment.

The following topics provide information for managing user authentication on host groups, fibre channel ports, and fabric switches:

- User authentication on page 7-30
- Fibre channel authentication on page 7-38
- Fibre channel port authentication on page 7-42
- Setting fibre channel port authentication on page 7-42)
- Registering user information on a fibre channel port on page 7-43)
- Registering user information on a fabric switch on page 7-44)
- Clearing fabric switch user information on page 7-45)
- Setting the fabric switch authentication mode on page 7-45)
- Enabling or disabling fabric switch authentication on page 7-46)

User authentication

When configuring a fibre channel environment, use LUN Manager to set user authentication for ports between the VSP storage system and hosts. In a fibre channel environment, the ports and hosts use *Null DH-CHAP* or *CHAP* (Challenge Handshake Authentication Protocol with a Null Diffie-Hellmann algorithm) as the authentication method.

User authentication is performed in a fibre channel environment in three phases:

1. A host group of the storage system authenticates a host that attempts to connect (authentication of hosts).
2. The host authenticates the connection-target host group of the storage system (authentication of host groups).

Caution: Because the host bus adapters at present do not support this function, this authentication phase is unusable in the fibre channel environment.

3. A target port of the storage system authenticates a fabric switch that attempts to connect (authentication of fabric switches).

The storage system performs user authentication by host groups. Therefore, the host groups and hosts need to have their own user information for performing user authentication.

When a host attempts to connect to the storage system, the *authentication of hosts* phase starts. In this phase, first it is determined whether the host group requires authentication of the host. If it does not, the host connects to the storage system without authentication. If it does, authentication is performed for the host, and when the host is authenticated successfully, processing goes on to the next phase.

After successful authentication of the host, if the host requires user authentication for the host group that is the connection target, the *authentication of host groups* phase starts. In this way, the host groups and hosts authenticate with each other, that is, *mutual authentication*. In the authentication of host groups phase, if the host does not require user authentication for the host group, the host connects to the storage system without authentication of the host group.

The settings for authentication of host groups are needed only when you want to perform mutual authentication. The following topics explain the settings required for user authentication.

- Settings for authentication of hosts on page 7-31
- Settings for authentication of ports (required if performing mutual authentication) on page 7-31

Settings for authentication of hosts

On the storage system, use LUN Manager to specify whether to authenticate hosts on each host group.

On a host group that performs authentication, register user information (group name, user name, and secret) of the hosts that are allowed to connect to the host group. A *secret* is a password used in CHAP authentication. When registering user information, you can also specify whether to enable or disable authentication on a host basis.

On hosts, configure the operating system and fibre channel host bus adapter driver for authentication by host groups with CHAP. You need to specify the user name and secret of the host used for CHAP. For details, see the documentation of the operating system and fibre channel host bus adapter driver in your environment.

Settings for authentication of ports (required if performing mutual authentication)

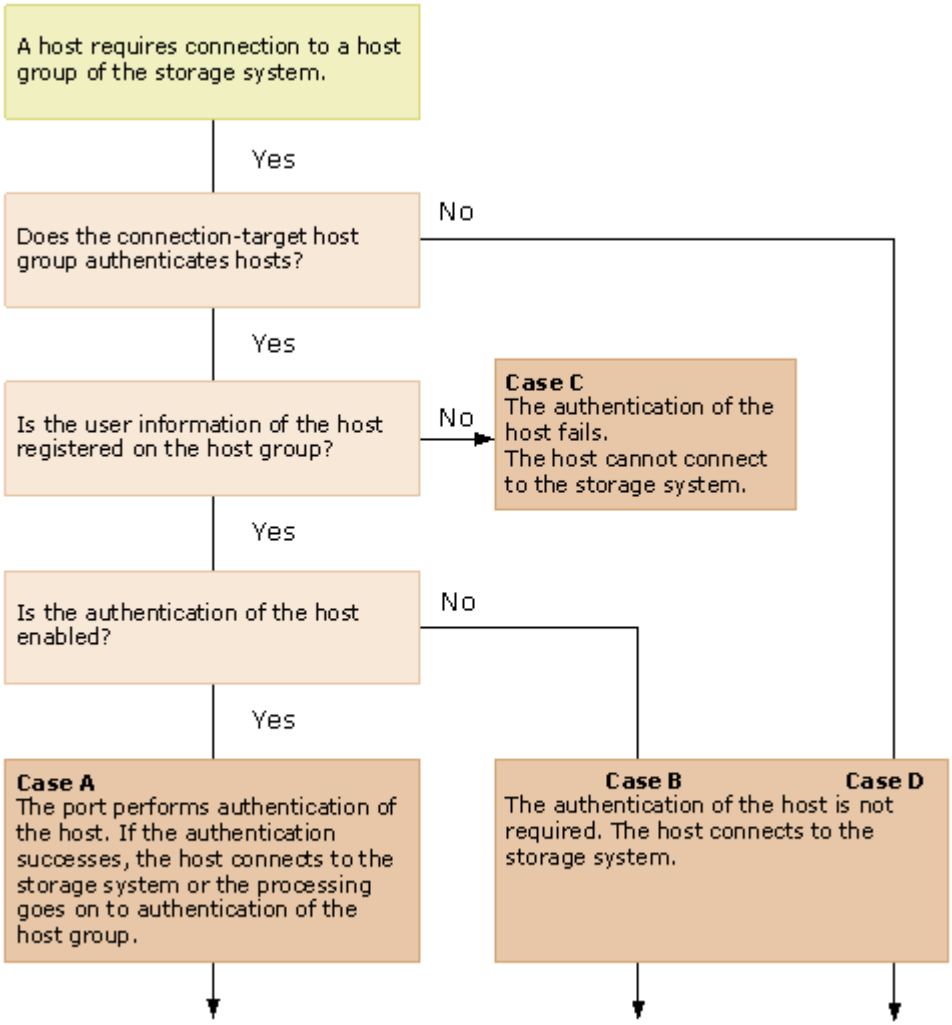
On the storage system, use LUN Manager to specify user information (user name and secret) of each host group.

On hosts, configure the operating system and fibre channel host bus adapter driver for authenticating host groups with CHAP. You need to specify the user name and secret of the host group that is the connection target. For details, see the documentation of the operating system and fibre channel host bus adapter driver in your environment.

Host and host group authentication

When a host attempts to connect to the storage system, the connection results of the authentication of the host differ depending on the host group settings.

The following diagram illustrates the flow of authentication of hosts in a fibre channel environment. The connection uses cases are detailed below the diagram.



Authenticating hosts (Cases A, B, and C)

The following cases describe the examples of performing authentication of host groups

Case A - The user information of the host is registered on the host group, and authentication of the host is enabled.

The host group authenticates the user information sent from the host. If authentication of the host is successful, either of the following occurs:

- When the host is configured for mutual authentication, authentication of the host group is performed.
- When the host is not configured for mutual authentication, the host connects to the storage system.

If the host is not configured for authentication by host groups with CHAP, the authentication fails and the host cannot connect to the storage system.

Case B - The user information of the host is registered on the host group, but authentication of the host is disabled.

The host group does not perform authentication of the host. The host will connect to the storage system without authentication regardless of whether the host is configured for authentication by host groups with CHAP.

Case C - The user information of the host is not registered on the host group.

Regardless of the setting on the host, the host group performs authentication of the host, but results in failure. The host cannot connect to the storage system.

Not authenticating hosts (Case D)

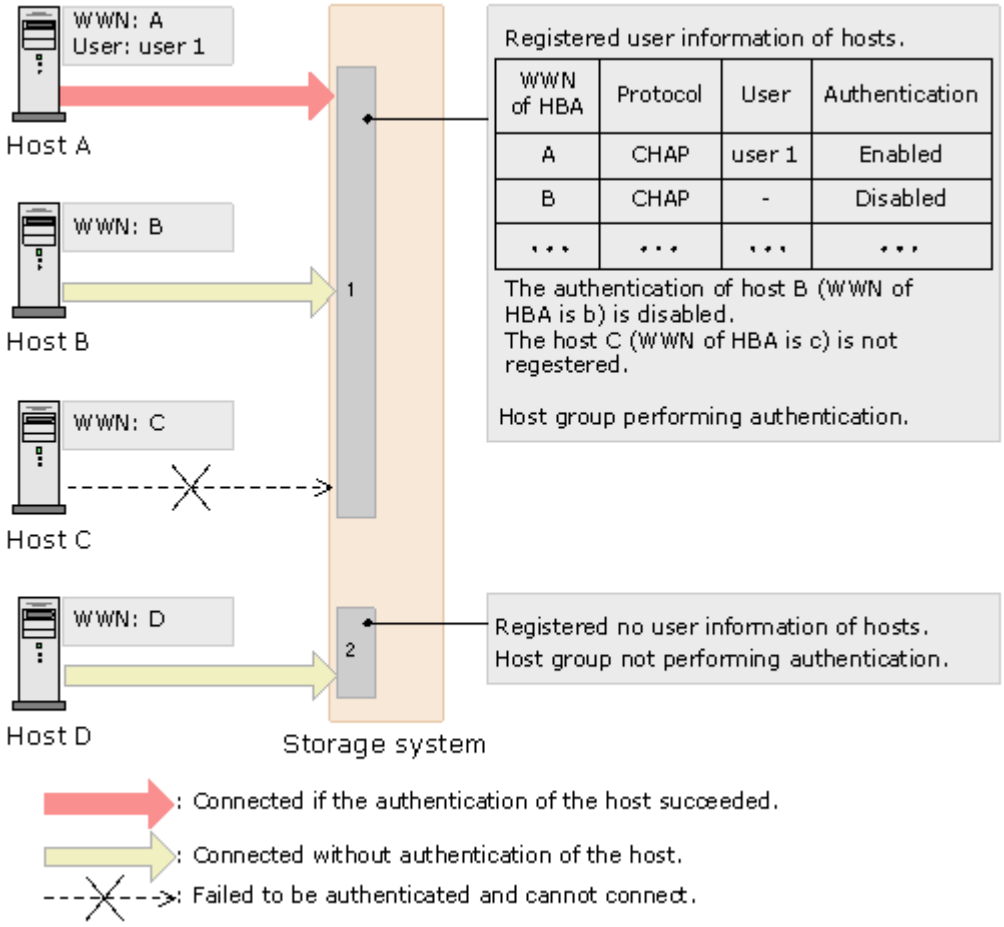
Case D is an example of connecting via a host group that does not perform authentication of hosts. The host will connect to the storage system without authentication of the host regardless of whether the host is configured for authentication by host groups with CHAP. In this case, though you need not register user information of the host on the host group, you can register it.

You should register user information of all the hosts to be connected to a host group that performs authentication of hosts. To allow a specific host to connect to such a host group without authentication, configure the host group and the host as follows.

On the host group: Register the user information of the host you want to allow to connect without authentication, and then disable the authentication setting of the host.

Example of authenticating hosts in a fibre channel environment

Following is an example of authentication of hosts in a fibre channel environment. In this figure, WWNs of host bus adapters (HBAs) are abbreviated, such as A, B, and so on.



In the example, host group 1 performs authentication of hosts, and host group 2 does not.

The user information of host A is registered on the host group 1, and the authentication setting is enabled. Therefore, if the authentication of the host is successful, host A can connect to the storage system (or, the processing goes on to the authentication of the host group). As a precondition of successful authentication, host A should be configured for authentication by host groups with CHAP.

The user information of host B is also registered on the host group 1, but the authentication setting is disabled. Therefore, host B can connect to the storage system without authentication.

The user information of host C is not registered on the host group 1. Therefore, when host C tries to connect to the storage system, the authentication fails and the connection request is denied regardless of the setting on host C.

Host D is attached to the host group 2 that does not perform authentication of hosts. Therefore, host D can connect to the storage system without authentication.

During authentication of hosts, the connection result is determined depending on the combination of the following host group settings:

- Setting of the host group in the **Port** tree: enable ( ) or disable ( )
- Whether the user information of the host that attempts to connect is registered on the host group

Port settings and connection results

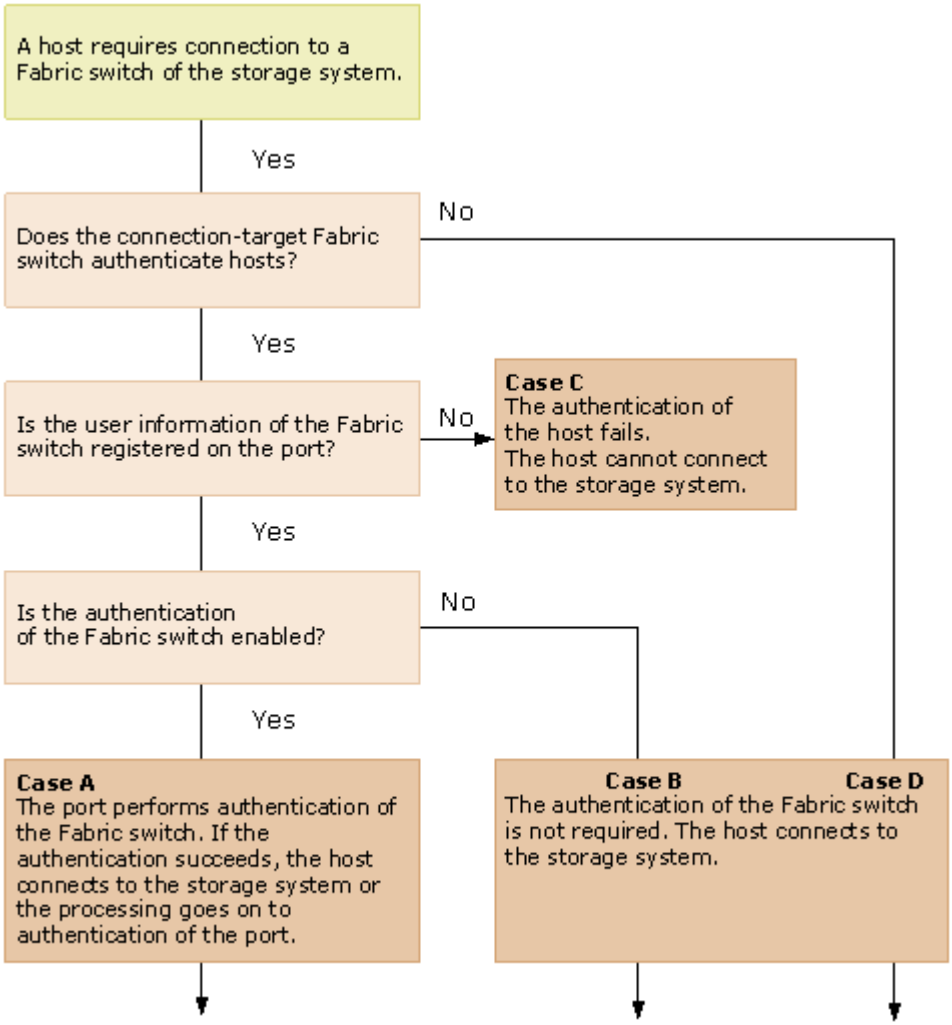
The following table shows the relationships between host group settings and the connection results in authentication of hosts. Unless otherwise noted, connection results are as described regardless of whether the host is configured for authentication by ports with CHAP.

Port settings		Host settings	Connection results
Authentication at host group	**User information of host**		
Enabled	Registered	Registered	Connected if the authentication of the host succeeded
Enabled	Registered	Not registered	Failed to be authenticated and cannot be connected
Enabled	Not registered	Registered	Failed to be authenticated and cannot be connected
Disabled	---	---	Connected without authentication of the host If a host is configured for authentication by ports with CHAP, authentication of the host will fail. To allow such a host to connect to the port without authentication, do not configure it for authentication by ports with CHAP.
---: This item does not affect the connection results, or cannot be specified.			

fabric switch authentication

When a host attempts to connect to the storage system, the connection results of the authentication of the fabric switch differs depending on the fabric switch setting related to each port.

The following figure illustrates the flow of authentication between fabric switch settings and the connection results. The setting of fabric switch authentication is independent from the setting of host authentication. The connection use cases are detailed below the diagram.



Authenticating fabric switches by ports (Cases A, B, and C)

- *If the user information of the fabric switch is registered on the port, and authentication of the fabric switch is enabled (Case A)*

  Each port authenticates the fabric switch. If the authentication of the fabric switch ends successfully, either of the following actions occurs:

  - When the fabric switch is configured for mutual authentication, processing continues to authentication of the port.
  - When the fabric switch is not configured for mutual authentication, the fabric switch connects to the storage system.

  If the fabric switch of the port is not configured for authentication with CHAP, the authentication fails and the fabric switch cannot connect to the storage system.
- *If the user information of the fabric switch is registered on the port, but authentication of the fabric switch is disabled (Case B)*

Each port does not perform authentication of the fabric switch. The fabric switch connects to the storage system without authentication regardless of whether the fabric switch is configured for authentication with CHAP.

- *If the user information of the fabric switch is not registered on the port (Case C)*

  Regardless of the setting on the fabric switch, the port performs authentication of the fabric switch, but results in failure. The fabric switch cannot connect to the storage system.

Not authenticating fabric switches by ports (Case D)

The fabric switch connects to the storage system without authentication of the host regardless of whether the fabric switch is configured for authentication with CHAP. In this case, though you need not register the user information of the fabric switch on the port, you can register it.

During authentication of hosts, the connection result is determined depending on the combination of the following port settings:

- Setting of the port in the **Port** tree: enable ( ) or disable ( )
- Whether the user information of the fabric switch that attempts to connect is registered on the port

fabric switch settings and connection results

The following table shows the relationship between the combinations of port settings and the connection results in authentication of fabric switches. Unless otherwise noted, connection results are as described regardless of whether the host is configured for authentication by fabric switches with CHAP.

Port Settings		fabric switch settings	Connection results
Authentication at fabric switch	**User information of fabric switch**		
Enabled	Registered	Registered	Connected if the authentication of the fabric switch succeeded
Enabled	Registered	Not registered	Failed to be authenticated and cannot be connected
Enabled	Not registered	Registered	Failed to be authenticated and cannot be connected
Disabled	---	---	Connected without authentication of the fabric switch

Port Settings		fabric switch settings	Connection results
Authentication at fabric switch	User information of fabric switch		
			If a fabric switch is configured for authentication by ports with CHAP, authentication of the host will fail. To allow such a fabric switch to connect to the port without authentication, do not configure it for authentication by ports with CHAP.
---: This item does not affect the connection results, or cannot be specified.			

Mutual authentication of ports

If mutual authentication is required, when authentication of a host is successful, the host in return authenticates the port. In authentication of ports, when user information (user name and secret) specified on the port side matches with that stored on the host, the host allows the host group to connect.

Fibre channel authentication

Enabling or disabling host authentication on a host group

You can specify whether to authenticate hosts on each host group. Change the user authentication settings of host groups to enable or disable authentication of hosts. By default, user authentication is disabled.

To enable host authentication on a host group

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. Double-click the **Fibre** folder and fibre channel port icon under the **Fibre** folder.
   When you double-click the **Fibre** folder, the fibre channel ports contained in the storage system appear as icons. If you double-click the fibre channel ports, host groups appear as icons. On the right of each icon appears the host group name.

   indicates the host group authenticates hosts. This is the default.

   indicates the host group does not authenticate hosts.

5. Right-click a host group that appears with and select **Authentication:Disable** -> **Enable**. The host group icon changes to , and the port name appears in blue.
6. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
7. Click **OK** to close the message. The settings are applied to the storage system.

To return the host group setting to , perform the same operation, except select the **Authentication:Enable** -> **Disable** menu in step 4.

Registering host user information

On a host group that performs authentication of hosts, register user information of all hosts that you allow to connect.

You should register user information of all the hosts to be connected to a host group that performs authentication of hosts. To allow a specific host to connect to such a host group without authentication, configure the host group and the host as follows.

On the host: it does not matter if you configure the host for authentication by ports with CHAP, or not.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, select a port or host group on which you want to register user information of a host.

   The user information of hosts currently registered on the selected port or host group appears in the **Authentication Information (Host)** list below the **Authentication Information (Target)** list.

   You can register user information of a host even if the port status is . In this case, however, the registered user information of a host is ignored.
4. Right-click any point in the **Authentication Information (Host)** list and select **Add New User Information**. The **Add New User Information (Host)** dialog box opens.
5. In this dialog box, specify the following user information of the host you want to allow connection.
   - **Group Name**: Specify the group name of host bus adapter. Select one from the list. In the list, all the group names of host bus adapters connected to the selected port by the cable appear.
   - **User Name**: Specify the WWN of the host bus adapter with up to 16 characters. You can use alphanumeric characters in a user name.

- **Secret**: Specify the secret (that is, a password used in CHAP authentication) between 12 to 32 characters.

  You can use alphanumeric characters, spaces, and the following symbols in a secret: . - + @ _ = : [ ] , ~
- **Re-enter Secret**: Specify the secret, again, for confirmation.
- **Protocol**: Specify the protocol used in the user authentication. This protocol is fixed to **CHAP**.

6. Click **OK** to close the **Add New User Information (Host)** dialog box. The specified user information of the host is added in blue in the **Authentication Information (Host)** list of the **Authentication** window.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
8. Click **OK** to close the message. The settings are applied to the storage system.

Changing host user information registered on a host group

You can change the registered user name or secret of a host, and enable and disable authentication settings after registration.

You cannot change the WWN when you change user information.

To change host user information registered on a host group

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, expand the **Fibre** folder and select a port or host group on which the user information you want to change is registered.

   All the user information of the hosts registered on the selected port or host group appears in the **Authentication Information (Host)** list below the **Authentication Information (Target)**.
4. In the **User Information (Host)** list, right-click a user information item that you want to change and select **Change User Information**. The **Change User Information (Host)** dialog box opens.
5. Change the user information of the host in the **Change User Information (Host)** dialog box. You can change the specifications of **User Name**, and **Secret**.
6. Click **OK** to close the **Change User Information (Host)** dialog box. The user information of the host is changed in blue in the **Authentication Information (Host)** list of the **Authentication** window.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
8. Click **OK** to close the message. The settings are applied to the storage system.

Deleting host user information

You can delete registered user information from a host group.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, expand the **Fibre** folder and select a port or host group on which the user information you want to delete is registered.

   The user information of hosts currently registered on the selected port or host group appears in the **Authentication Information (Host)** list below the **Authentication Information (Target)**.
4. In the **Authentication Information (Host)** list, right-click a user information item that you want to delete.
5. Select **Delete User Information**. The **Delete Authentication Information** dialog box opens asking whether to delete the selected host user information.
6. Click **OK** to close the message.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the setting to the storage system.
8. Click **OK** to close the message. The setting is applied to the storage system.

Registering user information for a host group (for mutual authentication)

You can perform mutual authentication by specifying user information for host groups on the storage system ports. Specify unique user information for each host group. You can change the specified user information for host groups in the same way you initially specify it.

To specify user information for a host group

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, select a port or host group whose user information you want to specify.

   The currently registered user information of the selected port or host group appears in the **Authentication Information (Target)** list.
4. Right-click any point in the **Authentication Information (Target)** list and select **Specify Authentication information**.
5. In the Specify Authentication Information dialog box, specify the user information of the port or host group selected in the **Port** tree.
   - **Port Name**: The port name of the selected port appears. You cannot change the port name.

- **User Name**: Specify the user name of the host group with up to 16 characters. You can use specified alphanumeric characters. User names are case-sensitive.
- **Secret**: Specify the secret (that is, a password used in CHAP authentication) between 12 to 32 characters. You can use alphanumeric characters, spaces, and the following symbols in a user name: . - + @ _ = : / [ ] , ~
- **Re-enter Secret**: Specify the secret, again, for confirmation.

6. Click **OK** to close the **Specify Authentication Information** dialog box. The specified user information of the port appears in blue in the **Authentication Information (Target)** list of the **Authentication** window.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
8. Click **OK** to close the message. The settings are applied to the storage system.

Clearing user information from a host group

You can clear user information from a host group.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, expand the **Fibre** folder and select a port or host group whose user information you want to clear.

   The currently registered user information of the port or host group appears in the **Authentication Information (Target)**.
4. Right-click any point in the **Authentication Information (Target)** list and select **Clear Authentication information**. The **Clear Authentication Information** dialog box opens asking whether to clear the user information of the selected host group.
5. Click **OK** to close the **Clear Authentication Information** dialog box. The user information of the selected host group disappears from the **Authentication Information (Target)** list.
6. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the setting to the storage system.
7. Click **OK** to close the message. The setting is applied to the storage system.

Fibre channel port authentication

Setting fibre channel port authentication

You can perform user authentication in a fibre channel environment by specifying authentication information on the fibre channel ports of the storage system.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder. Information about the port appears in the **Port Information** list of the **Authentication** window.
4. Right-click any point in the **Port Information** list and select **Set Port Information**.
5. In the **Set Port Information** dialog box, specify the port information.
   - **Time out**: Specify the period of time from when authentication fails to when the next authentication session is ended. This period of time is between 15 to 60 seconds. The initial value of the **Time out** is 45 seconds.
   - **Refusal Interval**: Specify the interval from when connection to a port fails to when the next authentication session starts, with up to 60 minutes. The initial value of the **Refusal Interval** is 3 minutes.
   - **Refusal Frequency**: Specify the number of times of authentication allowable for connection to a port with up to 10 times. The initial value of the **Refusal Frequency** is 3 times.
6. Click **OK** to close the **Set Port Information** dialog box.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
8. Click **OK** to close the message. The settings are applied to the storage system.

Registering user information on a fibre channel port

You can perform user authentication in a fibre channel environment by registering user information on the fibre channel ports of the storage system.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. In the **Port** tree, double-click the **Fibre** folder. Information about the port appears in the tree of the **Authentication** window.
5. Right-click any icon of port in the **Port** tree and select **Default Setting(User Name / Secret)**.
6. In the **Default Setting(User Name/Secret)** dialog box, specify the user information.

- **User Name**: Specify the user name of fibre channel with up to 16 characters. You can use alphanumeric characters in a user name. User names are case-sensitive.
- **Secret**: Specify the secret (that is, a password used in CHAP authentication) between 12 to 32 characters.

  You can use alphanumeric characters, spaces, and the following symbols in a secret: . - + @ _ = : / [ ] , ~
- **Re-enter Secret**: Specify the secret, again, for confirmation.

7. Click **OK** to close the **Default Setting (User Name/Secret)** dialog box.
8. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the setting to the storage system.
9. Click **OK** to close the message. The setting is applied to the storage system.

Registering user information on a fabric switch

You can perform user authentication in a fibre channel environment by registering user information on the fabric switch of the storage system.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.

   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. In the **Port** tree, double-click the **Fibre** folder. Information about the fabric switch appears in the **Fabric Switch Information** list below the **Port Information** list.
5. Right-click any point in the **Fabric Switch Information** list and select **Specify User Information**.
6. In the **Specify Authentication Information** dialog box, specify the user information of the host you want to allow connection.

   - **User Name**: Specify the user name of the fabric switch with up to 16 characters.

     You can use alphanumeric characters in a user name.
   - **Secret**: Specify the secret (that is, a password used in CHAP authentication) between 12 to 32 characters.

     You can use alphanumeric characters, spaces, and the following symbols in a secret: . - + @ _ = : / [ ] , ~
   - **Re-enter Secret**: Specify the secret, again, for confirmation.
7. Click **OK** to close the **Specify Authentication Information** dialog box.
8. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.

9. Click **OK** to close the message. The settings are applied to the storage system.

Clearing fabric switch user information

You can clear the specified user information of a fabric switch from the storage system.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. In the **Port** tree, double-click the **Fibre** folder. Information about the fabric switch appears in the **Fabric Switch Information** list below the **Port Information** list.
5. Right-click any point in the **Fabric Switch Information** list and select **Clear Authentication information**. The **Clear Authentication Information** dialog box opens asking whether to clear the user information of the selected fabric switch.
6. Click **OK** to close the **Clear Authentication Information** dialog box.
7. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
8. Click **OK** to close the message. The settings are applied to the storage system.

Setting the fabric switch authentication mode

You can specify the authentication mode of a fabric switch.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. In the **Port** tree, double-click the **Fibre** folder. Information about the fabric switch appears in the **Fabric Switch Information** list below the **Port Information** list.
5. Right-click any point in the **Fabric Switch Information** list and select **Authentication Mode: unidirectional->bi-directional**.
6. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.

7. Click **OK** to close the message. The settings are applied to the storage system.

To return the fibre channel setting, perform the same operation, except that you must select the **Authentication Mode: bi-directional->unidirectional** menu in step 4.

Enabling or disabling fabric switch authentication

By default, the fabric switch authentication is disabled. To enable fabric switches to authenticate hosts, enable the user authentication settings of fabric switches.

1. On the menu bar, select **Actions**, **Port/Host Group**, and then **Authentication**.
2. In the **Authentication** window, click to change to **Modify** mode.
3. In the **Port** tree, double-click the **Storage System** folder.
   If the storage system contains any fibre channel adapters, the **Fibre** folder appears below the **Storage System** folder.
4. In the **Port** tree, double-click the **Fibre** folder. Information about the fabric switch appears in the **Fabric Switch Information** list below the **Port Information** list.
5. Right-click any point in the **Fabric Switch Information** list and select **Authentication:Disable->Enable**.
6. Click **Apply** in the **Authentication** window. A message appears asking whether to apply the settings to the storage system.
7. Click **OK** to close the message. The settings are applied to the storage system.

To return the fabric switch setting so that the switch cannot authenticate hosts, perform the same operation, except select the **Authentication:Enable->Disable** menu in step 4.

Managing hosts

Changing WWN or nickname of a host bus adapter

In fibre channel environments, host bus adapters can be identified by WWNs or nicknames.

1. Select the **Hosts** tab using one of the following ways.
   - Click **Ports/Host Groups** in the **Storage Systems** tree.
   - Click **Ports/Host Groups** in the **Storage Systems** tree, and then select a port from the tree.
   - Click **Ports/Host Groups** in the **Storage Systems** tree, select a port from the tree, and then select a host group from the tree.

2. Select the **Hosts** tab, and then select the host bus adapter you want to change from the list of hosts.
3. Select **Edit Host**. The **Edit Host** window opens.
4. To change the WWN, select the **HBA WWN** check box, and then type a new WWN in **HBA WWN**.

   To change the nickname, select the **Host Name** check box, and then type a new nickname in **Host Name**.
5. If necessary, check **Apply same settings to the HBA WWN in all ports**.

   If checked, new settings affect other ports. For example, if the same host bus adapter (the same WWN) is located below ports CL1-A and CL2-A in the tree, when you select the host bus adapter (or the WWN) from below one of the ports and change the nickname to hba1, the host bus adapter below the other port will also be renamed hba1.

   However, new settings will not affect any port if:

   - The resulting nickname is already used as the nickname of a host bus adapter connected to the port, or
   - The resulting WWN exists in the port.
6. Click **Finish**.
7. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.

   If **Apply same settings to the HBA WWN in all ports** is checked, a dialog box opens listing the host bus adapter to be changed. Confirm the changes and click **OK**. Otherwise, click **Cancel**.

   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Changing the name or host mode of a host group

Use LUN Manager to change the name or host mode of a host group. You can change only the host mode option of the host group for the initiator port. You cannot use this procedure on the host group for the external port.

Caution: Before changing the host mode of a host group, you should back up data on the port to which the host group belongs. Setting host mode should not be destructive, but data integrity cannot be guaranteed without a backup.

To change the name or the host mode of a host group

1. Click **Ports/Host Groups** in the **Storage Systems** tree.

   The list of available ports appear in the tree.
2. Select the **Host Groups** tab, or select a port from the tree and then select the **Host Groups** tab.
3. Select a host group.
4. Select **Edit Host Groups**. The **Edit Host Groups** window opens.
5. To change the name of the host group, select the **Host Group Name** option, and then type a new host group name.

6. To change the host mode, select the **Host Mode** option, and then select the new host mode from the **Host Mode** table. The **Mode No.** column indicates option numbers. Select the option you want to specify, and then click **Enable**.
7. If necessary, select an option you want to specify in the **Host Mode Options**. For detailed information about host mode options, see Host mode options on page 7-11.
8. Click **Finish**.
9. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.

Initializing host group 0

Use this procedure to set host group 0 (zero) to its initial state. This removes all the WWNs from host group 0 and also removes all the LU paths related to host group 0. This procedure also changes the host mode of host group 0 to Standard and initializes the host group name. For example, if you initialize host group 0 for the port CL1-A, the name of host group 0 will change to 1A-G00.

To initialize host group 0

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
   The list of available ports appear in the tree.
2. Select the **Host Groups** tab, or select a port from the tree and then select the **Host Groups** tab.
3. Select the host group 0 which is displayed as host group (00).
4. On the menu bar, click **Actions**, **Port/Host Group**, and then **Delete Host Groups**. Or, select **Delete Host Groups** from the lower right of the window. The **Delete Host Groups** window opens.
5. Confirm the settings and enter the task name in the **Task Name** box.
   A task name can consist of up to 32 ASCII characters (letters, numerals, and symbols). Task names are case-sensitive. (date) - (task name) is input by default.
6. Click **Apply** in the **Delete Host Groups** window.
   A message appears, asking whether to delete it.
   If the **Go to tasks window for status** check box is selected, the **Tasks** window appears.
7. Click **OK** to close the message.

Deleting a host bus adapter from a host group

1. Select the **Hosts** tab in one of the following ways.
   - Click **Ports/Host Groups** in the **Storage Systems** tree.
   - Click **Ports/Host Groups** in the **Storage Systems** tree and select a port from the tree.

- Click **Ports/Host Groups** in the **Storage Systems** tree and select a port from the tree, and then select a host group from the tree.

2. Select a host bus adapter.
3. Select **Remove Hosts**.
4. In the **Remove Hosts** window, if necessary, check **Remove selected hosts from all host groups containing the hosts in the storage system**.
   If this check box is selected, selected hosts are removed from all host groups containing the hosts in the storage system.
5. Click **Finish**.
6. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   A message appears asking whether to delete it.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.
7. Click **OK** to close the message.

Deleting old WWNs from the WWN table

If you disconnect a host that has been connected via a cable to your storage system, the WWN for the host will remain in the WWN list of the LUN Manager window. Use LUN Manager to delete from the WWN list a WWN for a host that is no longer connected to your storage system.

To delete old WWNs from the WWN table

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
2. Select the **Login WWNs** tab.
3. Select the WWNs you want to delete.
4. Select **Delete Login WWNs**. The **Delete Login WWNs** window opens.
5. In the **Confirm** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   A message appears asking whether to delete it.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.
6. Click **OK** to close the message.

Deleting a host group

Use LUN Manager to delete a host group.

If host group 0 (zero) is deleted, all WWNs that belong to host group 0 are deleted and all LU paths that correspond to host group 0 are deleted. The host mode of host group 0 becomes Standard, and the host group name is initialized. To remove all the WWNs and LU paths from host group 0, you must initialize host group 0. For details, see Initializing host group 0 on page 7-48.

To delete a host group

1. Click **Ports/Host Groups** in the **Storage Systems** tree.
   The list of available ports appear in the tree.
2. Select the **Host Groups** tab, or select a port from the tree and then select the **Host Groups** tab.
3. Select a host group that you want to delete.
4. Select **Delete Host Groups**.
5. In the **Delete Host Groups** window, confirm the settings, in **Task Name** type a unique name for this task or accept the default, and then click **Apply**.
   If **Go to tasks window for status** is checked, the **Tasks** window opens.
6. Click **OK** to close the message.

8

Troubleshooting

The information in this chapter can help you troubleshoot problems when provisioning a storage system.

If a failure occurs and a message appears, see the *Hitachi Storage Navigator Messages* for further instructions.

For problems and solutions related to using Storage Navigator, see the *Hitachi Storage Navigator User Guide*.

- ☐ Troubleshooting VLL
- ☐ Troubleshooting Dynamic Provisioning
- ☐ Troubleshooting Data Retention Utility
- ☐ Troubleshooting provisioning while using Command Control Interface
- ☐ Calling the customer support

Troubleshooting VLL

If a failure occurs while you are operating, see the *Hitachi Storage Navigator Messages*.

For the problems and solutions regarding the Storage Navigator, see the *Hitachi Storage Navigator User Guide*

Troubleshooting Dynamic Provisioning

The following table provides troubleshooting instructions for using Dynamic Provisioning.

Problems	Causes and Solutions
Cannot install Dynamic Provisioning.	Cause: • Shared memory for the V-VOL management area is not installed. Solution: • Call the customer support and check if the shared memory for the V-VOL management area is installed.
Pool usage level exceeds the threshold.	Causes: • Too many DP-VOLs are associated with a pool, or too much data is stored in a pool. • Capacity of the pool is insufficient. • The threshold of the pool is too low. Solutions: • Add some pool-VOLs to increase the capacity of the pool. See Increasing pool capacity on page 5-101. • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • Set a larger value to the threshold of the pool. See Changing pool thresholds on page 5-93. After correcting the causes of SIM 620XXX and 621XXX or 620XXX and 626XXX, you need to complete the SIMs (see Manually completing a SIM on page 5-96). If you do not complete the SIMs, no new SIM will occur even if the usage level increases and again exceeds the threshold (target SIM codes are 620XXX, 621XXX, and 626XXX). SIMs 620XXX, 621XXX, 625000, and 626XXX are automatically completed if you increase pool capacity by adding pool-VOLs, because the condition that caused the SIM is removed.

Problems	Causes and Solutions
	Caution: You need free volumes to add as pool-VOLs. If there are no free volumes, create new volumes or ask the customer support to add drives. Therefore, it may take time to solve the problem.
Cannot create a DP-VOL.	Causes: • Usage of the pool has reached to 100%. • Something in the storage system is blocked. • Too many DP-VOLs are assigned, or Subscription Limit is too low. Solutions: • Add some pool-VOLs to the pool. See Increasing pool capacity on page 5-101. • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • Increase the value of Subscription Limit for the pool. See Changing the pool subscription limit on page 5-94. • Ask the customer support to solve the problem.
Cannot add a pool-VOL.	Causes: • 1,024 pool-VOLs are already defined in the pool. • The pool-VOL does not fill the requirements for a pool-VOL. • Something in the storage system is blocked. Solution: • Change the setting of the LDEV to satisfy the requirement of the Pool-VOL. See Pool-VOL requirements on page 5-5.
A pool-VOL is blocked. SIM code 627XXX is reported.	Causes: • A failure occurred in two or more data drives. Solutions: • Ask the customer support to solve the problem.
A pool is blocked.	Causes: • The breaker has been turned off and the shared memory has been lost, and then the system has been started. Solutions: • Ask the customer support to solve the problem.
A pool cannot be restored.	Causes: • Processing takes time, because something in the storage system is blocked. • The pool-VOL is blocked. • The DP-VOL capacity has increased but has been reduced back to the previous DP-VOL capacity. • Usage of the pool has reached to 100%.

Problems	Causes and Solutions
	Solutions: • After waiting for a while, click **File > Refresh All** on the menu bar of the Storage Navigator main window, and check the pool status. • If you increased the DP-VOL capacity but the DP-VOL capacity has been reduced back to the previous DP-VOL capacity, follow the instructions in Requirements for increasing DP-VOL capacity on page 5-8 to make sure that the capacity is increased, and then restore the pool. • Add some pool-VOLs to the pool to increase the capacity of the pool. See Increasing pool capacity on page 5-101). • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • Ask the customer support to solve the problem.
A pool cannot be deleted.	Causes: • The pool usage is not 0. • External volumes are removed from the pool before you delete the pool. • DP-VOLs have not been deleted. Solutions: • Confirm that the pool usage is 0 after the DP-VOLs are deleted, and then you can delete the pool. • Ask the customer support to solve the problem.
A failure occurs to the application for monitoring the volumes installed in a host.	Causes: • Free space of the pool is insufficient. • Something in the storage system is blocked. Solutions: • Check the free space of the pool and increase the capacity of the pool. See Increasing pool capacity on page 5-101). • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • Ask the customer support to solve the problem.
When the host computer tries to access the port, error occurs and the host cannot access the port.	Causes: • Free space of the pool is insufficient. • Something in the storage system is blocked. Solutions: • Check the free space of the pool and increase the capacity of the pool. See Increasing pool capacity on page 5-101.

Problems	Causes and Solutions
	• Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • Ask the customer support to solve the problem.
When you are operating Storage Navigator, a timeout occurs frequently.	Causes: • The load on the Storage Navigator computer is too heavy, so that the Storage Navigator computer cannot respond to the SVP. • The period of time until when time-out occurs is set too short. Solutions: • Wait for a while, then try the operation again. • Verify the setting of the environment parameter of Storage Navigator RMI time-out period. For information about how to set the RMI time-out period, see the *Hitachi Storage Navigator User Guide*.
DP-VOL capacity cannot be increased.	See Troubleshooting provisioning while using Command Control Interface on page 8-8 and identify the cause. Solutions: • After clicking **File > Refresh All** on the menu bar of the Storage Navigator main window, confirm whether the processing for increasing DP-VOL capacity meets conditions described in Requirements for increasing DP-VOL capacity on page 5-8. • Retry the operation after 10 minutes or so. • Ask the customer support to solve the problem.
Cannot reclaim zero pages in a DP-VOL.	Causes: • Zero pages in the DP-VOL cannot be reclaimed from Storage Navigator because the DP-VOL does not meet conditions for releasing pages in a DP-VOL. Solutions: • Make sure that the DP-VOL meets the conditions described in Releasing pages in a DP-VOL on page 5-112.
The DP-VOL cannot be released if the process to reclaim zero pages in the DP-VOL is interrupted.	Causes: • Pages of the DP-VOL are not released because the process of reclaiming zero pages was interrupted. Solutions: • Make sure that the DP-VOL meets the conditions described in Releasing pages in a DP-VOL on page 5-112.

Problems	Causes and Solutions
Cannot release the Protect attribute of the DP-VOLs. SIM code 628000 was issued.	Causes: • The pool is full. • The pool-VOL is blocked. • The pool-VOL that is an external volume is blocked. Solutions: • Add pool-VOLs to the pool to increase the free space in the pool. See Increasing pool capacity on page 5-101. • Perform the reclaiming zero pages operation to release pages in which zero data are stored. See Releasing pages in a DP-VOL on page 5-112. • Contact the customer support to restore the pool-VOL. • If the blocked pool-VOL is an external volume, verify the status of the path blockade and the external storage system. • After performing above solutions, release the Protect attribute of the DP-VOLs using the Data Retention window of Storage Navigator (if the Data Retention Utility is installed). For information about Data Retention Utility, see *Provisioning Guide for Open Systems*.
SIM code such as 620XXX, 621XXX, 625000 or 626XXX was issued.	Causes: • Pool usage level exceeds the threshold. Solutions: • Add pool-VOLs to the pool to increase the free space in the pool. See Increasing pool capacity on page 5-101. • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111.
SIM code 622XXX was issued	Causes: • Usage of the pool has reached to 100%. Solutions: • Add pool-VOLs to the pool to increase the free space in the pool. See Increasing pool capacity on page 5-101. • Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111. • The Protect attribute of Data Retention Utility may have been set to DP-VOLs. After performing the above solutions, release the Protect attribute of the DP-VOLs using the Data Retention window of Storage Navigator.

Problems	Causes and Solutions
SIM code 624000 was issued.	Causes: The size of the pools and DP-VOLs configuration exceeds the supported capacity. Solutions: • Remove pools that are not used. • Remove DP-VOLs that are not used. • Remove Thin Image pairs that are not used. • Shrink pool capacities.

Formatted pool capacity displayed in the View Pool Management Status window does not increase.	Causes:
	• Another pool is being formatted.
	• The pool usage level reaches up to the threshold.
	• The pool is blocked.
	• I/O loads to the storage system are high.
	• The cache memory is blocked.
	• Pool-VOLs are blocked.
	• Pool-VOLs which are external volumes are blocked.
	Solutions:
	• Confirm the display again after waiting for a while.
	• Add pool-VOLs to the pool to increase the free space in the pool. For more information, see Increasing pool capacity on page 5-101.
	• Perform the operation to reclaim zero pages in order to release pages in which zero data are stored. See About releasing pages in a DP-VOL on page 5-111.
	• Restore the pool.
	• Confirm the display again after decreasing I/O loads of the storage system.
	• Contact the customer support to restore the cache memory.
	• Contact the customer support to restore the pool-VOL.
	• If the blocked pool-VOL is an external volume, confirm following:
	  ◦ Path blockage
	  ◦ Status of the storage system

If you are unable to solve a problem using the above suggestions, or if you encounter a problem not listed, please contact the customer support.

If an error occurs during the operations, the error code and error message appear in the error message dialog box. For more information about error messages, see *Hitachi Storage Navigator Messages*.

Troubleshooting Data Retention Utility

If an error occurs with Data Retention Utility, the Error Detail Dialog Box on page F-5 appears. The Error Detail dialog box displays error locations and error messages.

The Error Detail dialog box does not display Storage Navigator error messages. To find information about Storage Navigator errors and solutions, see the *Hitachi Storage Navigator User Guide*.

Data Retention Utility troubleshooting instructions

The following table provides troubleshooting instructions for using Data Retention Utility.

Problems	Probable Causes and Solutions
You cannot find some volumes in the list of the **Data Retention** window.	If volumes are combined into a LUSE volume, the volume list shows only the top LDEV of the combined volumes. To view all the volumes combined into a LUSE volume, right-click the volume and then select **Volume Detail**.
The **Disable/ Enable** or the **Enable/Disable** button on the Data Retention window is unavailable. Nothing happens when you click the button.	You have been making changes in the Data Retention window, but the changes have not been applied to the storage system. Apply the changes first, and then perform the extension lock operation. You can find the changes by: • scrolling the current list up and down. • selecting another CU from the tree and then scrolling the list up and down.
Open-systems hosts cannot read from or write to a volume.	• The volume is protected by the read-only attribute. Write failure is reported as an error message. • The volume is protected by the Protect attribute. Read (or write) failure is reported as an error message.
Mainframe hosts cannot read from or write to a volume.	• The volume is protected by the read-only attribute. Write failure is reported as a Write Inhibit condition. • The volume is protected by the Protect attribute. Read (or write) failure is reported as a cc=3 condition.
The number of days in the **Retention Term** does not decrease	The number of days in the **Retention Term** is calculated based on the operating time of the storage system. Therefore, the number of days in the **Retention Term** may not decrease.

Troubleshooting provisioning while using Command Control Interface

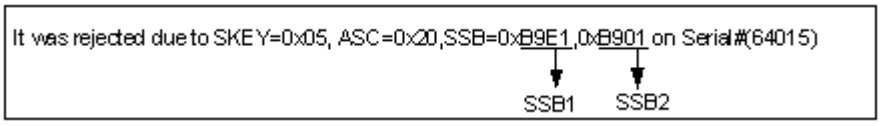
If an error occurs while operating Data Retention Utility or Dynamic Provisioning while using CCI, you might identify the cause of the error by referring to the log appearing on the CCI window or the CCI operation log file.

The CCI operation log file is stored in the following directory.
`/HORCM/log*/curlog/horcmlog_HOST/horcm.log`

where

- * is the instance number.
- HOST is the host name.

The following is an example of a log entry in the CCI window.



Errors when operating CCI (Dynamic Provisioning, SSB1: 0x2e31/0xb96d)

Error Code (SSB2)	Error Contents	Solutions
0x0bf5	Communication error occurred while the DP-VOL capacity expansion was being performed.	Execute the **`raidcom get ldev`** command or the **`raidvchkdsp -v aou`** command to confirm the specified DP-VOL capacity. If the capacity is not expanded, execute the command again.
0x9100	The command cannot be executed because user authentication is not performed.	Perform user authentication.
0xb900/ 0xb901/ 0xaf28	Error occurred when increasing DP-VOL capacity operation.	Ask the customer support to solve the problem.
0xb902	The operation was rejected because the configuration was being changed by SVP or Storage Navigator, or because the DP-VOL capacity was going to be increased by another instance of the CCI.	Increase the DP-VOL capacity after finishing operations on your storage system, such as the Virtual LUN operation or a maintenance operation. See Caution in Requirements for increasing DP-VOL capacity on page 5-8.
0xaf22	The operation was rejected because the specified volume is placed online with the OS which does not support EAV (Extended Address Volume).	Increase the DP-VOL capacity after the specified volume is placed online with the OS which supports EAV.
0xaf24	The operation was rejected because the total DP-VOL capacity exceeded the pool reservation rate after the capacity was increased.	Specify a capacity so that the pool reservation rate will not be exceeded.
0xaf25	The operation to increase capacity cannot be performed on the specified DP-VOL.	Check the emulation type of the specified DP-VOL.

Error Code (SSB2)	Error Contents	Solutions
0xaf26	The operation was rejected because of lack of cache management devices due to increased capacity.	Specify a capacity so that the maximum number of cache management devices will not be exceeded.
0xaf29	Because the specified volume was not a DP-VOL, the operation was rejected.	Makes sure that the volume is a DP-VOL.
0xaf2a	Because the specified capacities are invalid or exceeded the value immediately below LDEV Capacity in the Expand Virtual Volumes window, the operation was rejected.	To increase capacity, specify the correct capacity that does not exceed the value immediately below LDEV Capacity in the Expand Virtual Volumes window. See the conditions for increasing DP-VOL capacity in Requirements for increasing DP-VOL capacity on page 5-8.
0xaf2b	Because the specified volume operation was not finished, the operation was rejected.	Re-execute the operation after a brief interval.
0xaf2c	Because the shared memory capacity is not enough to increase the specified capacity, the operation was rejected.	Confirm the value immediately below LDEV Capacity in the Expand Virtual Volumes window.
0xaf2e	Because the specified DP-VOL was used by other software or was being formatted, the operation was rejected.	Wait until formatting of the specified volume is finished, or see Using Dynamic Provisioning or Dynamic Tiering with other VSP products on page 5-10 and confirm whether the DP-VOL is used with software in which that the DP-VOL capacity cannot be increased.
0xaf2f	Because the DP-VOL capacity was increased when the microcode was replaced, the operation was rejected.	Re-execute the operation after the microcode is replaced.
0x0b2b	Because the **`raidcom extend ldev`** command was executed with specifying the **`-cylinder`** option to the DP-VOL for the open system, the operation was rejected.	Re-execute the **`raidcom extend ldev`** command without specifying the **`-cylinder`** option.

Errors when operating CCI (Data Retention Utility, SSB1:2E31/ B9BF/B9BD)

Error Code (SSB2)	Description
9100	The command cannot be executed because user authentication is not performed.
B9BD	The setting failed because the specified volume does not exist.
B9C2	The specified volume is a command device.
B9C4	The command was rejected due to one of the following reasons: • The specified volume is a P-VOL or S-VOL of Copy-on-Write Snapshot. • The specified volume is a virtual volume. • The specified volume is a pool volume. • The specified volume is an S-VOL of Universal Replicator. • The specified volume is a journal volume. • The specified volume is reserved for the Volume Migration function. • The specified volume is a P-VOL or S-VOL of ShadowImage. • The consumed capacity exceeded the licensed capacity. • The access attribute cannot be changed because the data retention term is set. • The specified volume is a command device. • The specified volume is in the PAIR or COPY status. • The specified volume does not exist. • The S-VOL Disable attribute is set to the specified volume. • The reserve function cannot be canceled using CCI.
B9C7	Data Retention Utility is not installed.
B9C9	The consumed capacity exceeded the licensed capacity.
B9CA	The command was rejected due to one of the following reasons: • Fewer days are set as the data retention term. • More than 60 years are set as the data retention term. • An interface other than Java updated the settings while Data Retention Utility was in the process of changing them. A conflict occurred between Java and the other interface.
B9CB	The retention term cannot be set because the access attribute is read/ write.

Calling the customer support

If you need to call the customer support, make sure you can provide as much information about the problem as possible. Include the circumstances surrounding the error or failure, the Storage Navigator configuration information saved by the Dump Tool, the exact content of messages appearing on the Storage Navigator, and severity levels and reference codes appearing on the Status tab of the Storage Navigator main window (see the *Hitachi Device Manager - Storage Navigator Messages*).

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

A

CCI command reference

This appendix provides information on Storage Navigator tasks and corresponding Command Control Interface commands used in provisioning.

- Storage Navigator tasks and CCI command list
- Parameter range for CCI options

Storage Navigator tasks and CCI command list

The following lists actions (tasks) that can be performed in the Storage Navigator GUI, and the corresponding commands that can be issued in CCI.

Item	Action name	CCI command
Logical Device	Create LDEVs	raidcom add ldev
	Delete LDEVs	raidcom delete ldev
	Edit LDEVs	raidcom modify ldev
	Format LDEVs	raidcom initialize ldev
	Block LDEVs	raidcom modify ldev
	Restore LDEVs	raidcom modify ldev
	Assign MP Blade	raidcom modify ldev
	Add LUN Paths	raidcom add lun
	Delete LUN Paths	raidcom delete lun
	Expand V-VOLs	raidcom extend ldev
	Reclaim Zero Pages	raidcom modify ldev
	Shredding	raidcom initialize ldev
Port/Host Group	Create Host Groups	raidcom add host_grp
	Delete Host Groups	raidcom delete host_grp
	Edit Host Groups	raidcom modify host_grp
	Add Hosts	raidcom add hba_wwn
	Add to Host Groups	raidcom add hba_wwn
	Remove Hosts	raidcom delete hba_wwn
	Edit Host	raidcom add hba_wwn
	Create Alternate LUN Paths	raidcom add lun
	Edit Ports	raidcom modify port
Pool	Create Pools	raidcom add dp_pool
	Expand Pool	raidcom add dp_pool
	Shrink pools	raidcom delete pool
	Delete Pools	raidcom delete pool
	Edit Pools	raidcom modify pool
	Monitor Pools	raidcom monitor pool
	Stop Monitoring Pools	raidcom monitor pool
	Start Tier Relocation	raidcom reallocate pool
	Stop Tier Relocation	raidcom reallocate pool
	Restore Pools	raidcom modify pool

Item	Action name	CCI command
	View Tier Properties	raidcom get dp_pool
External Storage	Disconnect External Volumes	raidcom disconnect external_grp
	Reconnect External Volumes	raidcom check_ext_storage

Parameter range for CCI options

The following table lists the ranges of parameters that can be set to the CCI options. For details, see the *Hitachi Command Control Interface Command Reference*.

Parameter	Values
Serial number	1 to 99999
LDEV ID	0 to 65279
Pool ID	0 to 127
Port number	CL1-A to CL7-R
LU number	0 to 2047
Resource group ID	0 to 1023
Parity group ID	gno: 1 to 32 sgno: 1 to 16
SSID	0004 to FFFE
Tiering policy ID	0 to 31
Loop ID for port	0x01 to 0xEF
VLAN ID	1 to 4094
CU#	00 to FE
LDEV ID used in a virtual storage machine	See the parameter of LDEV ID.
Virtual port number	See the parameter of Port number.
SSID for LDEV in a virtual storage machine	See the parameter of SSID.

B

Resource Partition Manager GUI reference

Sections in this appendix describe the windows, wizards, and dialog boxes of the Resource Partition Manager used in configuring resource groups.

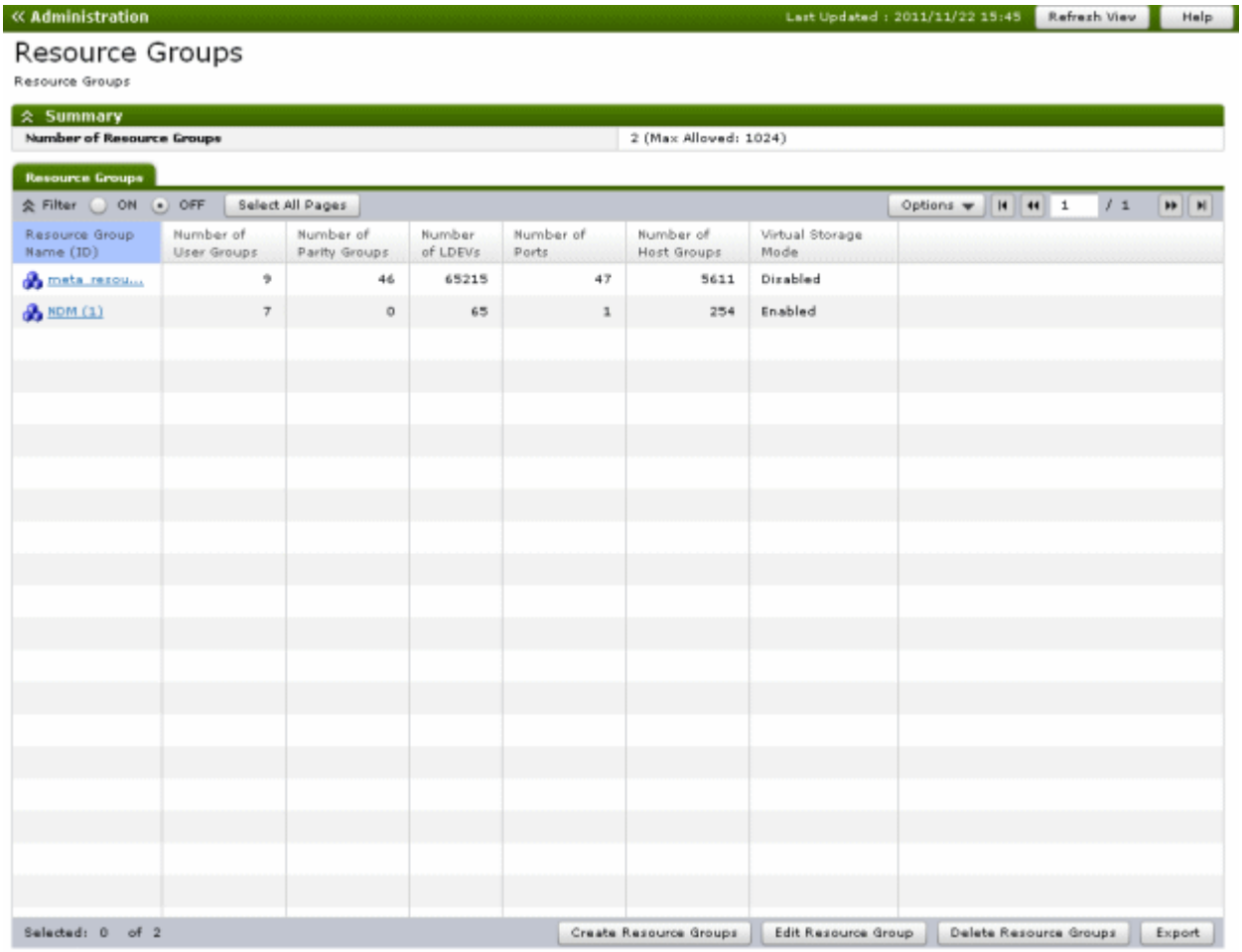
For information about common Storage Navigator operations, such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

- ☐ Resource Groups window
- ☐ Window after selecting a resource group
- ☐ Create Resource Groups wizard
- ☐ Edit Resource Group wizard
- ☐ Add Resources wizard
- ☐ Remove Resources window
- ☐ Delete Resource Groups window
- ☐ Resource Group Properties window

Resource Groups window

Use this window to create or delete resource groups, and to view, edit, or export information about resource groups. You must have the correct user permissions to perform tasks on resource groups.

- Summary and buttons on page B-2
- Resource Groups tab on page B-3



Summary and buttons

Item	Description
Number of Resource Groups	The number of resource groups configured in your storage system. The maximum allowed is 1024.
Virtual Storage Mode	Displays whether the virtual ID of the resource group is enabled or disabled.
Create Resource Groups	Opens the Create Resource Group window, where you can create one or more new resource groups. The results will appear in this window

Item	Description
Edit Resource Group	Opens the Edit Resource Group window where you can edit the name of a selected resource group.
Delete Resource Groups	Opens the Delete Resource Groups window, where you can delete one or more resource groups selected in this window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as for backup or reporting.

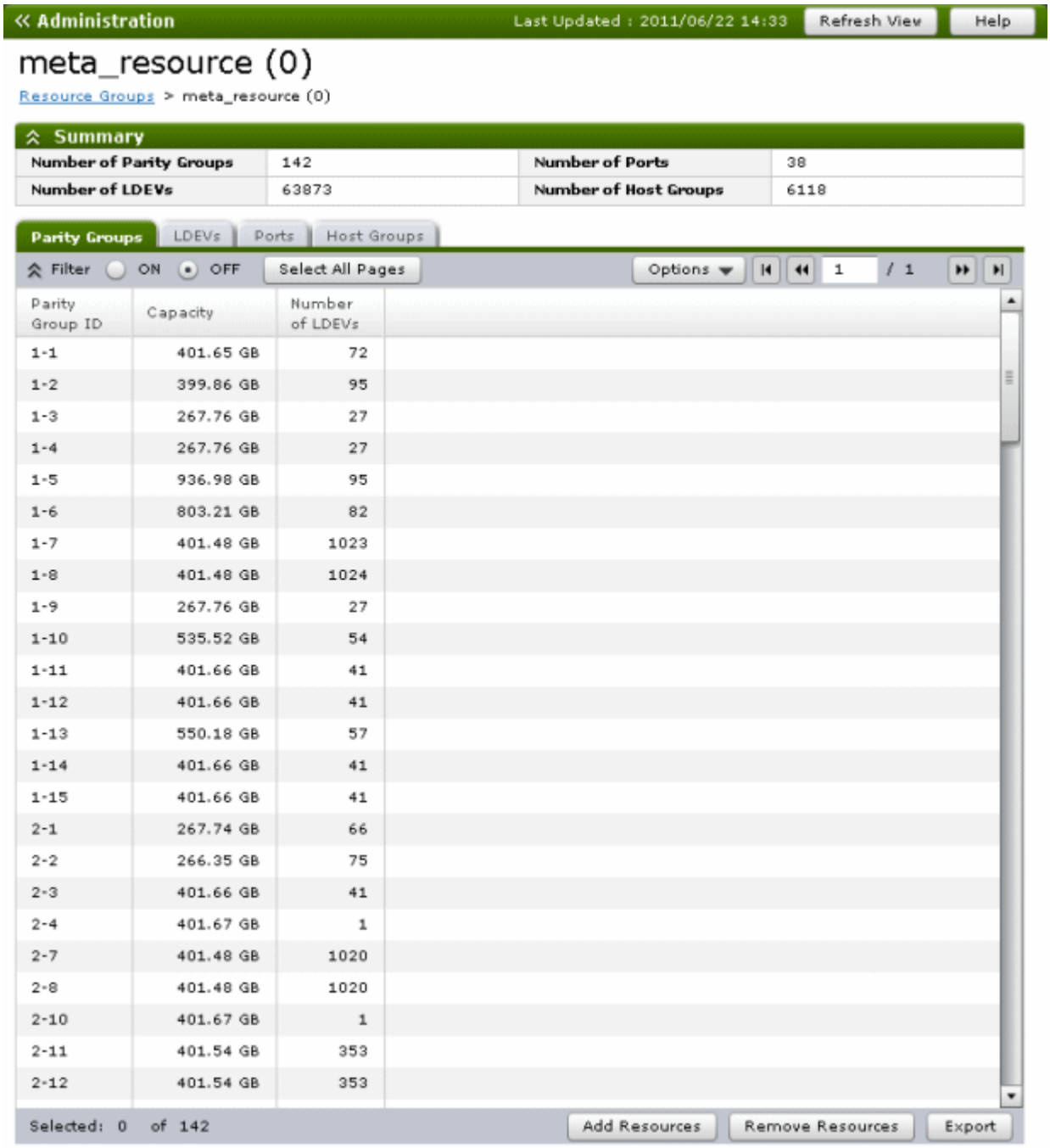
Resource Groups tab

Item	Description
Resource Group Name (ID)	Name and identifier of a resource group.
Number of User Groups	Number of user groups where the resource group is assigned.
Number of Parity Groups	Number of parity groups that are assigned to the resource group.
Number of LDEVs	Number of LDEVs that are assigned to the resource group.
Number of Ports	Number of ports that are assigned to the resource group.
Number of Host Groups	Number of host groups that are assigned to the resource group.
Virtual Storage Mode	Displays whether the virtual ID of the resource group is enabled or disabled.

Window after selecting a resource group

This window opens when you select a resource group in the Resource Groups window. It provides information about parity groups, LDEVs, ports, and host groups in the selected resource group.

- Summary on page B-4
- Parity Groups tab on page B-5
- LDEVs tab on page B-6
- Ports tab on page B-8
- Host Groups tab on page B-10



Summary

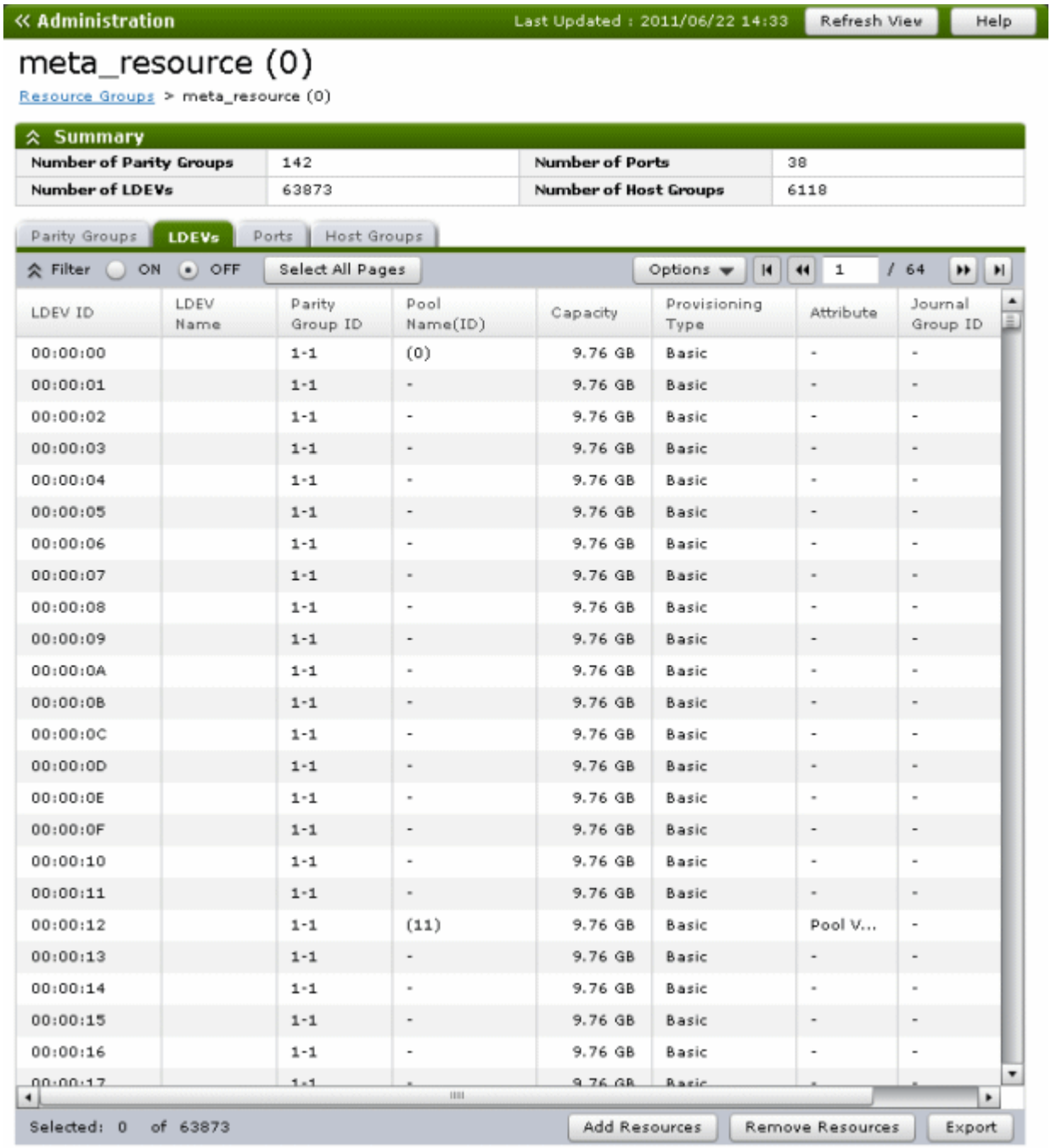
Item	Description
Number of Parity Groups	Number of parity groups that are assigned to the resource group.
Number of LDEVs	Number of LDEVs that are assigned to the resource group.
Number of Ports	Number of ports that are assigned to the resource group.

Item	Description
Number of Host Groups	Number of host groups that are assigned to the resource group.

Parity Groups tab

Item	Description
Parity Group ID	Identifiers of parity groups that are already defined.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in each parity group.
Add Resources	Opens the Add Resources window, where you can add one or more resources to the resource group.
Remove Resources	Opens the Remove Resources window, where you can remove one or more resources from the resource group.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

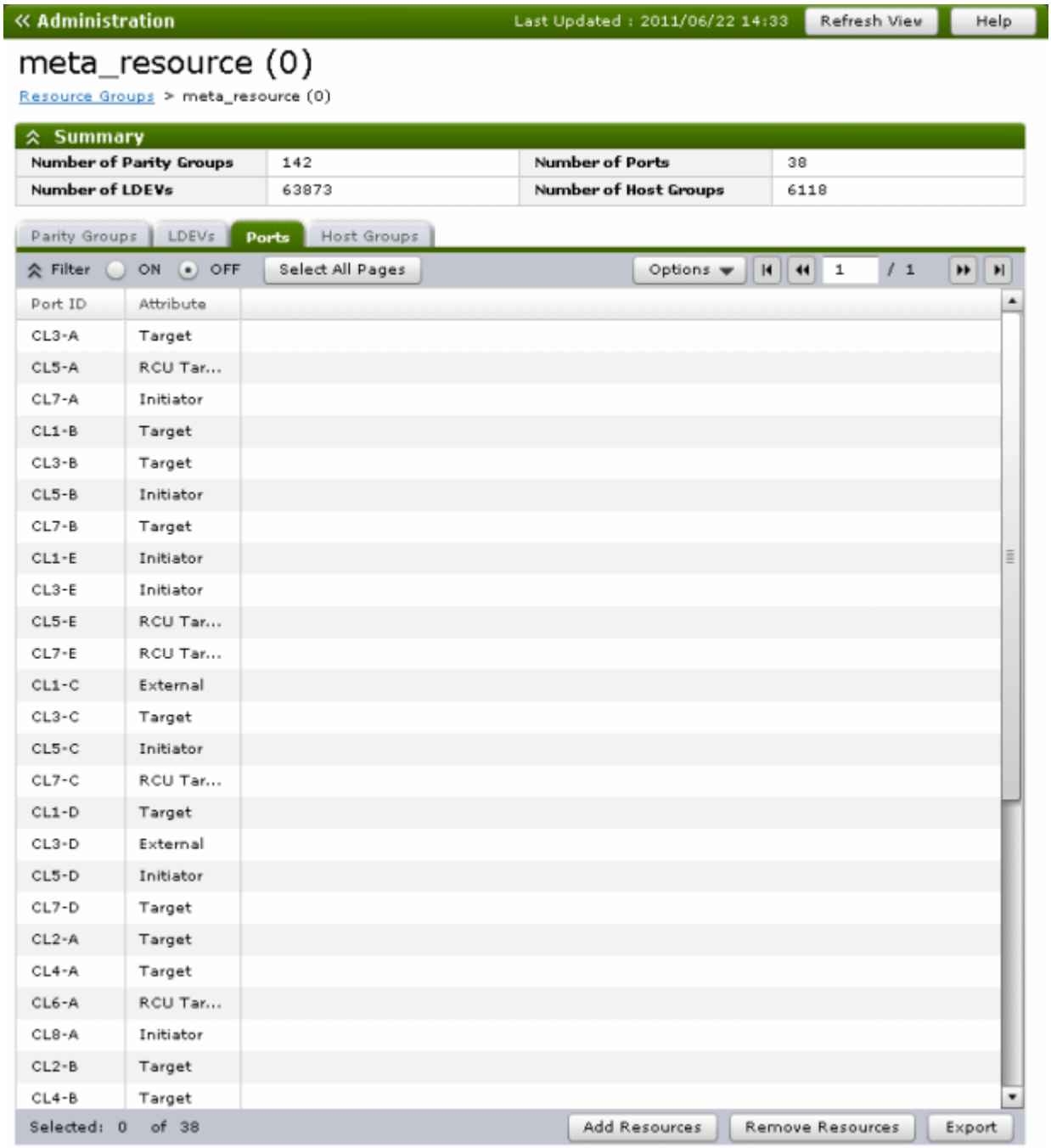
LDEVs tab



Item	Description
LDEV ID	LDEV identifiers. Some undefined LDEV IDs may appear. A hyphen appearing in the LDEV name indicates the LDEV is undefined.
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier in which the LDEV belongs.

Item	Description
Pool Name (ID)	Pool name and identifier in which the LDEV belongs.
Capacity	Capacity of each LDEV.
Provisioning Type	Provisioning type of each volume. • Basic: Internal volume • DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe • External: External volume • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume • External MF: Migration volume
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: Command device. • Remote Command Device. • System Disk. • JNL VOL: Journal volume. • Pool VOL: Pool volume. The number in parentheses is the pool identifier. • Reserved VOL: Reserved volume. • Quorum Disk: Quorum disk for High Availability Manager. • TSE: TSE-VOL. • Nondisruptive Migration: Volume for nondisruptive migration. • Hyphen (-): Volume in which the attribute is not defined.
Journal Group ID	Journal group identifier when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.
Add Resources	Opens the Add Resources window, where you can add one or more resources to the resource group.
Remove Resources	Opens the Remove Resources window, where you can remove one or more resources from the resource group.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

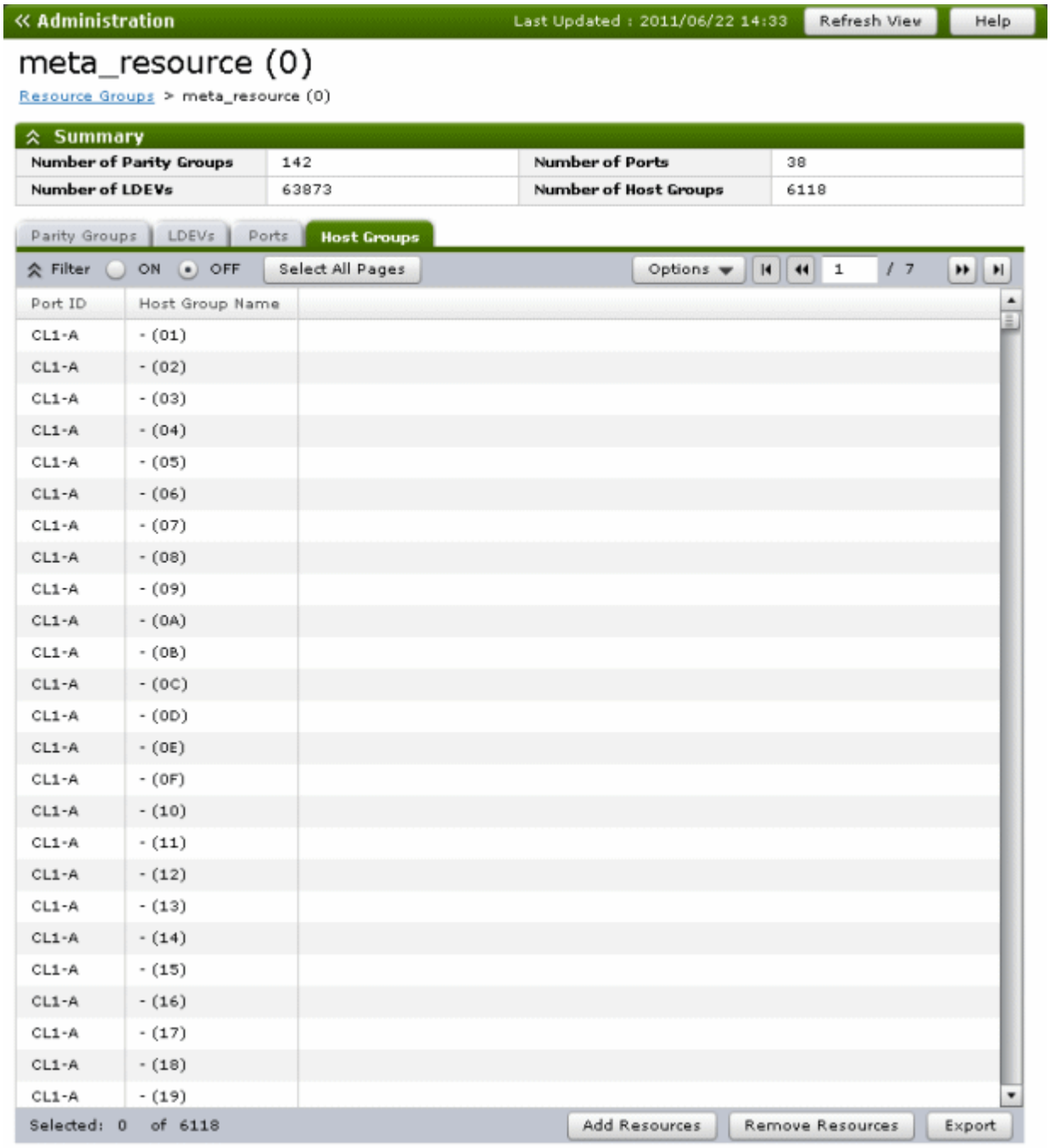
Ports tab



Item	Description
Port ID	Identifiers of the ports that are already mounted.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host.

Item	Description
	• RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Add Resources	Opens the Add Resources window, where you can add one or more resources to the resource group.
Remove Resources	Opens the Remove Resources window, where you can Remove one or more resources from the resource group.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Host Groups tab



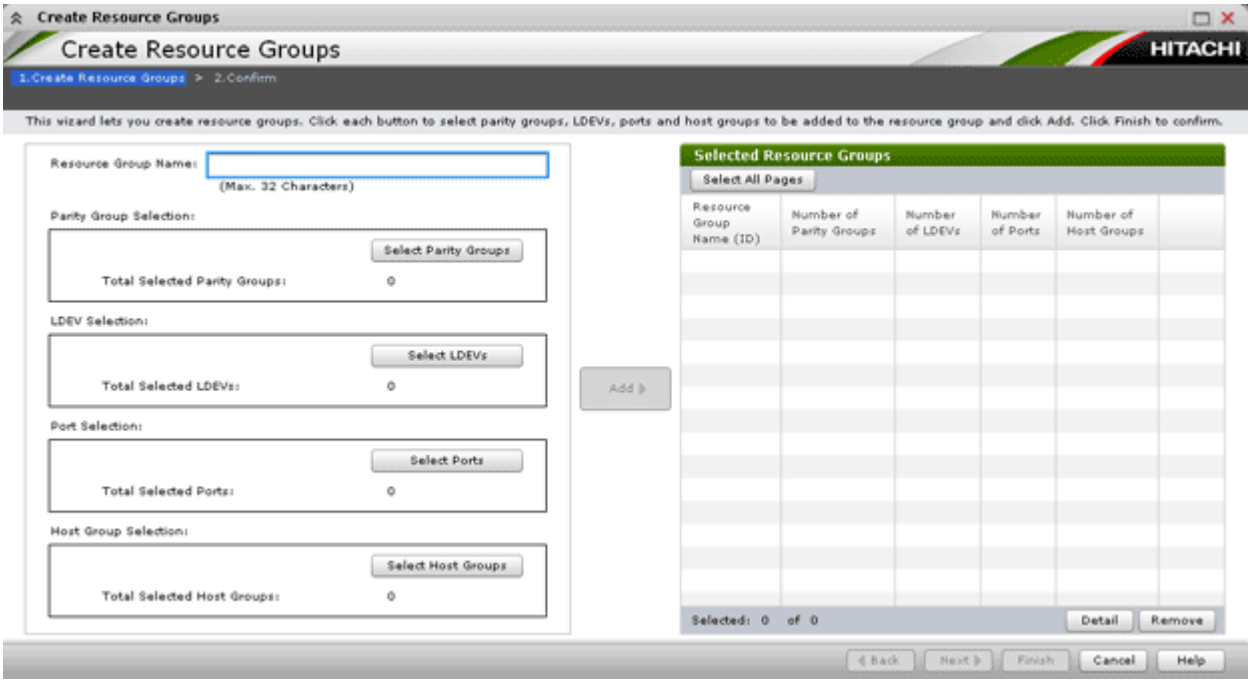
Item	Description
Port ID	Port identifiers.
Host Group Name	Name and identifier of each host group that uses a port. Some undefined host groups may appear. A hyphen indicates the host group is undefined.
Add Resources	Opens the Add Resources window, where you can add one or more resources to a resource group.

Item	Description
Remove Resources	Opens the Remove Resources window, where you can remove one or more resources from a resource group.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Create Resource Groups wizard

Create Resource Groups window

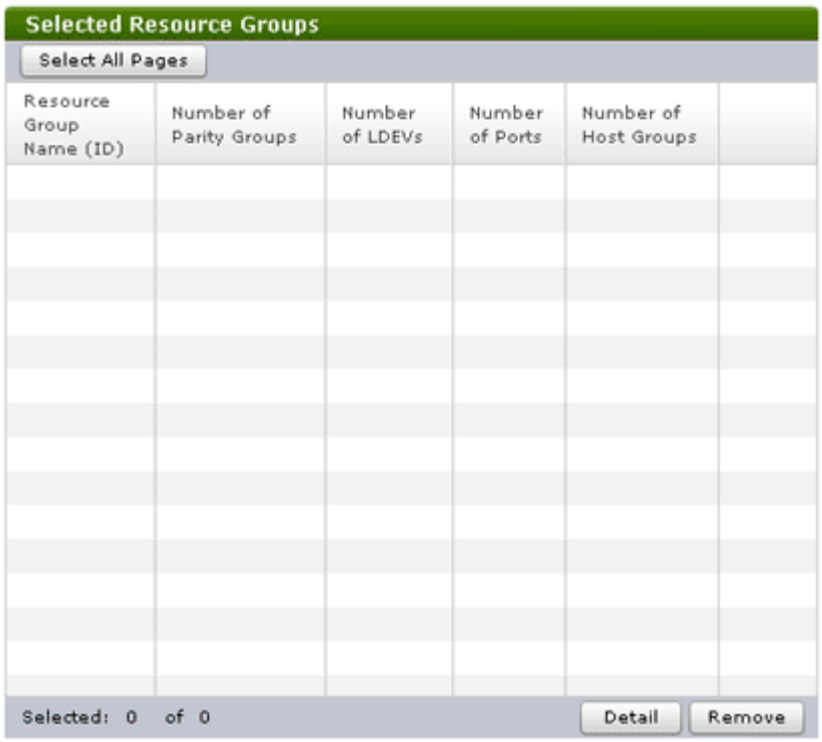
Use this window to designate the parity groups, LDEVs, ports, and host groups, if any, that will make up a resource group.



Setting fields

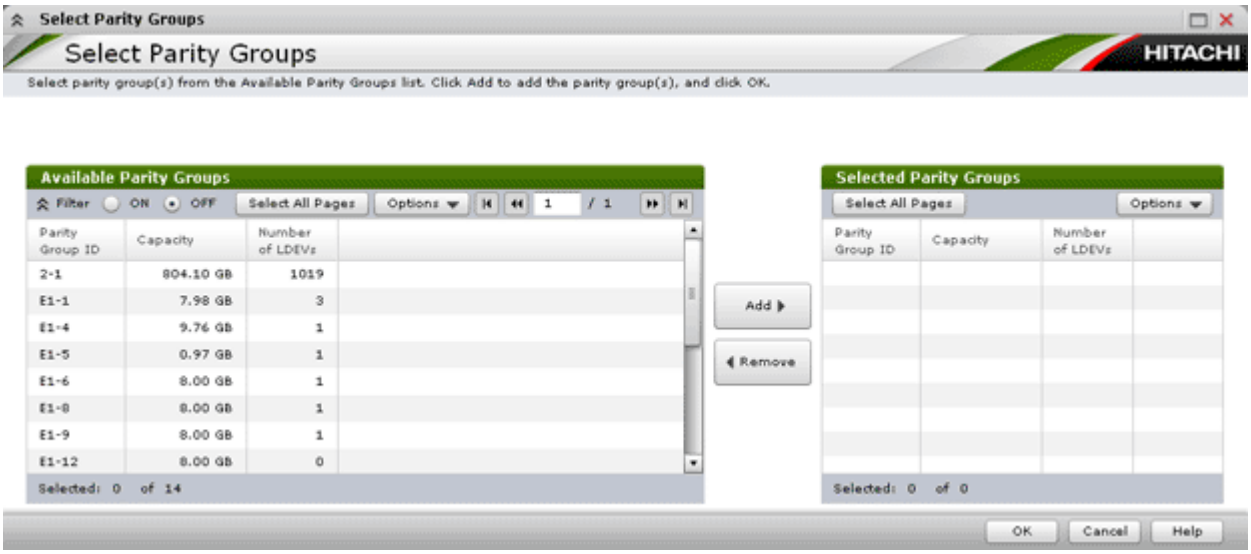
Item	Description
Resource Group Name	Type a unique name for this resource group. the following rules apply: • meta_resource cannot be set as a resource group name. • Names should be unique, and multiple occurrences of the same resource group name are not allowed in one storage system. • Resource names are case-sensitive. • Usable characters are alphanumeric, spaces, and symbols (! # $ % & ' ( ) + - . = @ [ ] ^ _ ` { } ~)
Select Parity Groups	Opens the Select Parity Groups window, where you select one or more parity groups to be assigned to the resource group.
Select LDEVs	Opens the Select LDEVs window, where you select one or more LDEVs to be assigned to the resource group.
Select Ports	Opens the Select Ports window, where you select one or more ports to be assigned to the resource group.
Select Host Groups	Opens the Select Host Groups window, where you select one or more host groups to be assigned to the resource group.
Add	Adds your settings to the Selected Resource Groups table.

Selected Resource Groups table

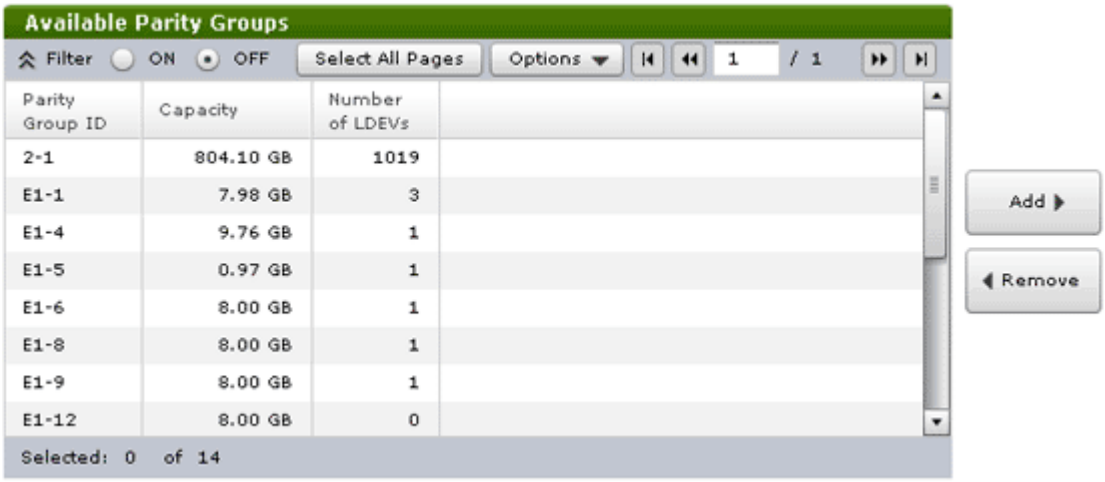


Item	Description
Resource Group Name (ID)	Name and identifier of each resource group. A hyphen indicates the ID number is not assigned before setting a resource group.
Number of Parity Groups	Number of parity groups to be assigned to the resource group.
Number of LDEVs	Number of LDEVs to be assigned to the resource group.
Number of Ports	Number of ports to be assigned to the resource group.
Number of Host Groups	Number of host groups to be assigned to the resource group.
Detail	Opens the Resource Group Property window, where you can view details of the selected resource group.
Remove	Removes a selected resource group.

Select Parity Groups window

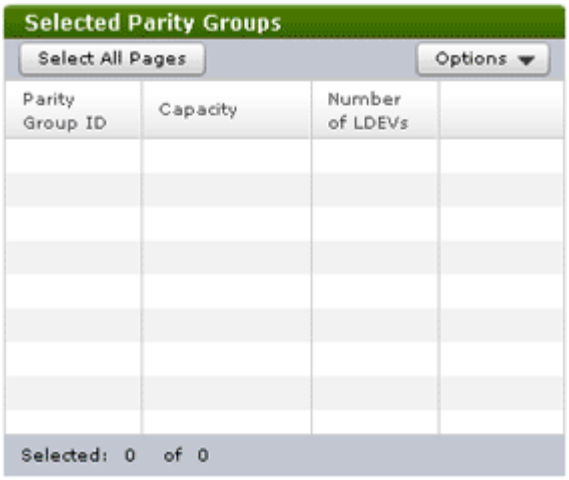


Available Parity Groups table



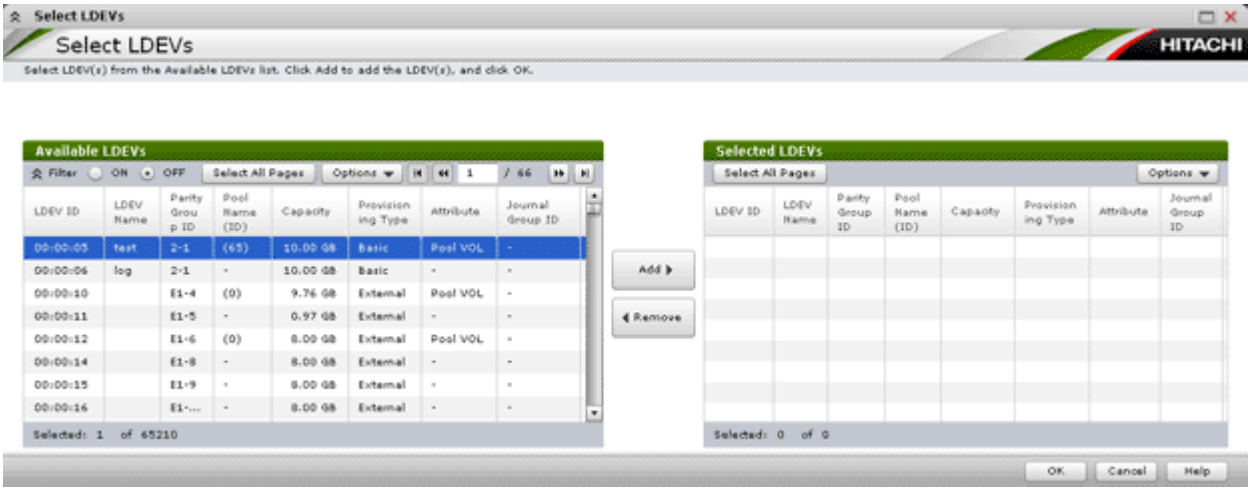
Item	Description
Parity Group ID	Parity group identifiers.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in each parity group.
Add	Adds one or more parity groups selected in the Available Parity Groups table to the Selected Parity Groups table.
Remove	Removes one or more selected parity groups from the Selected Parity Groups table and relocates the parity groups to the Available Parity Groups table.

Selected Parity Groups table

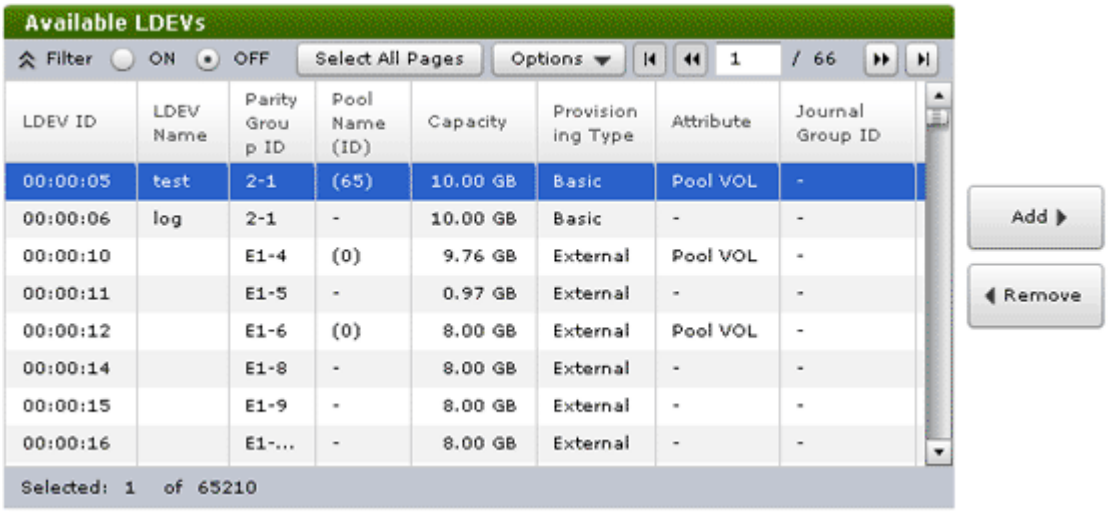


Item	Description
Parity Group ID	Parity group identifiers.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in each parity group.

Select LDEVs window



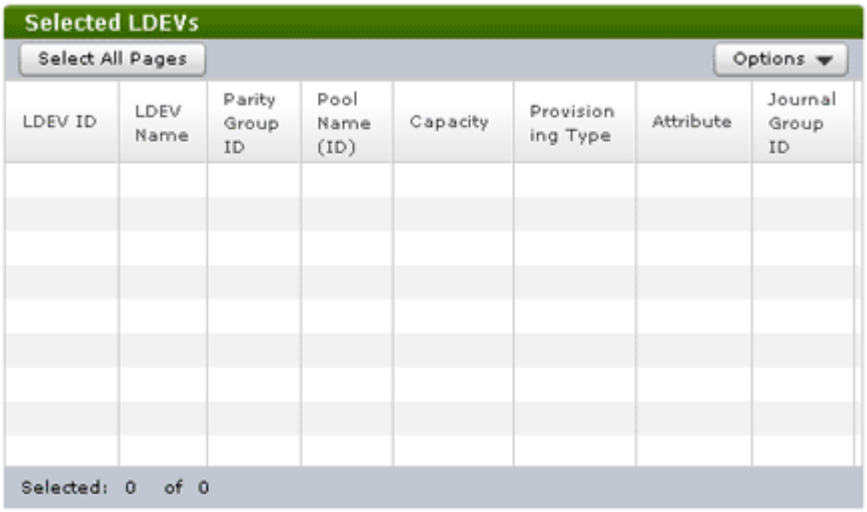
Available LDEVs table



Item	Description
LDEV ID	LDEV identifiers. LDEV IDs may be appear for undefined LDEVs. A hyphen appearing in columns to the right of the LDEV ID and LDEV name (for example, Parity Group ID, Pool Name ID, Capacity, and so on) indicates the LDEV is undefined.
LDEV Name	LDEV names.
Parity Group ID	Parity group identifier where the LDEV belongs.
Pool Name (ID)	Pool name and identifier where the LDEV belongs.
Capacity	Capacity of each LDEV.
Provisioning Type	Provisioning type of each volume. Basic: Internal volume DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe External: External volume Snapshot: Thin Image volume or Copy-on-Write Snapshot volume
Attribute	Attribute of the volume indicating how the LDEV is used. Command Device: Command device Remote Command Device: Remote command device System Disk: System disk JNL VOL: Journal volume Pool VOL: Pool volume. The number in parentheses shows the pool ID. Reserved VOL: Reserved volume Quorum Disk: Quorum disk for High Availability Manager. TSE: TSE-VOL Nondisruptive Migration: Volume for nondisruptive migration

Item	Description
	Hyphen (-): Volume in which the attribute is not defined
Journal Group ID	Journal group identifier when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.
Add	Adds one or more LDEVs selected in the Available LDEVs table to the Selected LDEVs table.
Remove	Removes one or more selected LDEVs from the Selected LDEVs table and relocates the LDEVs to the Available LDEVs table.

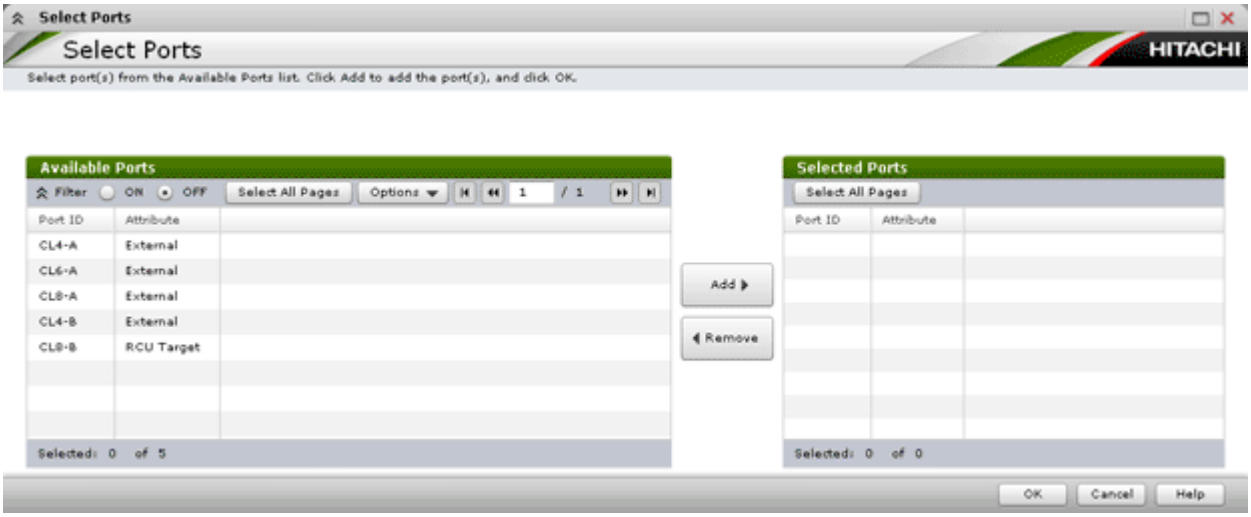
Selected LDEVs table



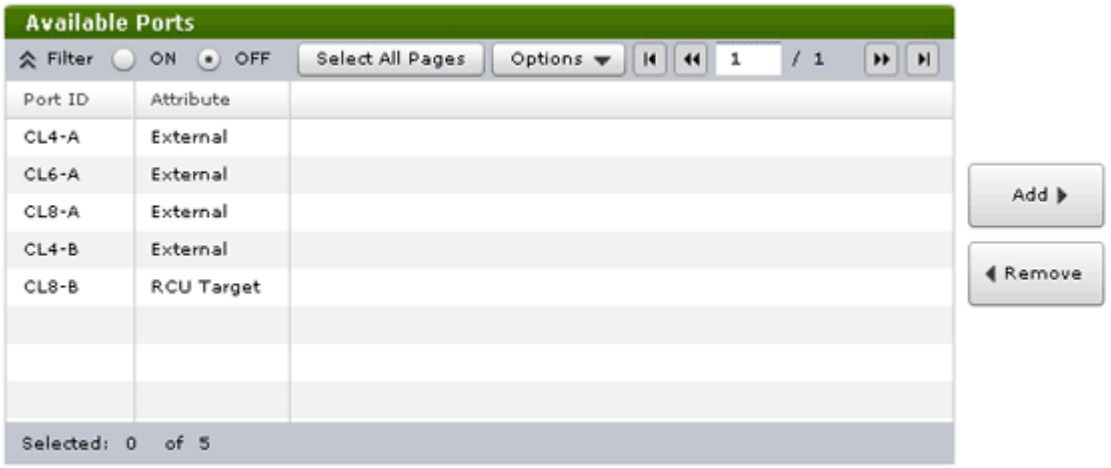
Item	Description
LDEV ID	LDEV identifiers. Some undefined LDEV IDs may appear. A hyphen in the LDEV name indicates the LDEV is undefined.
LDEV Name	LDEV names.
Parity Group ID	Parity group identifier where the LDEV belongs.
Pool Name (ID)	Pool name and identifier where the LDEV belongs.
Capacity	Capacity of the LDEV.
Provisioning Type	Displays the type of each volume. Basic: Internal volume DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe External: External volume Snapshot: Thin Image volume or Copy-on-Write Snapshot volume External MF: Migration volume
Attribute	Attribute of the volume indicating how the LDEV is being used.

Item	Description
	• Command Device: Command device. • Remote Command Device. • System Disk. • JNL VOL: Journal volume. • Pool VOL: Pool volume. The number in parentheses is the pool identifier. • Reserved VOL: Reserved volume. • Quorum Disk: Quorum disk for High Availability Manager. • TSE: TSE-VOL. • Nondisruptive Migration: Volume for nondisruptive migration. • Hyphen (-): Volume in which the attribute is not defined.
Journal Group ID	Journal group identifier when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.

Select Ports window

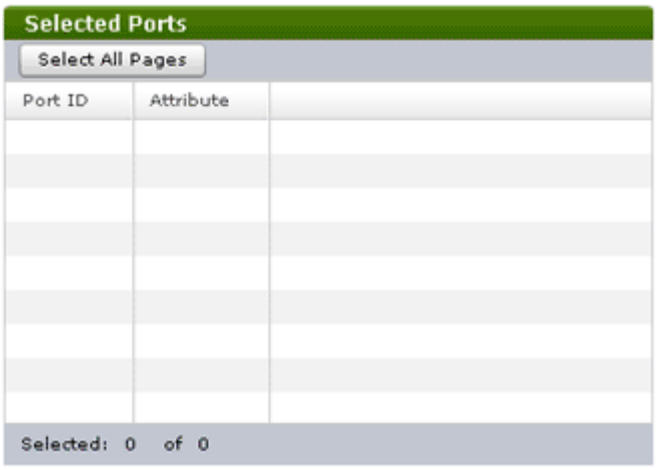


Available Ports table



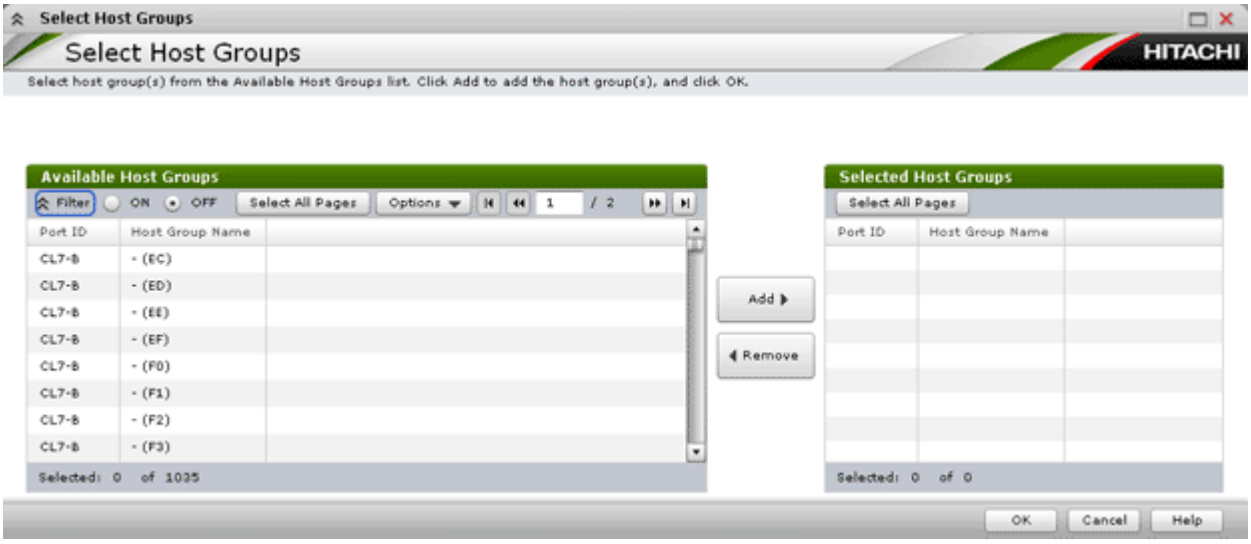
Item	Description
Port ID	Port identifier.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Add	Adds one or more ports selected in the Available Ports table to the Selected Ports table.
Remove	Removes one or more selected ports from the Selected Ports table and relocates the ports to the Available Ports table.

Selected Ports table

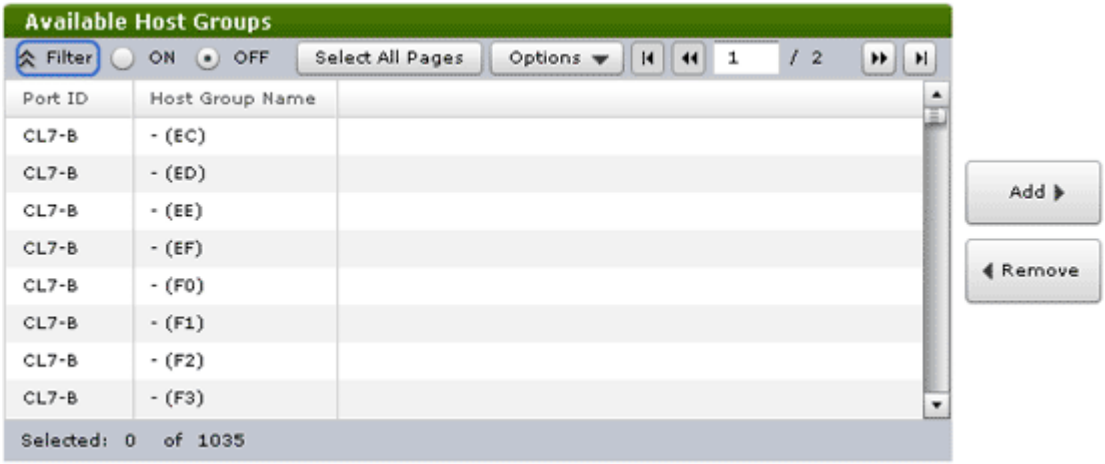


Item	Description
Port ID	Port identifier.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.

Select Host Groups window

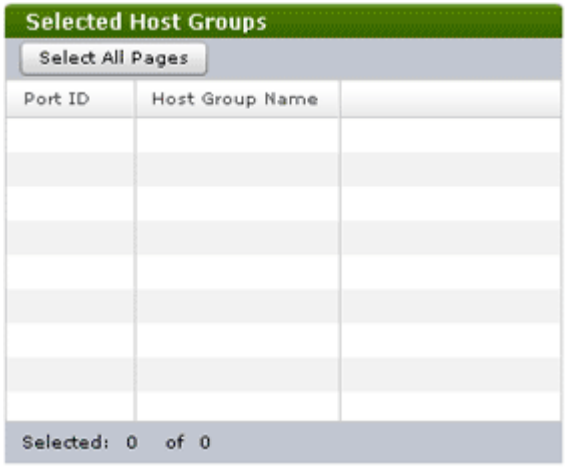


Available Host Groups table



Item	Description
Port ID	Port identifiers.
Host Group Name	Name and identifier of each host group that uses a port. Some undefined host groups may appear. A hyphen indicates the host group is undefined.
Add	Adds one or more host groups selected in the Available Host Groups table to the Selected Host Groups table.
Remove	Removes one or more selected host groups from the Selected Host Groups table and relocates the host groups to the Available Host Groups table.

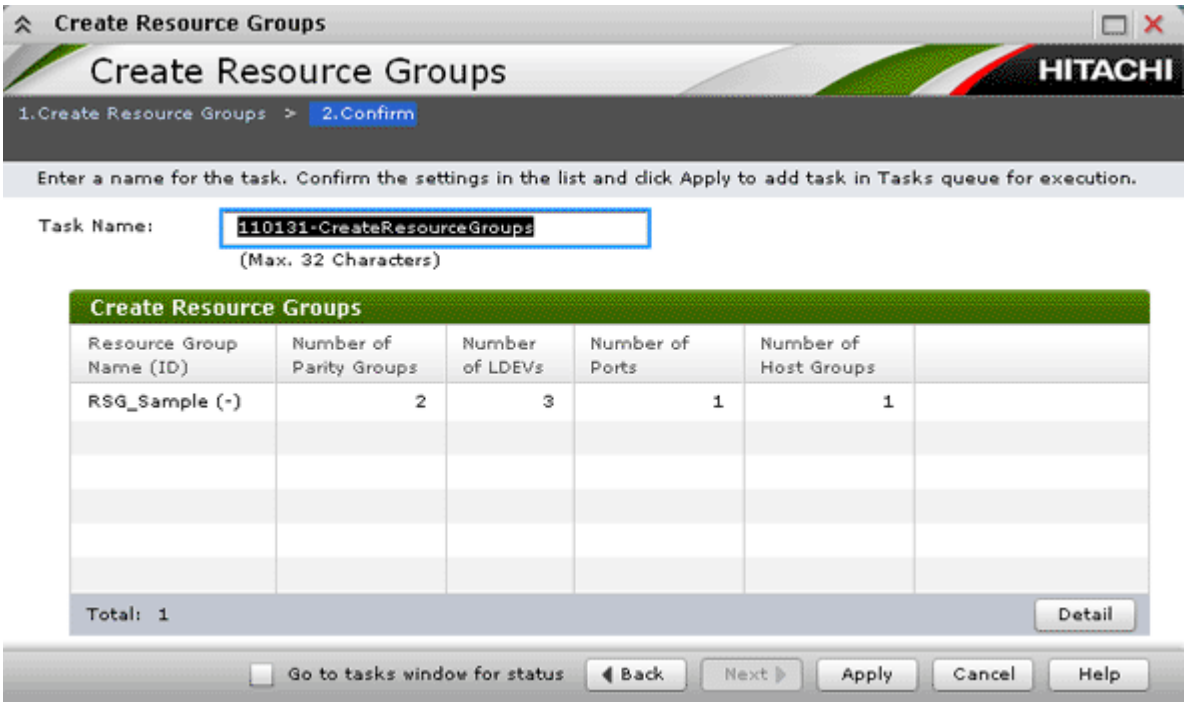
Selected Host Groups table



Item	Description
Port ID	Port identifiers.
Host Group Name	Name and identifier of each host group that uses a port. Some undefined host groups may appear. A hyphen indicates the host group is undefined.

Create Resource Groups Confirm window

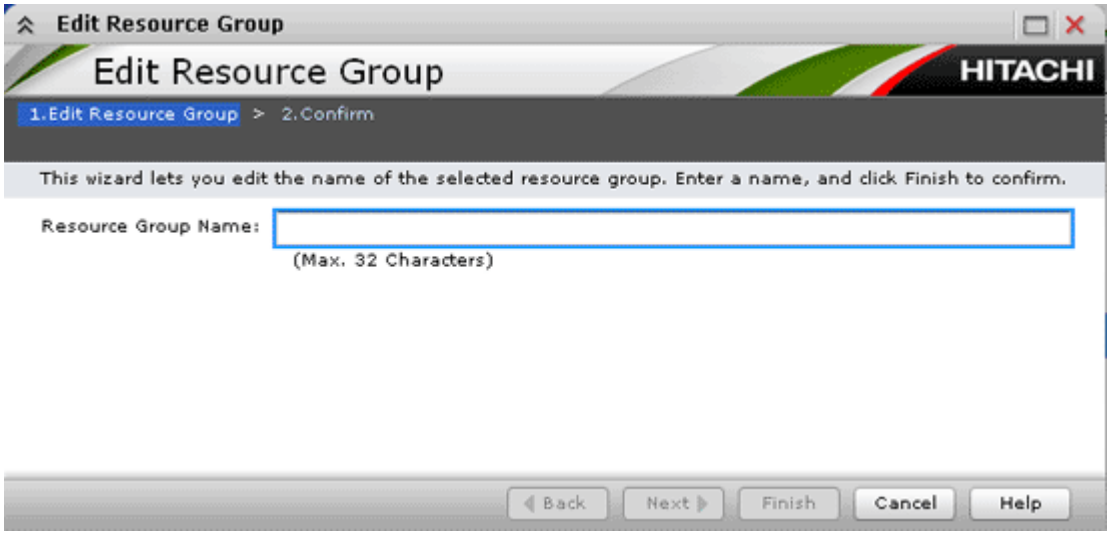
Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Item	Description
Resource Group Name (ID)	Name and identifier of each resource group.
Number of Parity Groups	Number of parity groups to be assigned to the resource group.
Number of LDEVs	Number of LDEVs to be assigned to the resource group.
Number of Ports	Number of ports to be assigned to the resource group.
Number of Host Groups	Number of host groups to be assigned to the resource group.
Detail	Opens the Resource Group Property window, where you can view the details of the selected resource group.

Edit Resource Group wizard

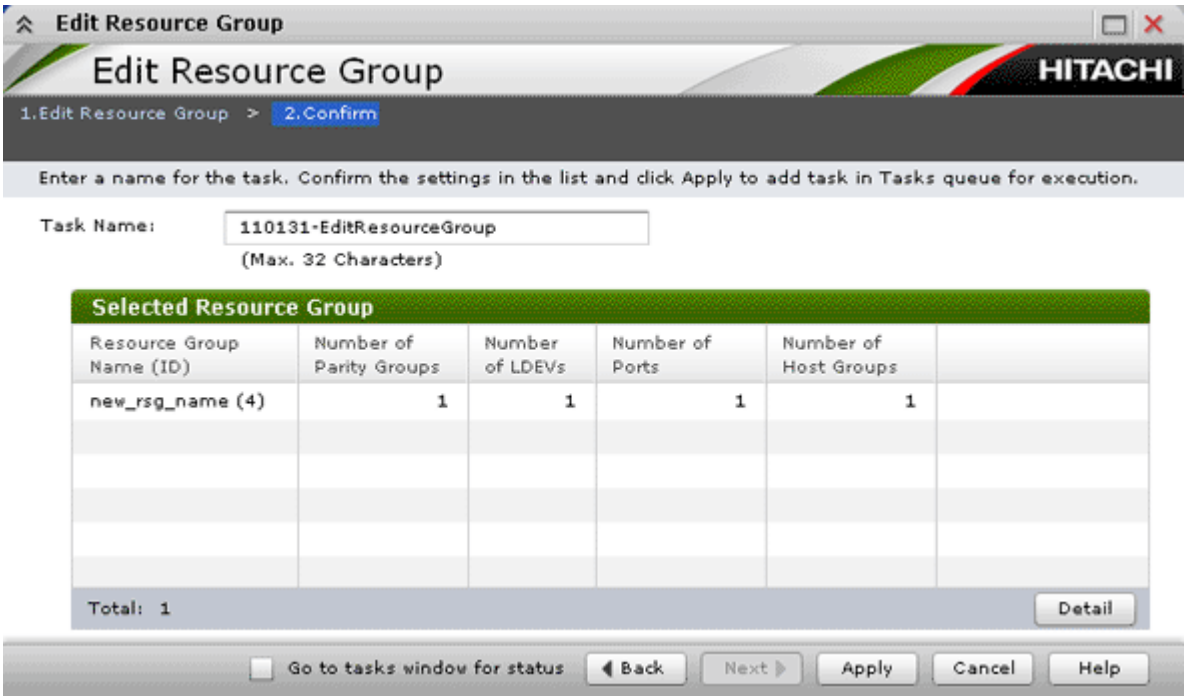
Edit Resource Group window



Item	Description
Resource Group Name	Type the name of the resource group after editing. • meta_resource cannot be set as a name. • Duplicate occurrences of the same resource group name are not allowed in one storage system. • Names are case-sensitive. • Usable characters are alphanumeric, spaces, and symbols (! # $ % & ' ( ) + - . = @ [ ] ^ _ ` { } ~)

Edit Resource Group Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

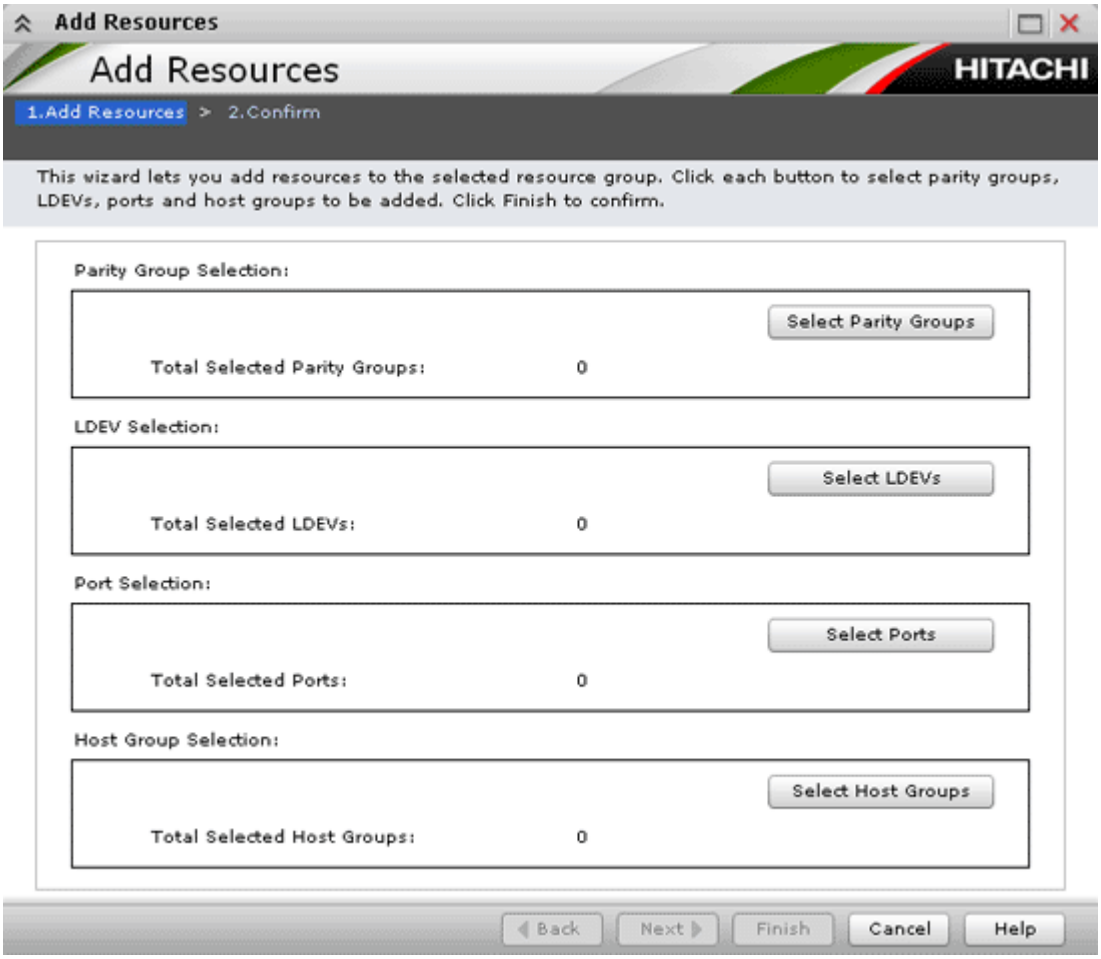


Selected Resource Group tab

Item	Description
Resource Group Name (ID)	Name and identifier of the edited resource group.
Number of Parity Groups	Number of parity groups that are assigned to the resource group.
Number of LDEVs	Number of LDEVs that are assigned to the resource group.
Number of Ports	Number of ports that are assigned to the resource group.
Number of Host Groups	Number of host groups that are assigned to the resource group.
Detail	Opens the Resource Group Property window, where you can view the details of the selected resource group.

Add Resources wizard

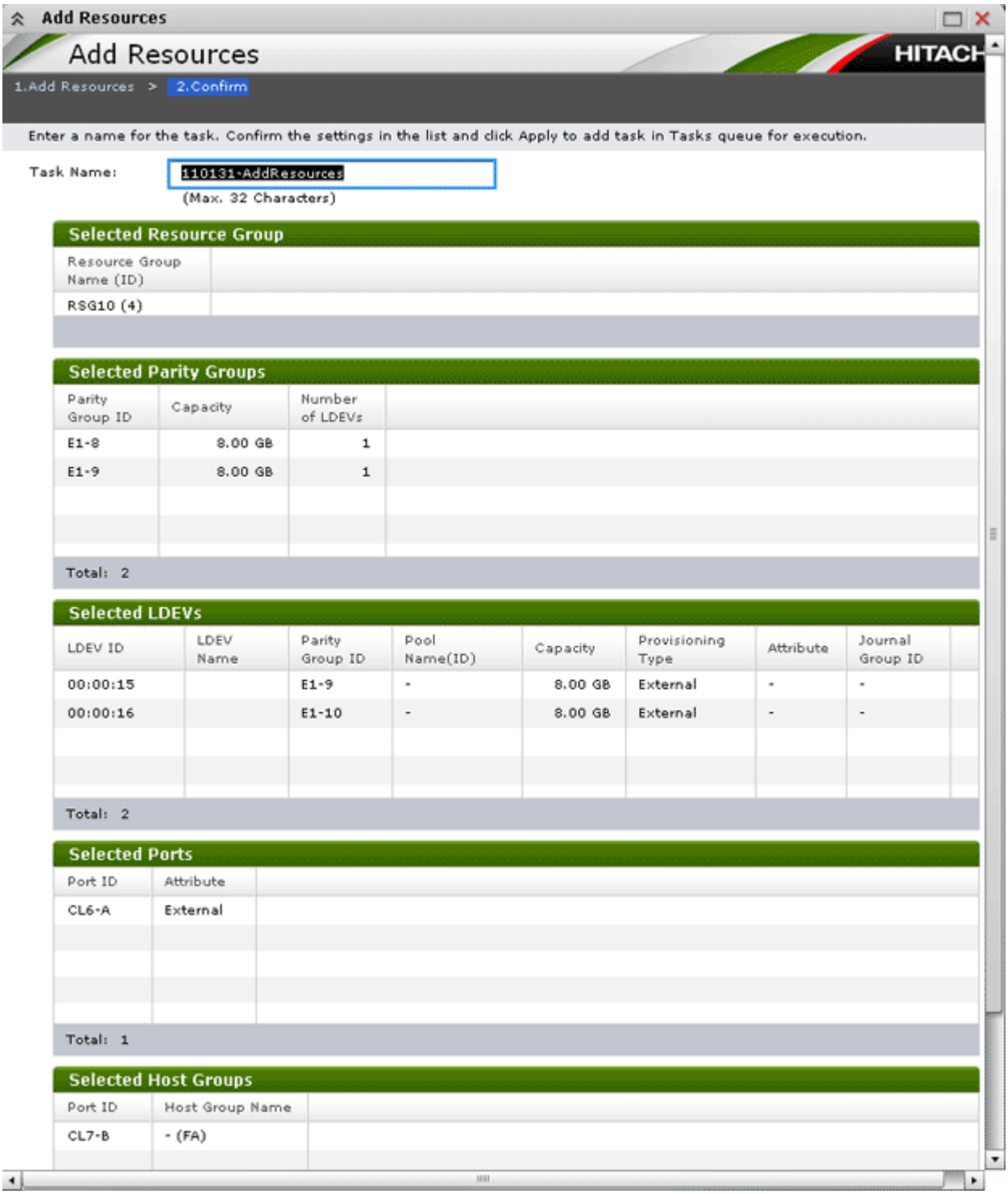
Add Resources window



Item	Description
Select Parity Groups	Opens the Select Parity Group window, where you can select one or more parity groups to be added to the resource group.
Select LDEVs	Opens the Select LDEVs window, where you can select one or more LDEVs to be added to the resource group.
Select Ports	Opens the Select Ports window, where you can select one or more ports to be added to the resource group.
Select Host Groups	Opens the Select Host group window, where you can select one or more host groups to be added to the resource group.

Add Resources Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Resource Group table

Item	Description
Resource Group Name (ID)	Name and identifier of the resource group to be added to the storage system.

Selected Parity Groups table

Item	Description
Parity Group ID	One or more parity group identifiers to be added to the resource group.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in each parity group.
Total	Total number of selected parity groups.

Selected LDEVs table

Item	Description
LDEV ID	The identifiers of the LDEVs to be added to a resource group. Some undefined LDEV IDs may appear. A hyphen in the LDEV name indicates the LDEV is undefined.
LDEV Name	LDEV names.
Parity Group ID	Parity group identifier where the LDEV belongs.
Pool Name (ID)	Pool name and identifier where the LDEV belongs.
Capacity	Capacity of the LDEV.
Provisioning Type	Provisioning type of the volume. • Basic: Internal volume • DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume • External MF: Migration volume
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: Command device. • Remote Command Device. • System Disk. • JNL VOL: Journal volume. • Pool VOL: Pool volume. The number in parentheses is the pool identifier. • Reserved VOL: Reserved volume. • Quorum Disk: Quorum disk for High Availability Manager. • TSE: TSE-VOL. • Nondisruptive Migration: Volume for nondisruptive migration. • Hyphen (-): Volume in which the attribute is not defined.
Journal Group ID	Journal group identifier appears when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.
Total	Total number of selected LDEVs.

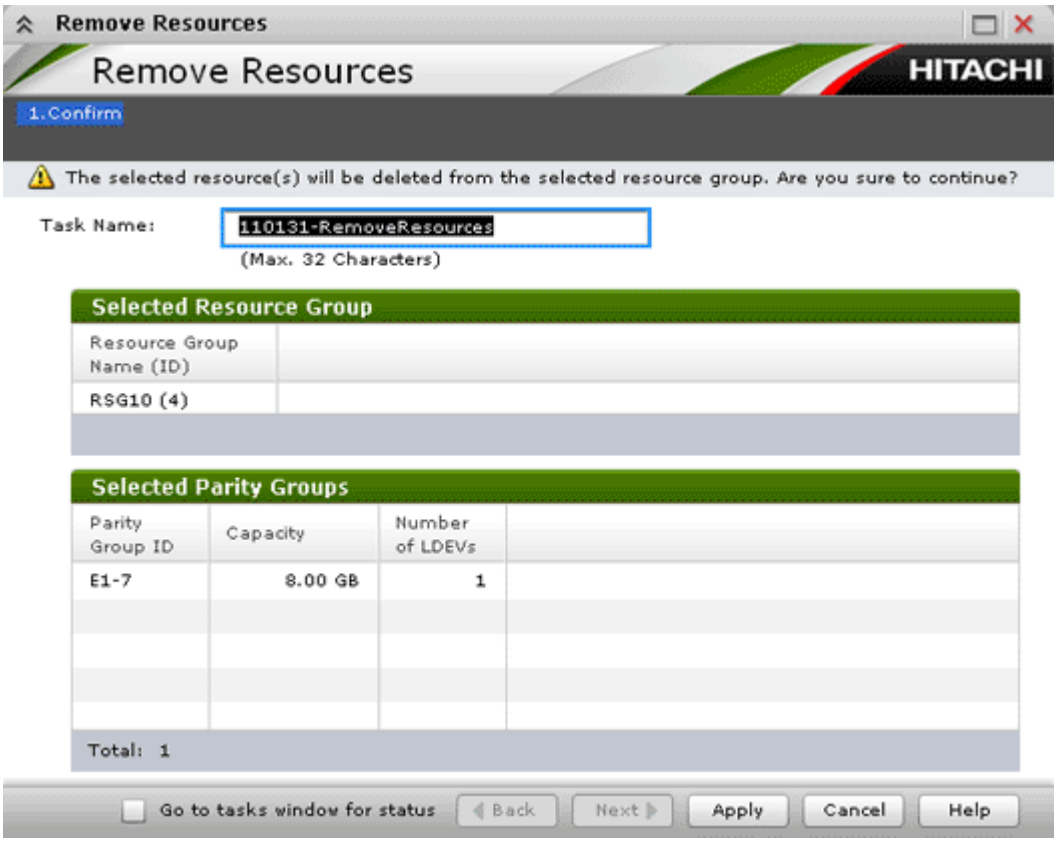
Selected Ports table

Item	Description
Port ID	Port identifiers to be added to a resource group.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Total	Total number of selected ports.

Selected Host Groups table

Item	Description
Port ID	Port identifiers that are used by the host group.
Host Group Name	Name and identifier of each host group to be added to a resource group. Some undefined host groups may appear. A hyphen indicates the host group is undefined.
Total	Total number of selected host groups.

Remove Resources window



Selected Resource Group table

Item	Description
Resource Group Name (ID)	Name and identifier of each resource group whose resources are deleted.

Selected Parity Groups table (when deleting parity groups)

Item	Description
Parity Group ID	Identifier of each parity group to be deleted from the resource group.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in the parity group.
Total	Total number of parity groups.

Selected LDEVs table (when deleting LDEVs)

Item	Description
LDEV ID	LDEV identifiers to be deleted from a resource group. Some undefined LDEV IDs may appear. A hyphen in the LDEV name indicates the LDEV is undefined.
LDEV Name	LDEV names to be deleted from the resource group.
Parity Group ID	Parity group ID where the LDEV belongs.
Pool Name (ID)	Pool name where the LDEV belongs.
Capacity	Capacity of each LDEV.
Provisioning Type	Provisioning type of each volume. Basic: Internal volume DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe External: External volume Snapshot: Thin Image volume or Copy-on-Write Snapshot volume External MF: Migration volume
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: Command device. • Remote Command Device. • System Disk. • JNL VOL: Journal volume. • Pool VOL: Pool volume. The number in parentheses is the pool identifier. • Reserved VOL: Reserved volume. • Quorum Disk: Quorum disk for High Availability Manager. • TSE: TSE-VOL. • Nondisruptive Migration: Volume for nondisruptive migration. • Hyphen (-): Volume in which the attribute is not defined.
Journal Group ID	Journal group ID when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.
Total	Total number of selected LDEVs.

Selected Ports table (when deleting ports)

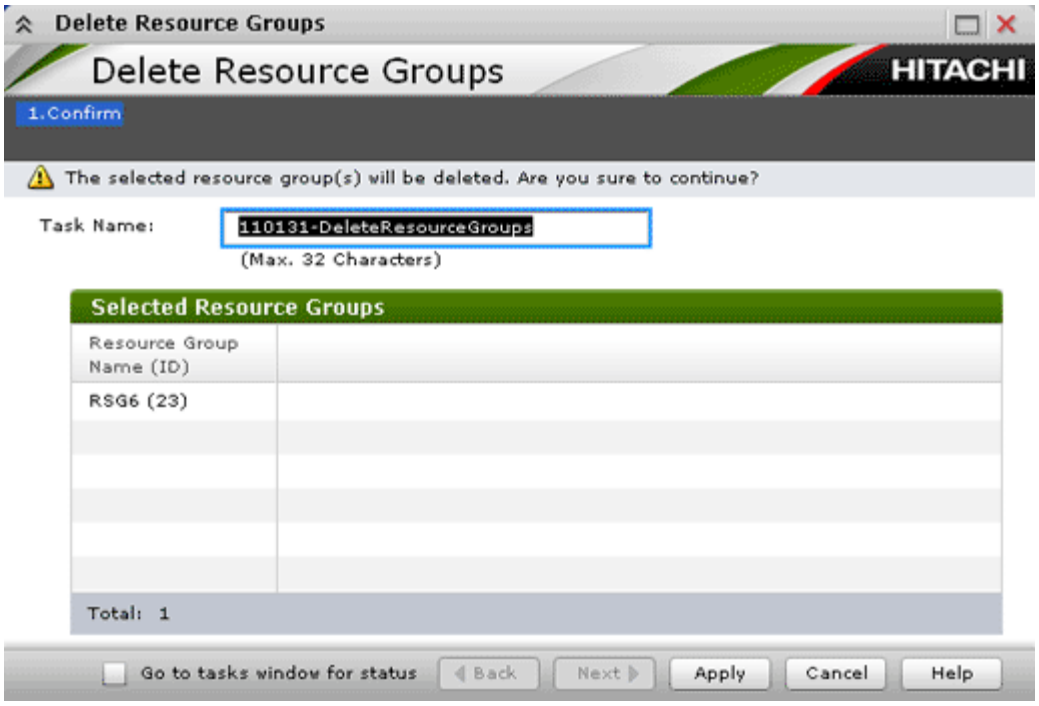
Item	Description
Port ID	Port IDs that to be deleted from the resource group.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host.

Item	Description
	• RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Total	Total number of selected ports.

Selected Host Groups table (when deleting Host Groups)

Item	Description
Port ID	Port IDs that are used by the host group.
Host Group Name	Name and ID of each host group name to be deleted from the resource group. Some undefined host group names may appear. A hyphen indicates the host group is undefined.
Total	Total number of selected host groups.

Delete Resource Groups window



Selected Resource Groups table

Item	Description
Resource Group Name (ID)	Name and ID of each resource group name to be deleted.

Resource Group Properties window

Resource Group Properties table

Item	Description
Resource Group Name (ID)	Name and ID of a resource group name.
Number of Parity Groups	Number of parity groups that are assigned to the resource group.
Number of LDEVs	Number of LDEVs that are assigned to the resource group.
Number of Ports	Number of ports that are assigned to the resource group.
Number of Host Groups	Number of host groups that are assigned to the resource group.

Parity Groups table

Item	Description
Parity Group ID	Parity group IDs.
Capacity	Capacity of each parity group.
Number of LDEVs	Number of LDEVs in each parity group.
Attribute	Displays the attribute of the parity group. Nondisruptive Migration: Parity group for nondisruptive migration. -: Parity group in which the attribute is not defined.
Total	Total number of selected parity groups.

LDEVs table

Item	Description
LDEV ID	LDEV IDs. Some undefined LDEV IDs may appear. A hyphen in the LDEV name indicates the LDEV is undefined.
LDEV Name	LDEV names.
Parity Group ID	Parity group ID where the LDEV belongs.
Pool Name (ID)	Pool name and ID where the LDEV belongs.
Capacity	Capacity of each LDEV.
Provisioning Type	Provisioning type of a volume. • Basic: Internal volume • DP: V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume • External: External volume

Item	Description
	• External MF: External volume
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: Command device. • Remote Command Device. • System Disk. • JNL VOL: Journal volume. • Pool VOL: Pool volume. The number in parentheses is the pool identifier. • Reserved VOL: Reserved volume. • Quorum Disk: Quorum disk for High Availability Manager. • TSE: TSE-VOL. • Nondisruptive Migration: Volume for nondisruptive migration. • Hyphen (-): Volume in which the attribute is not defined.
Journal Group ID	Journal group ID when the attribute is JNL VOL. A hyphen indicates the attribute is other than JNL VOL.
Total	Total number of selected volumes.

Ports table

Item	Description
Port Name	Port IDs.
Attribute	Displays the attribute of each port. Initiator, Target, RCU Target, or External is displayed.
Total	Total number of selected ports.

Host Groups table

Item	Description
Port ID	Port IDs that are used by the host group.
Host Group Name	Name and ID of each host group. Some undefined host group names may appear. A hyphen indicates the host group is undefined.
Total	Total number of selected host groups.

C

LDEV GUI reference

Sections in this appendix describe the windows, wizards, and dialog boxes used in creating LDEVs.

For information about common Storage Navigator operations, such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

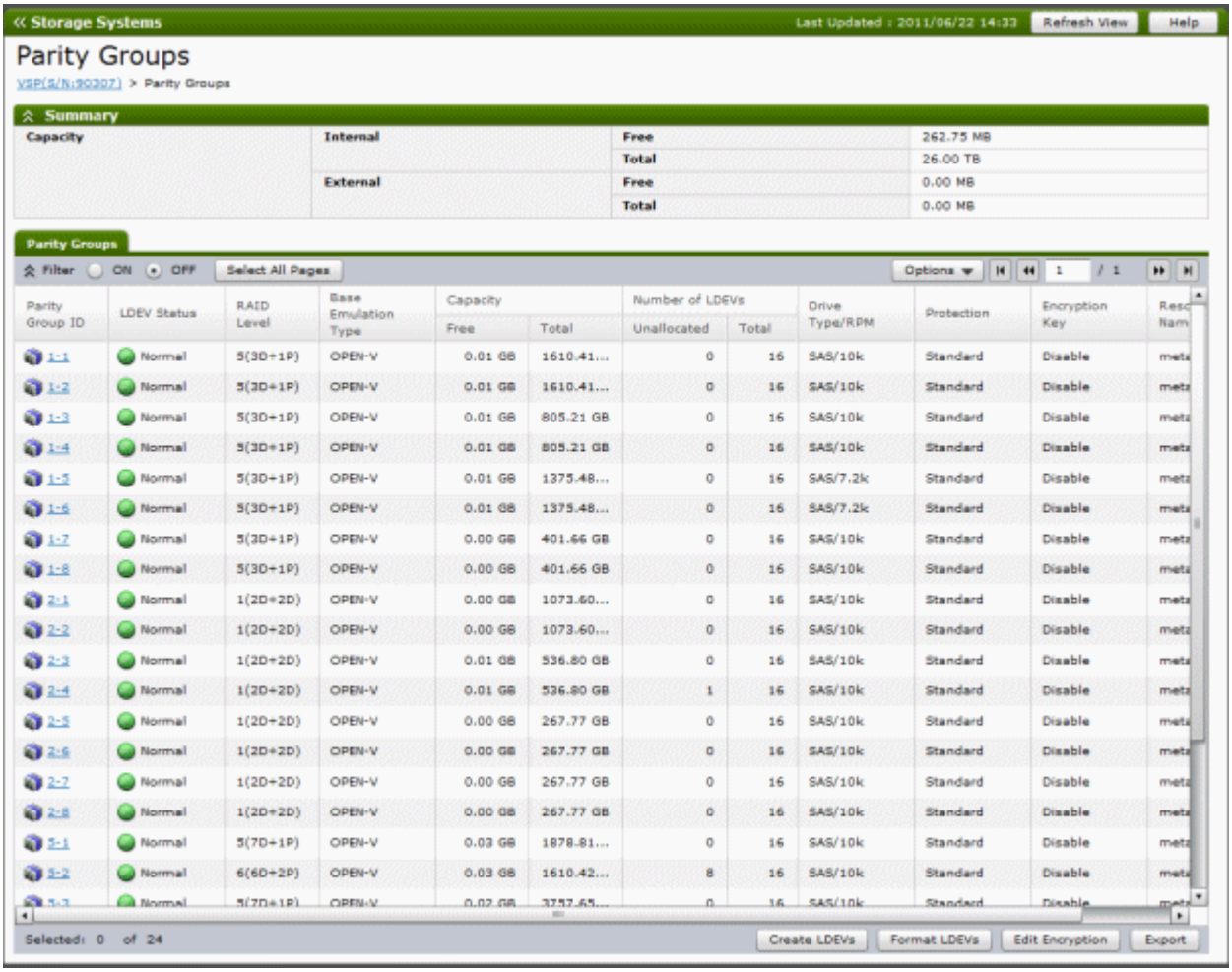
- ☐ Parity Groups window
- ☐ Parity Groups window after selecting Internal (or External) under Parity Groups
- ☐ Window after selecting a parity group under Internal (or External) of Parity Groups
- ☐ Window after selecting Logical Devices
- ☐ Create LDEVs wizard
- ☐ Edit LDEVs wizard
- ☐ Change LDEV Settings window
- ☐ View SSIDs window
- ☐ Select Free Spaces window
- ☐ Select Pool window
- ☐ View LDEV IDs window
- ☐ View Physical Location window

- Edit SSIDs window
- Change SSIDs window
- Format LDEVs wizard
- Restore LDEVs window
- Block LDEVs window
- Delete LDEVs window
- LDEV Properties window
- Top window when selecting Components
- Top window when selecting controller chassis under Components
- Edit Processor Blades wizard
- Assign Processor Blade wizard
- View Management Resource Usage window

Parity Groups window

Use this window to view information about parity groups. Only the parity groups assigned to the logged-on user are available.

- Summary on page C-3
- Parity Groups tab on page C-4



Summary

Item	Description
Capacity - Internal	Capacity of all of the parity groups in the internal volume. • Free[1]: Free space capacity of the internal volume. • Total[2]: Total capacity of the internal volume.
Capacity - External	Capacity of all of the parity groups in the external volume. • Free[1]: Free space capacity of the external volume. • Total[2]: Total capacity of the external volume.
Notes:	

Item	Description
1. The control information, such as control cylinders, used by the storage system is not included in the Free space. 2. The total capacity of the LDEVs and Free capacity is displayed in the Total.	

Parity Groups tab

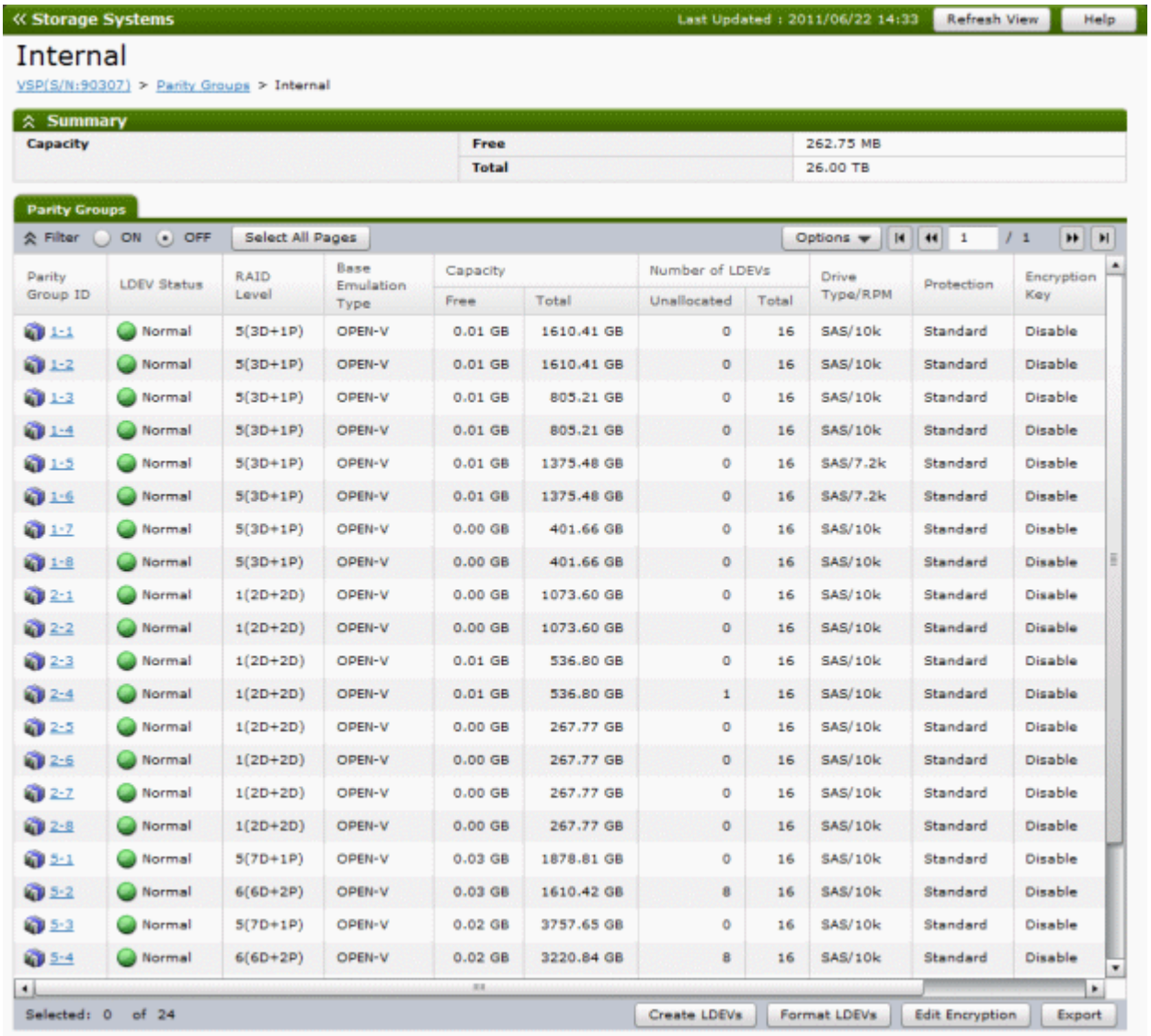
Item	Description
Parity Group ID	Parity group identifier of the parity group in the storage system.
LDEV Status	Status of each LDEV in the parity group. Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written on a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated). Either RAID level of the parity group appears.
Base Emulation Type	Emulation type of each parity group.
Capacity - Free	Capacity of the free space of each parity group. The control information, such as control cylinders, used by the storage system is not included in the displayed capacity.
Capacity - Total	The total capacity of the LDEVs and "Capacity - Free" is displayed.
Number of LDEVs - Unallocated	Number of unallocated LDEVs in each parity group.
Number of LDEVs - Total	Total number of LDEVs in each parity group.

Item	Description
Drive Type/RPM	Drive type and rpm in use on this LDEV.
Protection	Protection status on the parity group. SATA-W/V, SATA-E, or Standard. Standard is for SAS, SSD, and External.
Encryption Key	Encryption key information. • Key identifier for the encrypted parity group, and • Disable for the non-encrypted parity group.
Attribute	Displays the attribute of the parity group. Nondisruptive Migration: Parity group for nondisruptive migration. Hyphen (-): The parity group in which the attribute is not defined.
Resource Group Name (ID)	Resource group name and ID of which this parity group is a member.
Create LDEVs	Opens the Create LDEVs window.
Format LDEVs	Opens the Format LDEVs window.
Edit Encryption	Opens the Edit Encryption window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Parity Groups window after selecting Internal (or External) under Parity Groups

Use this window to view information about the parity groups in the internal (or external) volume. Only the parity groups assigned to the logged-on user are available.

- Summary on page C-6
- Parity Groups tab on page C-7



Summary

Item	Description
Capacity - Free	The free space capacity of the internal (or external) volume. The control information, such as control cylinders, used by the storage system is not included in the displayed capacity.
Capacity - Total	The total capacity of the LDEVs and "Capacity - Free" is displayed.

Parity Groups tab

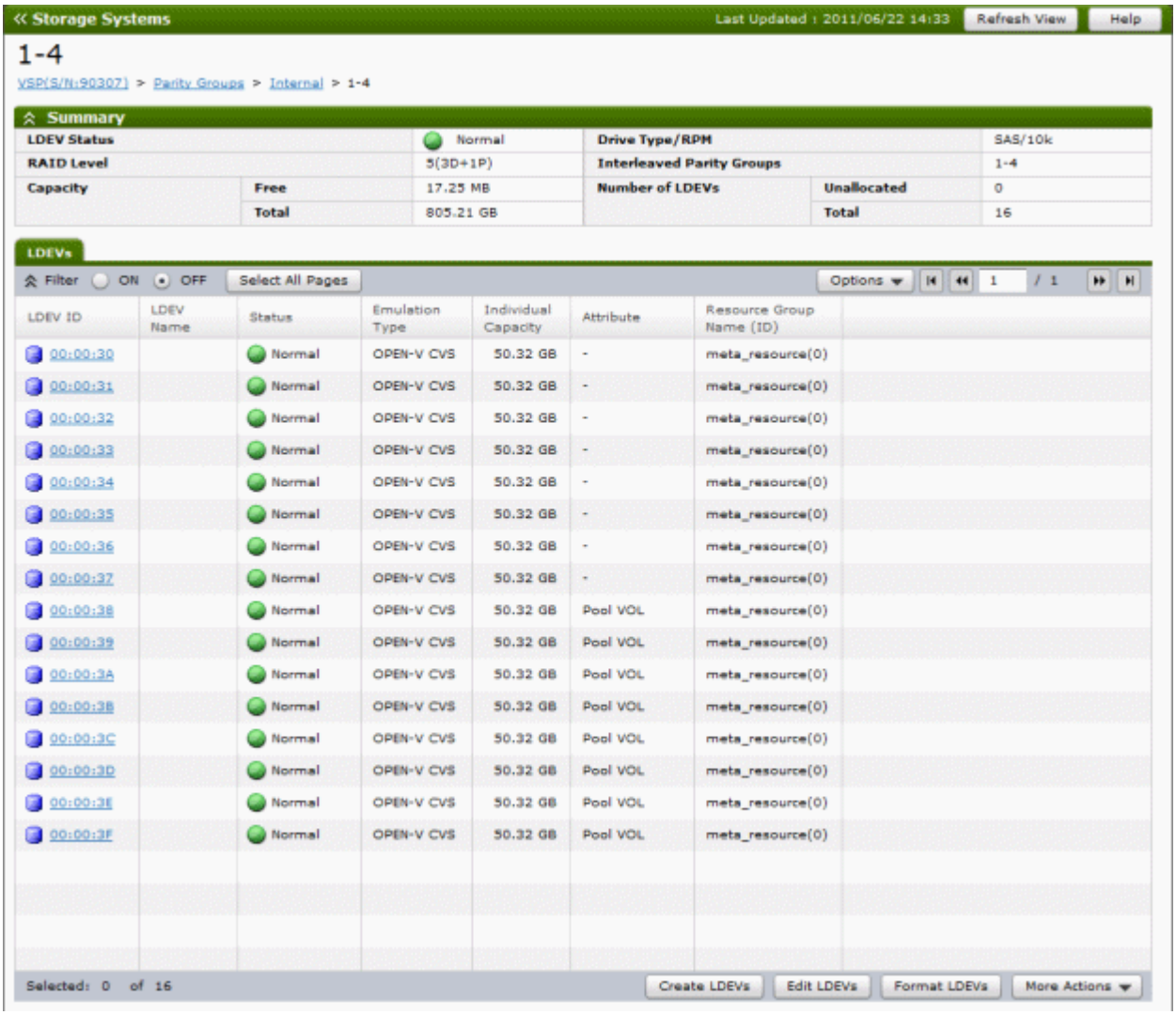
Item	Description
Parity Group ID	The parity group identifiers of the parity groups in the storage system.
LDEV Status	The icons indicate the LDEV status. Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written on a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated). Either RAID level of the parity group appears.
Base Emulation Type	Emulation type.
Capacity - Free	Capacity of the free space. The control information, such as control cylinders, used by the storage system is not included in the displayed capacity.
Capacity - Total	The total capacity of the LDEVs and "Capacity - Free" is displayed.
Number of LDEVs - Unallocated	Number of unallocated LDEVs.
Number of LDEVs - Total	Total number of LDEVs.
Drive Type/RPM	Drive type and rpm in use on this LDEV.
Protection	Protection status on the parity group. SATA-W/V, SATA-E, or Standard. Standard is for SAS, SSD, and External.
Encryption Key	Encryption key information. • Key identifier for the encrypted parity group.

Item	Description
	• Disable for the non-encrypted parity group.
Attribute	Displays the attribute of the parity group. Nondisruptive Migration: Parity group for nondisruptive migration. Hyphen (-): The parity group in which the attribute is not defined.
Resource Group Name (ID)	Resource group name and ID of which this parity group is a member.
Create LDEVs	Opens the Create LDEVs window.
Format LDEVs	Opens the Format LDEVs window.
Edit Encryption	Opens the Edit Encryption window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Window after selecting a parity group under Internal (or External) of Parity Groups

Use this window to view information about the parity groups in the internal (or external) volume. Only the parity groups assigned to the logged-on user are available.

- Summary on page C-9
- LDEVs tab on page C-10



Summary

Item	Description
LDEV Status	Current status of the LDEV. Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted.

Item	Description
	Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written on a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Capacity - Free	Capacity of the free space. The control information, such as control cylinders, used by the storage system is not included in the displayed capacity.
Capacity - Total	The total capacity of the LDEVs and "Capacity - Free" is displayed.
Drive Type/RPM	Drive type and rpm in use on this LDEV.
Interleaved Parity Groups	Interleaved (concatenated) parity groups.
Number of LDEVs-Unallocated	Number of unallocated LDEVs.
Number of LDEVs - Total	Total number of LDEVs.

LDEVs tab

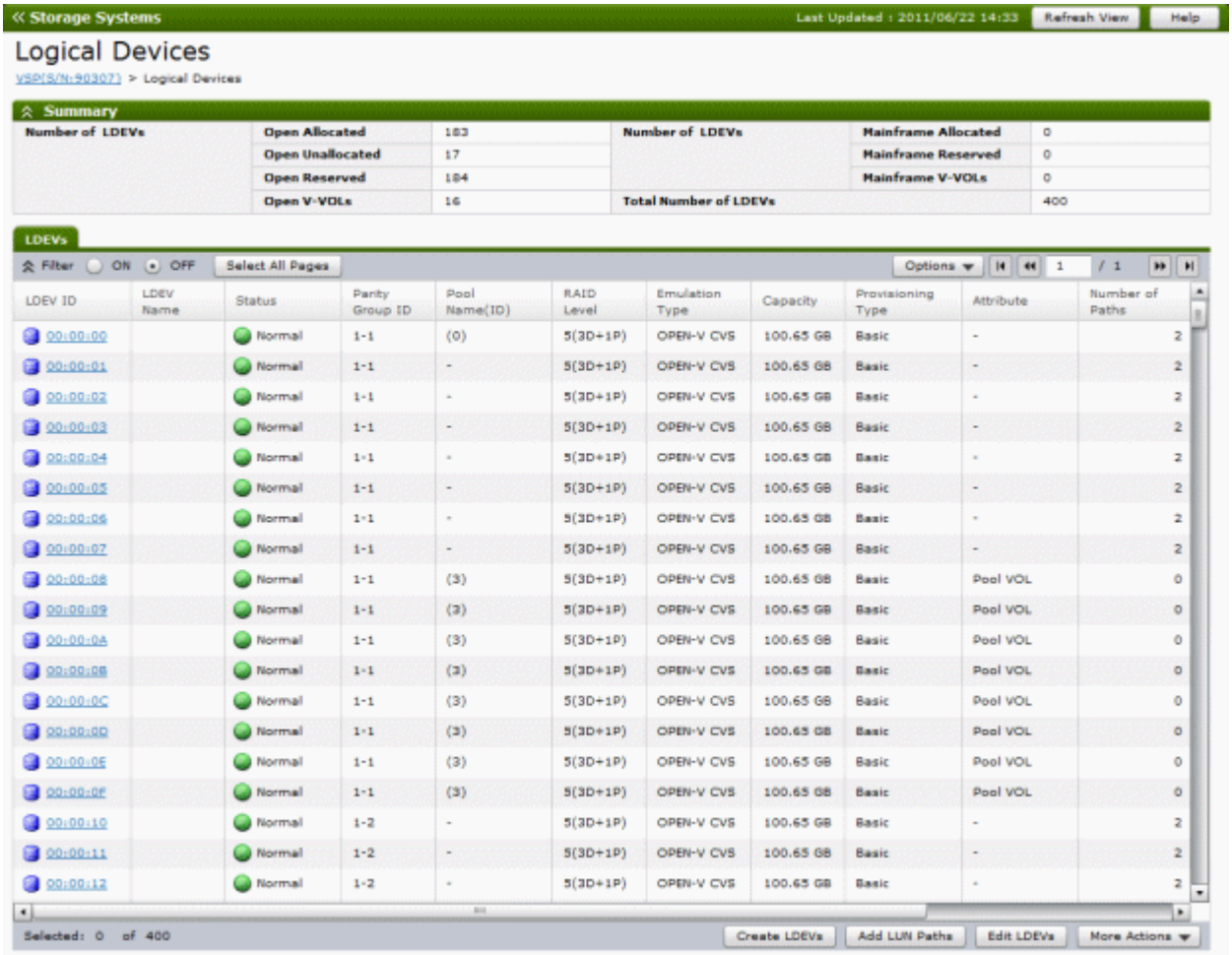
Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name.
Status	LDEV status. Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected.

Item	Description
	Copying: Data in the volume is being copied. Read Only: Data cannot be written on a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
Emulation Type	Emulation type.
Individual Capacity	Capacity of the selected LDEV.
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: The volume is a command device. • Remote Command Device: The volume is a remote command device. • System Disk: The volume is a system disk. • JNL VOL: The volume is a journal volume. • Pool VOL: The volume is a pool volume. The number in the parenthesis indicates the pool identifier. • Reserved VOL: The volume is a reserved volume. • Quorum Disk: The volume is a quorum disk for High Availability Manager. • Nondisruptive Migration: Volume for nondisruptive migration. • TSE: TSE-VOL • Hyphen (-): Volume in which the attribute is not defined
Resource Group Name (ID)	Resource group name and identifier of the LDEV.
Create LDEVs	Opens the Create LDEVs window.
Edit LDEVs	Opens the Edit LDEVs window.
Format LDEVs	Opens the Format LDEVs window.
Delete LDEVs*	Opens the Delete LDEVs window.
Shred LDEVs*	Opens the Shred LDEVs window.
Block LDEVs*	Opens the Block LDEVs window.
Restore LDEVs*	Opens the Restore LDEVs window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.
*Available when you click **More Actions**.	

Window after selecting Logical Devices

Use this window to view information about logical devices. Only the LDEVs assigned to the logged-on user are available.

- Summary on page C-12
- LDEVs tab on page C-13



Summary

Item	Description
Number of LDEVs - Open Allocated	Number of allocated LDEVs for open system.
Number of LDEVs - Open Unallocated	Number of unallocated LDEVs for open system.
Number of LDEVs - Open Reserved	Number of reserved LDEVs for the open system.
Number of LDEVs - Open V-VOLs	Number of allocated V-VOLs for the open system.

Item	Description
Number of LDEVs - Mainframe Allocated	Number of allocated LDEVs for the mainframe system.
Number of LDEVs - Mainframe Reserved	Number of reserved LDEVs for the mainframe system.
Number of LDEVs - Mainframe V-VOLs	Number of allocated V-VOLs for the mainframe system.
Total Number of LDEVs	Total number of LDEVs.

LDEVs tab

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name.
Status	LDEV status. Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written on a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name (pool identifier).
RAID Level	RAID level. An asterisk (*) indicates that the parity group that the LDEV belong to is interleaved (concatenated).
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type to be assigned to the LDEV.

Item	Description
	• Basic: Internal volume. • DP: DP-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume • External MF: Migration volume
Attribute	Attribute of the volume indicating how the LDEV is being used. • Command Device: Volume is a command device. • Remote Command Device: Volume is a remote command device. • System Disk: Volume is a system disk. • JNL VOL: Volume is a journal volume. • Pool VOL: Volume is a pool volume. The number in the parentheses shows the pool identifier. • Reserved VOL: Volume is a reserved volume. • Quorum Disk: Volume is a quorum disk for High Availability Manager. • TSE: TSE-VOL • Nondisruptive Migration: This volume is for nondisruptive migration. • Hyphen (-): Volume other than the above.
Access Attribute[1]	Displays the access attribute of the LDEV.
Number of paths	Number of paths set for the LDEV.
V-VOL Management Task	Displays the V-VOL management task being performed on a Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, or a Dynamic Tiering for Mainframe V-VOL. • Reclaiming Zero Pages: The process is in progress. • Waiting for Zero Page Reclaiming: The process has been waited. • Hyphen (-): The process is not being performed on the LDEV.
MP Blade ID[2]	Processor blade identifier.
Resource Group Name (ID)	Resource group name and ID of which this LDEV is a member.
Create LDEVs	Opens the Create LDEVs window.
Add LUN Paths	Opens the LUN Paths window.
Edit LDEVs	Opens the Edit LDEVs window.
Format LDEVs[3]	Opens the Format LDEVs window.
Delete LDEVs[3]	Opens the Delete LDEVs window.
Shred LDEVs[3]	Opens the Shred LDEVs window.
Delete LUN Paths[3]	Opens the Delete LUN Paths window.

Item	Description
Edit Command Device[3]	Opens the Edit Command Devices window
Block LDEVs[3]	Opens the Block LDEVs window.
Restore LDEVs[3]	Opens the Restore LDEVs window.
Assign MP Blade[3]	Opens the Assign Processor Blade window.
Delete UUIDs[3]	Opens the Delete UUIDs window.
Reclaim Zero Pages[3]	Opens the Reclaim Zero Pages window.
Stop Reclaiming Zero Pages[3]	Opens the Stop Reclaiming Zero Pages window.
Expand V-VOLs[3]	Opens the Expand V-VOLs window.
Export[3]	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

[1] Does not appear by default. To display this item, change the **Column Settings** of the table option. For details about the **Column Settings** window, see the Hitachi Storage Navigator User Guide.

[2] If an MP blade is blocked due to a failure, the processing to be performed by the MP blade where the failure occurred is taken over by another normal MP blade. See MP blade priorities after takeover on page C-15 for priorities assumed by MP blades after takeover.

[3] Appears when you click **More Actions**.

MP blade priorities after takeover

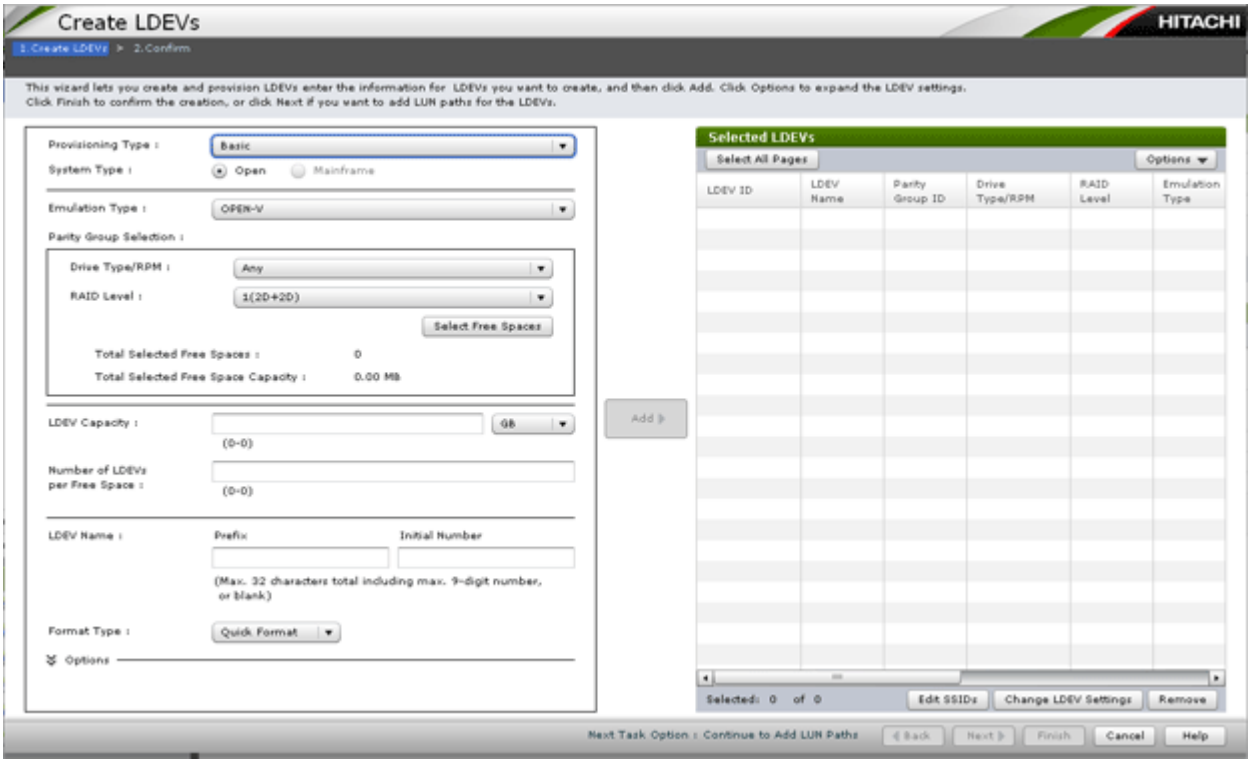
MP blade blocked by failure	Priority assumed by MP blades after takeover						
	1st	2nd	3rd	4th	5th	6th	7th
MPB 0	MPB 2	MPB 1	MPB 3	MPB 6	MPB 5	MPB 4	MPB 7
MPB 1	MPB 3	MPB 2	MPB 0	MPB 7	MPB 6	MPB 5	MPB 4
MPB 2	MPB 0	MPB 3	MPB 1	MPB 4	MPB 7	MPB 6	MPB 5
MPB 3	MPB 1	MPB 0	MPB 2	MPB 5	MPB 4	MPB 7	MPB 6
MPB 4	MPB 6	MPB 5	MPB 7	MPB 2	MPB 1	MPB 0	MPB 3
MPB 5	MPB 7	MPB 6	MPB 4	MPB 3	MPB 2	MPB 1	MPB 0
MPB 6	MPB 4	MPB 7	MPB 5	MPB 0	MPB 3	MPB 2	MPB 1
MPB 7	MPB 5	MPB 4	MPB 6	MPB 1	MPB 0	MPB 3	MPB 2

Create LDEVs wizard

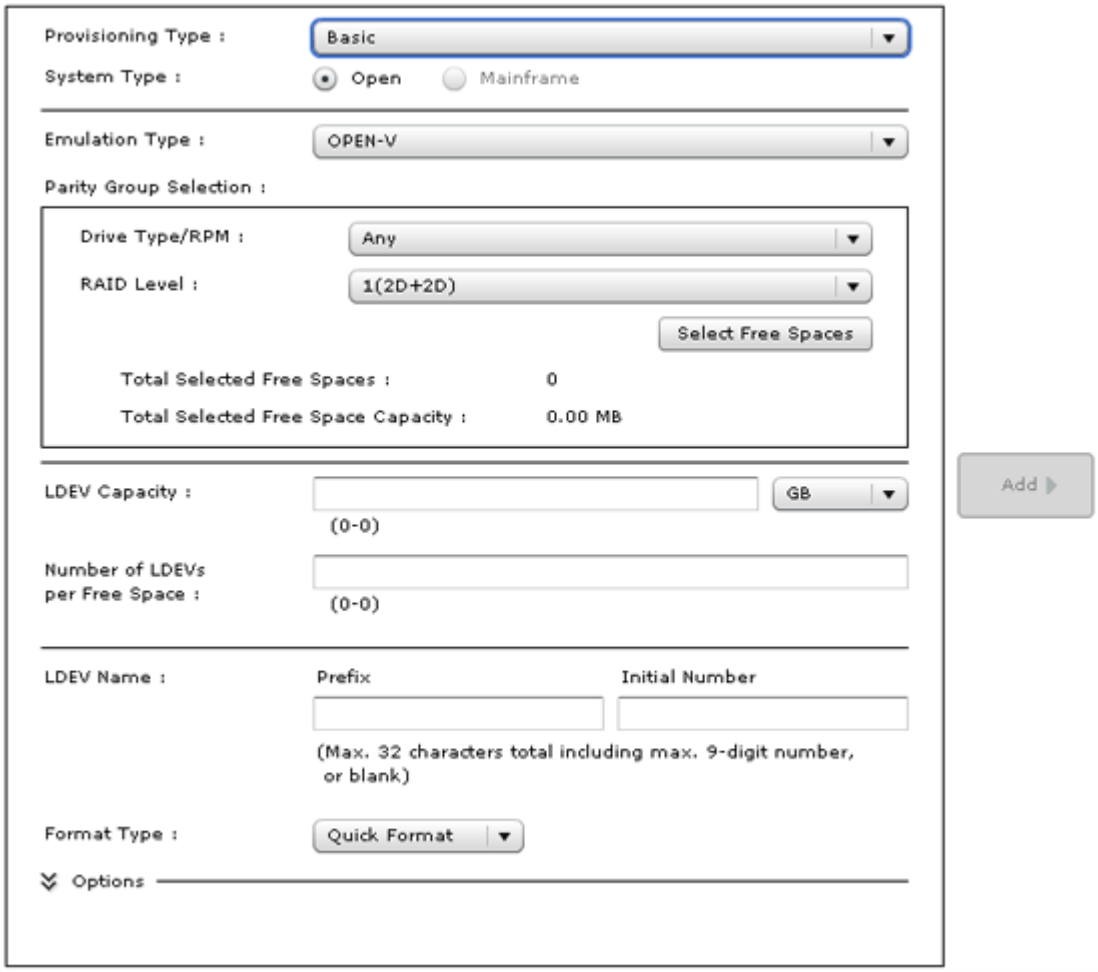
Use this window to create and provision LDEVs. You can create multiple LDEVs at once when setting up your storage system. After the storage system is in operation, use this window to create additional LDEVs as needed.

Create LDEVs window

- Setting fields on page C-17
- Selected LDEVs table on page C-22



Setting fields



Item	Description
Provisioning Type	Select the type of LDEV. Basic: Internal volume. Dynamic Provisioning: DP-VOL. External: External volume. Snapshot: Thin Image volume or Copy-on-Write Snapshot volume
System Type	Select the system of LDEV. Open: Volume for open system. Mainframe: Volume of mainframe system.
Emulation Type	Select the LDEV emulation. For open system, OPEN-V is default. For mainframe system, 3380 is default. Note: The emulation type might differ depending on the configuration.

Item	Description
Multi-Tier Pool	Select Enable or Disable of using Dynamic Tiering or Dynamic Tiering for Mainframe. Enable: The pool for Dynamic Tiering or Dynamic Tiering for Mainframe is displayed in the Select Pool window. Disable: The pool for Dynamic Provisioning or Dynamic Provisioning for Mainframe is displayed in the Select Pool window.
TSE Attribute	Select whether to create TSE-VOL or not. Enable: TSE-VOL is created. Disable: TSE-VOL is not created. If all the following conditions are satisfied, you can specify this item: • Selected **Mainframe** in the **System Type** • Selected **Disable** in the **Multi-Tier Pool** field
Parity Group Selection, Pool Selection, or External Volume Selection	Select the parity group to which the LDEV is assigned. Parity Group Selection: Displayed when you create internal volumes. Pool Selection: Displayed when you create DP-VOLs. External Volume Selection: Displayed when you create external volumes.
Drive Type/RPM	Select the hard disk drive type and RPM. Any: All types of disk drives and RPMs that can be contained in the system. SSD: Containing SSD (SLC, MLC) and FMD. SAS/RPM: SAS drive and RPM. SATA/RPM: SATA drive and RPM. External Storage: External storage system. Mixed: Mixes the hard disk drive type.
RAID Level	Select the RAID level. External Storage is selected from the Drive Type/RPM field, a hyphen (-) appears.
Select Free Spaces	Displays the Select Free Spaces window.
Select Pool	Displays the Select Pool window.
Total Selected Free Spaces	Displays the number of the selected free spaces.
Total Selected Free Space Capacity	Displays the total capacity of the free spaces.
Selected Pool Name (ID)	Displays the selected pool name and ID.
Selected Pool Capacity	Displays the selected pool capacity.
LDEV Capacity	Specify the LDEV capacity. Specify the LDEV capacity to create in a free space, a pool, or an external volume. Detailed calculation of the LDEV capacity differs depending on the specification of the unit. For details, see VLL size calculations on page 3-5.

Item	Description
Number of LDEVs per Free Space, Number of LDEVs, or Number of LDEVs per External Volume	Specify the number of LDEVs to create in a free space, pool, or the external volume.
LDEV Name	LDEV name. Specify the prefix characters and the initial number. Prefix is a fixed character string. Initial Number is the initial number of the LDEV name. Specify the prefix characters and the initial number according to the rules below. You can specify up to 32 characters total. Example: • 1: Up to 9 numbers are added (1, 2, 3... 9). • 08: Up to 92 numbers are added (08, 09, 10... 99). • 23: Up to 77 numbers are added (23, 24, 25... 99). • 098: Up to 902 numbers are added (098, 099, 100... 999).
Format Type	Specify the format type. This appears when an internal or external volume is used. Quick Format: Quick formatting is the default format type. You cannot select this when the provisioning type is something other than the internal volume. Write to Control Blocks: You can select this option when the external mainframe volume is created. This is default when selecting the external volume of the mainframe system. Normal Format: Normal formatting. No Format: Volumes are not formatted.
Initial LDEV ID	Specify the LDEV ID. LDKC is fixed to 00. Default of CU and DEV is 00:00. For creating multiple LDEVs, select the interval of the assigned LDEV ID from the Interval list.
View LDEV IDs	Displays the View LDEV IDs windows.
Initial SSID	Specify the SSID. The default is 0004. When creating multiple LDEVs, specify the beginning number setting to the LDEV.
View SSIDs	Displays the View SSIDs window.
CLPR	Cache logical partition number, displayed as *ID*:*CLPR*.
Processor Blade	Specify the processor blade you want to assign to the LDEV. You can select an ID from MPB0 to MPB7. If automatic assignment is enabled for one or more processors, you can also select Auto.

Item	Description
	If Auto is enabled, the default is Auto. If Auto is disabled, the default is the lowest number of the processor blade.
Tiering Policy	Tiering Policy: All(0) is selected by default. You can change a level from Level1(1) to Level5(5) or from Level6(6) to Level31(31). See Notes on tiering policy settings on page 5-51. You can specify this function when the Multi-Tier Pool is enabled.
New Page Assignment Tier	Specify the new page assignment tier you want to assign to the LDEV. Middle is selected by default. You can select from the levels of High, Middle, and Low. See New New page assignment tier on page 5-53. You can specify this function when the Multi-Tier Pool is enabled.
Relocation Priority	Specify this option if the LDEV is to be relocated preferentially. You can select Default or Prioritize. You can specify this function when the Multi-Tier Pool is enabled.
Create LDEVs as System Disk	Select this option when creating LDEVs as the system disk.
Add	Adds the LDEVs that have settings specified in the setting field is added to the Selected LDEVs table.

The items that can be set in this window depend on the type of volume you are creating. The following table lists the items that can be set according to volume type.

Item	Internal volume	V-VOL for open system	V-VOL for mainframe system	External volume	Snapshot volume
Provisioning Type	Required	Required	Required	Required	Required
System Type	Required	Required	Required	Required	Required
Emulation Type	Required	Required	Required	Required	Required
Multi-Tier Pool	N/A	Required	Required	N/A	N/A
TSE Attribute	N/A	Disabled	Required	N/A	N/A
Drive Type/RPM	Required	Required	Required	Disabled	N/A
RAID Level	Required	Required	Required	Disabled	N/A
Select Free Spaces	Required	N/A	N/A	Required	N/A
Select Pool	N/A	Required	Required	N/A	N/A
LDEV Capacity	Required	Required	Required	Required	Required
Number of LDEVs per Free Space	Required	N/A	N/A	N/A	N/A

Item	Internal volume	V-VOL for open system	V-VOL for mainframe system	External volume	Snapshot volume
Number of LDEVs	N/A	Required	Required	N/A	Required
Number of LDEVs per External Volume	N/A	N/A	N/A	Required	N/A
LDEV Name	Optional	Optional	Optional	Optional	Optional
Format Type	Required	N/A	N/A	Required	N/A
Initial LDEV ID	Optional	Optional	Optional	Optional	Optional
View LDEV IDs	Optional	Optional	Optional	Optional	Optional
Initial SSID	Optional	Optional	Optional	Optional	Optional
View SSIDs	Optional	Optional	Optional	Optional	Optional
CLPR	N/A	Optional	Optional	N/A	Optional
Processor Blade	Optional	Optional	Optional	Optional	Optional
Tiering Policy	N/A	Optional	Optional	N/A	N/A
New Page Assignment Tier	N/A	Optional	Optional	N/A	N/A
Relocation Priority	N/A	Optional	Optional	N/A	N/A
Create LDEVs as System Disk	Optional	N/A	N/A	Optional	N/A

Selected LDEVs table

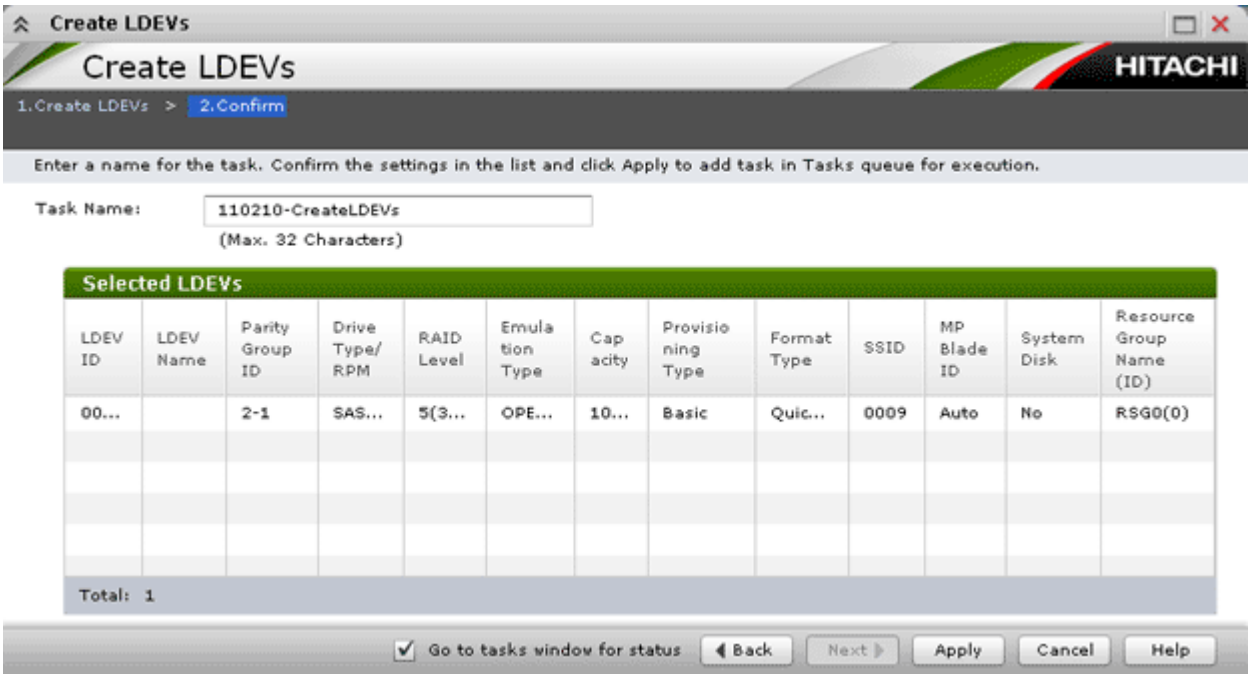
Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name, including the combination of prefix characters and the initial number.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Drive Type/RPM	Drive type and rpm in use on this LDEV.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Format Type	Format type.
SSID	Storage system identifier in hexadecimal format.
CLPR	Cache logical partition number, displayed as *ID*:*CLPR*.

Item	Description
	For detailed information about CLPRs, see the *Performance Guide*.
MP Blade ID	Processor blade identifier. If **Auto** is selected, the ID is automatically assigned.
System Disk	Indicates whether the LDEV is being used as the system disk. • Yes: System disk. • No: Not system disk.
Multi-Tier Pool	Indicates whether Dynamic Tiering or Dynamic Tiering for Mainframe is enabled or disabled. • Enable: The LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe. • Disable: The LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe.
Tiering Policy	The tiering policy name and ID for the LDEV.
New Page Assignment Tier	Displays the new page assignment tier for the LDEV.
Relocation Priority	Displays the relocation priority assigned to the LDEV.
Attribute	A hyphen (-) is displayed.
Resource Group Name (ID)	Resource group name and ID of which this LDEV is a member.
Edit SSIDs	Opens the Edit SSIDs window.
Change LDEV Settings	Opens the Change LDEV Settings window.
Remove	Removes the added LDEV.

Create LDEVs Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

Note: Information in this topic assumes that only a single task is executed. If multiple tasks are executed, the window displays all configuration items. To check information of a configuration item, click **Back** to return to the configuration window, and then click **Help**.



Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name, including the combination of prefix characters and the initial number.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name (pool identifier).
Drive Type/RPM	Drive type and rpm in use on this LDEV.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Type of LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Format Type	Format type.
SSID	Storage system identifier in hexadecimal format.
CLPR	Cache logical partition number, in *ID*:*CLPR* format.

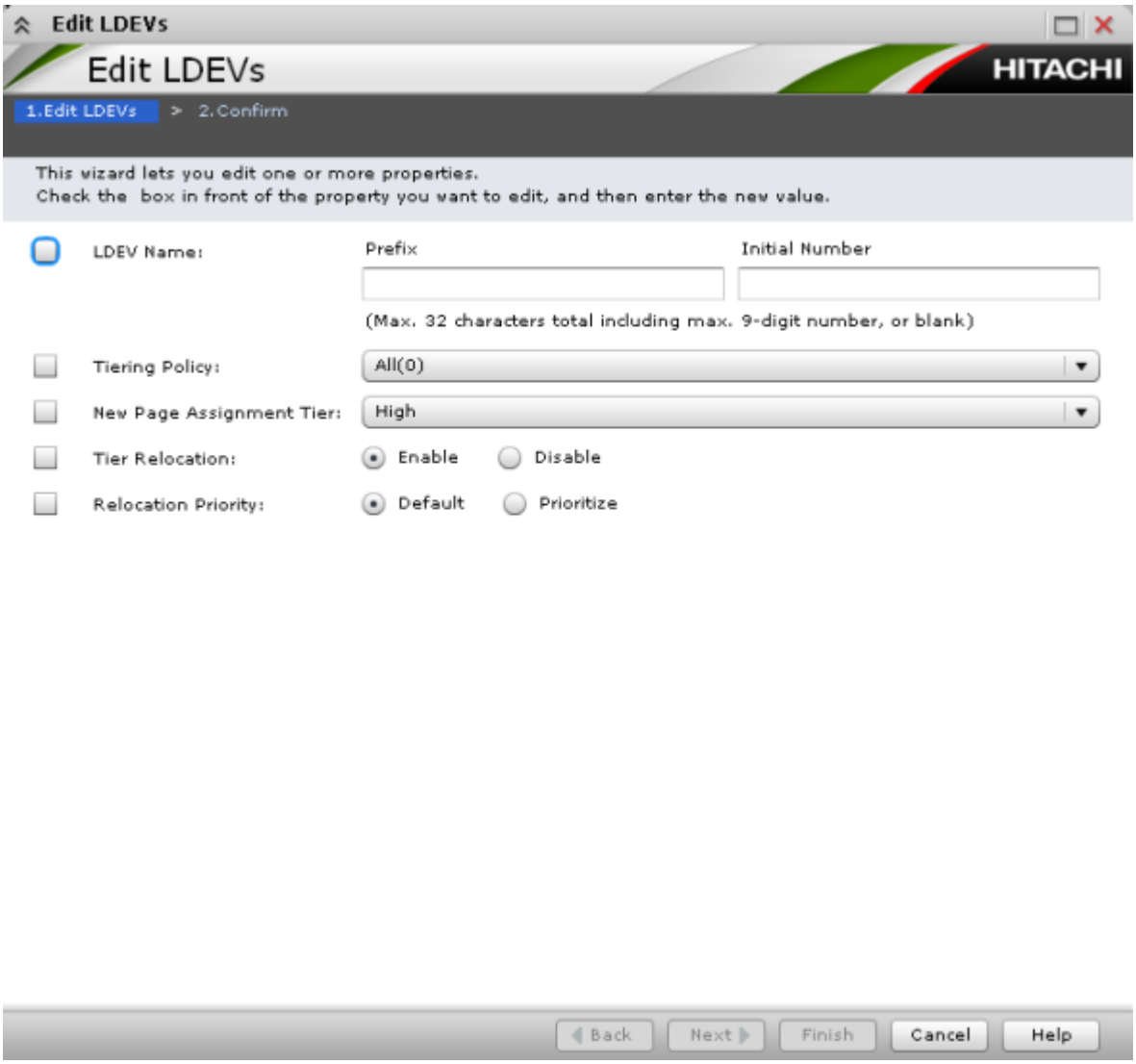
Item	Description
	For detailed information about CLPRs, see the *Performance Guide*.
MP Blade ID	Processor blade identifier. If **Auto** is selected, the ID is automatically assigned.
System Disk	Indicates whether the LDEV is being used as the system disk. • Yes: System disk. • No: Not system disk.
Multi-Tier Pool	Displays whether Dynamic Tiering or Dynamic Tiering for Mainframe is enabled or disabled. Enable: The LDEV for Dynamic Tiering or Dynamic Tiering for Mainframe is displayed. Disable: The LDEV for Dynamic Provisioning or Dynamic Provisioning for Mainframe is displayed.
Tiering Policy	Displaying the tiering policy name and ID for the LDEV.
New Page Assignment Tier	Displays the new page assignment tier for the LDEV.
Relocation Priority	Relocation priority assigned to the LDEV.
Attribute	Displays the attribute of the LDEV. TSE: TSE-VOL. -: Volume in which attribute is not defined.
Resource Group Name (ID)	Resource group name and ID of which this LDEV is a member.

Edit LDEVs wizard

Use this window to change the LDEV name.

Edit LDEVs window

Use this window to edit LDEV properties.

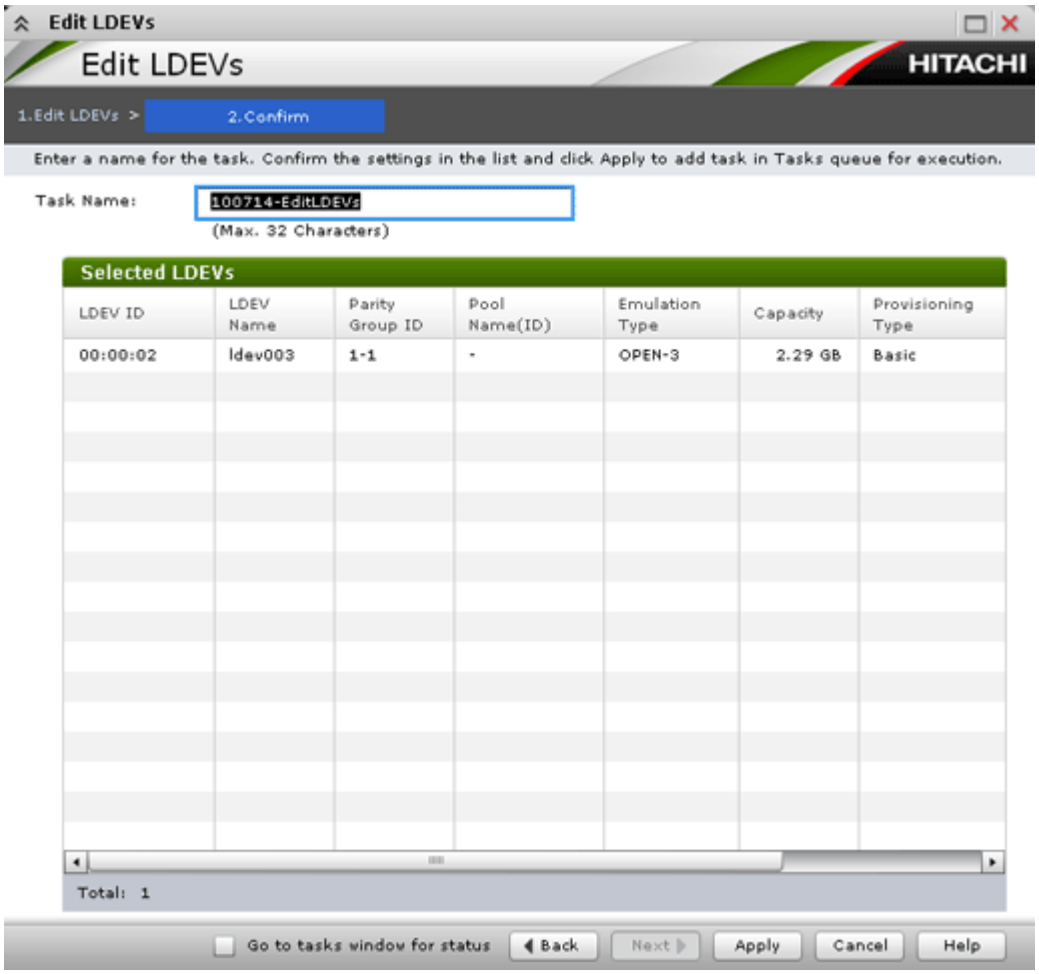


Item	Description
LDEV Name	Specify the LDEV name, using up to 32 characters. • Prefix: Fixed character string. • Initial Number: Initial number. Specify the prefix characters and the initial number according to these rules. • 1: Up to 9 numbers are added (1, 2, 3 ... 9) • 08: Up to 92 numbers are added (08, 09, 10 ... 99) • 23: Up to 77 numbers are added (23, 24, 25 ... 99) • 098: Up to 902 numbers are added (098, 099, 100 ... 999)
Tiering Policy	Specify the tiering policy for the LDEV. For details about the setting. You can specify this function only when the V-VOLs using Dynamic Tiering or Dynamic Tiering for Mainframe are available. See Notes on tiering policy settings on page 5-51

Item	Description
New Page Assignment Tier	Specify the new page assignment tier you want to assign to the LDEV. Middle is set by default. You can select from High, Middle, or Low. See New page assignment tier on page 5-53. You can specify this function only when the V-VOLs that use Dynamic Tiering or Dynamic Tiering for Mainframe are available.
Tier Relocation	Specify Enable or Disable for the performing of the tier relocation. You can specify this function only when the V-VOLs using Dynamic Tiering or Dynamic Tiering for Mainframe are available.
Relocation Priority	Specify the relocation priority assigned to the LDEV. You can set this function under the following conditions: • When there are V-VOLs where Dynamic Tiering or Dynamic Tiering for Mainframe is enabled. • When the tier relocation is enabled.

Edit LDEVs Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

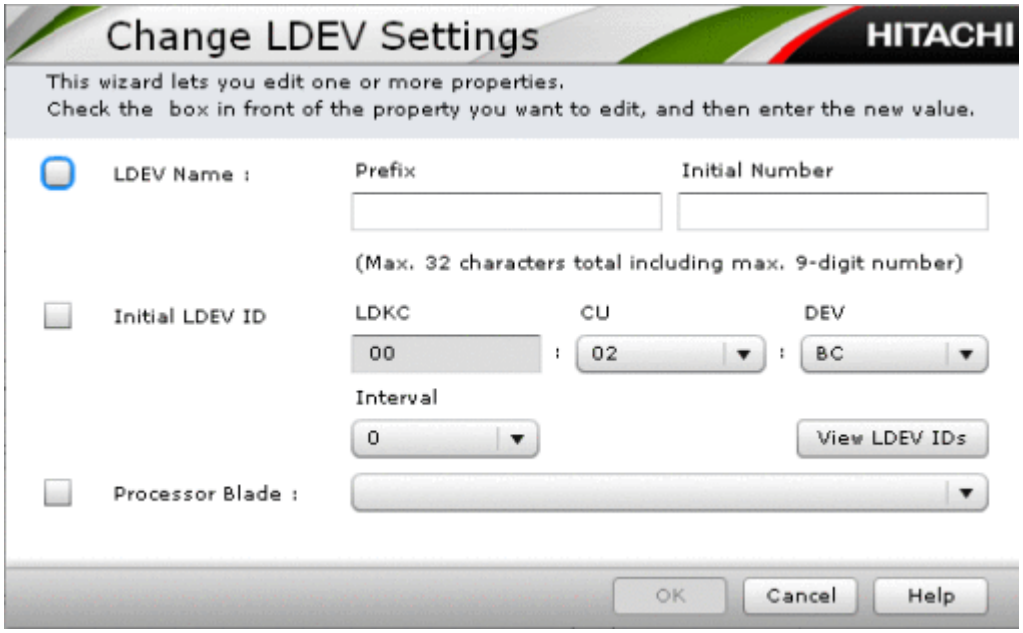


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name, including the combination of prefix characters and the initial number.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Type of LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.

Item	Description
Tiering Policy	Tiering policy. A hyphen is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
New Page Assignment Tier	Displays the new page assignment tier for the LDEV. A hyphen (-) is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
Tier Relocation	Displays whether tier relocation is enabled or disabled. A hyphen (-) is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
Relocation Priority	Displays the relocation priority assigned to the LDEV. A hyphen is displayed if LDEV is the one of following: • LDEV other than Dynamic Tiering. • LDEV other than Dynamic Tiering for Mainframe. • The tier relocation of LDEV is set to disabled.

Change LDEV Settings window

Use this window to edit one or more LDEV properties.

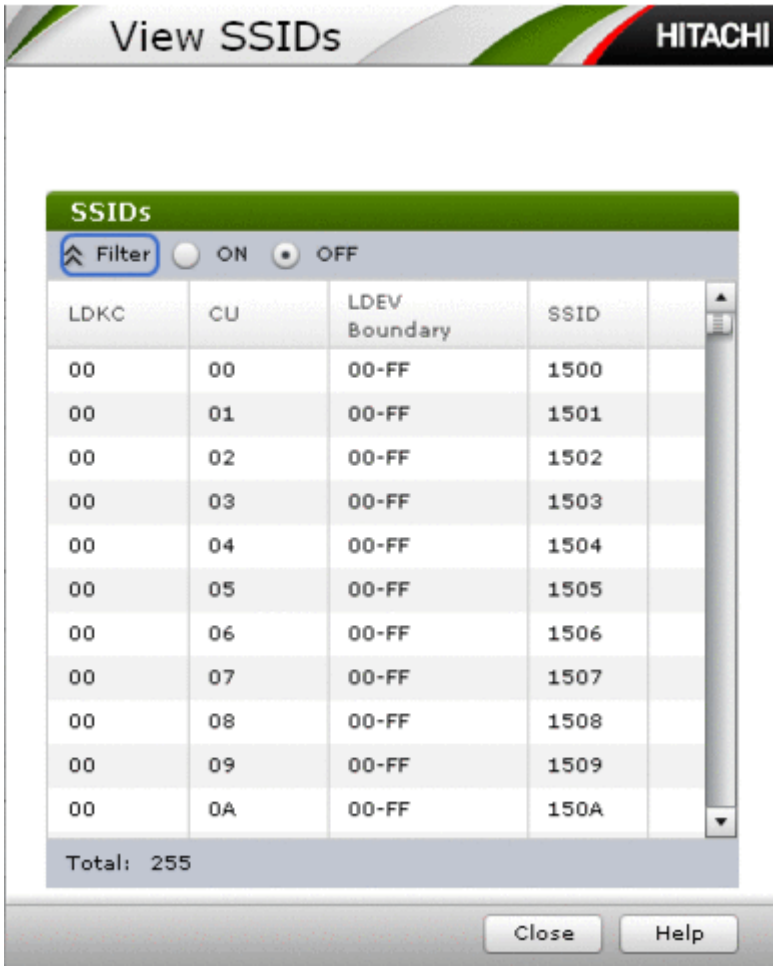


Item	Description
LDEV Name	Specify the LDEV name, using up to 32 characters. Prefix: Fixed character string. Initial Number: Initial number.

Item	Description
	Specify the prefix character and the initial number according to these rules. • 1: Up to 9 numbers are added (1, 2, 3 ... 9) • 08: Up to 92 numbers are added (08, 09, 10 ... 99) • 23: Up to 77 numbers are added (23, 24, 25 ... 99) • 098: Up to 902 numbers are added (098, 099, 100 ... 999)
Initial LDEV ID	Specify the LDEV identifier, which is the combination of LDKC, CU, and LDEV. Assigns the ID at a certain interval starting with the ID you specify.
LDKC	Specify the LDKC number. It is fixed to 00.
CU	Specify the CU number.
DEV	Specify the LDEV number.
Interval	Specify the interval of the assigned LDEV ID.
View LDEV IDs	Opens the View LDEV IDs window.
Processor Blade	Select the processor blade you want to assign to the LDEV. Select any ID or Auto. Select an ID from MPB0 to MPB7. If automatic assignment is enabled for one or more processors, you can also select Auto.

View SSIDs window

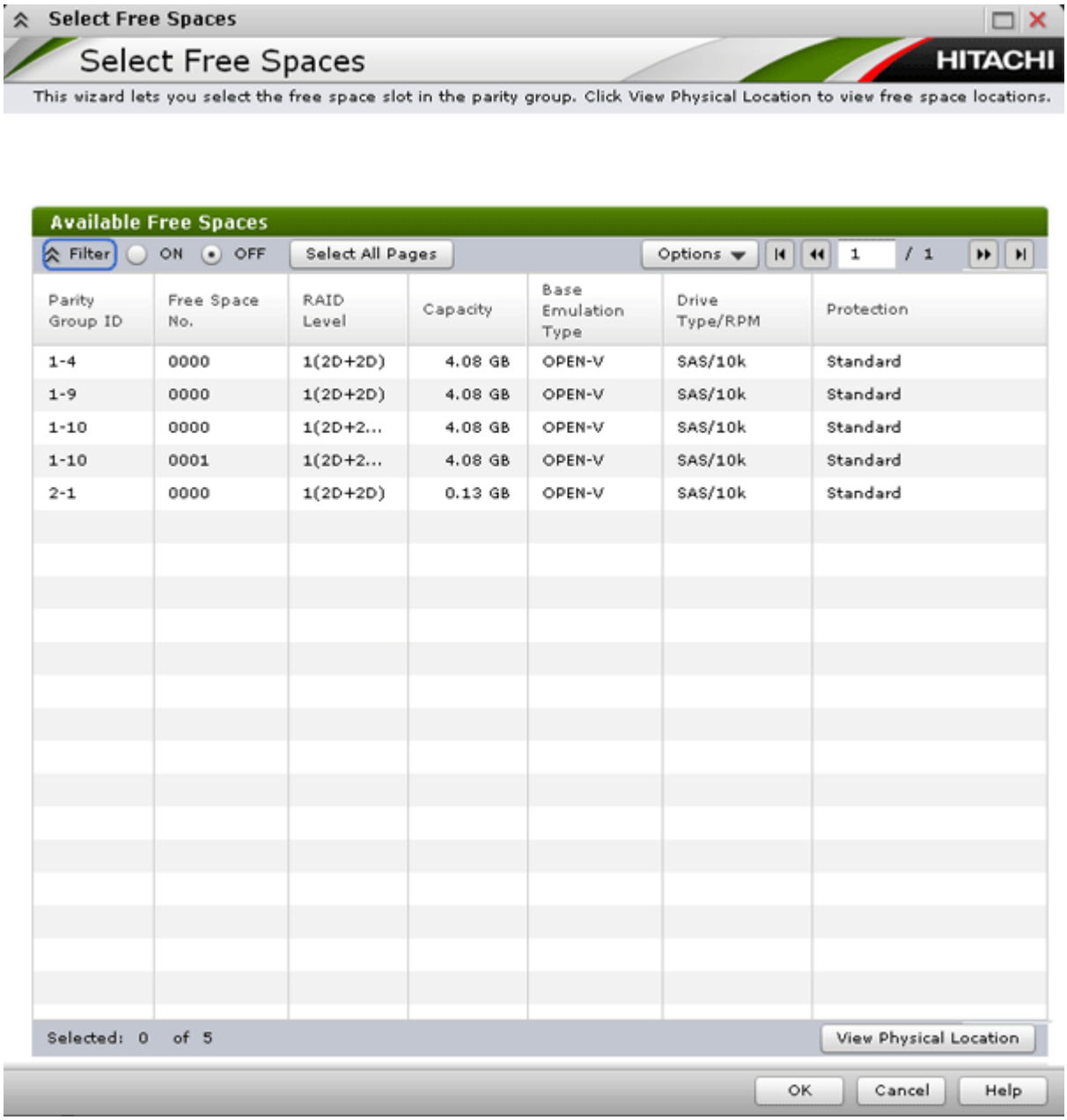
Use this window to view storage system identifier information.



Item	Description
LDKC	LDKC number.
CU	Control unit number.
LDEV Boundary	The range of LDEVs that can be allocated to the SSID. Each LDEV group (divided by LDEV boundary) has a unique SSID.
SSID	Storage system identifier in hexadecimal format.

Select Free Spaces window

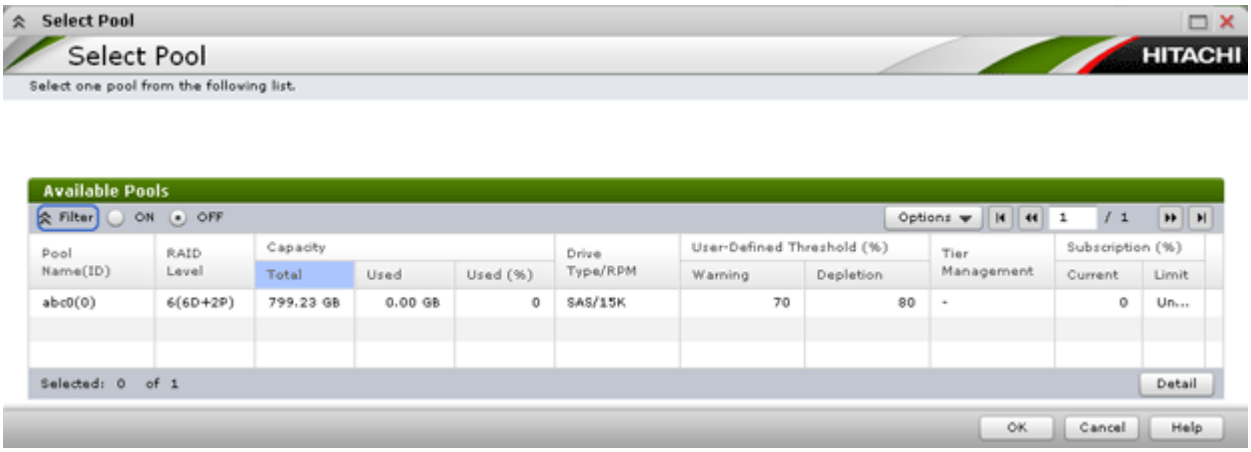
Use this window to view information about available free space slots in the parity group. Only the free spaces in the parity groups assigned to the logged-on user are available.



Item	Description
Parity Group ID	Parity group identifier.
Free Space No.	Sequence number for identifying free space in the parity group.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Capacity	Capacity of free space.
Base Emulation Type	Emulation type of the parity group.
Drive Type/ RPM	Drive type and rpm in use on this LDEV.

Item	Description
Protection	Protection status on the parity group. SATA W/V, SATA E, or Standard. SAS, SSD, and External appears as Standard.
View Physical Location	Opens the View Physical Location window.

Select Pool window



Available Pools table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level.
Capacity	Displays information about the pool capacity. • Total: Total capacity of pool. • Used: Used pool capacity. • Used (%): Pool usage rates for pool capacity. Used (%) displays the value which is truncated after the decimal point of the actual value.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed.

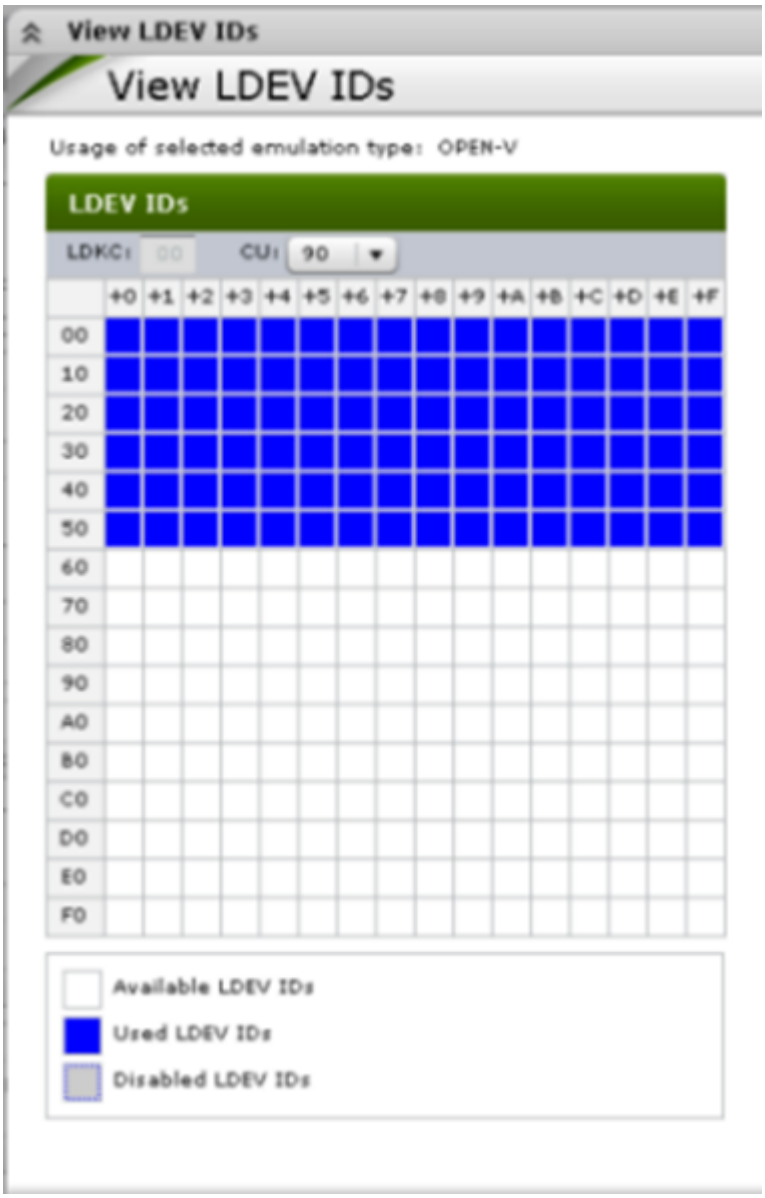
Item	Description
Tier Management	Displays Auto or Manual according to the Tier Management setting when Dynamic Tiering or Dynamic Tiering for Mainframe is enabled. Displays Manual for pools other than Dynamic Tiering or Dynamic Tiering for Mainframe which are available for monitoring. For other pools, a hyphen (-) is displayed.
Subscription (%)	Displays information about subscription of the pool. • Current: Percentage of the total V-VOL capacity assigned to the pool and the V-VOL capacity to be created. • Limit: Percentage of the subscription limit of the pool.
Detail	Displays the Pool Properties window when selecting a row and clicking this button

View LDEV IDs window

Use this window to view available, used, and disabled LDEV IDs in matrix format. The vertical scale in the matrix represents the second-to-last digit of the LDEV number, and the horizontal scale represents the last digit of the LDEV number.

In the matrix, cells of used LDEV numbers display in blue, unselectable in gray, and unused in white. The LDEV numbers corresponding to any one of the following conditions cannot be specified:

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



Item	Description
Usage of selected emulation type	Emulation type selected in the Create LDEVs window. See Emulation groups and types on page C-35 for a list.
LDEV IDs	LDEV identifier, which is the combination of LDKC, CU, and LDEV. LDKC: Indicates the LDKC number. CU: Indicates the CU number.

Emulation groups and types

The following table shows the emulation groups and emulation types for mainframe systems.

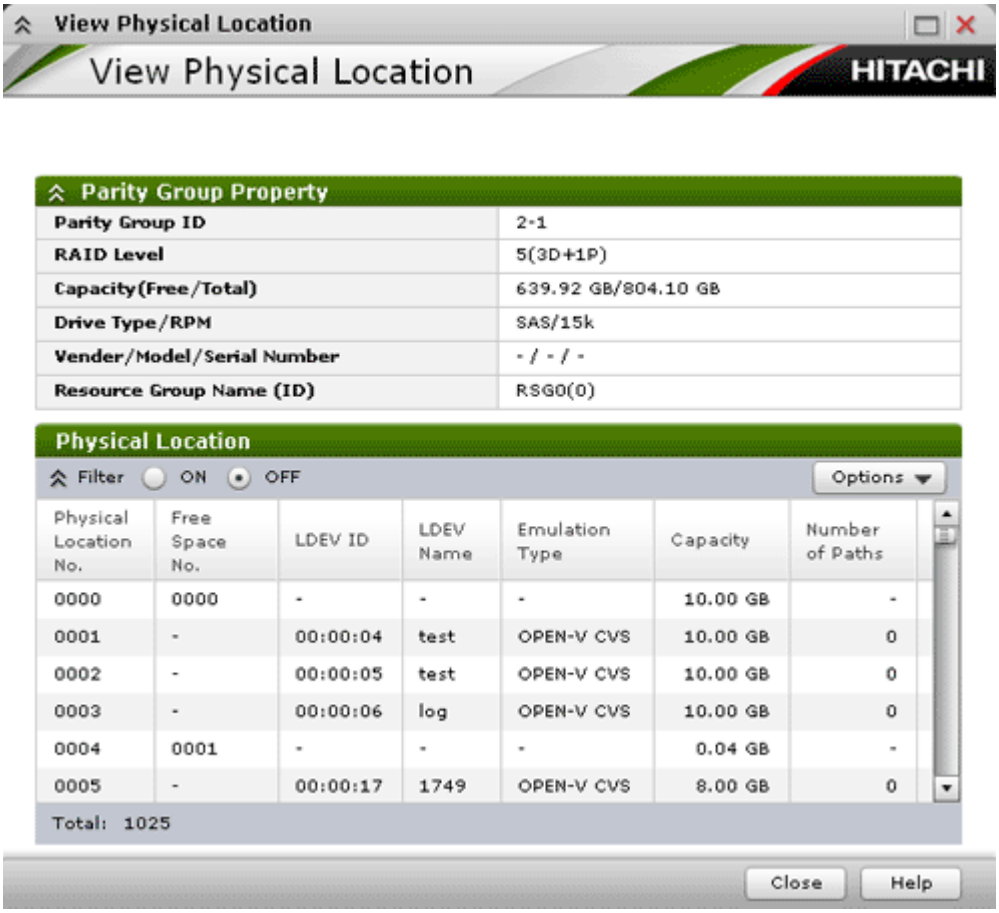
Emulation group	D-type (Overseas PCM) emulation type
Group 1	3390-3, 3390-A, 3390-3A, 3390-3B, 3390-3C, 3390-9, 3390-9A, 3390-9B, 3390-9C, 3390-L, 3390-LA, 3390-LB, 3390-LC, 3390-M, 3390-MA, 3390-MB, 3390-MC, 3390-V
Group 2	3390-3R
Group 3	3380-3, 3380-3A, 3380-3B, 3380-3C

The following table shows the emulation groups and emulation types for open systems.

Emulation group	D-type (Overseas PCM) emulation type
Group 4	OPEN-3, OPEN-8, OPEN-9, OPEN-E
Group 5	None
Group 6	OPEN-V

View Physical Location window

Use this window to view information about the physical location of where free spaces and LDEVs are assigned in a parity group.



Parity Group Property table

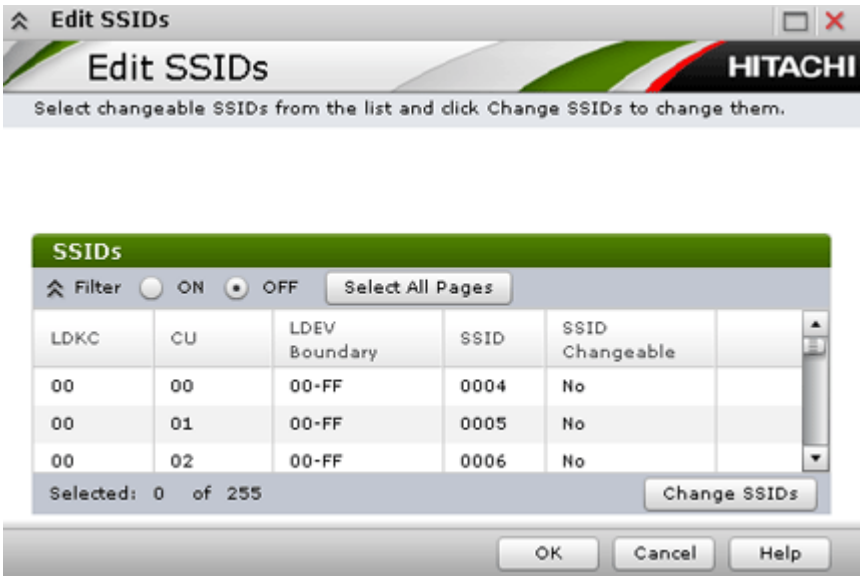
Item	Description
Parity Group ID	Parity group identifier. For an interleaved parity group, all parity groups that are contained in the interleaved parity group are shown.
RAID Level	RAID level. An asterisk "*" indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Capacity (Free/Total)	Free capacity and total capacity of the parity group. The control information, such as control cylinders, used by the storage system is not included in the Free space. The total capacity of the LDEVs and Free capacity is displayed in the Total.
Drive Type/ RPM	Drive type and rpm in use on this LDEV.
Vendor/Model/Serial Number	For external volumes, vendor name, model name, and serial number appear. For internal volumes, -/-/- appears.
Resource Group Name (ID)	Resource group name and ID of which this parity group is a member.

Physical Location table

Item	Description
Physical Location No.	Location where the free spaces and LDEVs are assigned.
Free Space No.	Free space number. The hyphenation appears for volumes other than free spaces.
LDEV ID	LDEV identifier. A hyphen (-) appears for other than LDEV IDs.
LDEV Name	LDEV name. A hyphen (-) appears for volumes other than LDEVs.
Emulation Type	Emulation type. A hyphen (-) appears for volumes other than LDEVs.
Capacity	Capacity of the LDEV.
Number of Paths	Number of paths set for the LDEV. A hyphen (-) appears for volumes other than LDEVs.

Edit SSIDs window

Use this window to select a storage system identifier whose properties can be changed.



Item	Description
LDKC	LDKC number.
CU	Control unit number.
LDEV Boundary	The range of LDEVs that can be allocated to the SSID. Each LDEV group (divided by LDEV boundary) has a unique SSID.
SSID	Storage system identifier in hexadecimal format.
SSID Changeable	Indicates whether the storage system identifier is can be changed. • Yes: The SSID can be changed. The SSID was assigned when creating LDEVs but has not yet been registered (unused). • No: The SSID can not be changed. The SSID has been registered (used) and cannot be changed. • Hyphen (-): The SSID is not assigned.
Change SSIDs	Select a row and click this button to open the Change SSID window.

Change SSIDs window

Use this window to change the SSID.

Item	Description
Initial SSID	Specify the initial storage system identifier in hexadecimal format. The default is 0004 if none is specified.

Format LDEVs wizard

Use this window to format LDEVs. LDEVs must be formatted before you can use the storage space.

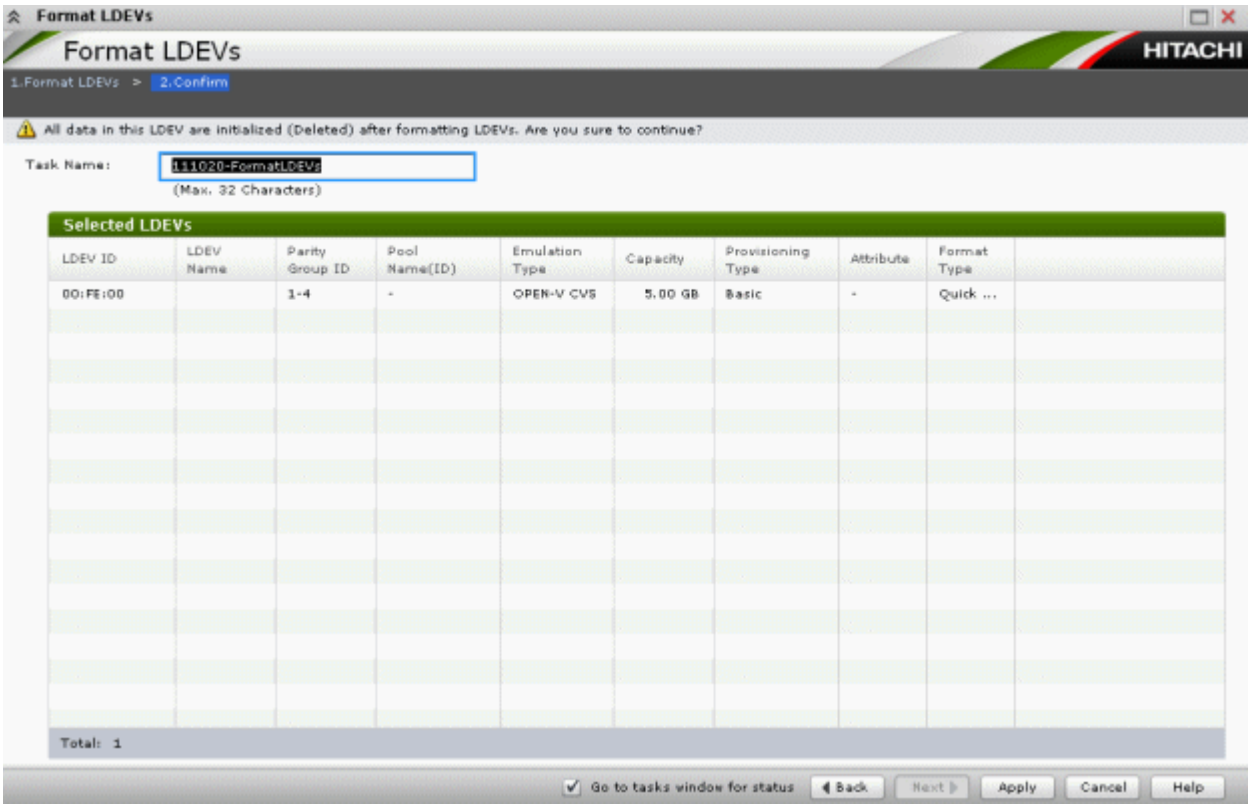
Format LDEVs window

Item	Description
Format Type	Select the type of formatting to be used on this LDEV. • Quick Format (default): Select this to perform quick-formatting. This option is available only for formatting an internal volume. • Write to Control Blocks: Select this when the provisioning type is for a mainframe external volume. The management area of external volumes for mainframe systems will be overwritten. This is the default option for an external volume.

Item	Description
	• Normal Format: Select this to perform normal-formatting. This option is available for formatting an internal volume, or an external volume whose emulation type is OPEN.
Number of Selected Parity Groups	Number of selected parity groups.

Format LDEVs Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

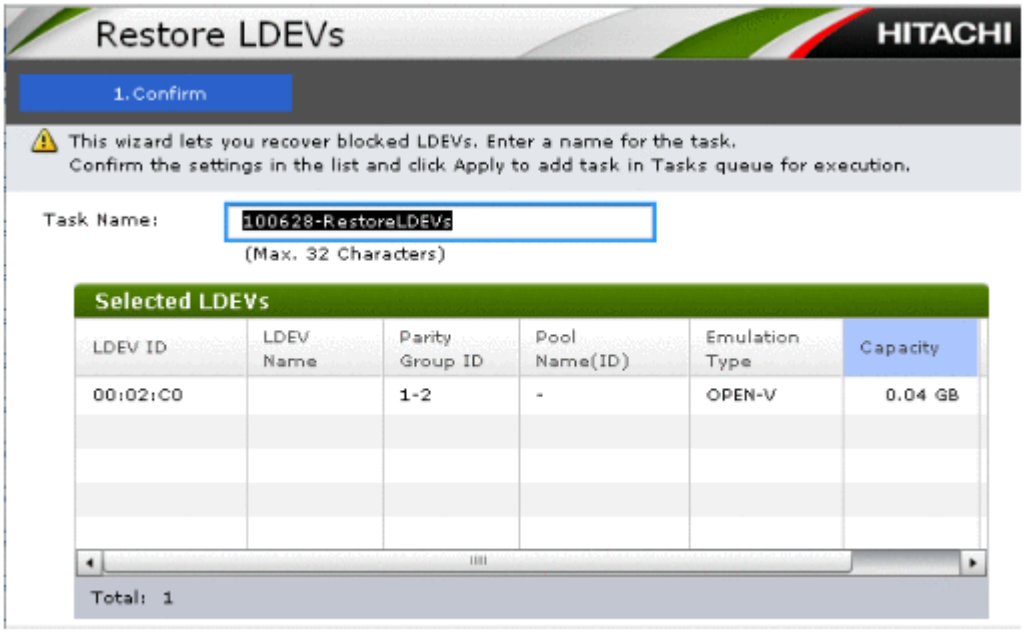


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type to be assigned to the LDEV.

Item	Description
	• Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. System Disk: System disk TSE: TSE-VOL. Hyphen (-): Volume in which the attribute is not defined.
Format Type	How the LDEV will be formatted. • Quick Format: Quick-formatting is performed. • Normal Format: Normal formatting is performed. • Write to Control Blocks: The management area of external volumes for mainframe systems is overwritten.

Restore LDEVs window

Use this window to recover blocked LDEVs.

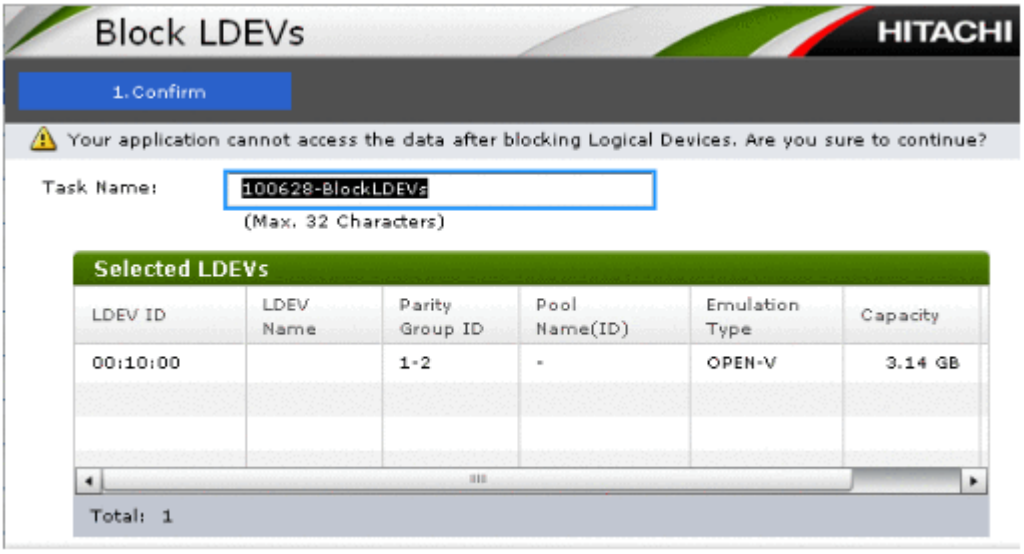


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.

Item	Description
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type assigned to the LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Remote Command Device: Remote command device. System Disk: System disk. JNL VOL: Journal volume. Reserved VOL: Reserved volume. Quorum Disk: Quorum disk for High Availability Manager. TSE: TSE-VOL. Nondisruptive Migration: Volume for nondisruptive migration. Hyphen (-): Volume in which the attribute is not defined.

Block LDEVs window

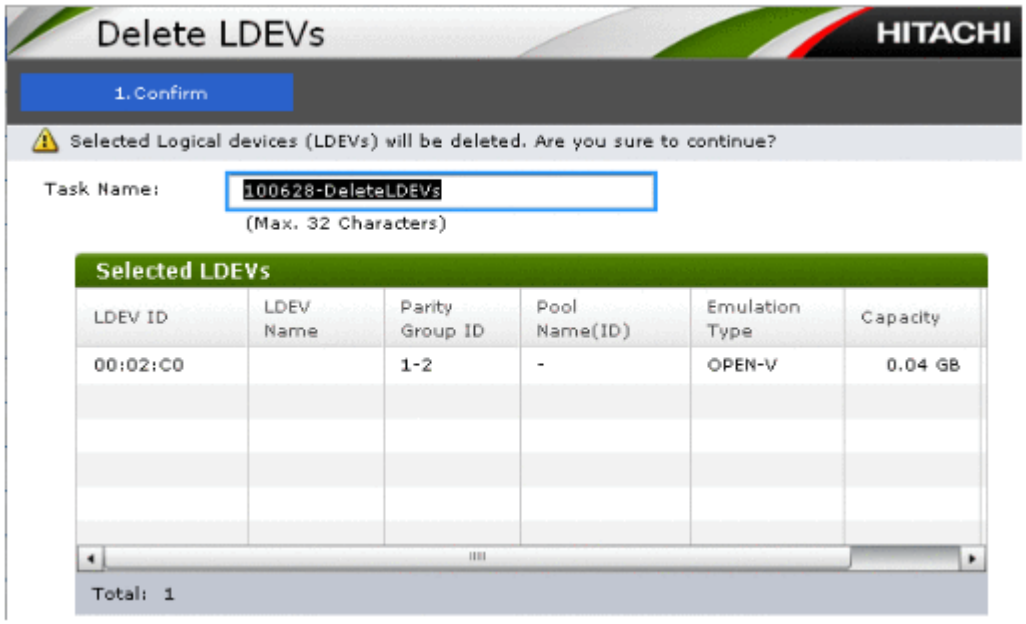
Use this window to block specific LDEVs. The data on the LDEV cannot be accessed when the LDEV is blocked.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type assigned to the LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Remote Command Device: Remote command device. System Disk: System disk. Reserved VOL: Reserved volume. Quorum Disk: Quorum disk for High Availability Manager. TSE: TSE-VOL. Nondisruptive Migration: Volume for nondisruptive migration. Hyphen (-): Volume in which the attribute is not defined.

Delete LDEVs window

Use the window to delete an LDEV from a parity group.

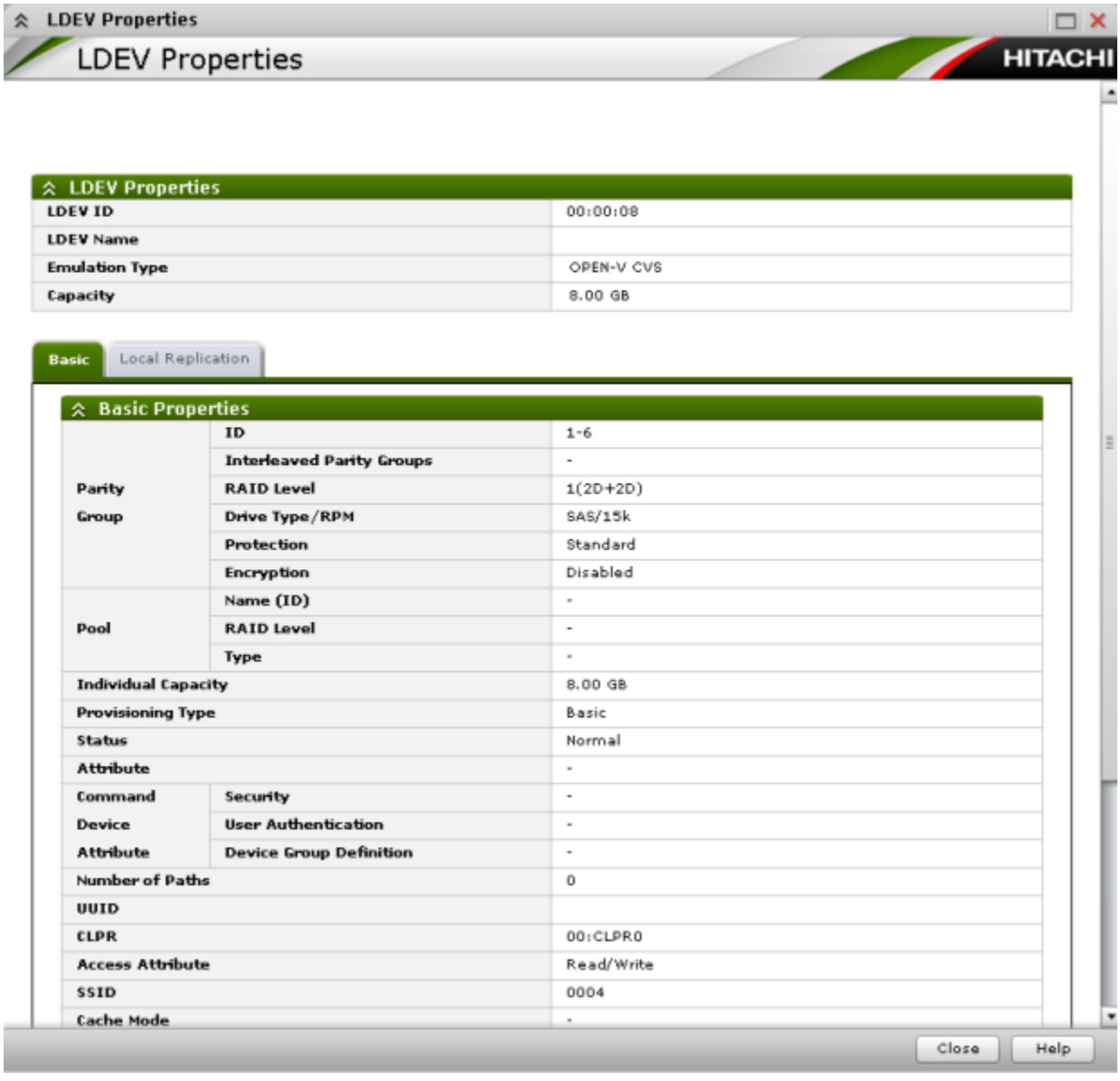


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type assigned to the LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. System Disk: System disk. TSE: TSE-VOL. Hyphen (-): Volume in which the attribute is not defined.

LDEV Properties window

Use this window to view properties assigned to a selected LDEV.

- LDEV Properties table on page C-45
- Basic tab on page C-46
- Local Replication Tab on page C-49



LDEV Properties table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.

Item	Description
Emulation Type	Displays the emulation type.
Capacity	Displays the LDEV capacity. If the component of the LUSE volume is selected, a hyphen (-) is displayed. If the top LDEV of the LUSE volume is selected, total capacity of the LUSE volume including components is displayed.

Basic tab

LDEV basic information is displayed in the Basic Properties, LUNs, Hosts, and Concatenated LDEVs(LUSE) tables.

Basic Properties table

Item	Description
Parity Group	ID: Displays the parity group ID. Interleaved Parity Groups: Displays the interleaved parity groups. RAID Level: Displays the RAID level of parity group. The asterisk (*) indicates the parity group is the interleaved parity group. Drive Type/RPM: Displays the hard disk drive type and RPM. Protection: SATA W/V, SATA E, or Standard is displayed. Standard indicates that a SAS drive, SSD, and an external volume is used. Encryption: Displays the setting (enable or disable) of encryption.
Pool	Name (ID): Displays the pool name and ID. RAID Level: Displays the RAID level of pool. Type: Displays the hard disk drive type of pool.
Individual Capacity	Displays the LDEV capacity of the selected LDEV.
Provisioning Type	Display the type of LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume. • External MF: Migration volume.
Status	Displays the LDEV status. Normal: Normal status. Blocked: Host cannot access blocked volumes. Warning: Problem occurs in the volumes. Formatting: Volumes are being formatted.

Item	Description
	Preparing Quick Format: Volumes are being prepared for quick formatting. Quick Formatting: Volumes are being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volumes are being copied. Read Only: Data cannot be written on the Read Only volumes. Shredding: Volumes are being shredded.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Remote Command Device: Remote command device. System Disk: System disk. JNL VOL: Journal volume. Pool VOL: Pool volume. The number in parentheses shows the pool ID. Reserved VOL: Reserved volume. Quorum Disk: Quorum disk for High Availability Manager. TSE: TSE-VOL. Nondisruptive Migration: Volume for nondisruptive migration. Hyphen (-): Volume in which the attribute is not defined.
Command Device Attribute	Security: Displays the setting (enable or disable) of Command Device Security. User Authentication: Displays the setting (enable or disable) of user authentication. Device Group Definition: Displays the setting (enable or disable) of Device Group Definition.
Number of Paths	Displays the number of paths of the selected LDEV. If the component of the LUSE volume is selected, a hyphen (-) is displayed.
UUID	Displays the UUID.
CLPR	Displays the ID and name of the CLPR in *ID*:*CLPR* format.
Access Attribute	Displays the access attribute of the LDEV.
SSID	Displays the SSID.
Cache Mode	Displays the cache mode.
V-VOL Management Task	Displays the V-VOL management task being performed on a Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, or a Dynamic Tiering for Mainframe V-VOL. • Reclaiming Zero Pages: The process is in progress.

Item	Description
	• Waiting for Zero Page Reclaiming: The process has been waited. • Hyphen (-): The process is not being performed on the LDEV.
Current MP Blade ID	Displays the current processor blade ID.
Current MP Blade Name	Displays the current processor blade name.
Assigned MP Blade ID	Displays the assigned processor blade ID.
Assigned MP Blade Name	Displays the assigned processor blade name.
Resource Group Name (ID)	Displays the resource group name and ID of the LDEV. The ID is provided in parentheses.
Tiering Policy	Displays the tiering policy name and ID.
New page Assignment Tier	Displays the new page assignment tier.
Tier Relocation	Displays the tier relocation setting.
Relocation Priority	Displays the relocation priority setting.

LUNs table

This table is not displayed if the path is not set.

Item	Description
Port ID	Port name.
Host Group Name	Host group name.
LUN ID	Identifier of the logical unit.

Hosts table

This table provides information about the host that can view LDEVs. This table is not available if the WWN is not registered in the host to which the path is set.

Item	Description
HBA WWN	WWN of the host that can view LDEVs.
Host Name	Host name.

Concatenated LDEVs (LUSE) table

If the volume is the top LDEV or the component in the LUSE volume, the information about the LDEV is not displayed.

Item	Description
LDEV ID	Displays the LDEV ID.
LDEV Name	Displays the LDEV name.
Parity Group ID	Displays the parity group ID.
Emulation Type	Displays the emulation type.
Individual Capacity	Displays the capacity of the LDEV.
LUSE Attribute	Displays the attribute of the LDEV in the LUSE volume. The Top is displayed if the LDEV locates in the top of the LUSE volume. The Member is displayed if the LDEV locates in the LUSE volume other than the top.

Local Replication Tab

Information about the volume of the local replication pair is displayed in the Replication Properties, and Pairs tables.

For details about each item, see *Hitachi ShadowImage® User Guide*, *Hitachi ShadowImage® for Mainframe User Guide*, *Hitachi Thin Image User Guide*, *Hitachi Copy-on-Write Snapshot User Guide*, or *Hitachi Compatible FlashCopy® User Guide*.

Replication Properties table

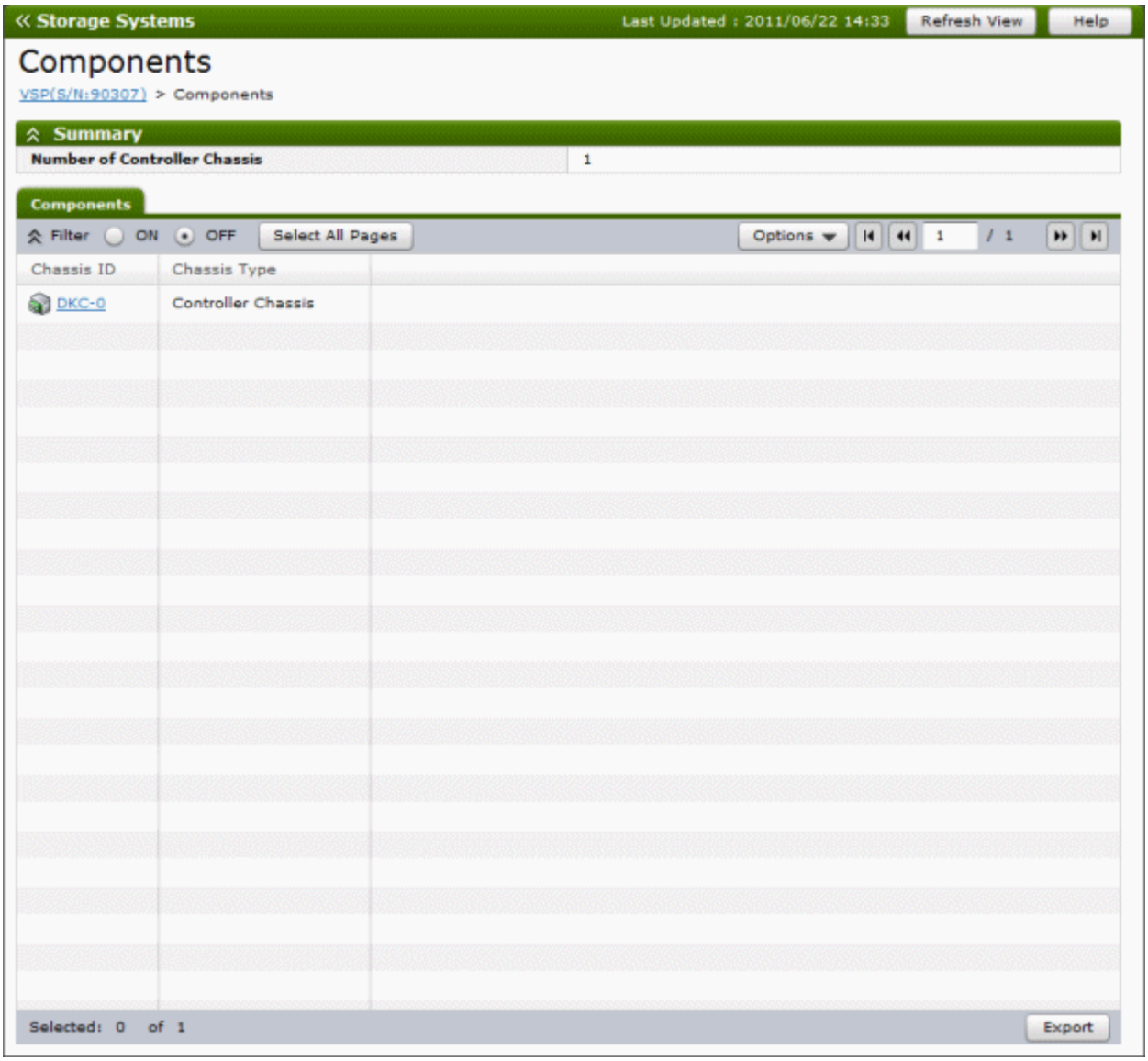
Item	Description
ShadowImage L1	Displays the status of the ShadowImage L1 pair.
ShadowImage L2	Displays the status of the ShadowImage L2 pair.
COW Snapshot	Displays the status of the Copy-on-Write Snapshot pair.
Thin Image	Displays the status of the Thin Image pair.
ShadowImage for Mainframe	Displays the status of the ShadowImage for Mainframe pair.
Compatible FlashCopy® V2	Displays the status of the Compatible FlashCopy® V2 relationship.
Compatible Software for IBM® FlashCopy® SE	Displays the status of the Compatible Software for IBM® FlashCopy® SE relationship.
Reserve Volume	If the volume is the reserved volume for the pair, Yes is displayed. If the volume other than the reserved volume is specified, No is displayed.

Pairs table

Item	Description
Primary Volume	Displays LDEV ID, LDEV Name, Emulation type, Capacity, CLPR ID, and CLPR name of the primary volume.
Copy Type	Displays the copy type of the pair.
Snapshot group	Displays the snapshot group name
Status	Displays the pair status.
Secondary Volume	Displays LDEV ID, LDEV Name, Emulation type, Capacity, CLPR ID, and CLPR name of the secondary volume.
Snapshot Date	Displays the date when the Snapshot data of the pair was stored.
Pool Name(ID)	Displays the pool name(ID) of the pair.
Copy Pace	Displays the pace of copying of the pair.
CTG ID	Displays the consistency group number of the pair.
Mirror Unit	Displays the mirror unit number of the pair.
Detail	Displays the View Pair Properties.

Top window when selecting Components

Use this window to view information about the controller chassis components in the storage system.



- Summary on page C-51
- Components tab on page C-51

Summary

Item	Description
Number of Controller Chassis	Number of controller chassis.

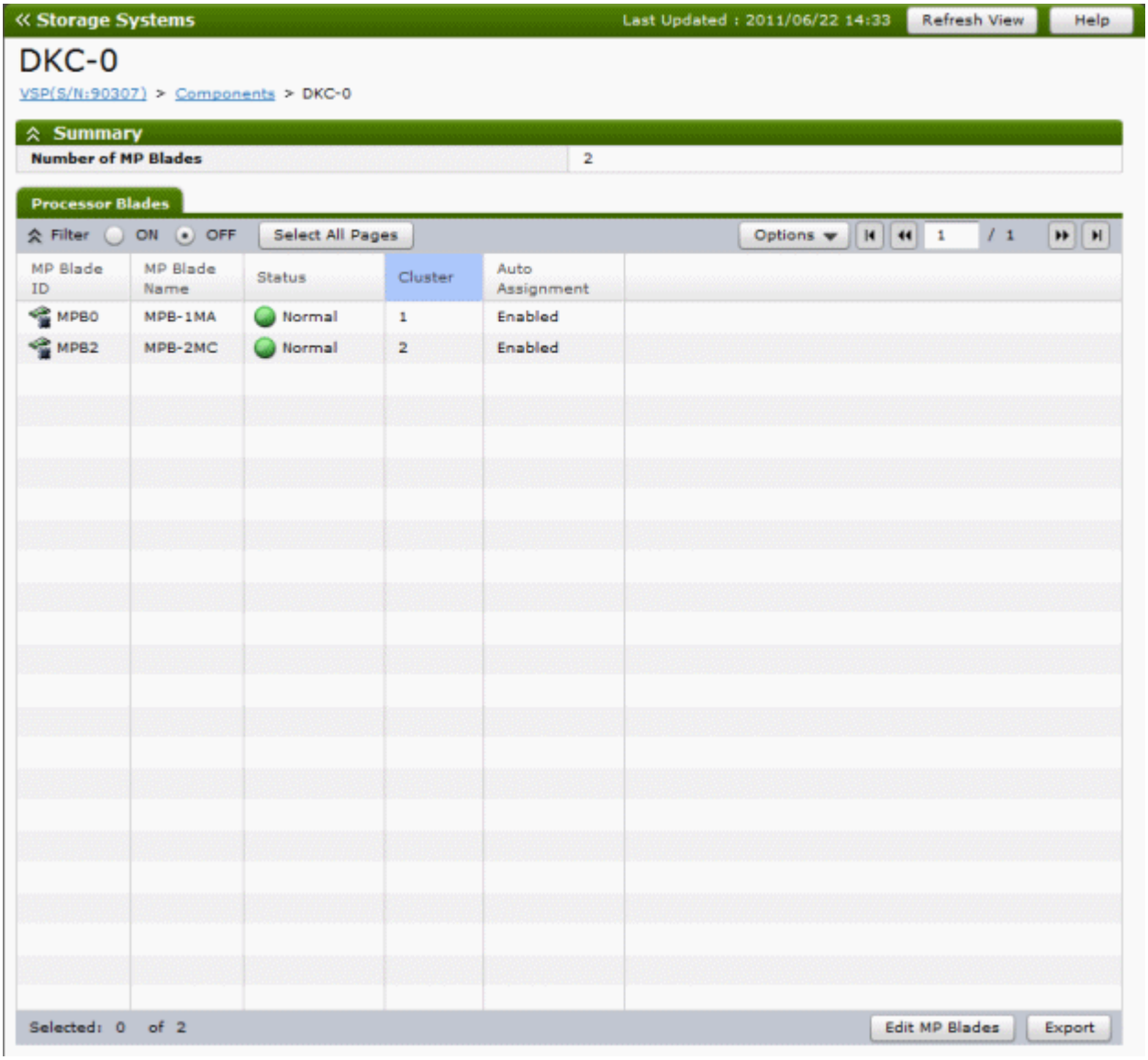
Components tab

Item	Description
Chassis ID	Chassis identifier of the storage system.

Item	Description
Chassis Type	Chassis type.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Top window when selecting controller chassis under Components

Use this window to view information about MP processor blades in the storage system.



- Summary on page C-53

- Processor Blades tab on page C-53

Summary

Item	Description
Number of MP Blades	Number of processor blades assigned to this component.

Processor Blades tab

Item	Description
MP Blade ID	Identifier of the processor blade.
MP Blade Name	Name of the processor blade.
Status	Status of the processor blade. Normal: Available. Warning: The processor blade is partially blocked. Blocked: The processor blade is blocked. Failed: The processor blade is in abnormal status.
Cluster	Cluster number of the processor blade.
Auto Assignment	Indicates whether the processor blade is automatically assigned to resources. Enabled: The processor blade is automatically assigned to resources (logical devices, external volumes, and journal volumes). Disabled: The processor blade is not automatically assigned to resources.
Edit MP Blades	Opens the Edit Processor Blades window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Edit Processor Blades wizard

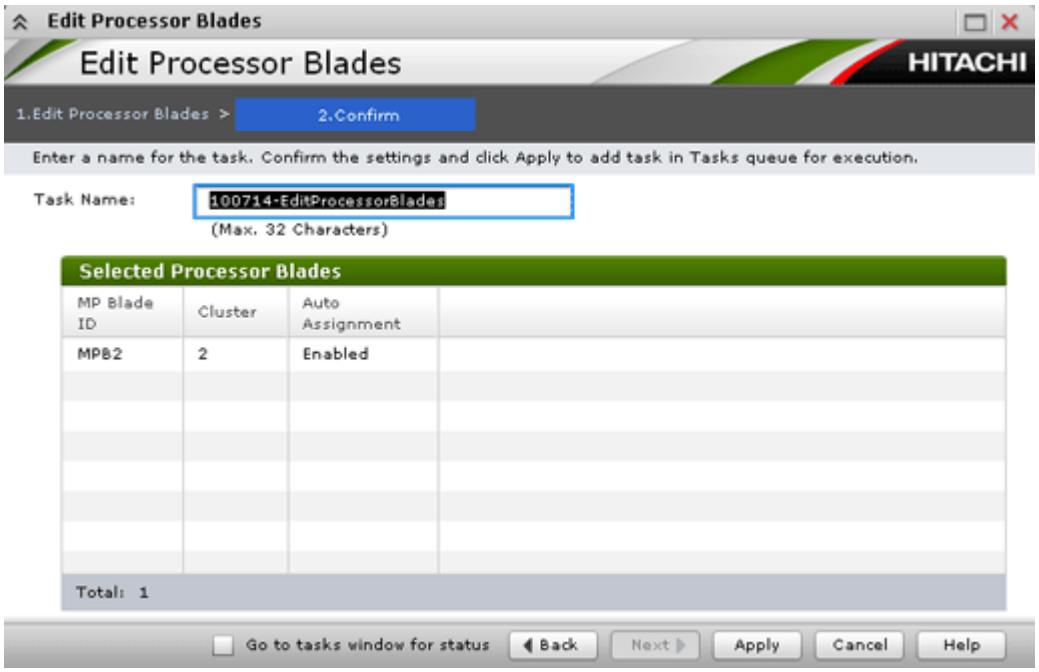
Use this wizard to enable or disable the storage system to automatically assign the load of resources controlled by the selected processor blades.

Edit Processor Blades window

Item	Description
Auto Assignment	Specify whether to automatically assign a processor blade to resources (logical devices, external volumes, and journal volumes). • Enable: Resources will be automatically assigned to the specified processor blade. • Disable: Resources will not be automatically assigned to the specified processor blade.

Edit Processor Blades Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Item	Description
MP Blade ID	Processor blade identifier.
Cluster	Cluster number of the processor blade.
Auto Assignment	Indicates whether automatic assignment of processor blades is in use. • **Enabled:** A processor blade is automatically assigned to resources (logical devices, external volumes, and journal volumes). • **Disabled:** A processor blade is not automatically assigned to resources.

Assign Processor Blade wizard

Use this wizard to assign a processor blade that will control selected resources.

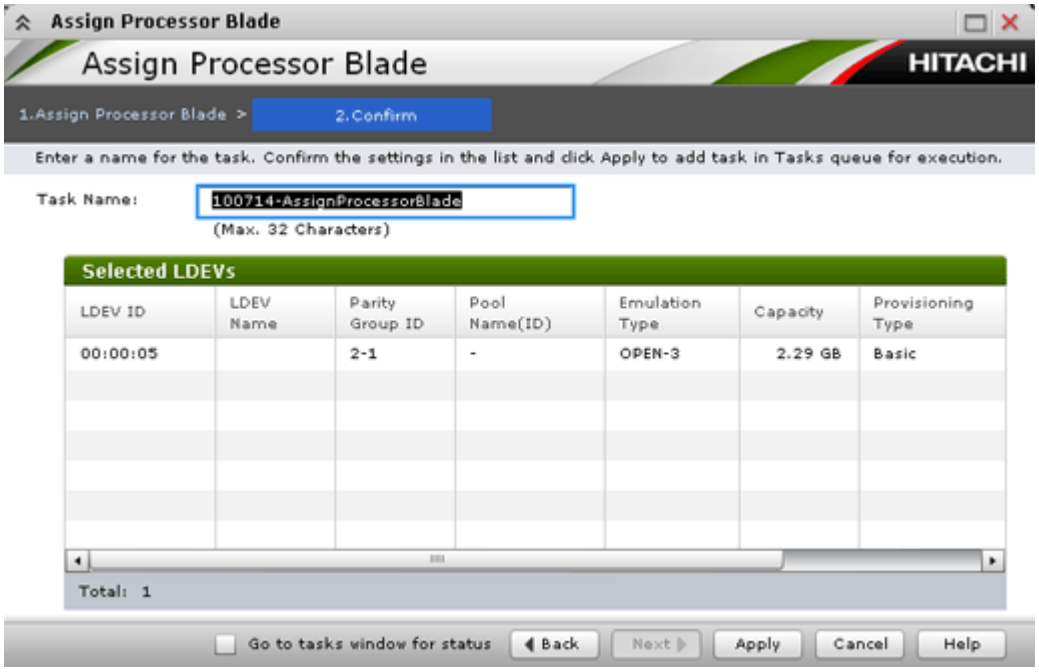
Assign Processor Blade window

Use this window to select a processor blade to assign to an LDEV.

Item	Description
Processor Blade	Change the processor blade assigned to the LDEV. *processor blade ID*: The selected processor blade is assigned to the LDEV.

Assign Processor Blade Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.

Item	Description
LDEV Name	LDEV name.
Parity Group ID	Parity group identifier.
Pool Name (ID)	Pool name and pool identifier.
Emulation Type	Emulation type.
Capacity	LDEV capacity.
Provisioning Type	Provisioning type to be assigned to the LDEV. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume. • External MF: Migration volume.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Remote Command Device: Remote command device. System Disk: System disk. JNL VOL: Journal volume. Pool VOL: Pool volume. The number in parentheses shows the pool ID. Reserved VOL: Reserved volume. Quorum Disk: Quorum disk for High Availability Manager. TSE: TSE-VOL. Nondisruptive Migration: Volume for nondisruptive migration. Hyphen (-): Volume in which the attribute is not defined.
MP Blade ID	Processor blade identifier to be set.

View Management Resource Usage window

Management Resource Usage table

Item	Description
Number of Cache Management Devices	The current number and maximum allowed number of cache management devices in the storage system are displayed.

D

LUSE GUI reference

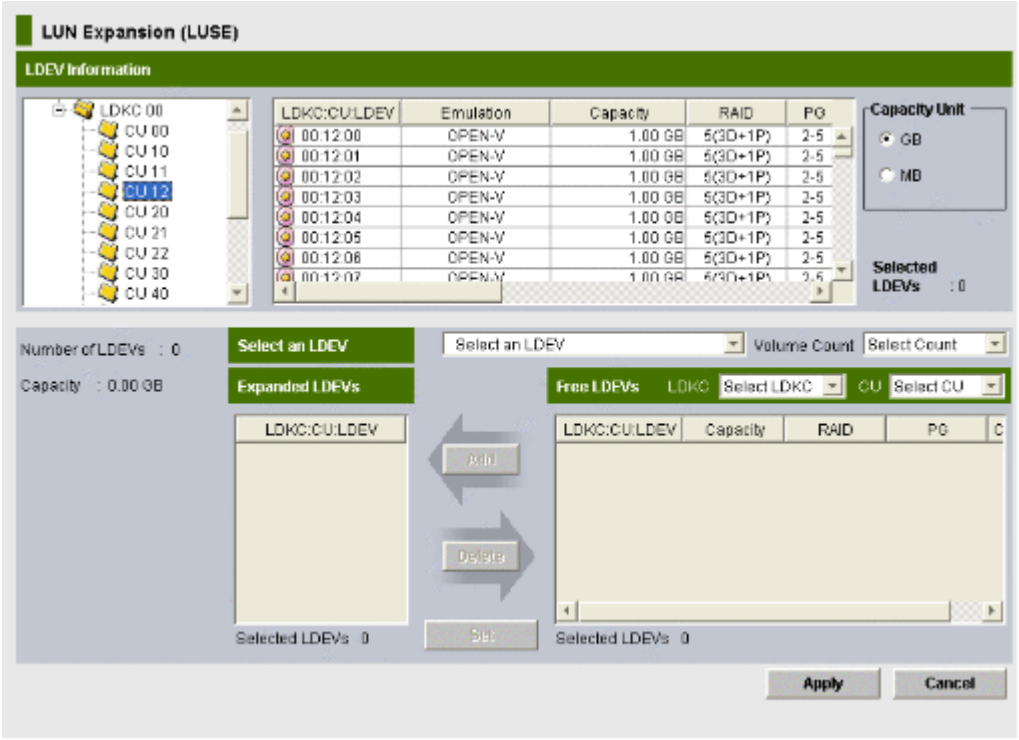
Sections in this appendix describe the LUN Expansion windows, wizards, and dialog boxes used in creating and configuring LUSE volumes.

For information about common Storage Navigator operations, such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

- ☐ LUN Expansion window
- ☐ LDEV operation detail
- ☐ RAID Concatenation dialog box
- ☐ Set LUSE confirmation dialog box
- ☐ Reset LUSE confirmation dialog box
- ☐ Release LUSE confirmation dialog box
- ☐ LUSE Detail dialog box

LUN Expansion window

This window provides information about the selected LDEV.



Item	Description
LDEV Information tree	Provides an outline view of the LDKC (logical DKC) and control units (CU) installed on the storage system.
LDEV Detail table	Provides detailed information for all open-system LDEVs in the selected CU.
LDEV operation detail	Provides LDEV operational detail.

LDEV Information tree

The **LDEV Information** tree provides an outline view of the LDKC (logical DKC) and control unit (CU) numbers installed on the storage system.

LDEV Detail table

The **LDEV Detail** table provides detailed information for all open-system LDEVs in the selected CU.

Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears. The LDEV status icons indicate:

Item	Description
	: Normal LDEV. : Expanded (LUSE) volume • An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*. • An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Emulation	Emulation type. If the selected LDEV is a LUSE volume, the emulation type appears with an asterisk and the number of volumes in the LUSE volume (for example, OPEN-E*5).
Capacity	LDEV capacity, in either MB or GB, depending on which unit is selected in the Capacity Unit box.
RAID	RAID level of the LDEV. A hyphen (-) indicates the RAID level is unspecified when the LDEV is an external LU or a virtual volume (V-VOL).
Protection	Data protection level. • SATA-W/V: Indicates the data protection level if the write and verify mode is set on a SATA drive. • SATA-E: Indicates the data protection level if the Enhanced mode is set on a SATA drive. • Standard: Indicates that a SAS drive, SSD, external volume, or virtual volume (V-VOL) is being used.
PG	Parity group. If the LDEV extends over two or more parity groups, the PG column shows the smaller parity group number. • A parity group number starting with E (for example, E1-1) indicates that the parity group consists of one or more external LUs. • A parity group number starting with V (for example, V1-1) indicates that the parity group consists of one or more virtual volumes (V-VOLs) for Thin Image or Copy-on-Write Snapshot.
Paths	Number of paths set for the LDEV. If this column shows the number of paths for an LDEV, you can use the LDEV as the top LDEV of a LUSE volume.
Access Attribute	Access attribute that is set for the LDEV. • Read/Write: Both read and write operations are permitted on the logical volume. • Read-only: Read operations are permitted on the logical volume. • Protect: Neither read nor write operations are permitted.
Cache mode	Local storage system cache mode. • Disable: Indicates the local storage system cache memory is set to be unused for responding to the I/O request for the external volume from the host.

Item	Description
	• Enable: Indicates the local storage system cache memory is set to be used for responding to the I/O request for the external volume from the host.
Ext. VOL Info	Drive types of external volumes. • Asterisk (*): Indicates a SATA or BD drive containing external volumes. • Dollar sign ($): Indicates an SSD containing external volumes. • Hyphen (-): Indicates a drive containing internal volumes. • Nothing appears for SAS drives containing external volumes.
Int. VOL Info	Drive types of internal volumes. • Asterisk (*): Indicates a SATA drive containing internal volumes. • Dollar sign ($): Indicates an SSD containing internal volumes. • Hyphen (-): Indicates a drive containing external volumes. • Nothing appears for a SAS drive containing internal volumes.
Resource Group Name (ID)	Resource group name and identifier of the LDEV.
CLPR	Two-digit identifier of the cache logical partition to which the selected volumes belong. For detailed information about CLPRs, see the *Performance Guide*.
Pool ID	Number of a pool associated with virtual volumes (V-VOLs) for Dynamic Provisioning. • Hyphen (-): Indicates a virtual volume (V-VOL) for Dynamic Provisioning is not associated with a pool. • Nothing appears for volumes that are not virtual volumes (V-VOLs) for Dynamic Provisioning.
Capacity Unit	Click an option to select the capacity, in either GB (default) or MB, of the LDEV selected in the Capacity column.
Selected LDEVs	Number of LDEVs that are selected in the LDEV Detail table.

LDEV operation detail

The remainder of the LUN Expansion window provides LDEV operational detail.

Item	Description
Select an LDEV	LDEVs and LUSE volumes of the selected CU that are eligible to become part of a LUSE volume appear in this list. The selected LDEV number becomes the top LDEV number of a LUSE volume.
Volume Count	The number of LDEVs that form a LUSE volume. For example, if you select 3 in the Volume Count box, three LDEVs are expected to form a LUSE volume and then three LDEVs are added to the Expanded LDEVs list.

Item	Description
	You can select an LDEV only from the Volume Count box. You cannot select a LUSE volume.
Expanded LDEVs	A list of the LDEVs that are selected as LUSE volume components. An LDEV is added to this list by clicking **Add**. • Selected LDEVs: Number of LDEVs selected in the Expanded LDEVs list. • Number of LDEVs: Total number of LDEVs selected in the Expanded LDEVs list. • Size: Total capacity, in either GB or MB, of the LDEVs selected in the Expanded LDEVs list.
Free LDEVs table	LDEVs or LUSE volumes selected in the Select an LDEV box that are eligible to become part of a LUSE volume appear in this list. Use the lists on the upper right of the Free LDEVs table to narrow entries in this table. If you select an LDKC and a CU from the LDKC and CU lists, the Free LDEVs table shows only the LDEVs belonging to the selected LDKC and CU.
Add	Moves a selected LDEV from the **Free LDEVs** list to the **Expanded LDEVs** list.
Delete	Moves a selected LDEV from the **Expanded LDEVs** list to the **Free LDEVs** list.
Set	Creates a LUSE volume consisting of the volumes currently in the **Expanded LDEVs** list. The new LUSE appears in blue bold italics on the **LUN Expansion** window in the **LDEV Detail** table, but is not actually created until you click **Apply**.
Apply	Applies the settings to the storage system.
Cancel	Cancels the settings.

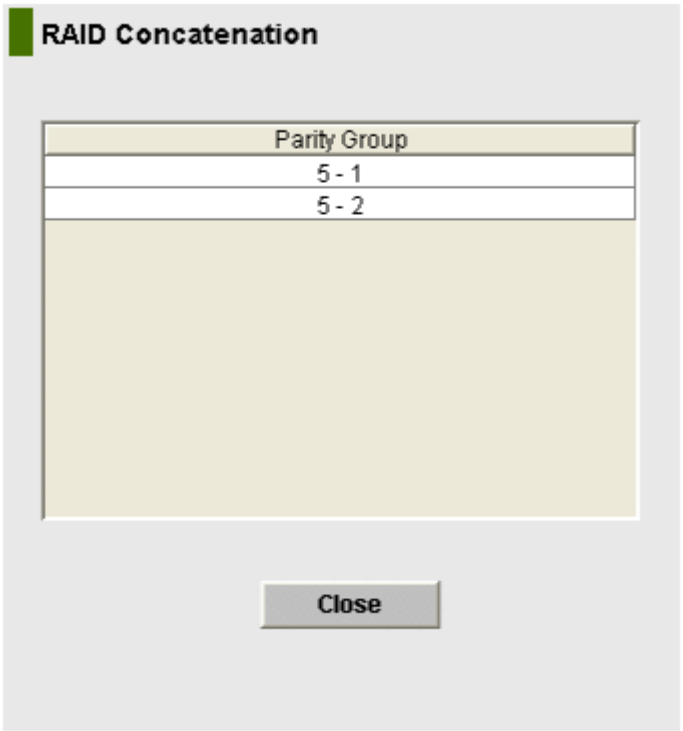
Free LDEVs table contains the following items

Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears. The LDEV status icons indicate: : Normal LDEV. : Expanded (LUSE) volume • An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*. • An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Capacity	Capacity of the LDEV.

Item	Description
RAID	RAID level of the LDEV. The RAID level is left unspecified with a hyphen (-) when the LDEV is an external LU or virtual volume (V-VOL).
Protection	Data protection level on the LDEV. • SATA-W/V: Indicates the data protection level if the write and verify mode is set on a SATA drive. • SATA-E: Indicates the data protection level if the Enhanced mode is set on a SATA drive. • Standard: Indicates that a SAS drive, SSD, external volume, or virtual volume (V-VOL) is being used.
PG	Parity group. If the LDEV extends over two or more parity groups, the **PG** column shows the smaller parity group number. A parity group number starting with E (for example, E1-1) indicates that the parity group consists of one or more external LUs. A parity group number starting with V (for example, V1-1) indicates that the parity group consists of one or more Thin Image or Copy-on-Write Snapshot virtual volumes (V-VOLs).
CLPR	Cache logical partition number. For detailed information about CLPRs, see the *Performance Guide*.
Selected LDEVs	Number of LDEVs selected in the Free LDEVs table.

RAID Concatenation dialog box

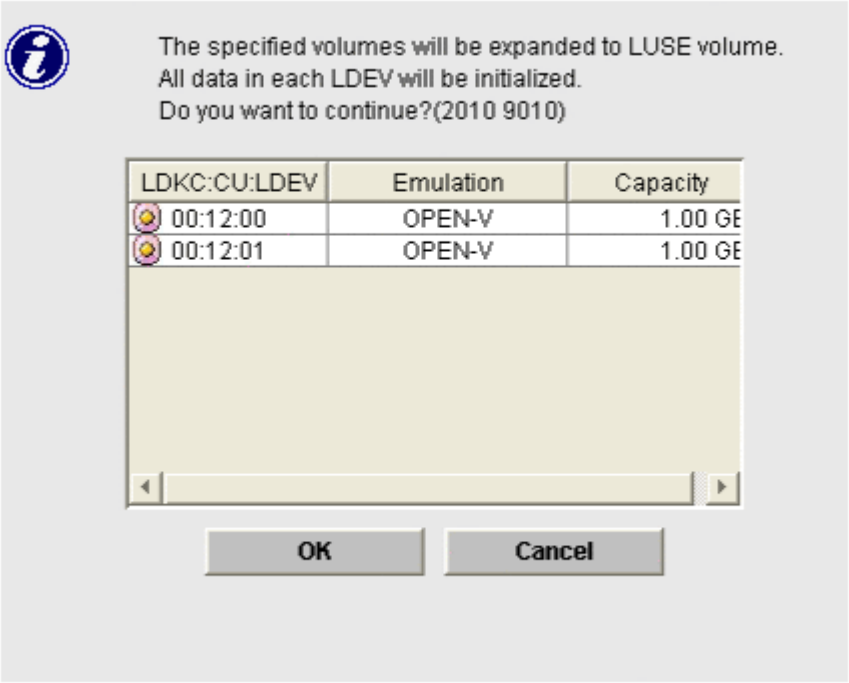
Use this dialog box to view concatenated parity groups.



Item	Description
Parity Group	Lists parity groups. A parity group number starting with E (for example, E1-1) indicates that the parity group consists of one or more external LUs.
Close	Closes the dialog box.

Set LUSE confirmation dialog box

When you select and right-click the free LDEVs that you want to form the LUSE volume in the **LDEV Detail** table, and select **Set LUSE Volume**, the **Set LUSE confirmation** dialog box opens. Verify that the LDEVs listed in the confirmation dialog box are the ones you want to use to create a LUSE volume.

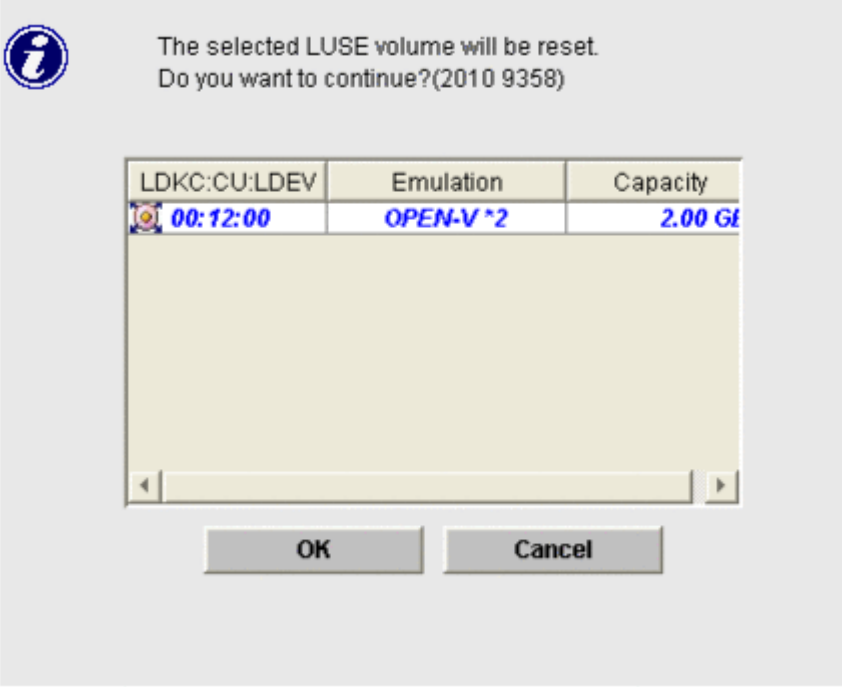


Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears. The LDEV status icons indicate: : Normal LDEV. : Expanded (LUSE) volume • An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*.

Item	Description
	• An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Emulation	Emulation type of the LDEV.
Capacity	Capacity of the LDEV.
OK	Creates the LUSE volume. Click this button to set the LUSE volume configuration having the LDEVs in the LUSE component list. The LDEVs registered as components of the LUSE volume appear in blue bold italics in the LDEV information list.
Cancel	Cancels the operation to create a LUSE volume using the LDEVs in the list.

Reset LUSE confirmation dialog box

Use this dialog box to confirm the selected LUSE volumes before resetting them. The list in this dialog box shows the LDEVs created into a LUSE volume but not yet registered to the storage system. Click **OK** to reset the LUSE volume or click **Cancel** to reset to the state before they were created.



Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears.

Item	Description
	The LDEV status icons indicate: : Normal LDEV. : Expanded (LUSE) volume An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*. An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Emulation	Emulation type of the LDEV.
Capacity	Capacity of the LDEV.
OK	Creates the LUSE volume. Click this button to create the LUSE volume configuration having the LDEVs in the LUSE component list. The LDEVs registered as components of the LUSE volume appear in blue bold italics in the LDEV information list.
Cancel	Cancels the operation to create a LUSE volume using the LDEVs in the list.

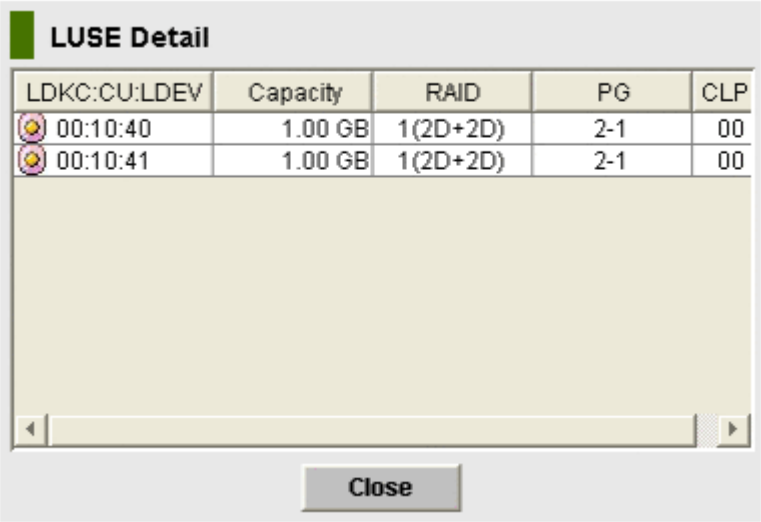
Release LUSE confirmation dialog box

This dialog box lists the LDEVs that contain LUSE volumes to be released. If the selected LUSE volume has a path or if any other than a LUSE volume is selected, this dialog box lists only LDEVs containing a LUSE volume to be released. For more information about error messages and actions on error, see the *Hitachi Storage Navigator Messages*.

Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears. The LDEV status icons indicate: : Normal LDEV. : Expanded (LUSE) volume • An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*. • An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Emulation	Emulation type of the LDEV.
Capacity	Capacity of the LDEV.
OK	Creates the LUSE volume. Click this button to set the LUSE volume configuration having the LDEVs in the LUSE component list. The LDEVs registered as components of the LUSE volume appear in blue bold italics in the LDEV information list.
Cancel	Cancels the operation to create a LUSE volume using the LDEVs in the list.

LUSE Detail dialog box

This dialog box provides information about the volumes (LDEVs) that are combined into a selected LUSE volume.



Item	Description
LDKC:CU:LDEV	The LDEV status icon, and the LDEV identifier (LDKC, CU, and LDEV numbers). If the selected LDEV is a LUSE volume, the LDEV number of the top LDEV in the LUSE volume appears. The LDEV status icons indicate: : Normal LDEV. : Expanded (LUSE) volume • An LDEV number ending with # (for example, 00:00:01#) indicates that the LDEV is an external volume. For details regarding external volumes, see the *Hitachi Universal Volume Manager User Guide*. • An LDEV number ending with V (for example, 00:00:01V) indicates that the LDEV is a virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot. For details regarding V-VOLs, see the *Hitachi Thin Image User Guide* or the *Hitachi Copy-on-Write Snapshot User Guide*.
Capacity	Capacity of the LDEV.
RAID	RAID level of the LDEV. A hyphen (-) indicates the RAID level is unspecified when the LDEV is an external LU or a virtual volume (V-VOL).
Protection	Data protection level on the LDEV. • SATA-W/V: Indicates the data protection level if the write and verify mode is set on a SATA drive. • SATA-E: Indicates the data protection level if the Enhanced mode is set on a SATA drive. • Standard: Indicates that a SAS drive, SSD, external volume, or virtual volume (V-VOL) is being used.

Item	Description
PG	Number of the parity group. • A parity group number starting with E (for example, E1-1) indicates that the parity group consists of one or more external LUs. • A parity group number starting with V (for example, V1-1) indicates that the parity group consists of one or more Thin Image or Copy-on-Write Snapshot virtual volumes (V-VOLs).
CLPR	Cache logical partition number. For detailed information about CLPRs, see the *Performance Guide*.
Close	Closes the LUSE Detail dialog box.

Dynamic Provisioning and Dynamic Tiering GUI reference

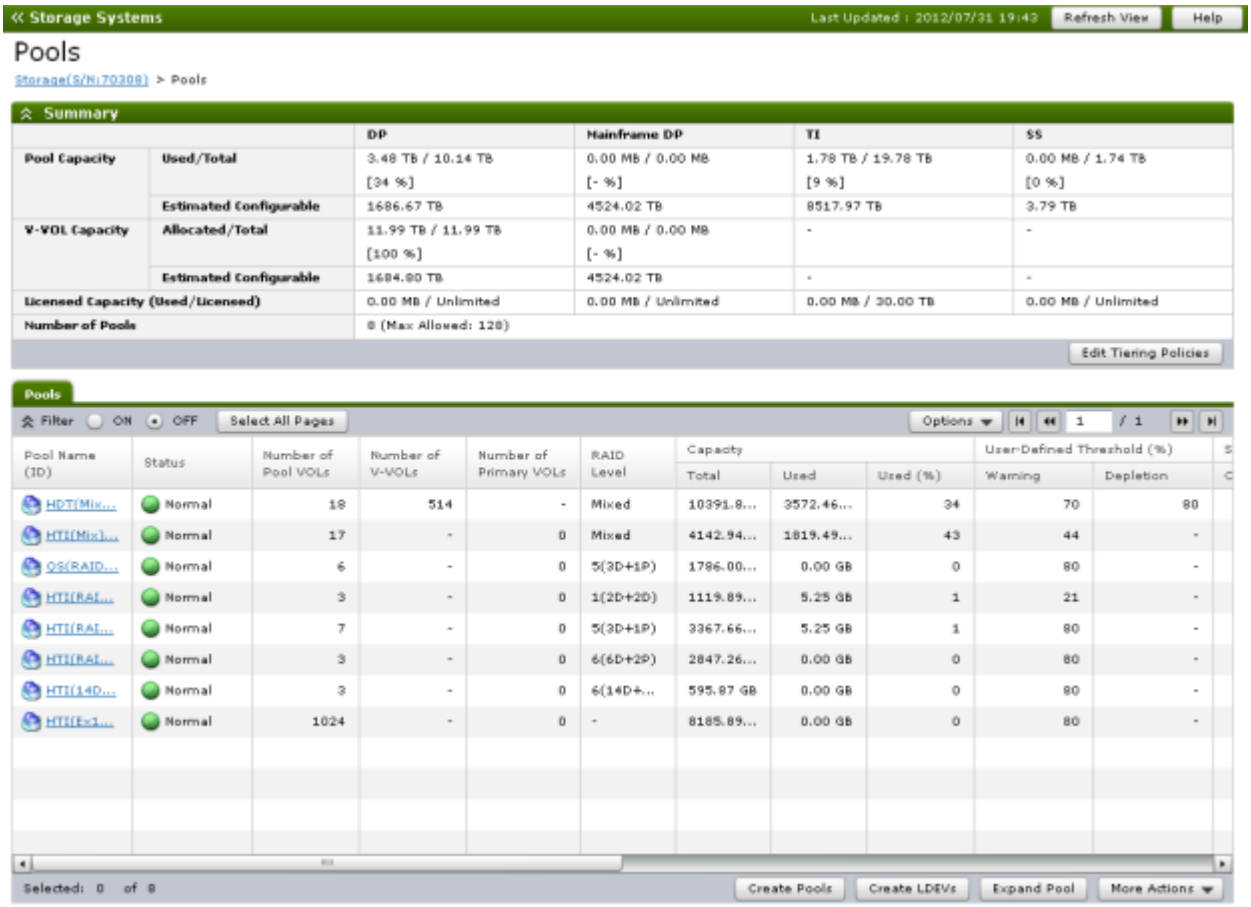
The Dynamic Provisioning and Dynamic Tiering windows, wizards, and dialog boxes are described in the following topics.

For information about common Storage Navigator operations such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

- ☐ Pools window after selecting pool (Pools window)
- ☐ Top window when selecting a pool under Pools
- ☐ Create Pools wizard
- ☐ Expand Pool wizard
- ☐ Edit Pools wizard
- ☐ Delete Pools wizard
- ☐ Expand V-VOLs wizard
- ☐ Restore Pools window
- ☐ Shrink Pool window
- ☐ Stop Shrinking Pools window
- ☐ Complete SIMs window
- ☐ Select Pool VOLs window

- Reclaim Zero Pages window
- Stop Reclaiming Zero Pages window
- Pool Property window
- View Tier Properties window
- Monitor Pools window
- Stop Monitoring Pools window
- Start Tier Relocation window
- Stop Tier Relocation window
- View Pool Management Status window
- Edit External LDEV Tier Rank wizard
- Edit Tiering Policies wizard
- Change Tiering Policy Window

Pools window after selecting pool (Pools window)



- Summary on page E-3
- Pools tab on page E-5

Summary

Item	Description
Pool Capacity[1]	Displays information about the pool capacity. • **Used/Total** **DP**: Displays the pool capacity (used/total) of Dynamic Provisioning and Dynamic Tiering. **Mainframe DP**: Displays the pool capacity (used/total) of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe. **TI**: Displays the pool capacity (used/total) of Thin Image. **SS**: Displays the pool capacity (used/total) of Copy-on-Write Snapshot. For each value, if the **Estimated Configurable** capacity is zero, ⚠ is displayed in the cell. • **Estimated Configurable**[2]

Item	Description
	DP: Displays the estimated pool capacity of Dynamic Provisioning and Dynamic Tiering. **Mainframe DP**: Displays the estimated pool capacity of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe. **TI**: Displays the remaining physical pool capacity that is configurable for Thin Image. **SS**: Displays the remaining physical pool capacity that is configurable for Copy-on-Write Snapshot.
V-VOL Capacity[1]	Displays information about the DP-VOL capacity. • **Allocated/Total** **DP**: In the **Allocated** field, total capacity of the Dynamic Provisioning and Dynamic Tiering DP-VOLs to which LU paths are allocated is displayed. In the **Total** field, total capacity of the Dynamic Provisioning and Dynamic Tiering DP-VOLs is displayed. **Mainframe DP**: In each of the **Allocated** and **Total** fields, total capacity of the Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe DP-VOLs is displayed. For each value, if the **Estimated Configurable** capacity is zero, ⚠ is displayed in the cell. • **Estimated Configurable**[2] **DP**: Displays the DP-VOL estimated configurable capacity of Dynamic Provisioning and Dynamic Tiering. **Mainframe DP**: Displays the DP-VOL estimated configurable capacity of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe.
Licensed Capacity (Used / Licensed)	**DP**: Displays the licensed capacity of Dynamic Provisioning. **Used** displays the total capacity of pools for Dynamic Provisioning and Dynamic Tiering, **Mainframe DP**: Displays the licensed capacity of Dynamic Provisioning for Mainframe. **Used** displays the total capacity of pools for Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe. **TI**: Displays the licensed capacity of the Thin Image. **SS**: Displays the licensed capacity of ShadowImage and Copy-on-Write Snapshot. Caution: In the **Licensed Capacity(Used/Licensed)** field, the total capacity of the system is displayed. The total capacity of the system includes capacities of LDEVs assigned to each user and resources other than LDEVs. Therefore, the value displayed as the "Used" Licensed Capacity **(Used/ Licensed)** might differ from the value of the "Total" Pool Capacity.
Number of Pools	Displays the total number of pools for Dynamic Provisioning, Dynamic Tiering, Thin Image, Copy-on-Write Snapshot, Dynamic Provisioning for Mainframe, and Dynamic Tiering for Mainframe.
Edit Tiering Policies	Displays the Edit Tiering Policies window.
Notes:	

Item	Description
1.	The total value of the **Total** cells under **Capacity** of each pool type in the **Pools** tab window and the total **Used** capacity of the **Pool Capacity** in the **Summary** table are almost same, but small differences might occur. The capacity used by the **Mainframe DP** volume is different from the capacity used by the DP volume. If the pool-VOL or DP-VOL for Dynamic Provisioning or Dynamic Provisioning for Mainframe is created, the estimated configurable pool capacity and estimated configurable V-VOL capacity for both DP and **Mainframe DP** change. The estimated capacity is calculated based on the configuration of current pools and DP-VOL, and remaining capacity of the shared memory.
2.	The estimated configurable capacity of Dynamic Provisioning or Dynamic Provisioning for Mainframe is the estimate of the DP-VOL capacity or the pool capacity that can be created by using the remaining capacity of the shared memory after deduction of the capacity of the shared memory used by the current pool and DP-VOL. The values of the **Estimated Configurable Pool Capacity** and the **Estimated Configurable V-VOL Capacity** can be used only as a guide, but are not guaranteed to create pools and DP-VOLs having the estimated configurable capacity. If the pool-VOL or DP-VOL for Dynamic Provisioning or Dynamic Provisioning for Mainframe is created or deleted, the estimated configurable pool capacity and estimated configurable V-VOL capacity for both Dynamic Provisioning and Dynamic Provisioning for Mainframe change.

Pools tab

Item	Description
Pool Name (ID)	Displays the pool name and pool ID. Clicking the pool name takes you to the pool information window in the lower hierarchy.
Status	Displays information about the pool status. Normal: Pool is in a normal status. Warning: Pool-VOL in the pool is blocked, or the pool is being shrunk. Exceeded Threshold: Used capacity of the pool exceeds the pool threshold. Shrinking: Pool-VOL is being reduced. Blocked: Pool is full, or an error occurred in the pool, indicating that the pool is blocked. If the pool is in both Warning and Blocked status, only Blocked is displayed.
Number of Pool VOLs	Displays the number of pool-VOLs associated with the pool.
Number of V-VOLs	Displays the number of V-VOLs associated with the pool. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Number of Primary VOLs	Displays the number of primary volumes of the Thin Image or Copy-on-Write Snapshot pairs. If the pool is other than the Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.

Item	Description
RAID level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates as Mixed.
Capacity	Displays information about the pool capacity. • Total: Total capacity of pool. Using Options, you can select unit of capacity. - One block means 512 bytes and one page means 42 megabytes in a pool capacity of Dynamic Provisioning, Dynamic Tiering, or Thin Image, - One slot means 58 kilobytes and one page means 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. - One block means 512 bytes and one page means 256 kilobytes in a pool capacity of Copy-on-Write Snapshot. • Used: Used pool capacity. • Used (%): Pool usage rates to pool capacity. Used (%) displays the value which is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed into Cylinder.
User-Defined Threshold (%)	Displays information about the threshold of a pool. • Warning: Warning threshold. • Depletion: Depletion threshold. For a Dynamic Provisioning or Dynamic Tiering pool, as for the pool with only one user-defined threshold setting, the system threshold (fixed at 80%) is enabled. If the user-defined threshold is 80% or less, the value is displayed in the Warning column. If the user-defined threshold is 81% or more, the value is displayed in the Depletion column. In this case, the other column displays a hyphen (-). For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion. **Caution**: For a pool with only one user-defined threshold setting, the system threshold (fixed at 80%) is enabled. If the used capacity of the pool exceeds the user-defined threshold, the SIM code 620XXX is reported. In the current version, the system threshold cannot be set because the user must set 2 of the user-defined thresholds: Warning and Depletion.
Subscription (%)	Displays information about subscription of the pool. • Current: Percentage of the total V-VOL capacity assigned to the pool. • Limit: Percentage of the subscription limit of the pool. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Current and Limit.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed.

Item	Description
	For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM of the pool. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
Tier Management	Displays whether Dynamic Tiering or Dynamic Tiering for Mainframe is enabled or disabled. If it is enabled Auto or Manual is displayed. If it is disabled, a hyphen (-) is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
CLPR	Displays the CLPR set for the Thin Image or Copy-on-Write Snapshot pool-VOLs. Displays in ID:CLPR form. For Pool-VOLs other than the Thin Image or Copy-on-Write Snapshot pool-VOL, a hyphen (-) is displayed.
Shrinkable	Displays whether the pool-VOL can be removed. For a Thin Image or Copy-on-Write Snapshot pool or while the pool is being shrunk, a hyphen (-) is displayed.
Monitoring Mode	Displays the monitoring mode that is set for the pool. If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Status	Displays the status of pool monitoring. • In Progress: The monitoring is being performed. • During Computation: The calculating is being processed. Other than these cases, a hyphen (-) is displayed.
Recent Monitor Data	Displays the latest monitoring data. • If the monitoring data exists, the monitoring period of time is displayed. Example: 2010/11/15 00:00 - 2010/11/15 23:59 • If the monitoring data is being obtained, only the starting time is displayed. Example: 2010/11/15 00:00 - • If the latest monitoring data does not exist, a hyphen (-) is displayed.
Pool Management Task	Displays the pool management task being performed to the pool.

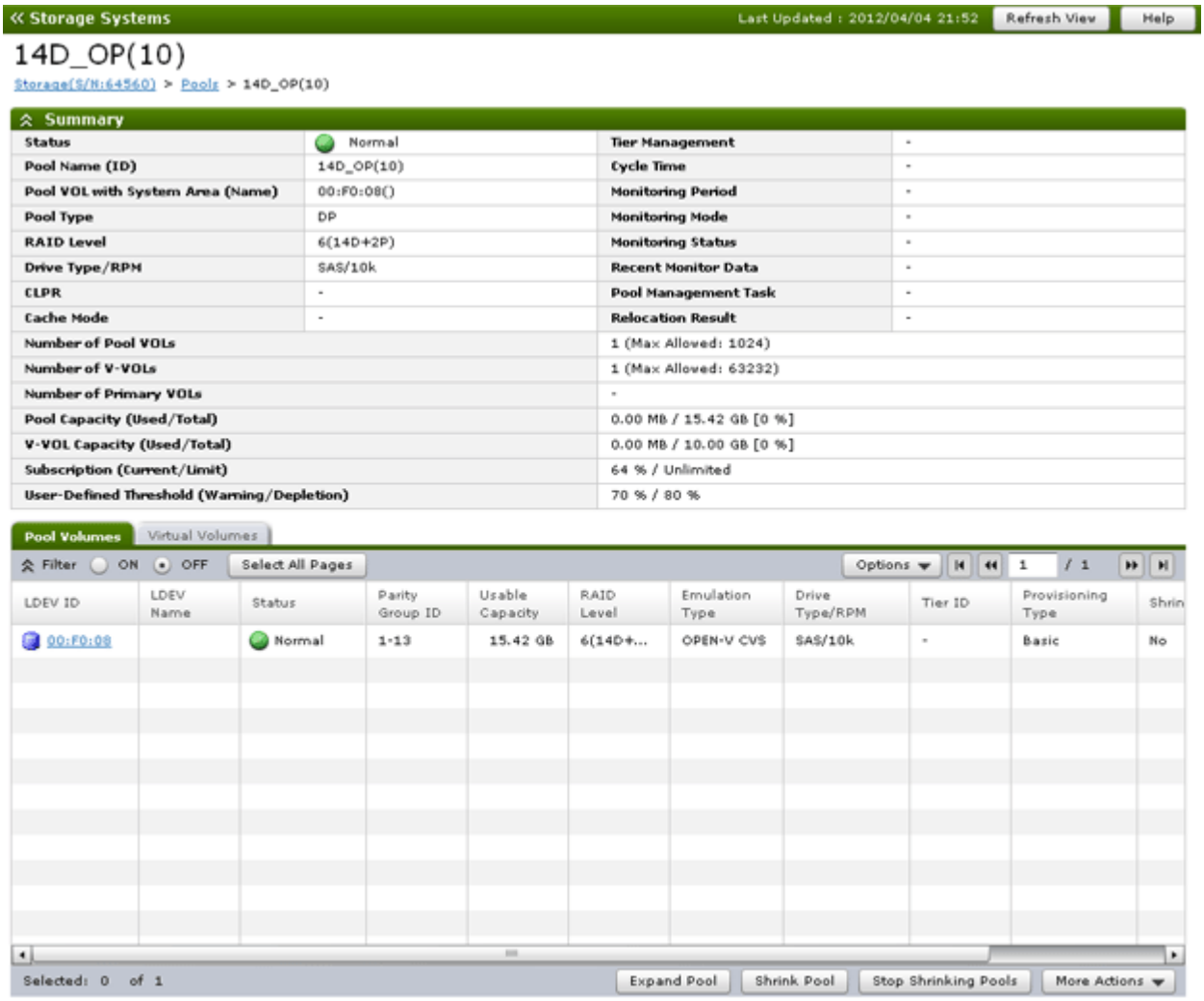
Item	Description
	• Waiting for Rebalance: The rebalance process is being waited. • Rebalancing: The rebalance process is being performed. • Waiting for Relocation: The tier relocation process is being waited. • Relocating: The tier relocation process is being performed. • Waiting for Shrink: The pool shrinking process is being waited. • Shrinking: The pool shrinking process is being performed. • Hyphen (-): The pool management task is not being performed to the pool. If the Thin Image or Copy-on-Write Snapshot pool is displayed, a hyphen (-) appears. For details about the tier relocation, see the tier relocation log file. For details about the table items of the tier relocation log file, see Tier relocation log file contents on page 5-42.
Relocation Result	Displays the status of the tier relocation processing. In Progress: The status of **Pool Management Task** is **Waiting for Relocation** or **Relocating**. Completed: The tier relocation operation is not in progress, or the tier relocation is complete. Uncompleted (n% relocated): The tier relocation is suspended at the indicated percentage progression. Hyphen (-): The pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.
Mixable[1]	Indicates whether pool-VOLs of different RAID levels can coexist in a pool. Enabled: Pool-VOLs of different RAID levels can coexist in the pool. For details about the requirements, see Pool-VOL requirements on page 5-5. Disabled: Pool-VOLs of different RAID levels cannot coexist in the pool. Hyphen (-): The pool is a Thin Image or Copy-on-Write Snapshot pool.
Create Pools	Displays the Create Pools window.
Create LDEVs	Displays the Create LDEVs window.
Expand Pool	Displays the Expand Pool window.
Delete Pools[2]	Displays the Delete Pools window.
Restore Pools[2]	Displays the Restore Pools window.
Edit Pools[2]	Displays the Edit Pools window.
Monitor Pools[2]	Displays the Monitor Pools window.

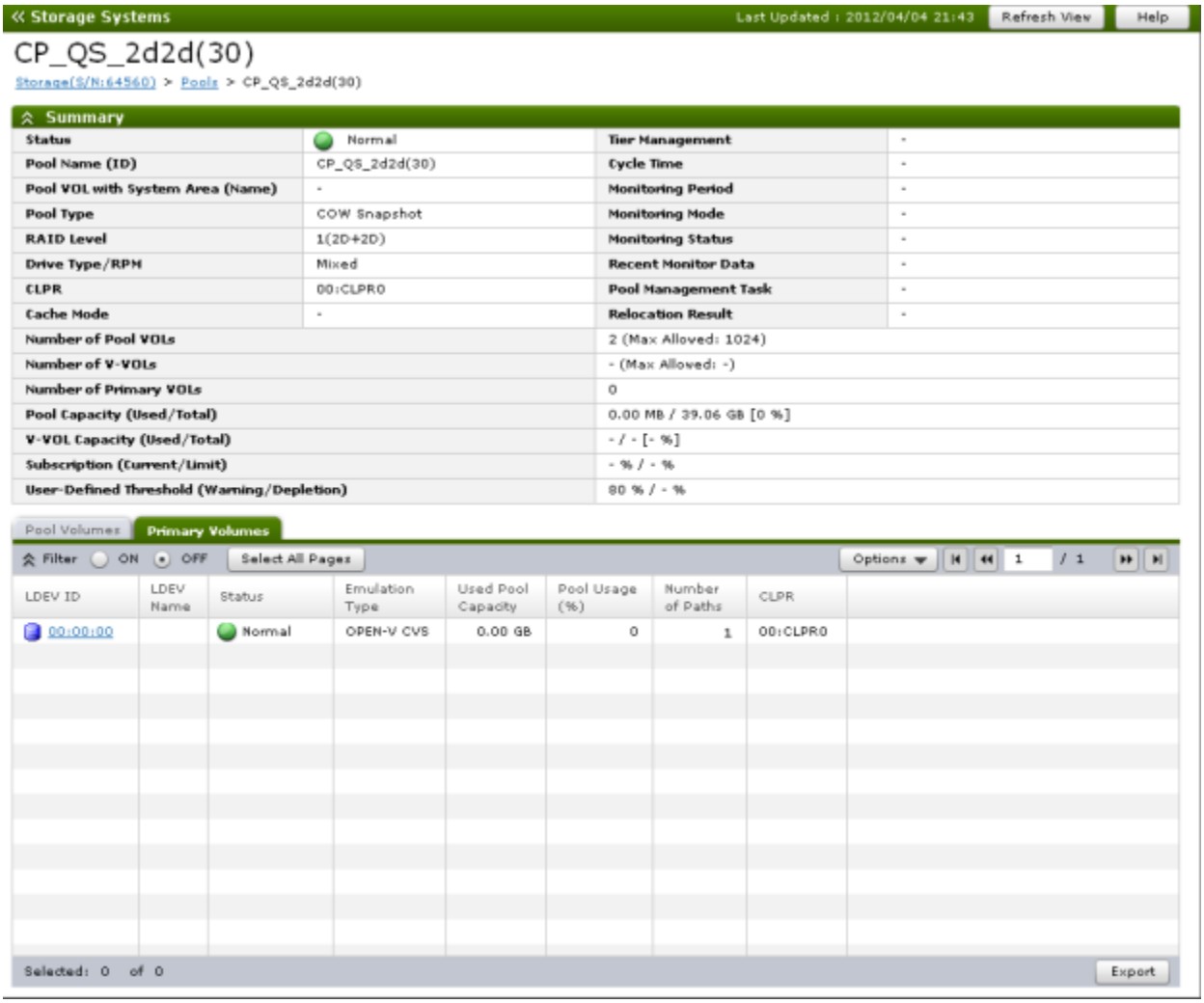
Item	Description
Stop Monitoring Pools[2]	Displays the Stop Monitoring Pools window.
Start Tier Relocation[2]	Displays the Start Tier Relocation window.
Stop Tier Relocation[2]	Displays the Stop Tier Relocation window.
Complete SIMs[2]	Displays the Complete SIMs window.
View Tier Properties[2]	Displays the View Tier Properties window. This window can be viewed only for the pools for which Dynamic Tiering or Dynamic Tiering for Mainframe is enabled.
View Pool Management Status[2]	Displays the View Pool Management Status window.
Export[2]	Displays the window for outputting table information.
Tier Relocation Log[2]	Displays the window to download the result of the tier relocation. For more information about the table item of the tier relocation file, see Tier relocation log file contents on page 5-42.

Notes:

1. Does not appear by default. To display this item, change settings in the **Column Settings** window of the table option. For details about the **Column Settings** window, see the *Hitachi Storage Navigator User Guide*.
2. Appears when you click **More Actions**.

Top window when selecting a pool under Pools





- Summary on page E-11
- Pool Volumes tab on page E-14
- Virtual Volumes tab on page E-15
- Primary Volumes tab on page E-18

Summary

Item	Description
Status	Displays information about the pool status. Normal: Pool is in a normal status. Warning: Pool-VOL in the pool is blocked, or the pool is being shrunk. Exceeded Threshold: Used capacity of the pool exceeds the pool threshold.

Item	Description
	Shrinking: Pool-VOL is being reduced. Blocked: The pool is full, or an error occurred in the pool, indicating that the pool is blocked. If the pool is in both Warning and Blocked status, only Blocked is displayed.
Pool Name (ID)	Displays the pool name and pool ID.
Pool VOL with System Area (Name)	Displays the LDEV ID and LDEV name of the pool-VOL which includes the pool management area. For Copy-on-Write Snapshot, a hyphen (-) is displayed.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates as Mixed.
Drive Type/RPM	Displays the hard disk drive type and RPM of the pool. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
CLPR	Displays the CLPR set for the Thin Image or Copy-on-Write Snapshot pool-VOLs. Displays in ID:CLPR form. For Pool-VOLs other than the Thin Image or Copy-on-Write Snapshot pool-VOL, a hyphen (-) is displayed.
Cache Mode	Displays whether the cache mode is enabled or disabled. For a configuration other than external volume configuration, a hyphen (-) is displayed.
Number of Pool VOLs	Displays the number of pool-VOLs set for the pool, and the maximum number of pool-VOLs that can be set for the pool.
Number of V-VOLs	Displays the number of V-VOLs associated with the pool, and the maximum number of V-VOLs that can be associated with the pool. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Number of Primary VOLs	Displays the number of primary volumes of the Thin Image or Copy-on-Write Snapshot pairs. When the applicable volume does not exist, a hyphen (-) is displayed.

Item	Description
Pool Capacity (Used/Total)	Displays the used and total pool capacity. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field.
V-VOL Capacity (Used/ Total)	Displays the used and total V-VOL capacity. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed along with the used and total V-VOL capacity.
Subscription (Current/Limit)	Displays the subscription (Rate of total V-VOL capacity associated with a pool to the pool capacity/Subscription that is set). For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Current or Limit.
User-Defined Threshold (Warning/Depletion)	Displays the user-defined threshold (Warning/Depletion). For a Dynamic Provisioning or Dynamic Tiering pool, as for the pool with only one of the user definition threshold set, the system threshold (fixed at 80%) is enabled. If the user-defined threshold is 80% or less, the value is displayed in the Warning column. If the user-defined threshold is 81% or more, the value is displayed in the Depletion column. In this case, the other column displays a hyphen (-). For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Tier Management	If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Cycle Time	Displays the cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Period	Displays the time of starting and ending of performance monitoring. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Mode	Displays the monitoring mode that is set for the pool. If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Status	Displays the status of pool monitoring. If the monitoring is being performed, In Progress is displayed. A hyphen (-) is displayed other than this case.
Recent Monitor Data	Displays the latest monitoring data. • If the monitoring data exists, the monitoring period of time is displayed. Example: 2010/11/15 00:00 - 2010/11/15 23:59 • If the monitoring data is being obtained, only the starting time is displayed.

Item	Description
	Example: 2010/11/15 00:00 - • If the latest monitoring data does not exist, a hyphen (-) is displayed.
Pool Management Task	Displays the pool management task being performed to the pool. • Waiting for Rebalance: The rebalance process is being waited. • Rebalancing: The rebalance process is being performed. • Waiting for Relocation: The tier relocation process is being waited. • Relocating: The tier relocation process is being performed. • Waiting for Shrink: The pool shrinking process is being waited. • Shrinking: The pool shrinking process is being performed. • Hyphen (-): The pool management task is not being performed to the pool. If the Thin Image or Copy-on-Write Snapshot pool is displayed, a hyphen (-) appears. For details about the tier relocation, see the tier relocation log file. For details about the table items of the tier relocation log file, see Tier relocation log file contents on page 5-42.
Relocation Result	Displays the status of the tier relocation processing. In Progress: The status of **Pool Management Task** is **Waiting for Relocation** or **Relocating**. Completed: The tier relocation operation is not in progress, or the tier relocation is complete. Uncompleted (n% relocated): The tier relocation is suspended at the indicated percentage progression. Hyphen (-): The pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.

Pool Volumes tab

Only the LDEVs assigned to the logged-on user are available.

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Status	Displays the following information about the pool-VOL status. Normal: Pool-VOL is in the normal status.

Item	Description
	Shrinking: Pool-VOL is being reduced. Blocked: Pool-VOL is blocked.
Parity Group ID	Displays the parity group ID.
Usable Capacity	Displays available capacity of page boundaries in a pool-VOL by the specified unit. For the pool-VOL with system area, the displayed capacity does not include the capacity of the management area. For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed to Cylinder.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates as Mixed.
Emulation Type	Displays the emulation type.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
Tier ID	Displays the tier ID. For a Dynamic Provisioning, Dynamic Provisioning for Mainframe, Thin Image, or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Provisioning Type	Displays the type of the LDEV. Basic: Internal volume. External: External volume.
Shrinkable	Displays whether the pool-VOL can be removed. For a Thin Image or Copy-on-Write Snapshot pool or while the pool is being shrunk, a hyphen (-) is displayed.
Resource Group Name (ID)	Displays the resource group names and IDs of the LDEV. The ID is provided in parentheses.
Expand Pool	Displays the Expand Pool window.
Shrink Pool	Displays the Shrink Pool window.
Stop Shrinking Pools	Displays the Stop Shrinking Pools window.
Edit External LDEV Tier Rank*	Displays the Edit External LDEV Tier Rank window. You cannot operate the pool other than the pool of Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, Dynamic Tiering for Mainframe.
Export*	Displays the window for outputting table information.
*Appears when you click **More Actions**.	

Virtual Volumes tab

This tab is displayed unless you select a Thin Image or Copy-on-Write Snapshot pool.

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Status	Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written to a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
Emulation Type	Displays the emulation type.
Capacity - Total	Displays the V-VOL capacity.
Capacity - Used	Displays the V-VOL used capacity. The displayed value on **Total** might be larger than the displayed value on **Used** due to following reasons: • **Used** displays the used V-VOL capacity which is rounded up on each page. • If the emulation type is 3390-A, the used capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl).
Capacity - Used(%)	Displays the V-VOL usage level.
Capacity	Displays the V-VOL capacity in the specified unit. Total: Displays the V-VOL total capacity. Used: Displays the V-VOL used capacity. Used (%): Displays the V-VOL usage rate. * The V-VOL used capacity is calculated, being rounded up for each page. Therefore, the total capacity might be displayed as the larger value than the used capacity.

Item	Description
Number of Paths	Displays the number of alternate paths. A hyphen(-) is displayed for the Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe V-VOL.
CLPR	Displays the CLPR ID.
Tiering Policy	Displays the tiering policy name and ID. All(0): Policy set when all tiers in the pool are used. Level1(1) - Level31(31): One of the policies from Level1 to Level31 is set. Hyphen (-): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
New Page Assignment Tier	Displays the new page assignment tier. High: High is set to V-VOL. Middle: Middle is set to V-VOL. Low: Low is set to V-VOL. Hyphen (-): V-VOL is not the Dynamic Tiering V-VOL.
Tier Relocation	Displays whether tier relocation is set to enabled or disabled. If the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL is not used, a hyphen (-) is displayed.
Relocation Priority	Displays the relocation priority. Prioritized: The priority is set to V-VOL. Blank: The priority is not set to V-VOL. Hyphen (-): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL or the tier relocation function is disabled.
Pool Management Task	Displays the pool management task being performed to the pool. Waiting for Rebalance: The rebalance process is being waited. Rebalancing: The rebalance process is being performed. Waiting for Relocation: The tier relocation process is being waited. Relocating: The tier relocation process is being performed. Waiting for Shrink: The pool shrinking process is being waited. Shrinking: The pool shrinking process is being performed. Hyphen (-): The pool management task is not being performed to the pool.
V-VOL Management Task	Displays the V-VOL management task being performed to V-VOL. Reclaiming Zero Pages: The zero page reclaiming processing is being performed. Waiting for Zero Page Reclaiming: The zero page reclaiming processing is being waited. Hyphen (-): The V-VOL management task is not being performed to V-VOL.

Item	Description
Attribute	Displays the attribute of the LDEV. TSE: TSE-VOL. Hyphen (-): Volume in which the attribute is not defined.
Access Attribute[1]	Displays the access attribute of the LDEV.
Resource Group Name (ID)	Displays the resource group names and IDs of the LDEV. The ID is provided in parentheses.
Create LDEVs	Displays the Create LDEV window.
Add LUN Paths	Displays the Add LUN Paths window. If Mainframe DP or DT is displayed in the Pool Type, you cannot select this item.
Expand V-VOLs	Displays the Expand V-VOLs window.
Format LDEVs[2]	Displays the Format LDEVs window.
Delete LDEVs[2]	Displays the Delete LDEVs window.
Shred LDEVs[2]	Displays the Shred LDEVs window.
Delete LUN Paths[2]	Displays the Delete LUN Paths window.
Block LDEVs[2]	Displays the Block LDEVs window.
Restore LDEVs[2]	Displays the Restore LDEVs window.
Edit LDEVs[2]	Displays the Edit LDEVs window.
Reclaim Zero Pages[2]	Displays the Reclaim Zero Pages window.
Stop Reclaiming Zero Pages[2]	Displays the Stop Reclaiming Zero Pages window.
View Tier Properties[2]	Displays the View Tier Properties window. This window can open only for a pool for which Dynamic Tiering is enabled.
View Pool Management Status[2]	Displays the View Pool Management Status window. For a Copy-on-Write Snapshot pool, nothing is displayed.
Export[2]	Displays the window for outputting table information.

[1] Does not appear by default. To display this item, change the **Column Settings** of the table option. For details about the **Column Settings** window, see the Hitachi Storage Navigator User Guide.

[2] Appears when you click **More Actions**.

Primary Volumes tab

If you select a Thin Image or Copy-on-Write Snapshot pool, this tab is displayed.

Item	Description
LDEV ID	Displays the combination of the LDKC, CU, and LDEV. Clicking **LDEV ID** opens the LDEV Properties window.

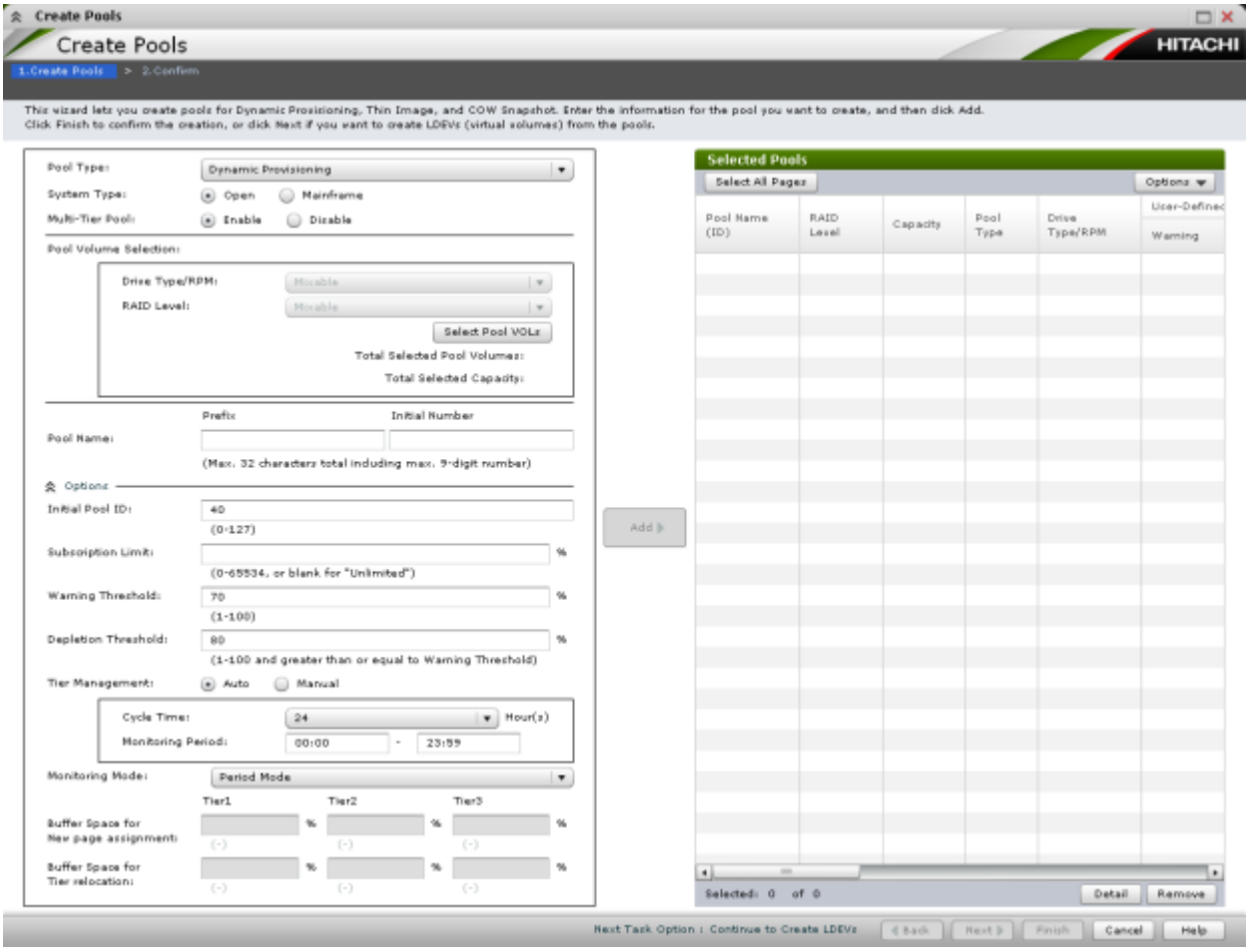
Item	Description
LDEV Name	Displays the LDEV name.
Status	Normal: Normal status. Blocked: Host cannot access a blocked volume. Warning: Problem occurs in the volume. Formatting: Volume is being formatted. Preparing Quick Format: Volume is being prepared for quick formatting. Quick Formatting: Volume is being quick-formatted. Correction Access: Access attribute is being corrected. Copying: Data in the volume is being copied. Read Only: Data cannot be written to a read-only volume. Shredding: Volume is being shredded. Hyphen (-): Any status other than the above.
Emulation Type	Displays the emulation type.
Used Pool Capacity	Displays the used pool capacity.
Pool Usage(%)	Displays the pool usage level.
Number of Paths	Displays the number of alternate paths.
CLPR	Displays the CLPR. Displays in ID:CLPR form.
Export	Displays the window for outputting table information.

Create Pools wizard

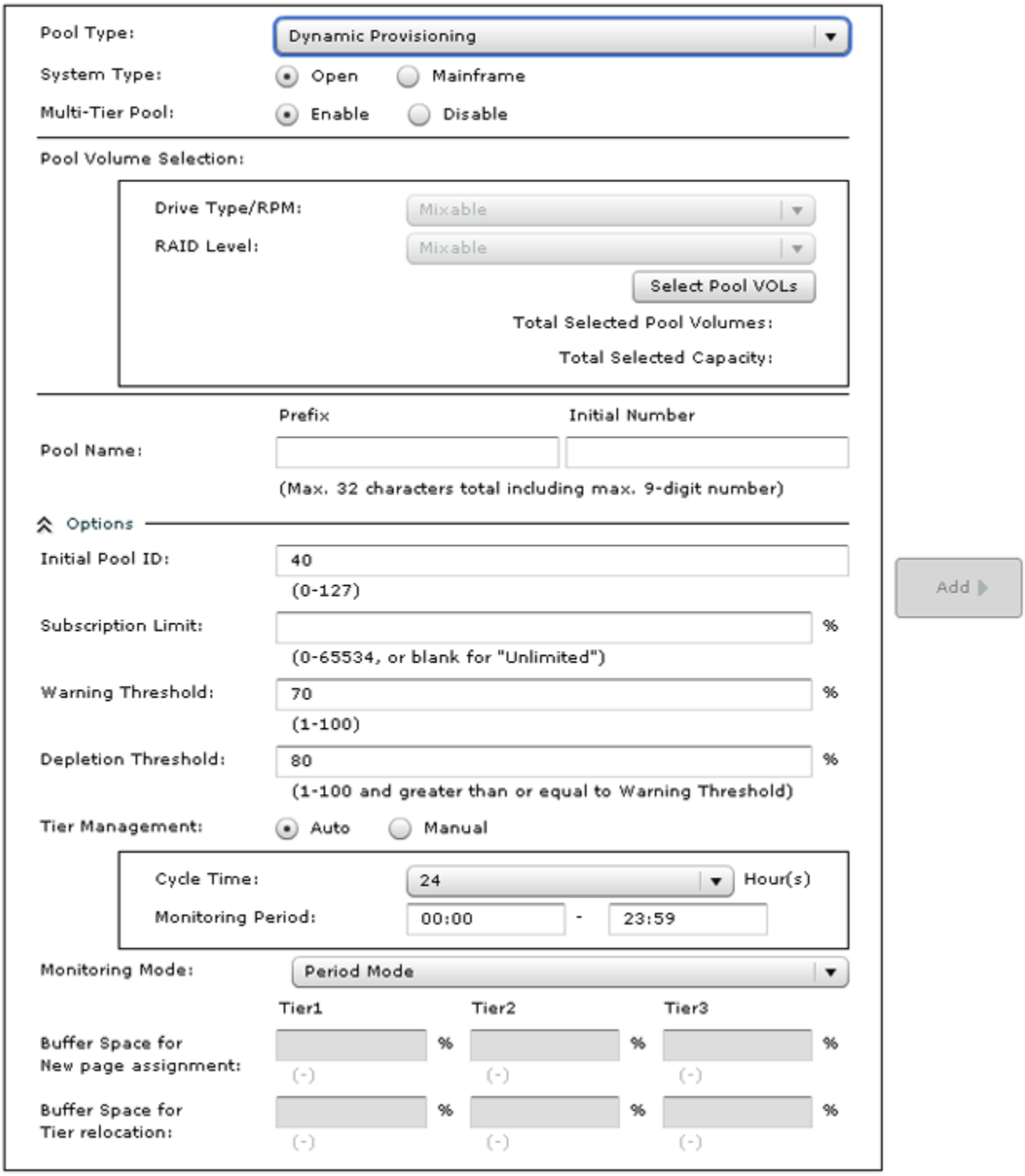
Create Pools window

Use this window to create new pools for Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot.

Caution: When you create the Dynamic Provisioning or Dynamic Provisioning for Mainframe pool, if you specify **Any** for **RAID level** to display the **Select Pool VOLs** window, external volumes with the cache mode set to disabled are not displayed in the **Available Pool Volumes** table because they cannot coexist with volumes of the other RAID levels:
When you select these volumes in the **Select Pool VOLs** window, specify a hyphen (-) for **RAID level**.



Setting fields



Item	Description
*Pool Type	Select the pool type. For Thin Image, select Thin Image. For Copy-on-Write Snapshot, select COW Snapshot. For following program products, select Dynamic Provisioning.

Item	Description
	• Dynamic Provisioning • Dynamic Tiering • Dynamic Provisioning for Mainframe • Dynamic Tiering for Mainframe
*System Type	Select the system type. If you select Thin Image or COW Snapshot, only Open is displayed.
*Multi-Tier Pool	If Dynamic Provisioning is selected for the pool type, you can enable or disable Multi-Tier Pool. If it is set to enabled, Dynamic Tiering or Dynamic Tiering for Mainframe is enabled.
*Drive Type/RPM	Select the hard disk drive type and RPM of the pool-VOL. **Mixable** appears. When the volume is the external volume, **Drive Type** displays **External Storage**.
*RAID Level	Select the RAID level of the pool-VOL. **Mixable** appears in the case of Dynamic Provisioning or Dynamic Tiering. A hyphen (-) appears when External Storage is selected in the Drive Type/RPM list.
*Select Pool VOLs	Opens the Select Pool VOLs window. Selecting a pool-VOL is mandatory.
Total Selected Pool Volumes	Displays the total number of the selected pool-VOLs.
Total Selected Capacity	Displays the total capacity of the selected pool-VOLs.
*Pool Name	Set the pool name. • Prefix: Enter the alphanumeric characters, which are fixed characters of the head of the pool name. The characters are case-sensitive. • Initial Number: Enter the initial number following the prefix name, which can be entered up to 9 digits. • You can enter up to 32 characters including the initial number.
Initial Pool ID	The smallest available number is entered in the text box as a default. No number appears in the text box if no available pool ID exists. If you specify the pool ID which is used already, the minimum pool ID after that the specified pool ID is automatically set.
Subscription Limit	Set the subscription limit of the pool from 0 to 65534 (%). If this is blank, the subscription is set to unlimited. When creating a Thin Image or Copy-on-Write Snapshot pool, this setting is not necessary.
Warning Threshold	Set the threshold between 1 and 100%. The default value is 70%.

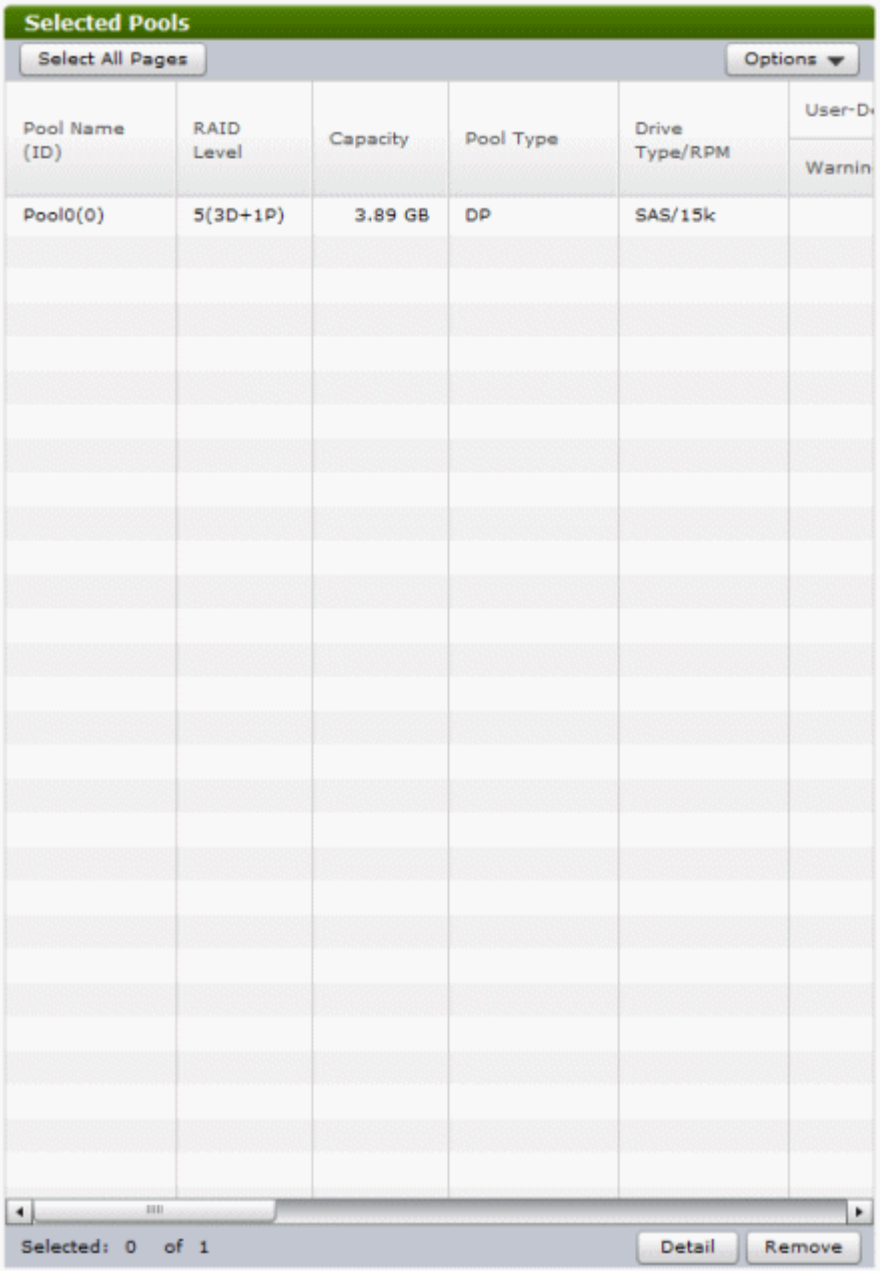
Item	Description
	For Thin Image or Copy-on-Write Snapshot: Set the threshold between 20% and 95%. The default value is 80%.
Depletion Threshold	Set the threshold between 1% and 100%. The default value is 80%. When creating a Thin Image or Copy-on-Write Snapshot pool, this setting is not necessary.
Tier Management	Select Auto or Manual of performance monitoring and tier relocation. • Cycle Time Select the cycle of performance monitoring and tier relocation. • Monitoring Period When 24 Hours is selected in the Cycle Time list, specify the time zone from 00:00 to 23:59 (default value), in which performance monitoring is to be performed. Take one or more hours between the starting time and the ending time. If you specify the starting time later than the ending time, the performance monitoring continues until the time when you specify as the ending time on the next day. This function can be set when the Multi-Tier Pool is enabled.
Monitoring Mode	Specifies the monitoring mode, If you perform the tier relocation weighted to the past period monitoring result, select Continuous Mode. If you perform the tier relocation on the specified cycle, select Period Mode. You can specify this function when the Multi-Tier Pool is enabled.
Buffer Space for New page assignment	You can set this function when the Multi-Tier Pool is enabled. Tier 1: Enter an integer value from 0 to 50 as the percentage (%) to set for tier 1. A default value depends on the hard disk drive type of pool-VOL in tier 1. The default value of SSD is 0%. The default value other than SSD is 8%. Tier 2: Enter an integer value from 0 to 50 as the percentage (%) to set for tier 2. A default value depends on the hard disk drive type of pool-VOL in tier 2. Tier 3: Enter an integer value from 0 to 50 as the percentage (%) to set for tier 3. A default value depends on the hard disk drive type of pool-VOL in tier 3.
Buffer Space for Tier relocation	You can set this function when the Multi-Tier Pool is enabled. Tier 1: Enter an integer value from 2 to 40 as the percentage (%) to set for tier 1. A default value is 2%. Tier 2: Enter an integer value from 2 to 40 as the percentage (%) to set for tier 2. A default value is 2%. Tier 3: Enter an integer value from 2 to 40 as the percentage (%) to set for tier 3. A default value is 2%.
*Items with asterisks require configuration.	

Caution: When you create the Dynamic Provisioning or Dynamic Provisioning for Mainframe pool, if you specify **Mixable** for **RAID level** to display the **Select Pool VOLs** window, external volumes with the cache mode set to disabled are not displayed in the **Available Pool Volumes** table because they cannot coexist with volumes of the other RAID levels:
When you select these volumes in the **Select Pool VOLs** window, specify a hyphen (-) for **RAID level**.

Add

When you click **Add**, the configured information is added to the right side of the Selected Pools table.

Selected Pools table



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays RAID level of the pool. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the total capacity of the created pool in the specified unit. For open systems, the displayed capacity is approximately 4.1 GB (capacity of the management area) less than the total capacity of the selected pool-VOLs.

Item	Description
	For mainframe systems, the displayed capacity is approximately 3.7 GB (capacity of the management area) less than the total capacity of the selected pool-VOLs.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM. If multiple drive types or RPMs exist in a pool, this field indicates Mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Subscription Limit (%)	Displays subscription limit of the pool. For Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Number of Pool VOLs	Displays the number of pool-VOLs.
Multi-Tier Pool	Displays the Dynamic Tiering or Dynamic Tiering for Mainframe information. • Monitoring Mode If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. • Tier Management If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual of performance monitoring and tier relocation is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Cycle Time Displays the cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Monitoring Period Displays the time zone of performance monitoring when 24 Hours is selected in the Cycle Time list. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.

Item	Description
Buffer Space for New page assignment (%)	Displays the information of the buffer space for new page assignment to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for new page assignment to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed. Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed. Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Buffer Space for Tier relocation (%)	Displays the information of the buffer space for tier relocation to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for tier relocation to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed. Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed. Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Detail	Displays the Pool Properties window when a row is selected, and shows the error window when a row is not selected or multiple rows are selected.
Remove	Deletes the pool selected in the Selected Pools window. Displays the error window when a row is not selected.

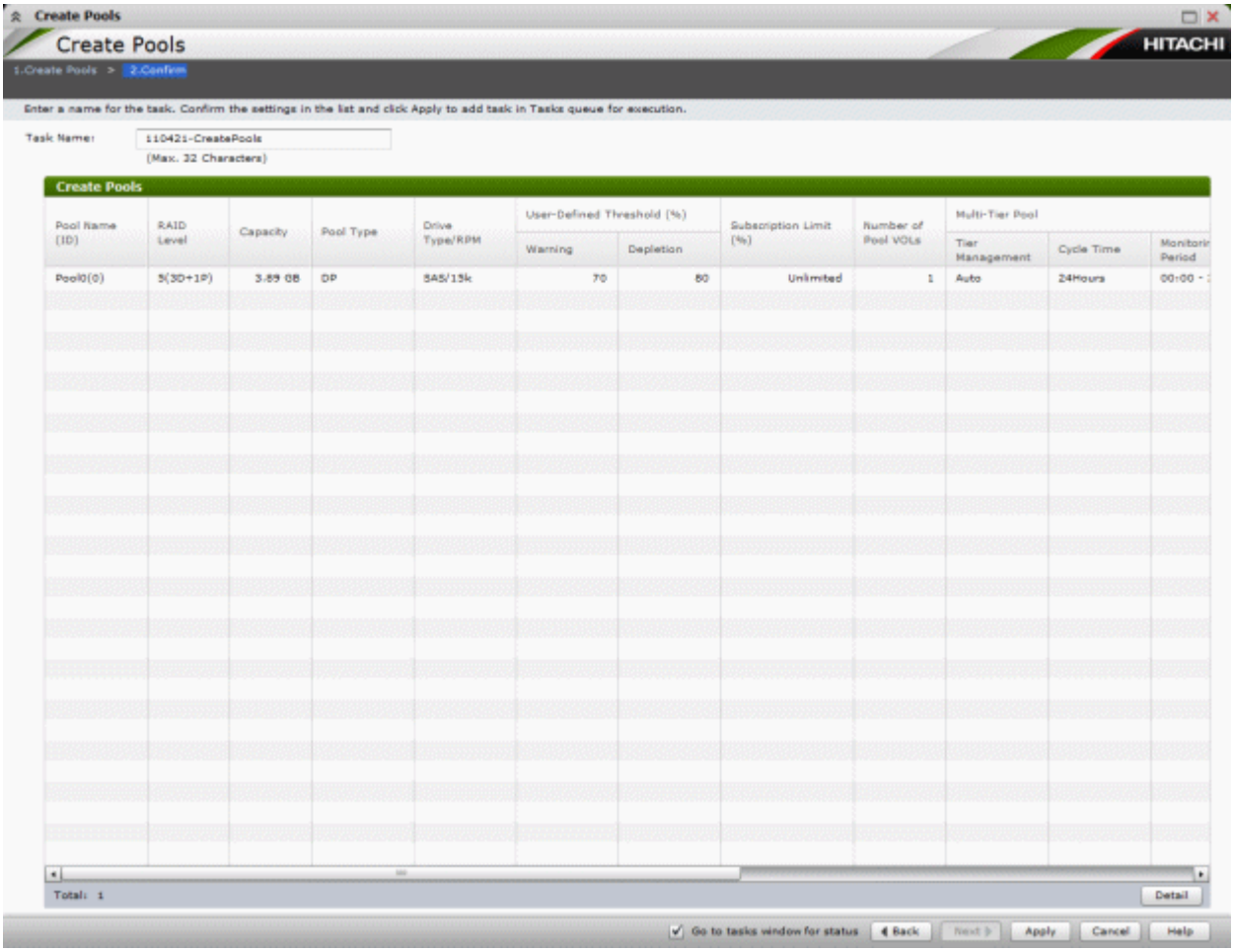
Next Task Option

Click **Next** to go to the task setting window, which is indicated in **Task Next Option**.

Create Pools Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

Information in this topic assumes only a single task is performed. If performing multiple tasks, the window shows all configuration items. To check information of a configuration item, click **Back** to return to the configuration window, and then click **Help**



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed.

Item	Description
	For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Subscription Limit (%)	Displays the subscription limit. For Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Number of Pool VOLs	Displays the number of pool-VOLs.
Multi-Tier Pool	Displays the Dynamic Tiering or Dynamic Tiering for Mainframe information. • Monitoring Mode If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. • Tier Management If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual of performance monitoring and tier relocation is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Cycle Time Displays the cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Monitoring Period Displays the time zone of performance monitoring when 24 Hours is selected in the Cycle Time list. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Buffer Space for New page assignment (%)	Displays the information of the buffer space for new page assignment to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for new page assignment to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed.

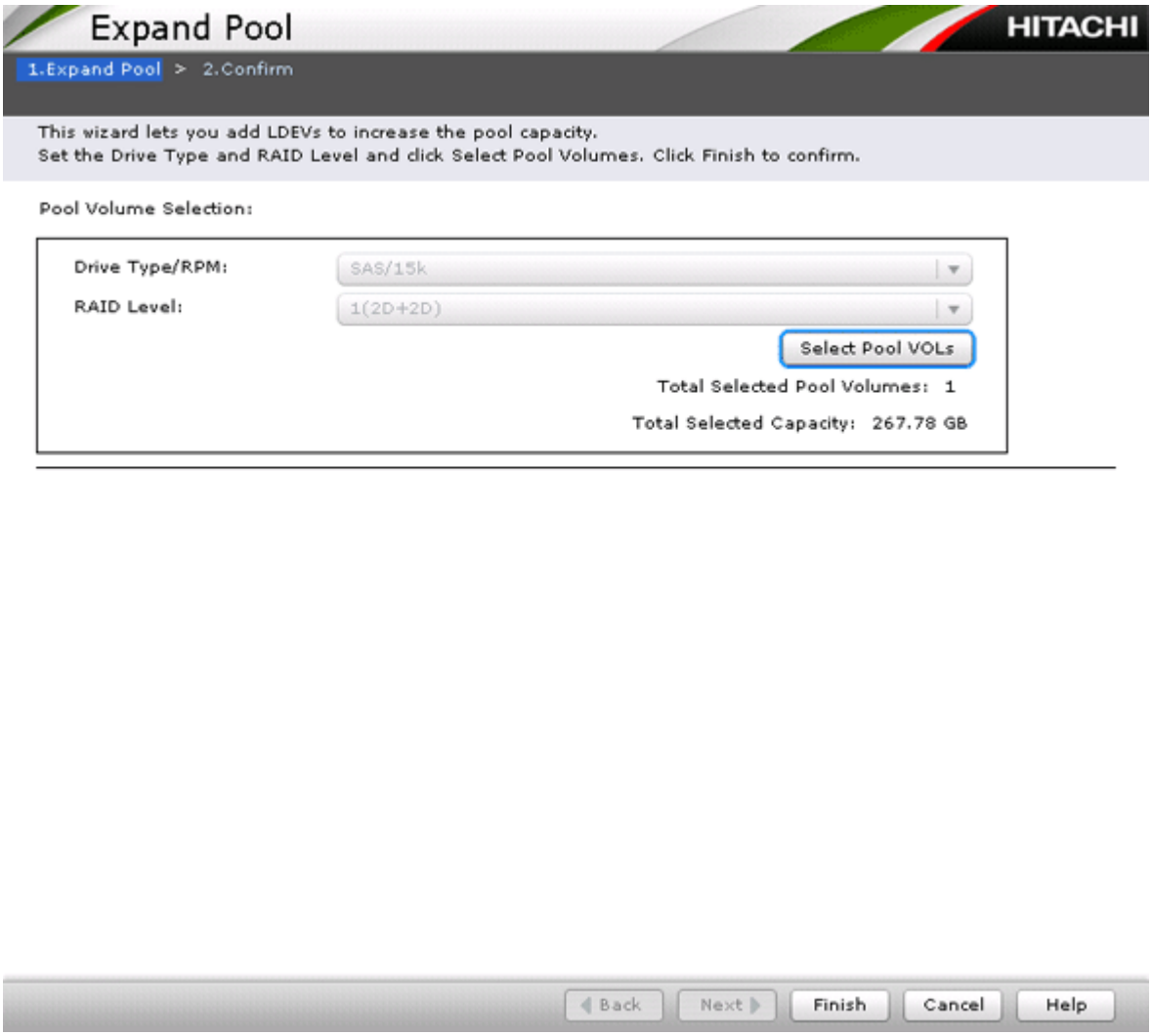
Item	Description
	Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed. Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Buffer Space for Tier relocation (%)	Displays the information of the buffer space for tier relocation to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for tier relocation to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed. Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed. Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Detail	Displays the Pool Properties window when a row is selected, and shows the error window when a row is not selected or multiple rows are selected.

Note: Information in this topic assumes that only a single task is executed. If multiple tasks are executed, this window displays all configuration items. To check information for a configuration item, click **Back** to return to each configuration window, and then click **Help**.

Expand Pool wizard

Expand Pool window

Use this window to add LDEVs to a pool to expand the pool to increase pool capacity.

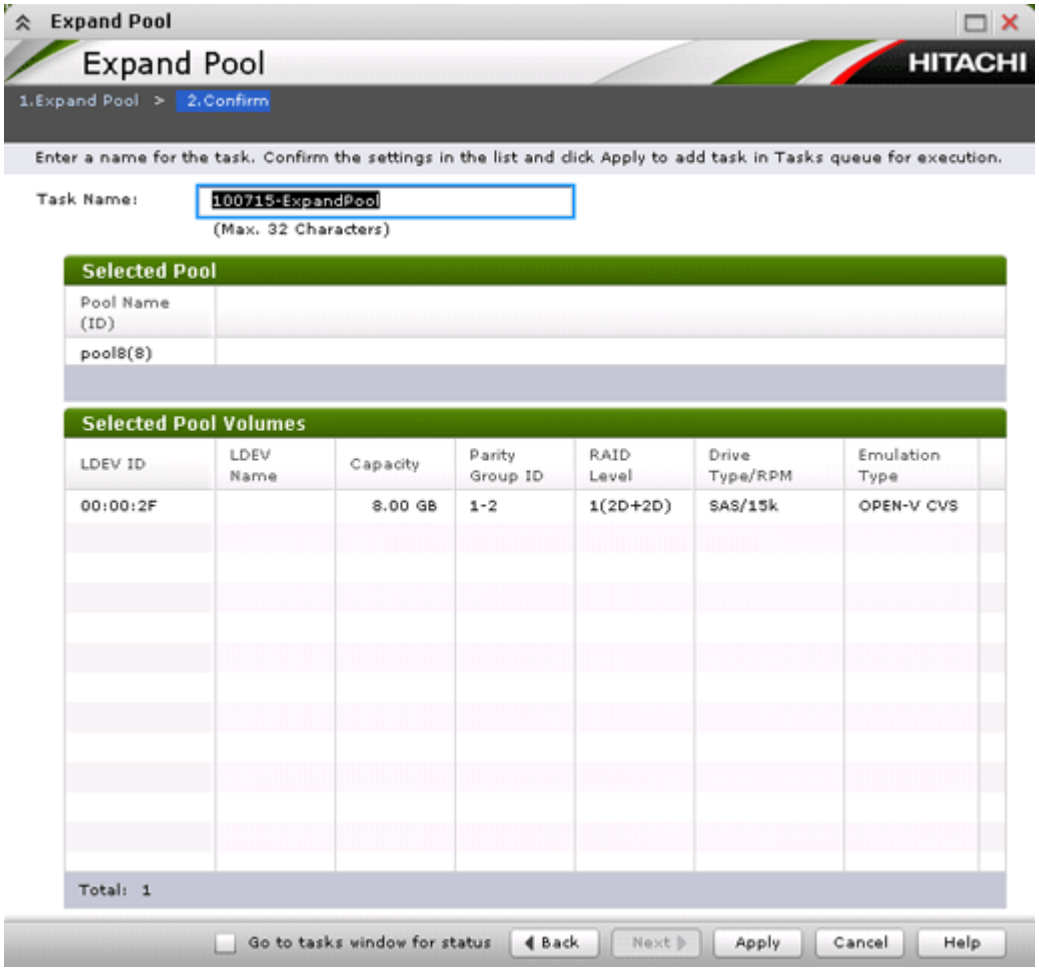


Item	Description
Drive Type/RPM	The Drive Type/RPM of the selected pool or **Mixable** is displayed. When the volume is the external volume, **Drive Type** displays **External Storage**.
RAID Level	Set the RAID level for the selected pool. If not set, **Mixable** appears. This setting is not available for Copy-on-Write Snapshot pools.
Select Pool VOLs	Opens the Select Pool VOLs window.
Total Selected Pool Volumes	Total number of the pool-VOLs selected for this pool.
Total Selected Capacity	Total capacity of the pool-VOLs selected for this pool.

Caution: When you create the Dynamic Provisioning pool, if you specify **Mixable** for **RAID level** to display the **Select Pool VOLs** window, external volumes with the cache mode set to disabled are not displayed in the **Available Pool Volumes** table because they cannot coexist with volumes of the other RAID levels:
When you select these volumes in the **Select Pool VOLs** window, specify a hyphen (-) for **RAID level**.

Expand Pool Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Pool table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.

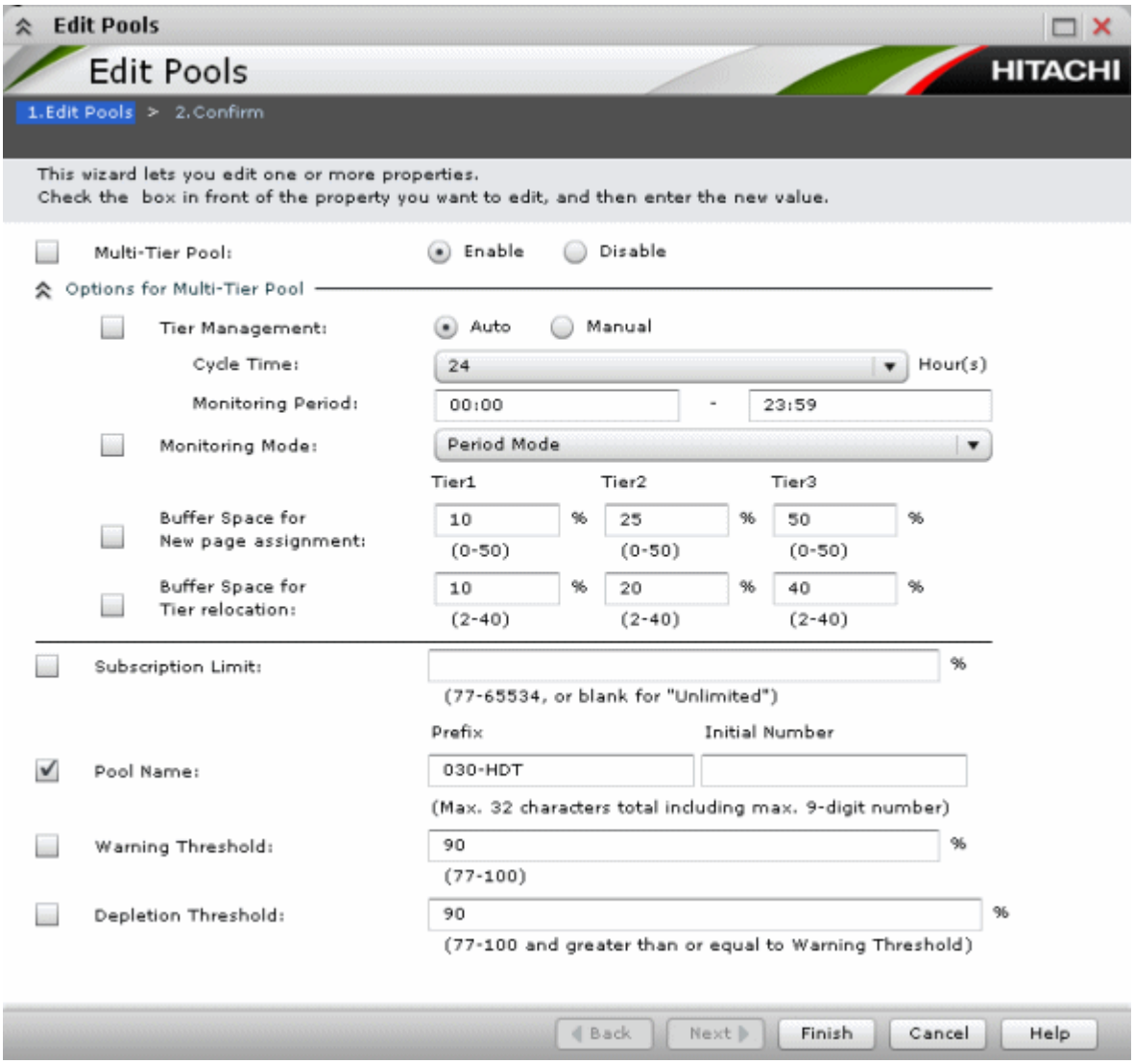
Selected Pool Volumes table

Item	Description
LDEV ID	Displays LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Capacity	Displays the pool-VOL capacity.
Parity Group ID	Displays the parity group ID.
RAID Level	Displays the RAID level. **Mixed** indicates multiple RAID levels exist in a pool.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
Emulation Type	Displays the emulation type.

Edit Pools wizard

Edit Pools window

Use this window to edit pool properties. If you want to change multiple properties for a pool two or more times, wait until the current task finishes, and then change the next settings. If you attempt to change settings before the current task finishes, only the settings in the next task will be applied, so the result might be different from what you expected.



Item	Description
Multi-Tier Pool	Select the check box, then **Enable** or **Disable** when using or not using Dynamic Tiering or Dynamic Tiering for Mainframe. If **Mixable** is set to **Enabled**, a pool that consists of the external volumes to which the cache mode is set to **Disable** cannot be changed from **Disable** to **Enable**. If **Mixable** is set to **Disabled**, the following pools cannot be changed from **Disable** to **Enable**. • Pool that consists of the external volumes. • Pool that consists of volumes of RAID 1. A pool that consists of pool-VOLs with different RAID levels cannot be changed from **Enable** to **Disable**. In Thin Image or Copy-on-Write Snapshot, you cannot change the setting of this function.

Item	Description
	If TSE-VOL is assigned to the selected pool, the pool cannot be changed from **Disable** to **Enable**.
Options for Multi-Tier Pool	Specifies the performance monitoring, tier relocation, edit buffer space for new page assignment, and buffer space for tier relocation if Multi-Tier Pool is set to **Enable**. In Thin Image or Copy-on-Write Snapshot, you cannot change the setting of this function. Select the Tier Management check box, and then set the tier management, the cycle time, and the monitoring period. • Tier Management: Select **Auto** or **Manual**. • Cycle Time: When selecting **Auto** in the Tier Management option, select the cycle of performance monitoring and tier relocation from the Cycle Time list. • Monitoring Period: When selecting 24 Hours in the Cycle Time list, specify the time of starting and ending of performance monitoring in 00:00 to 23:59 (default value). Take one or more hours between the starting time and the ending time. If you specify the starting time later than the ending time, the performance monitoring continues until the time when you specify as the ending time on the next day. Select the Monitoring Mode check box, and then set the monitoring mode. Monitoring Mode: Specify the monitoring mode. If you perform the tier relocation weighted to the past period monitoring result, select Continuous Mode. If you perform the tier relocation on the specified cycle, select Period Mode. Select the Buffer Space for New page assignment check box, and then set the buffer space for new page assignment. Buffer Space for New page assignment: Enter an integer value from 0 to 50 as the percentage (%) to set for tier 1, tier 2, and tier 3. If there is no tier, you cannot set this item. Select the Buffer Space for Tier relocation check box, and then set the buffer space for tier relocation. Buffer Space for Tier relocation: Enter an integer value from 2 to 40 as the percentage (%) to set for tier 1, tier 2, and tier 3. If the check box is not selected, you cannot set this item. You must set all items if you change the pool setting from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe). If the check box is selected, you cannot collapse the Options for Multi-Tier Pool field.
Subscription Limit	Select the Subscription Limit check box, and then enter the subscription limit (%). In Thin Image or Copy-on-Write Snapshot, you cannot change the setting of this function.

Item	Description
	• If this field is blank, the subscription is set to be unlimited. • The following shows the available range: (Total V-VOL capacity allocated to the pool/pool capacity) ×100(%) +1 to 65534(%) • You cannot configure the subscription limit if both of the following conditions are satisfied: - The subscription is unlimitedly set. - ((Total V-VOL capacity allocated to the pool/pool capacity) ×100) exceeds 65534. • If the check box is not selected, the subscription limit is disabled.
Pool Name	Select the Pool Name check box, and then enter the pool name. • Prefix: Enter the alphanumeric characters, which are fixed characters of the head of the pool name. The characters are case-sensitive. • Initial Number: Enter the initial number following the prefix name, which can be entered up to 9 digits.* • You can enter up to the 32 characters including the initial number. The initial number should be 9 or less digits. *When a pool is selected, the pool name appears in the Prefix text box by default. When multiple pools are selected, the initial number from the set number to the maximum number of the digit number is automatically set. Example: • When 1 is set in the Initial Number field, number 1 to 9 is automatically given to the pool name. • When 08 is set in the Initial Number field, number 08 to 99 is automatically given to the pool name. • When 098 is set in the Initial Number field, number 098 to 999 is automatically given to the pool name.
Warning Threshold	Select the Warning Threshold check box, and then enter a threshold. The minimum threshold is the pool usage rate plus 1%. The maximum threshold is 100%. For Thin Image or Copy-on-Write Snapshot, you cannot change the setting of this function. Copy-on-Write Snapshot: Check Warning Threshold and enter a threshold. You cannot set this item if the result of the following calculation exceeds 95: (*used-pool-capacity*/*pool-capacity*) * 100 (%)
Depletion Threshold	Select the Depletion Threshold check box, and then enter a threshold. The minimum threshold is the pool usage rate plus 1%. The maximum threshold is 100%. If you change the Thin Image or Copy-on-Write Snapshot pool, you cannot set this item.

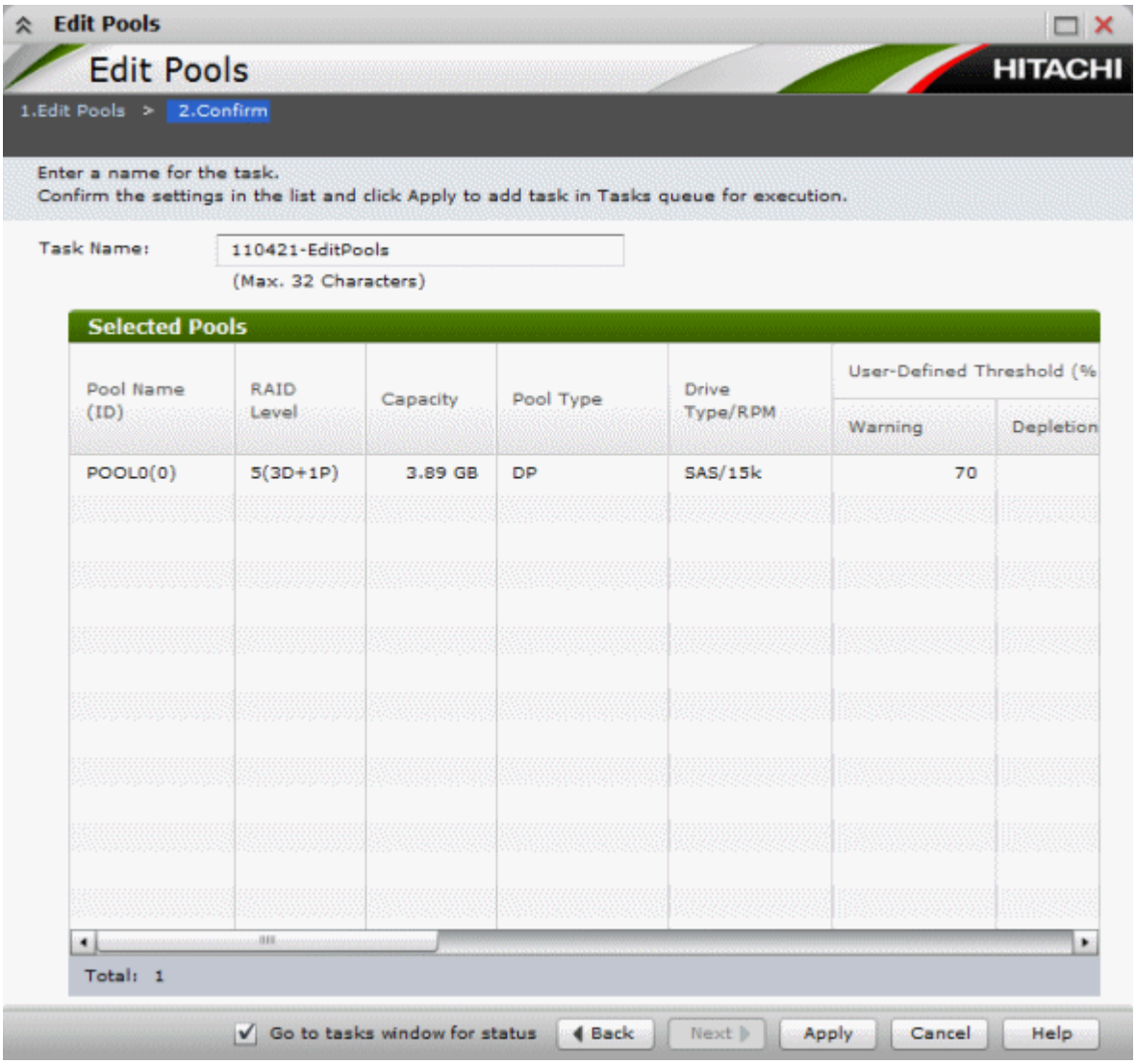
Caution: If you want to change multiple parameters for a pool two or more times, wait until the current task finishes, and then change the next settings. If you attempt to change settings before the current task finishes, only the settings in the next task will be applied, so the result might be different from what you expected.
If you use Dynamic Provisioning, Dynamic Tiering, Thin Image, or Copy-on-Write Snapshot for the pool in which only one of the user-defined thresholds is set, the system threshold (fixed at 80%) is enabled. When the **Edit Pools** window opens on the pool to which the system threshold is enabled, the lower value of the user-defined threshold or the system threshold is assigned to the **Warning Threshold**, and the other value is assigned to the **Depletion Threshold**. In this case, the text box of the assigned system threshold is blank. In the pool for which the system threshold is enabled, if either of the thresholds is changed, the unchanged threshold is defined as follows:

- If you change only **Warning Threshold**, the higher value of the user-defined threshold or the system threshold (fixed at 80%) is defined as **Depletion Threshold**.
- If you change only **Depletion Threshold**, the lower value of the user-defined threshold or the system threshold (fixed at 80%) is defined as **Warning Threshold**.

In this case, note that the reported SIM code number changes when the pool usage capacity exceeds the threshold. If the threshold changes once, the system threshold is not enabled again.

Edit Pools Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



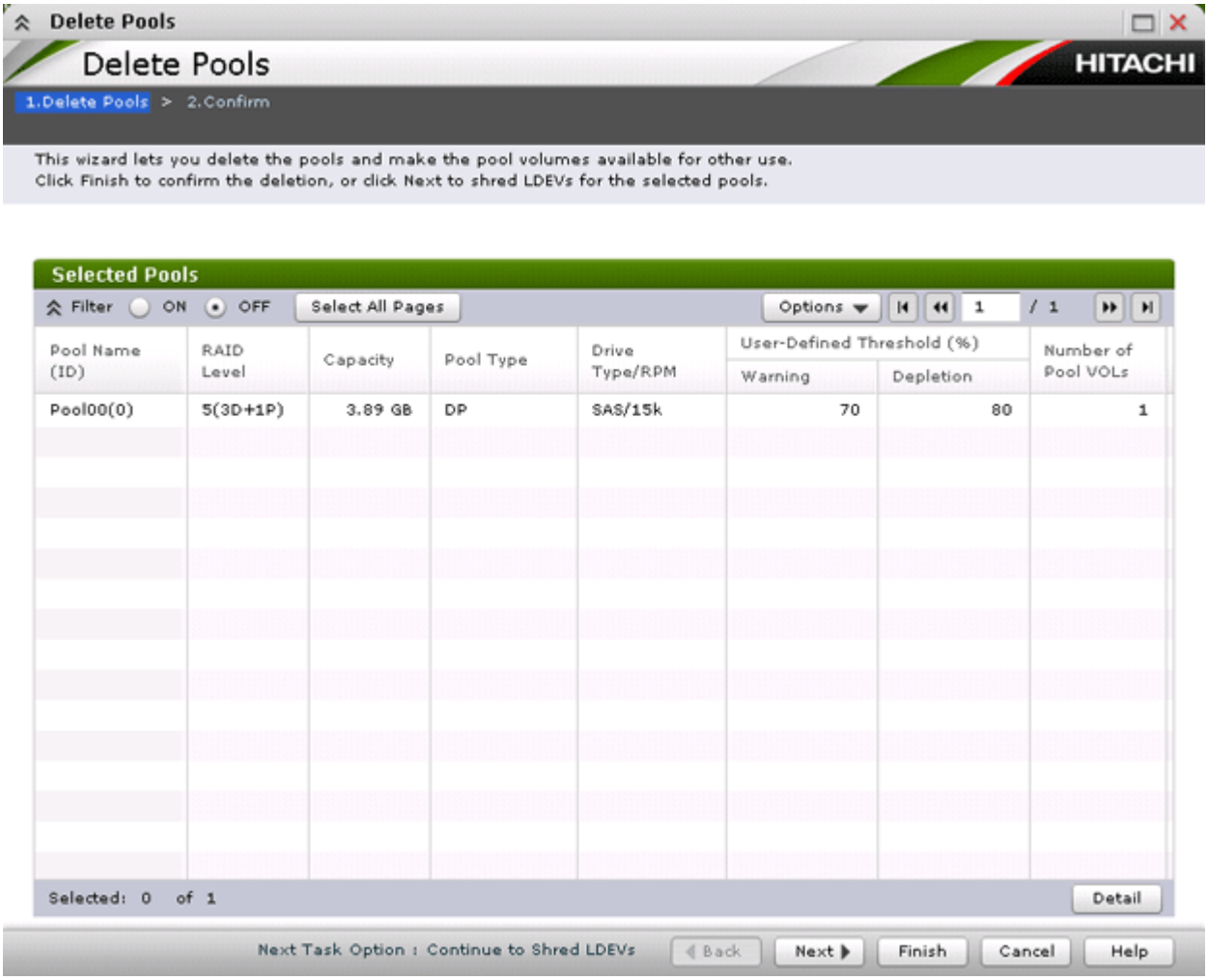
Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.

Item	Description
Drive Type/RPM	Displays the hard disk drive type and RPMs. If multiple drive types or RPMs exist in a pool, this field indicates Mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Subscription Limit (%)	Displays the subscription limit. For Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed.
Number of Pool VOLs	Displays the number of pool-VOLs.
Multi-Tier Pool	Displays the Dynamic Tiering or Dynamic Tiering for Mainframe information. • Monitoring Mode: If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Tier Management: If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual of performance monitoring and tier relocation is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Cycle Time: Displays the cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed. • Monitoring Period: Displays the time zone of performance monitoring when 24 Hours is selected in the Cycle Time list. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Buffer Space for New page assignment (%)	Displays the information of the buffer space for new page assignment to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for new page assignment to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed. Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed.

Item	Description
	Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Buffer Space for Tier relocation (%)	Displays the information of the buffer space for tier relocation to each tier. Tier 1: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, the buffer space for tier relocation to tier 1 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, a hyphen (-) is displayed. Tier 2: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 2 does not exist, a hyphen (-) is displayed. Tier 3: If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If you make the Dynamic Tiering or Dynamic Tiering for Mainframe function unavailable, or tier 3 does not exist, a hyphen (-) is displayed.

Delete Pools wizard

Delete Pools window



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed.

Item	Description
	For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM of the pool. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Displays the number of pool-VOLs.
Mixable	Indicates whether pool-VOLs of different RAID levels can coexist in a pool. Enabled: Pool-VOLs of different RAID levels can coexist in the pool. For details about the requirements, see Pool-VOL requirements on page 5-5. Disabled: Pool-VOLs of different RAID levels cannot coexist in the pool. Hyphen (-): The pool is a Thin Image or Copy-on-Write Snapshot pool.
Detail	Displays the Pool Properties window when a row is selected, and shows the error window when a row is not selected or multiple rows are selected.

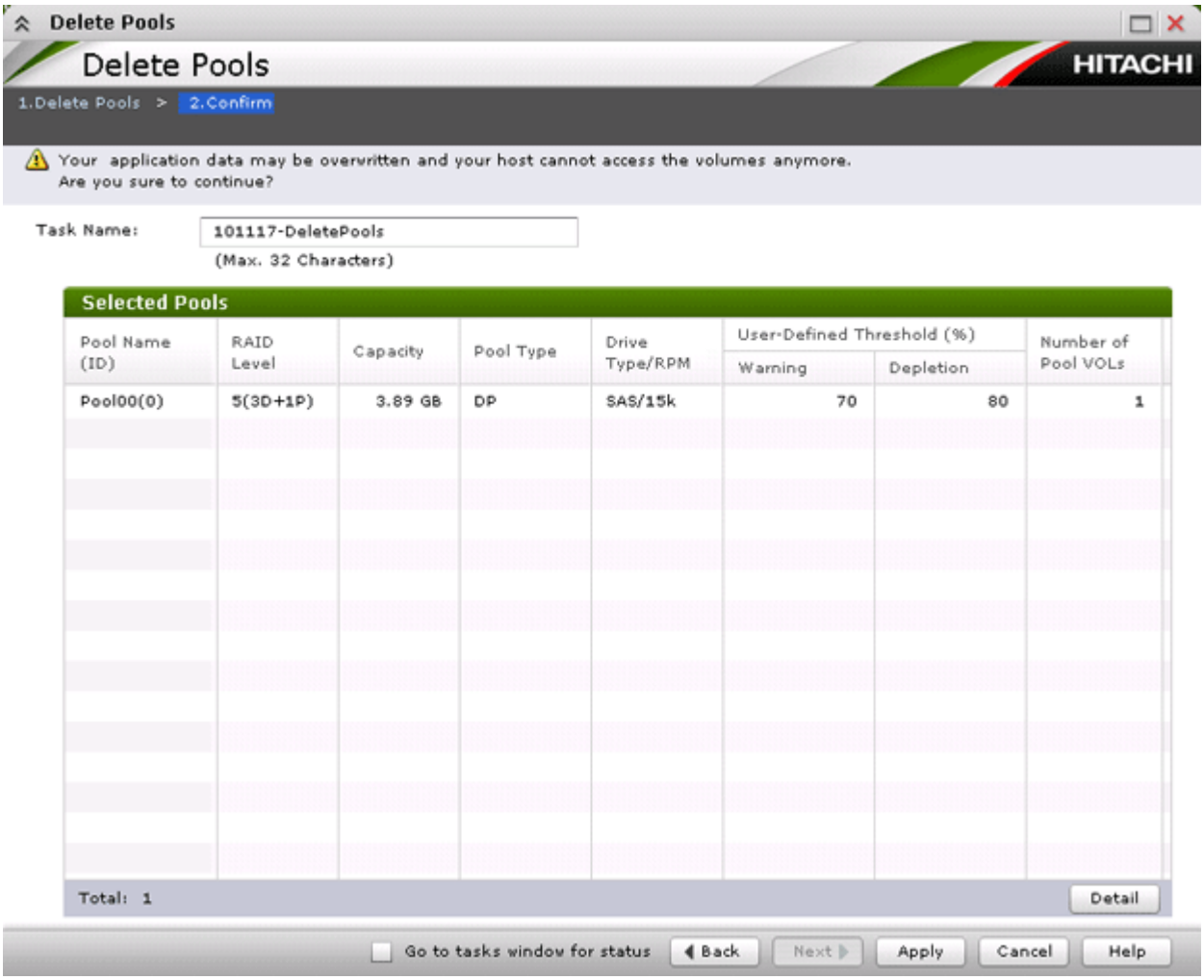
Next Task Option

Click **Next** to go to the task setting window, which is indicated in **Task Next Option**.

Delete Pools Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

Information in this topic assumes only a single task is performed. If performing multiple tasks, the window shows all configuration items. To check information of a configuration item, click **Back** to return to the configuration window, and then click **Help**.



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity. In the case of LUSE, shows the LUSE capacity.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.

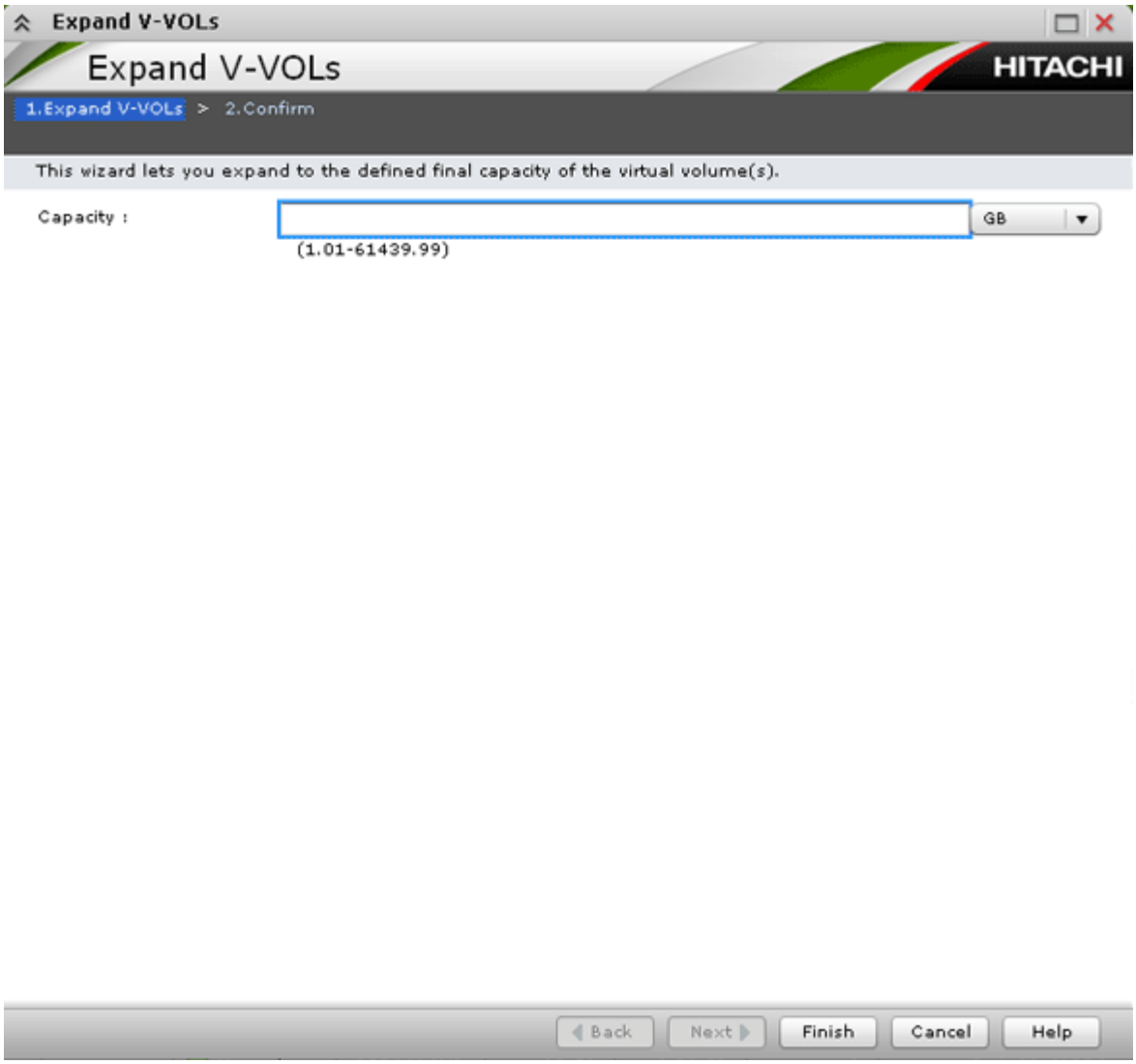
Item	Description
Drive Type/RPM	Displays the hard disk drive type and RPM. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Displays the number of pool-VOLs.
Mixable	Indicates whether pool-VOLs of different RAID levels can coexist in a pool. Enabled: Pool-VOLs of different RAID levels can coexist in the pool. For details about the requirements, see Pool-VOL requirements on page 5-5. Disabled: Pool-VOLs of different RAID levels cannot coexist in the pool. Hyphen (-): The pool is a Thin Image or Copy-on-Write Snapshot pool.
Detail	Displays the Pool Properties window when a row is selected, and shows the error window when a row is not selected or multiple rows are selected.

Note: Information in this topic assumes that only a single task is executed. If multiple tasks are executed, this window displays all configuration items. To check information of a configuration item, click **Back** to return to each configuration window, and then click **Help**.

Expand V-VOLs wizard

Expand V-VOLs window

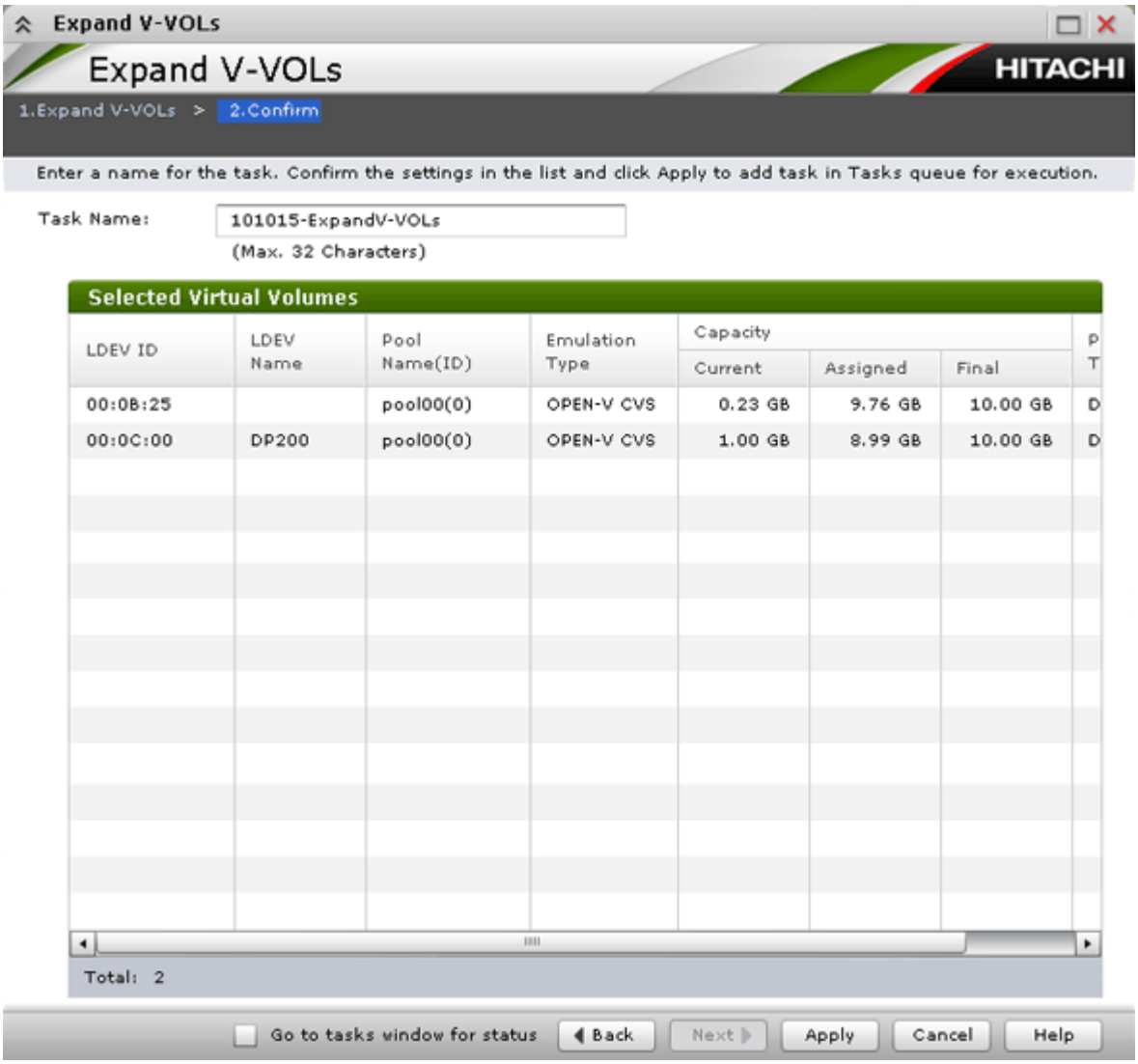
Use this wizard to expand the V-VOLs to the defined final capacity of the virtual volumes.



Item	Description
Capacity	Specify the V-VOL (LDEV) capacity within the range of values indicated below the text box.

Expand V-VOLs Confirm window

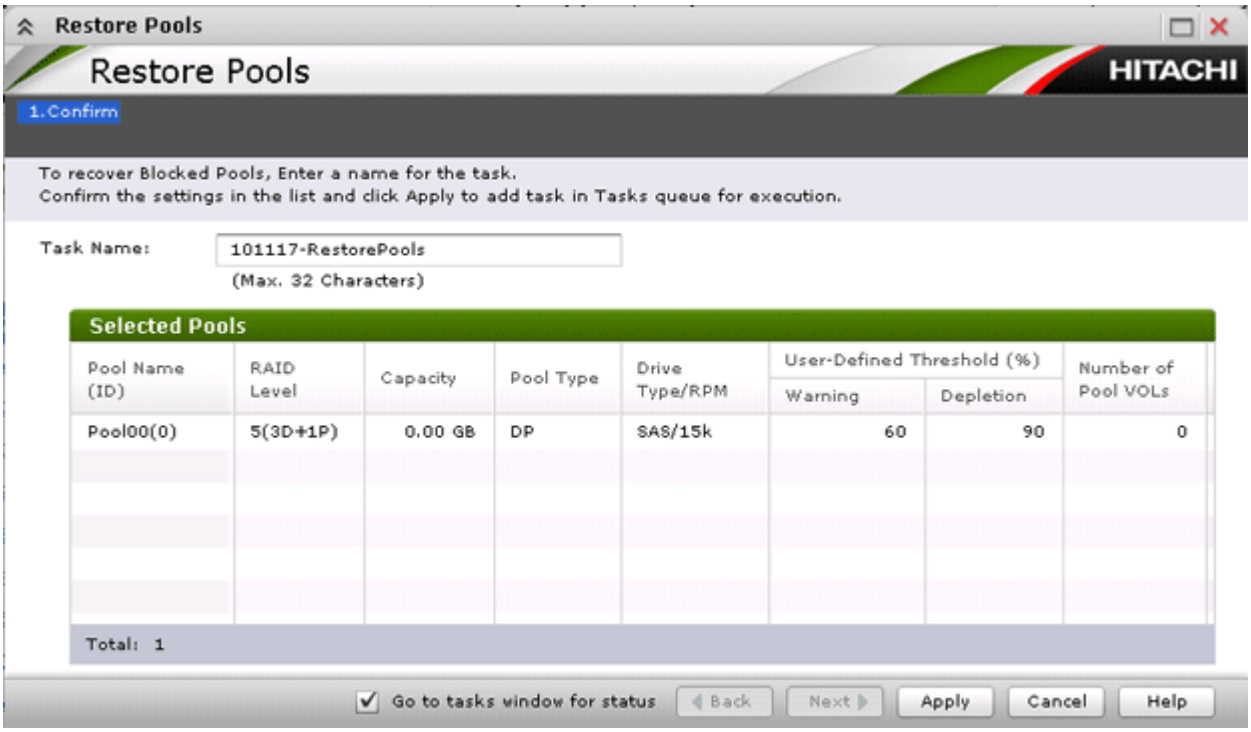
Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Pool Name (ID)	Displays the pool name and pool ID.
Emulation Type	Displays the emulation type.
Capacity	Displays the capacity of the LDEV. • Current: Displays the capacity before expanding the volume. • Assigned: Displays the capacity that is derived by the current value subtracted from the final value. The value may not be exact because the size is displayed with two decimal places. • Final: Displays the capacity after expanding the volume.

Item	Description
Provisioning Type	Displays the LDEV type. In this case, DP is displayed.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. TSE: TSE-VOL. Hyphen (-): Volume in which the attribute is not defined.

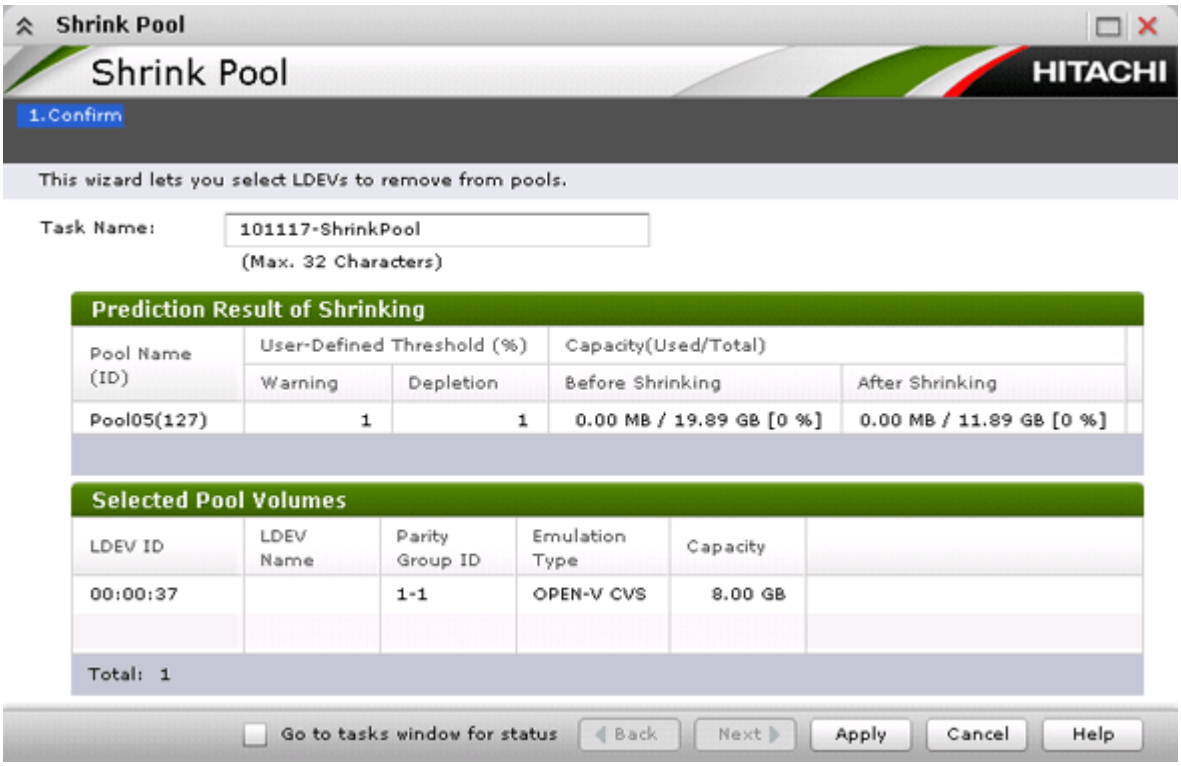
Restore Pools window



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity. If the pool is blocked and pool-VOLs that belong to the pool cannot be identified, 0 is displayed.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed.

Item	Description
	For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Displays the number of pool-VOLs. If the pool is blocked and pool-VOLs that belong to the pool cannot be identified, 0 is displayed.

Shrink Pool window



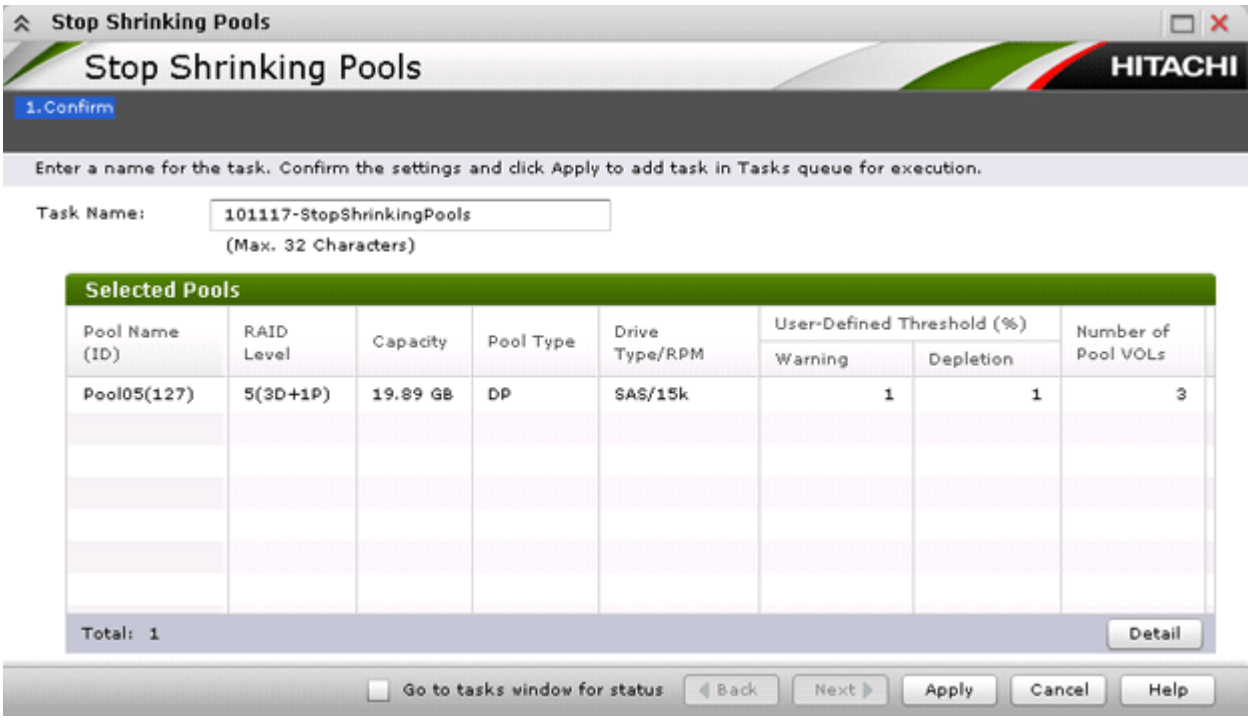
Prediction Result of Shrinking table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed. For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Capacity(Used/Total)	Displays the capacity before and after shrinking. • Before Shrinking: Displays the used capacity, total capacity before shrinking and the usage rates. • After Shrinking: Displays the used capacity, total capacity after shrinking and the usage rates.

Selected Pool Volumes table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Parity Group ID	Displays the parity group ID.
Emulation Type	Displays the emulation type.
Capacity	Displays the pool-VOL capacity.

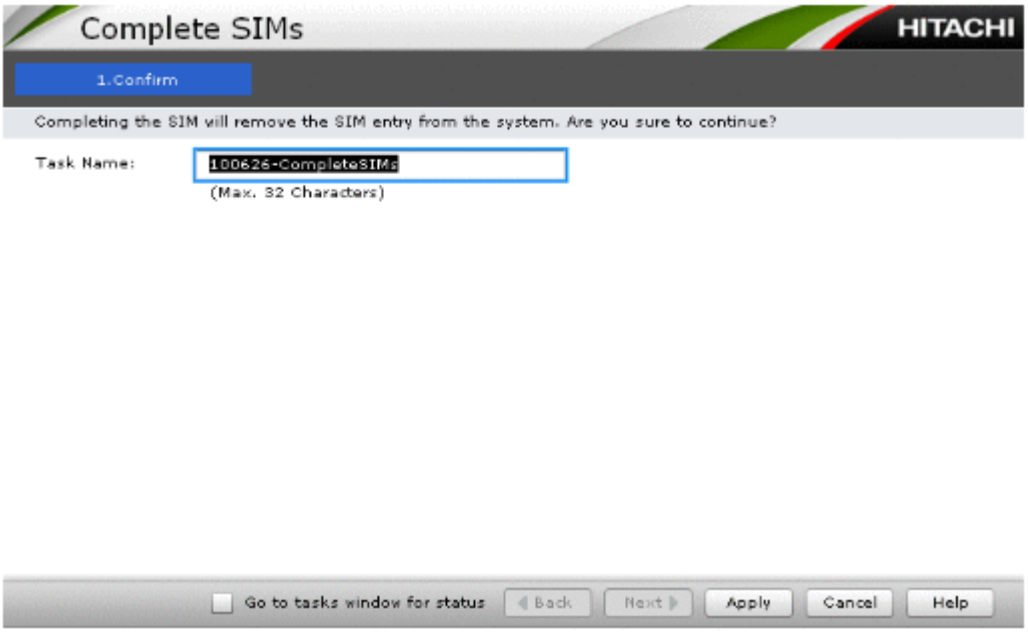
Stop Shrinking Pools window



Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
Capacity	Displays the pool capacity.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Copy-on-Write Snapshot pool, COW snapshot is displayed.
Drive Type/RPM	Displays the hard disk drive type and RPM. If multiple drive types or RPMs exist in a pool, this field indicates that drive types or RPMs are mixed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
User-Defined Threshold (%)	Displays the pool threshold. • Warning: Warning threshold is displayed. • Depletion: Depletion threshold is displayed.

Item	Description
	For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Displays the number of pool-VOLs.
Detail	Displays the Pool Properties window when a row is selected, and shows the error window when a row is not selected or multiple rows are selected.

Complete SIMs window

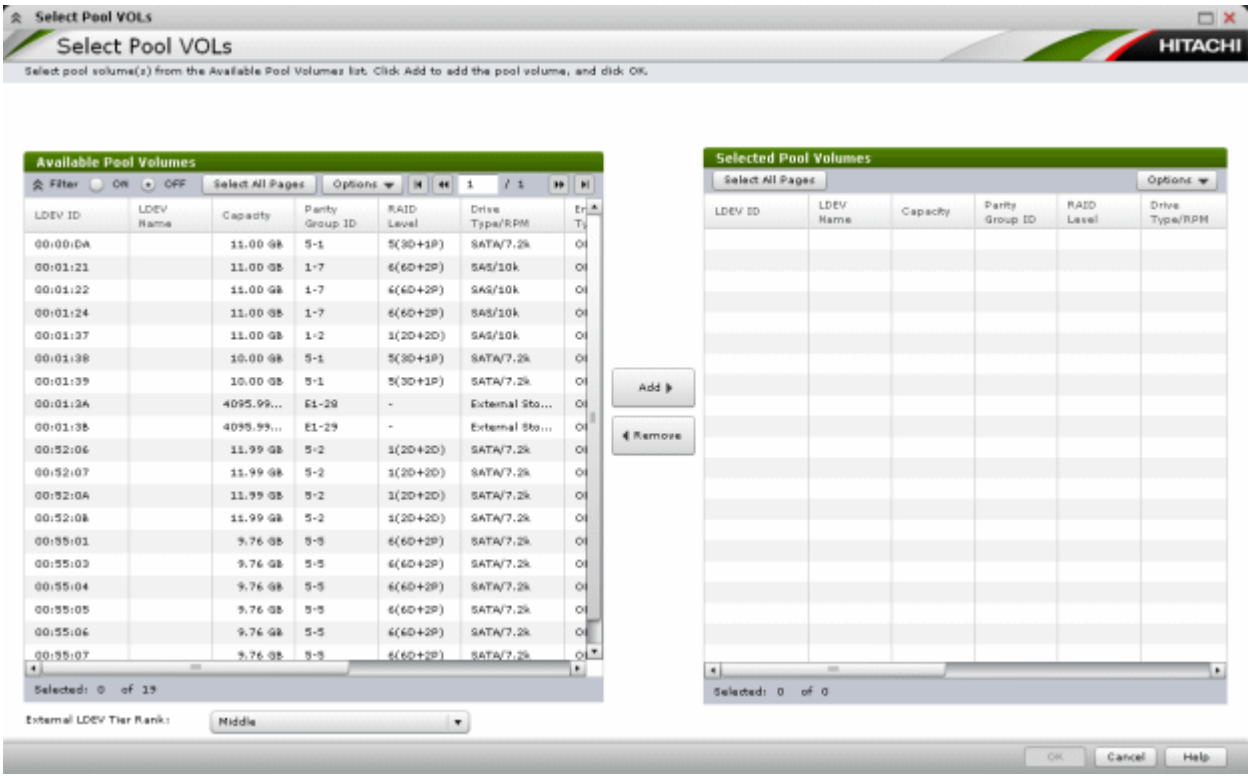


Item	Description
Task Name	Confirm the settings, type a unique task name or accept the default, and then click **Apply**. A task name is case-sensitive and can be up to 32 ASCII letters, numbers, and symbols. The default is <date>-<window name>.

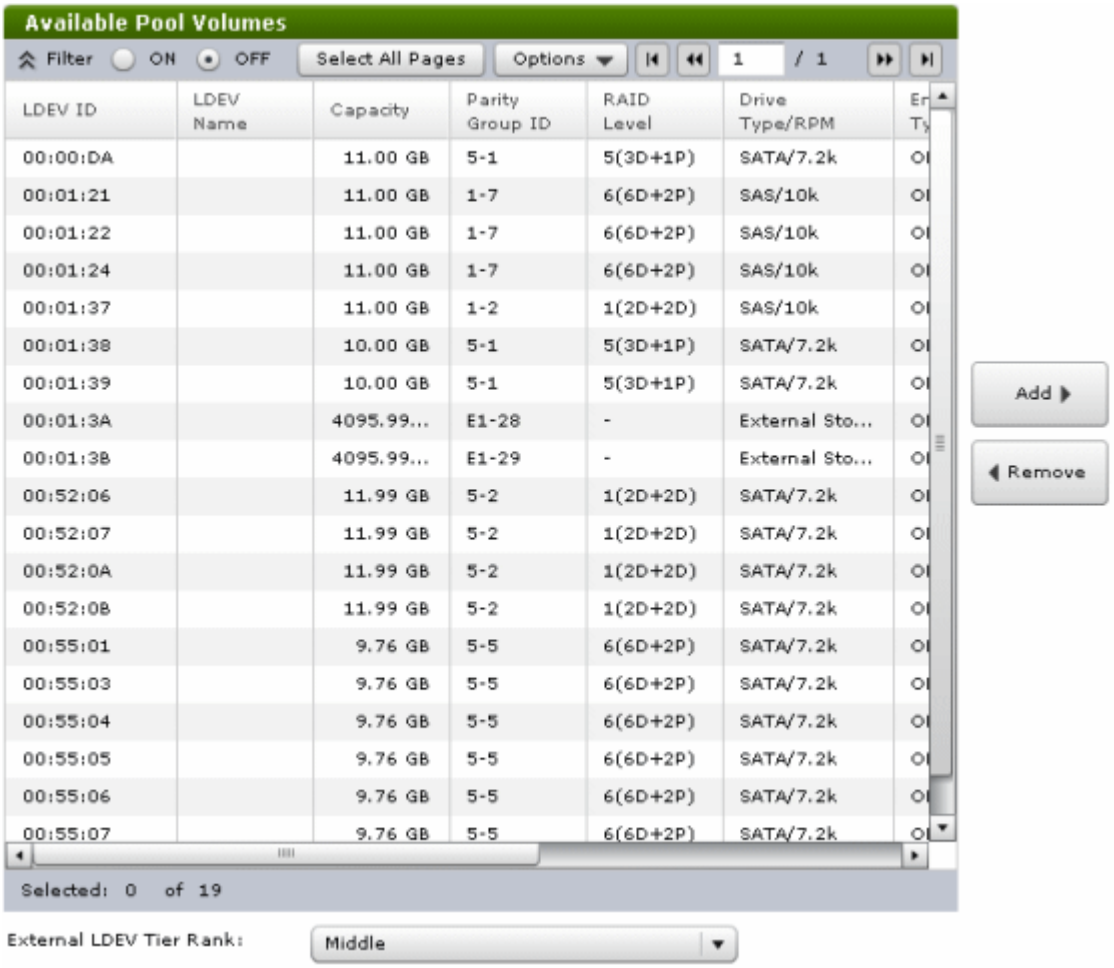
Select Pool VOLs window

Use this window to add pool-VOLs to a pool. Up to 1024 volumes can be added including the volumes already in the pool. Only the LDEVs assigned to the logged-on user are available.

- Up to three different drive types of pool-VOLs can be registered in the same pool.


Select Pool VOLs
Select Pool VOLs
HITACHI
Select pool volume(s) from the Available Pool Volumes list. Click Add to add the pool volume, and click OK.
Available Pool Volumes
Filter
ON
OFF
Select All Pages
Options
LDEV ID
LDEV Name
Capacity
Parity Group ID
RAID Level
Drive Type/RPM
Selected: 0 of 19
Add
Remove
Selected Pool Volumes
Select All Pages
Options
LDEV ID
LDEV Name
Capacity
Parity Group ID
RAID Level
Drive Type/RPM
Selected: 0 of 0
External LDEV Tier Rank:
Middle
OK
Cancel
Help

Available Pool Volumes table



Only the LDEVs assigned to the user are displayed.

Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Capacity	Displays the pool-VOL capacity.
Parity Group ID	Displays the parity group ID.
RAID Level	Displays the RAID level.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage**.
Emulation Type	Displays the emulation type.
Provisioning Type	Displays the type of the LDEV. Basic: Internal volume. External: External volume.

Item	Description
CLPR	Displays the CLPR. Displays in ID:CLPR form.
Cache Mode	Displays whether the cache mode is enabled. If the LDEV is not an external volume, a hyphen (-) is displayed.
Resource Group Name (ID)	Displays the resource group names and IDs of the LDEV. The ID is provided in parentheses.

External LDEV Tier Rank

Specify the tier rank of the external volume. If there is no external volume in the **Available Pool Volumes** table or **Selected Pool Volumes** table, you cannot select this option.

Add

When you select a row in the Available Pool Volumes table and click **Add**, the selected pool-VOL is added to the Selected Pool Volumes table.

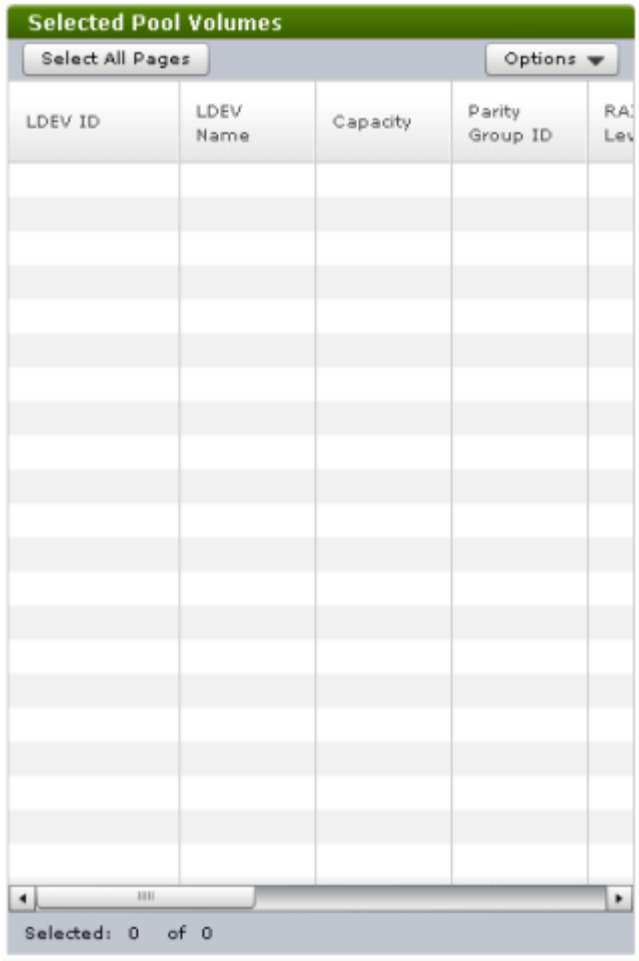
Note: Up to 1,024 volumes can be added including the volumes already in the pool.
When adding a volume to the pool for which Multi-Tier Pool is enabled, note the following:
For a pool, you can add volumes whose **Drive Type/RPM** settings are the same and whose **RAID Level**s are different. For example, you can add the following volumes to the same pool:

- Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (3D+1P)
- Volume whose **Drive Type/RPM** is SAS/15K and whose **RAID Level** is 5 (7D+1P)

Remove

When you select a row in Selected Pool Volumes table and click **Remove**, the selected pool-VOL is removed from the Selected Pool Volumes table.

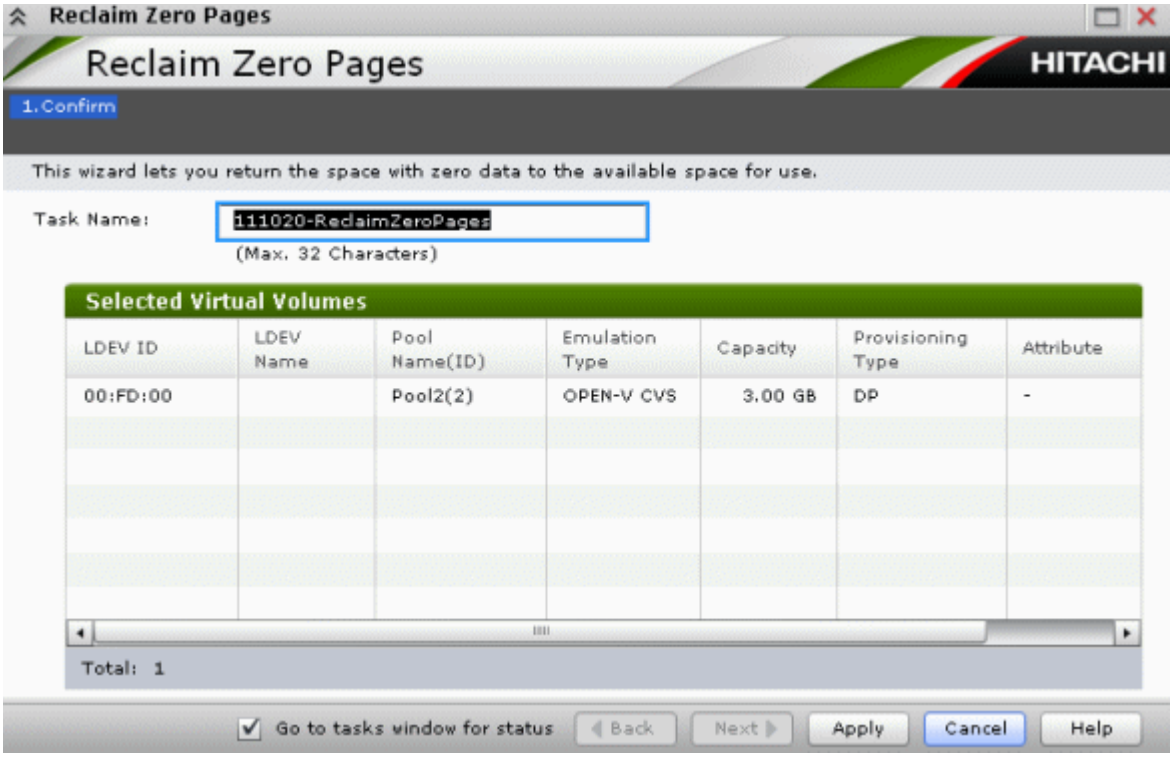
Selected Pool Volumes table



Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Capacity	Displays the pool-VOL capacity.
Parity Group ID	Displays the parity group ID.
RAID Level	Displays the RAID level.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage**.
External LDEV Tier Rank	Displays the tier rank of the external volume. If the volume is not an external volume, a hyphen(-) is displayed.
Emulation Type	Displays the emulation type.
Provisioning Type	Displays the type of the LDEV. Basic: Internal volume. External: External volume.

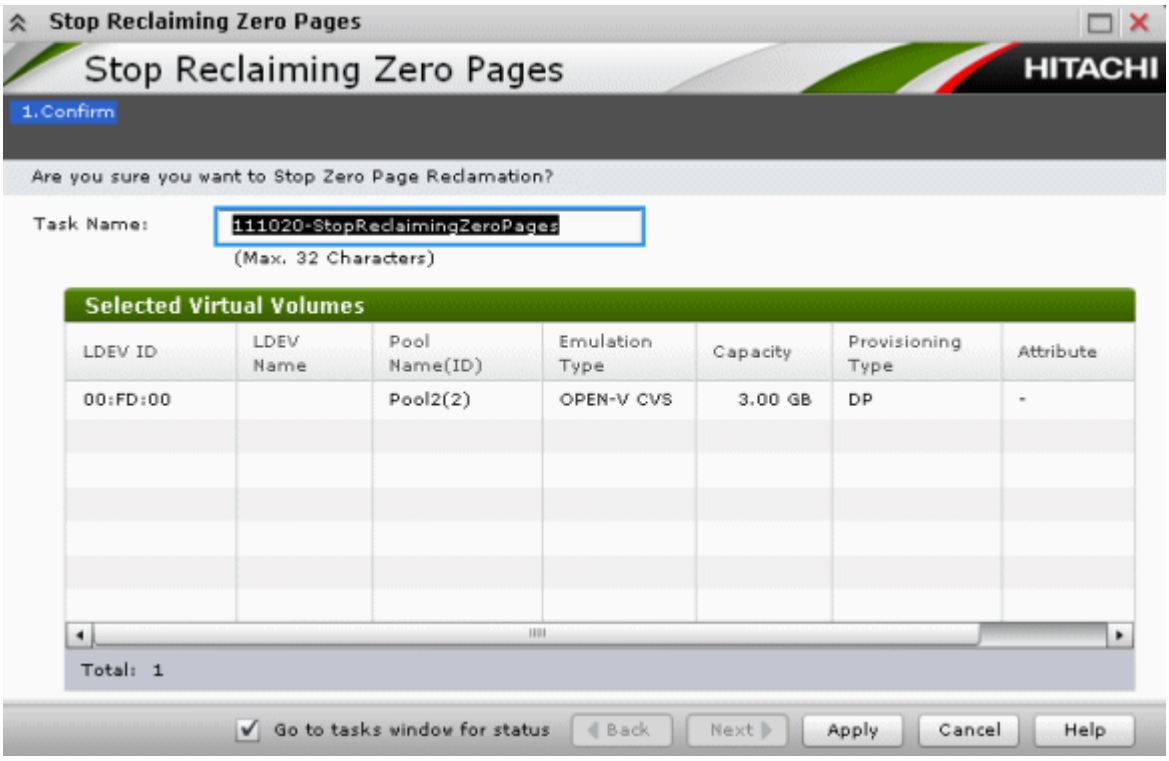
Item	Description
CLPR	Displays the CLPR. Displays in ID:CLPR form.
Cache Mode	Displays whether the cache mode is enabled. If the LDEV is not an external volume, a hyphen (-) is displayed.
Resource Group Name (ID)	Displays the resource group names and IDs of the LDEV. The ID is provided in parentheses.

Reclaim Zero Pages window



Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Pool Name (ID)	Displays the pool name and pool ID.
Emulation Type	Displays the emulation type.
Capacity	Displays the capacity.
Provisioning Type	Displays the LDEV type. In this case, DP is displayed.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Hyphen (-): Volume in which the attribute is not defined.

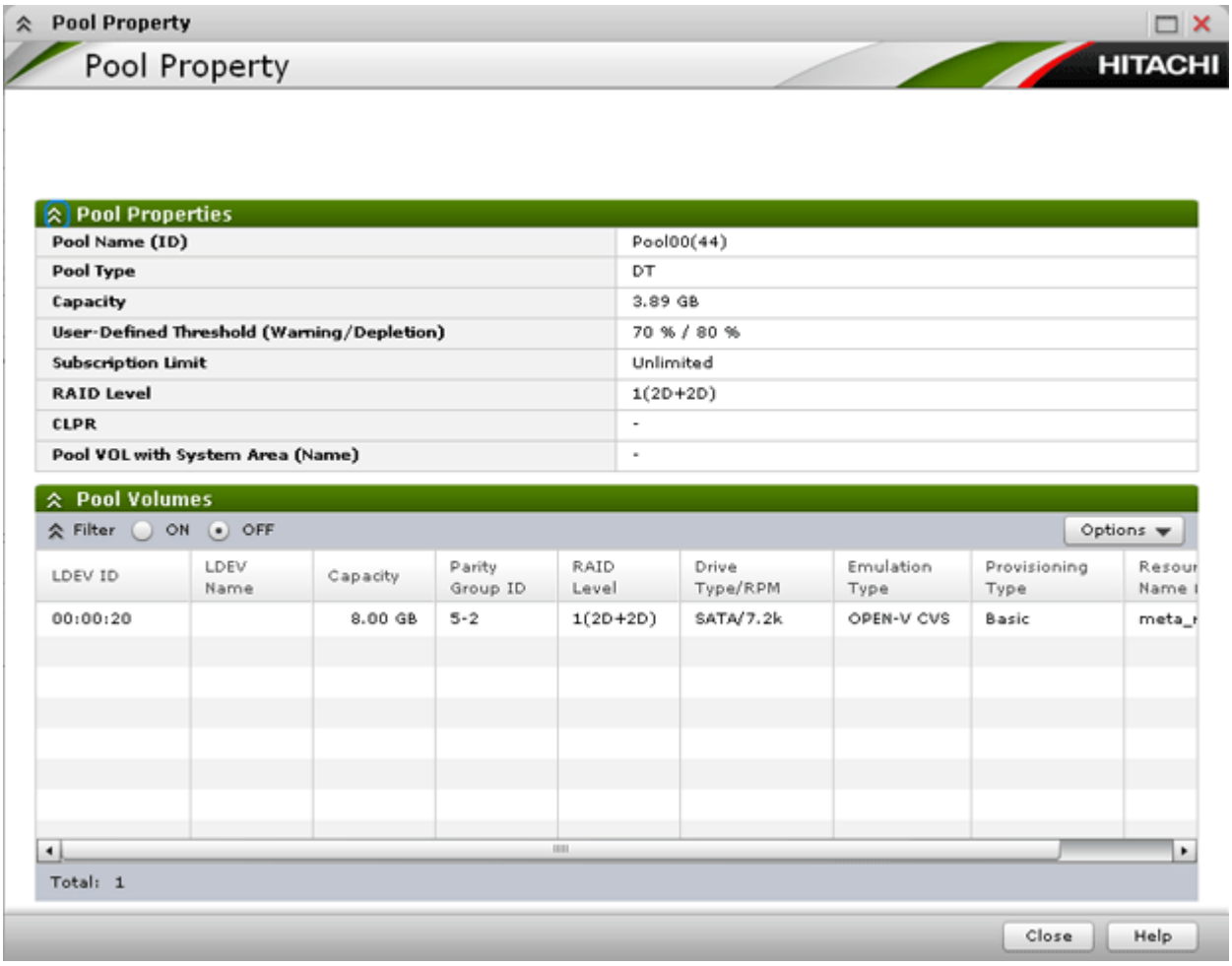
Stop Reclaiming Zero Pages window



Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Pool Name (ID)	Displays the pool name and pool ID.
Emulation Type	Displays the emulation type.
Capacity	Displays the capacity.
Provisioning Type	Displays the LDEV type. In this case, DP is displayed.
Attribute	Displays the attribute of the LDEV. Command Device: Command device. Hyphen (-): Volume in which the attribute is not defined.

Pool Property window

Use this window to view and change pool properties. Only the LDEVs assigned to the logged-on user are available.



Pool Properties table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed. For a Copy-on-Write Snapshot pool, SS is displayed.
Capacity	Displays the pool capacity in the specified unit.
User-Defined Threshold (Warning/Depletion)	Displays the user-defined threshold (Warning/Depletion).
Subscription Limit	Displays the subscription limit.

Item	Description
	For a Thin Image or Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Current or Limit.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed.
CLPR	Displays the CLPR set for the Thin Image or Copy-on-Write Snapshot pool-VOLs. Displays in ID:CLPR form. For Pool-VOLs other than the Thin Image or Copy-on-Write Snapshot pool-VOL, a hyphen (-) is displayed.
Pool VOL with System Area (Name)	Displays LDEV ID and LDEV name of the pool-VOL which includes the system area. If you open this window from the Selected Pools table in the Create Pool window, a hyphen(-) is displayed. For a Copy-on-Write Snapshot pool, a hyphen (-) is displayed for Current or Limit.

Pool Volumes table

Only the LDEVs assigned to the user are displayed.

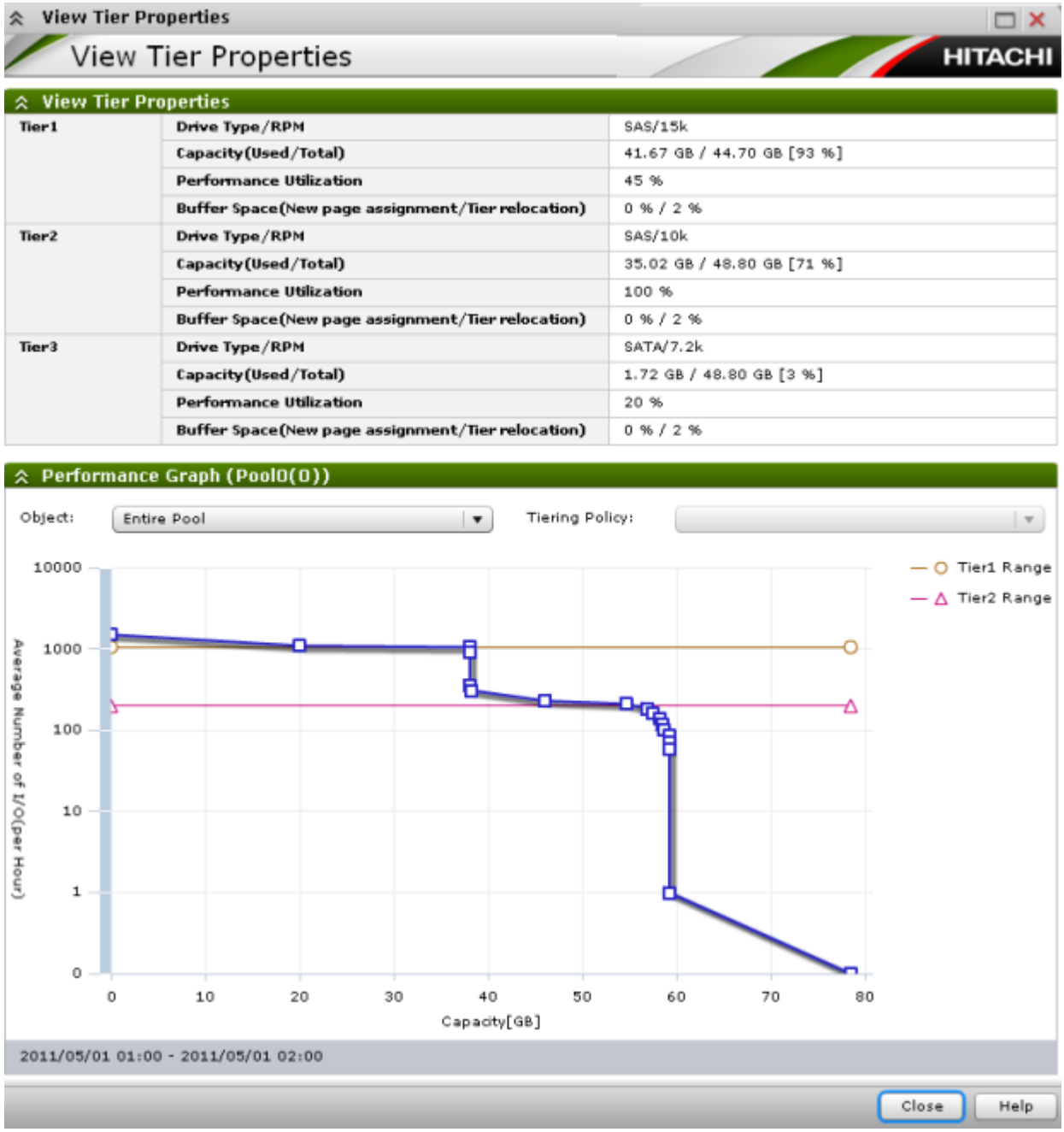
Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Capacity	Displays the pool volumes capacity in the specified unit. If you open this window from the Selected Pools table in the Create Pool window, the LDEV capacity selected in the Select Pool VOLs window is displayed.
Parity Group ID	Displays the parity group ID.
RAID Level	Displays the RAID level.
Drive Type/RPM	Displays the hard disk drive type and RPM. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
Emulation Type	Displays the emulation type.
Provisioning Type	Displays the type of the LDEV. Basic: Internal volume. External: External volume.
Resource Group Name (ID)	Displays the resource group names and IDs of the LDEV. The ID is provided in parentheses.

View Tier Properties window

This window shows tier properties and a performance graph:

- For pools on page E-60
- For V-VOLs on page E-63

When the pool name (pool ID) appears in the graph banner, you are looking a pool information. When the LDEV name (LDEV ID) appears in the graph banner, you are looking at V-VOL information.



For pools

The following table lists the View Tier Properties table information concerning pools.

Item	Description
Tier 1	Tier 1 is a high-speed hierarchy. • Drive Type/RPM: Displays the hard disk drive type and RPM of tier 1.[1] • Capacity (Used/Total): Displays the used and total capacity of tier 1.[2] • Performance Utilization: Displays rate of the average used capacity while the performance information is being collected.[3] • Buffer Space (New page assignment/Tier relocation): Displays buffer spaces for new page assignment and tier relocation of tier 1.
Tier 2	Tier 2 is a middle-speed hierarchy. • Drive Type/RPM: Displays the hard disk drive type and RPM of tier 2.[1] • Capacity (Used/Total): Displays the used and total capacity of tier 2.[2] • Performance Utilization: Displays rate of the average used capacity while the performance information is being collected.[3] • Buffer Space (New page assignment/Tier relocation): Displays buffer spaces for new page assignment and tier relocation of tier 2.
Tier 3	Tier 3 is a low-speed hierarchy. • Drive Type/RPM: Displays the hard disk drive type and RPM of tier 3.[1] • Capacity (Used/Total): Displays the used and total capacity of tier 3.[2] • Performance Utilization: Displays rate of the average used capacity while the performance information is being collected.[3] • Buffer Space (New page assignment/Tier relocation): Displays buffer spaces for new page assignment and tier relocation of tier 3.

Notes:

1. If multiple types exist in a tier, **Mixed** is displayed. When the volume is the external volume, **Drive Type** displays **External Storage** and the value of the external LDEV tier rank.
2. Capacity (Used/Total) is updated asynchronously with Performance Utilization. It is updated whenever the **View Tier Properties** window is opened.
3. Performance Utilization is updated when the performance monitoring information is collected. It is updated asynchronously with Capacity (Used/Total). If ? is displayed, take actions according to the instruction shown in the footer of the performance graph. If an error message and the countermeasure are not shown in the footer of the performance graph, refresh the window. If ? still appears, call the customer support.

The following table describes the details of the performance graph when pool information is present.

Item	Description
Performance Graph (*pool name*(*pool ID*))	Displays the pool name and ID.
Object	Select the object to display a graph. Entire Pool: Displays the graph of the entire pool. Tiering Policy: Displays the graph per tiering policy. Select the policy from the tiering policy.
Tiering Policy	Select the level of the tier of which is displayed in the graph. If Entire Pool is selected in the Object, this option appears dimmed. You can select All(0) or from Level1(1) to Level31(31).
Performance Graph	Displays the performance graph. Period Mode: The vertical scale indicates the average number of I/Os per hour. The horizontal scale indicates the capacity. Continuous Mode: The vertical scale indicates the average number of I/Os per hour. The number of I/Os is calculated with the past cycle monitoring data weighted to the current cycle monitoring data. The horizontal scale indicates the capacity.
Tier1 Range	Displays the Tier1 range.
Tier2 Range	Displays the Tier2 range.
Used capacity of the each tiering policy	• Tier 1: Displays the used capacity of the each tiering policy in the tier 1. • Tier 2: Displays the used capacity of the each tiering policy in the tier 2. • Tier 3: Displays the used capacity of the each tiering policy in the tier 3 • Total: Displays the total used capacity of the each tiering policy in the tier 1, tier 2 and tier 3.
Footer area	Displays the start time and end time of the performance monitoring. When acquisition of the performance graph fails, the **Warning** icon is displayed along with an error message and solution. In the parentheses, an error code is displayed.

The following describes how to read the performance graph when it contains pool information.

The vertical scale of the graph indicates an average number of I/Os by each hour and the horizontal scale indicates capacity (GB) of the area where the I/Os are performed. In the screen above, the first dot shows approximately 1,500 I/Os on the vertical scale and 0 GB on the horizontal scale. The second dot shows approximately 1,100 I/Os and 20 GB. The third dot shows approximately 1,050 I/Os and 38 GB.

This indicates that 20 GB of capacity is available of over 1,100 I/Os but less than 1,500 I/Os between the first dot and the second dot, and 18 GB (38 GB minus 20 GB) of capacity is available of over 1,050 I/Os but less than 1,100 I/Os between the second dot and the third dot. The I/O counts on a dot were processed on the capacity by subtracting the previous dot's capacity from the dot's capacity.

The two lines in the graph indicate tier 1 range and tier 2 range. They are calculated when the collection of performance monitoring has been completed (monitoring period is completed). They show the boundary of each tier.

The sample graph, above, shows 1,050 I/Os for tier 1 range, and 200 I/Os for tier 2 range. This case means the area with 1,050 or more I/Os moves to tier 1, the area with over 200 I/Os but less than 1,050 I/Os moves to tier 2, and the area with less than 200 I/Os moves to tier 3. However, the area in the appropriate tier does not move. When the cursor is placed on a dot of the graph, information such as average I/O counts, capacity, and tier range appears over the dot.

When no I/Os are in the lower tier with multiple tiers, the tier range line is placed at 0 on the vertical scale.

For example, if the dot is placed far from the lower limit of the tier range, the lower limit levels of the Tier 1 Range and Tier 2 Range are adjusted to improve the visibility of the performance graph. In this case, the value that is obtained by Command Control Interface may not correspond with the value of the dot displayed in a performance graph.

For V-VOLs

The following table provides the View Tier Properties table information when LDEV information is present.

Item	Description
Tier 1	Tier 1 is the most frequently accessed and high-speed hierarchy. • Drive Type/RPM: The drive type and rpm of tier 1.* • Capacity (Used): The used capacity of tier 1. • Performance Utilization: Not available. • Buffer Space (New page assignment/Tier relocation): Buffer spaces for new page assignments and tier relocation of tier 1.
Tier 2	Tier 2 is the second frequently accessed and middle-speed hierarchy. • Drive Type/RPM: The drive type and rpm of tier 2.* • Capacity (Used): The used capacity of tier 2. • Performance Utilization: Not available. • Buffer Space (New page assignment/Tier relocation): Buffer spaces for new page assignments and tier relocation of tier 2.

Item	Description
Tier 3	Tier 3 is the less frequently accessed and low-speed hierarchy. • Drive Type/RPM: The drive type and rpm of tier 3.* • Capacity (Used): The used capacity of tier 3. • Performance Utilization: Not available. • Buffer Space (New page assignment/Tier relocation): Buffer spaces for new page assignments and tier relocation of tier 3.
* If multiple types exist in a tier, **Mixed** is displayed. When the volume is the external volume, Drive Type displays **External Storage** and the value of the external LDEV tier rank.	

The following table describes the details of the performance graph when LDEV information is presented.

Item	Description
Performance Graph (*LDEV name*(*LDEV ID*))	Displays the LDEV name and ID.
Performance Graph	Displays the performance graph. The vertical scale indicates the average I/O per hour. The horizontal scale indicates the capacity.
Tier1 Range	Displays the Tier1 range.
Tier2 Range	Displays the Tier2 range.
Footer area	Displays the start time and end time of the performance monitoring. When acquisition of the performance graph fails, the **Warning** icon is displayed along with an error message and solution. In the parentheses, an error code is displayed.

The following describes how to read the performance graph when LDEV information is presented.

The vertical scale of the graph indicates an average number of I/Os by each hour and the horizontal scale indicates a capacity, in GB, of the area where the I/Os are performed. In the screen above, the first dot shows approximately 1,500 I/Os on the vertical scale and 0 GB on the horizontal scale. The second dot shows approximately 1,100 I/Os and 20 GB. The third dot shows approximately 1,050 I/Os and 38 GB.

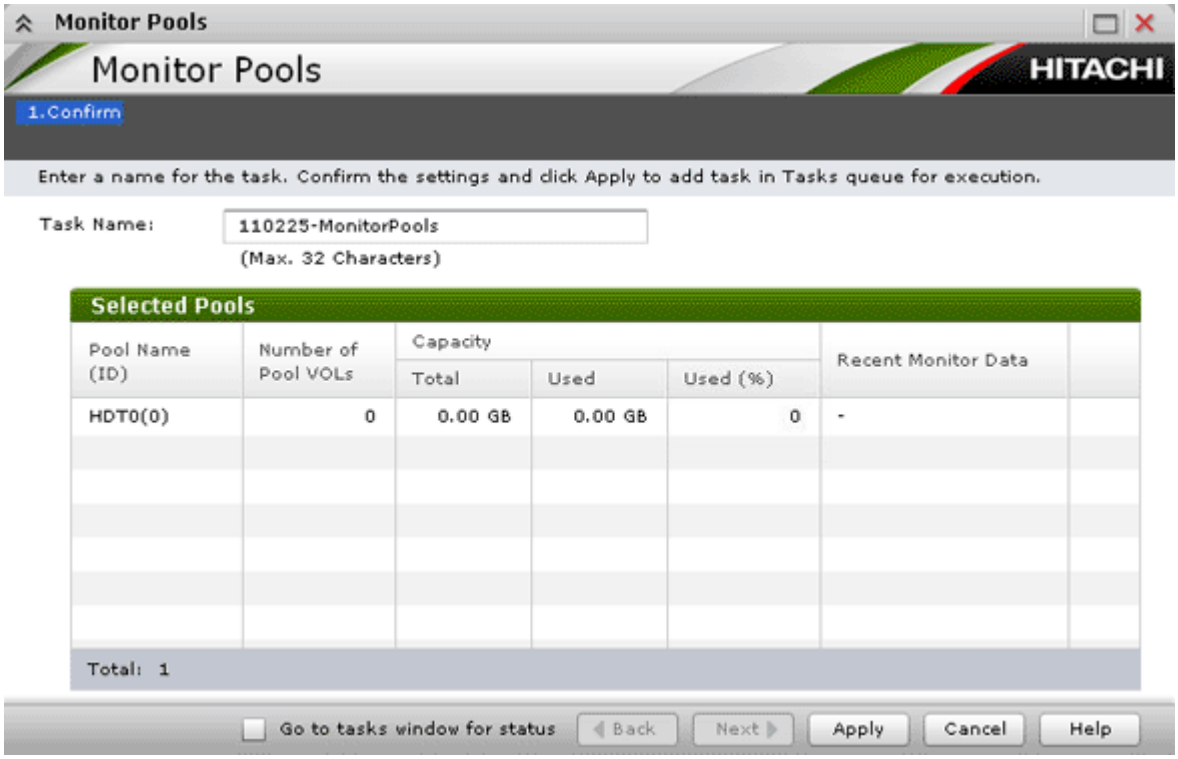
This indicates that 20 GB of capacity is available of over 1,100 I/Os but less than 1,500 I/Os between the first dot and the second dot, and 18 GB (38 GB - 20 GB) of capacity is available of over 1,050 I/Os but less than 1,100 I/Os between the second dot and the third dot. The I/O counts on a dot were processed on the capacity subtracted the previous dot's capacity from the dot's capacity.

The two lines in the graph indicate tier 1 range and tier 2 range. These ranges are calculated when the collection of performance monitoring data is complete (monitoring period is completed). They show the boundary of each tier.

The sample graph shows 1,050 I/Os for tier 1 range, and 200 I/Os for tier 2 range. This case means the area with 1,050 or more I/Os moves to tier 1, the area with over 200 I/Os but less than 1,050 I/Os moves to tier 2, and the area with less than 200 I/Os moves to tier 3. However, the area in the appropriate tier does not move. When the cursor is placed on a dot of the graph, the information such as average I/O counts, capacity, and tier range appears on the dot.

When no I/Os are in the lower tier with multiple tiers, the tier range line is placed at 0 on the vertical scale.

Monitor Pools window

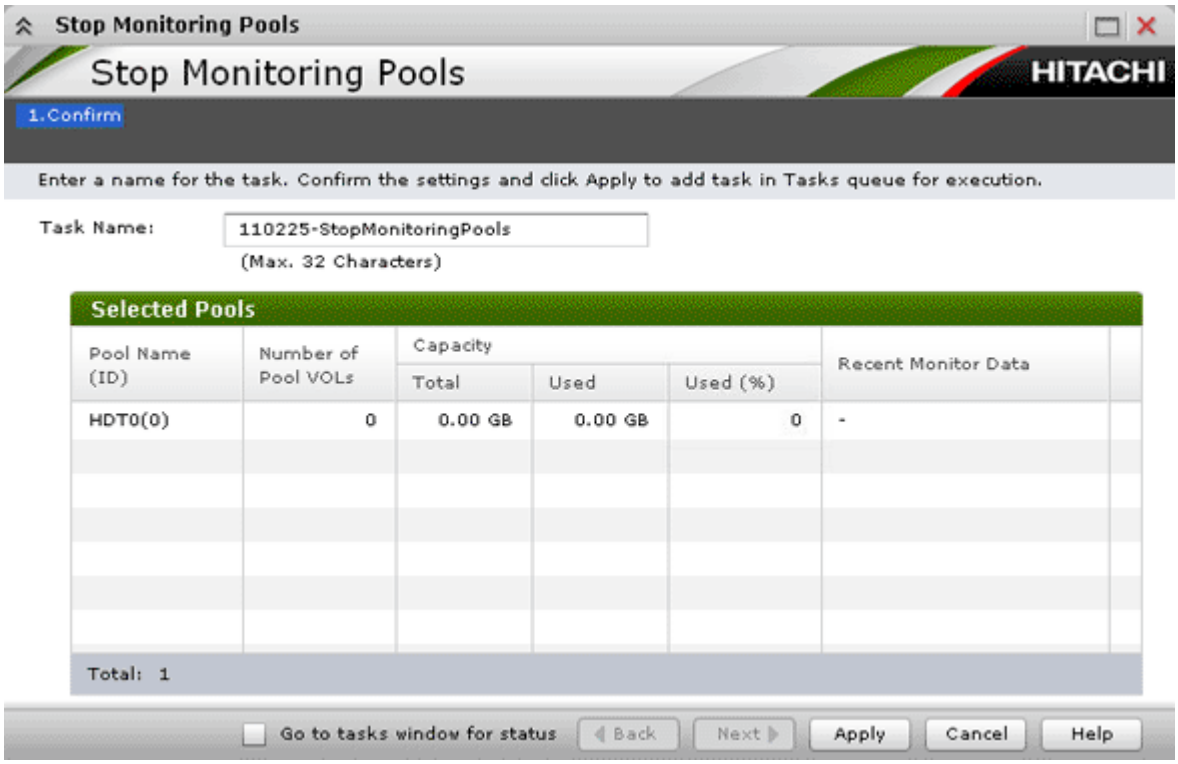


Selected Pools table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Number of Pool VOLs	Displays the number of pool-VOLs in the selected pool.
Capacity	Displays the information about the pool capacity. • Total: Total capacity of pool. Using Options, you can select unit of capacity.

Item	Description
	◦ One block equals 512 bytes and one page equals 42 megabytes in a pool capacity of Dynamic Provisioning, Dynamic Tiering, or Thin Image. ◦ One block equals 512 bytes and one page equals 256 kilobytes in a pool capacity of Copy-on-Write Snapshot. ◦ One block equals 512 bytes and one page equals 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. • Used: Used pool capacity. • Used (%): Pool usage rates to pool capacity. Used (%) displays the value which is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed into Cylinder.
Recent Monitor Data	Displays the period of monitoring time as follows: *Starting-time-Ending-time* If the monitoring data is being obtained, only the starting time is displayed. If the latest monitoring data does not exist, a hyphen (-) is displayed.

Stop Monitoring Pools window

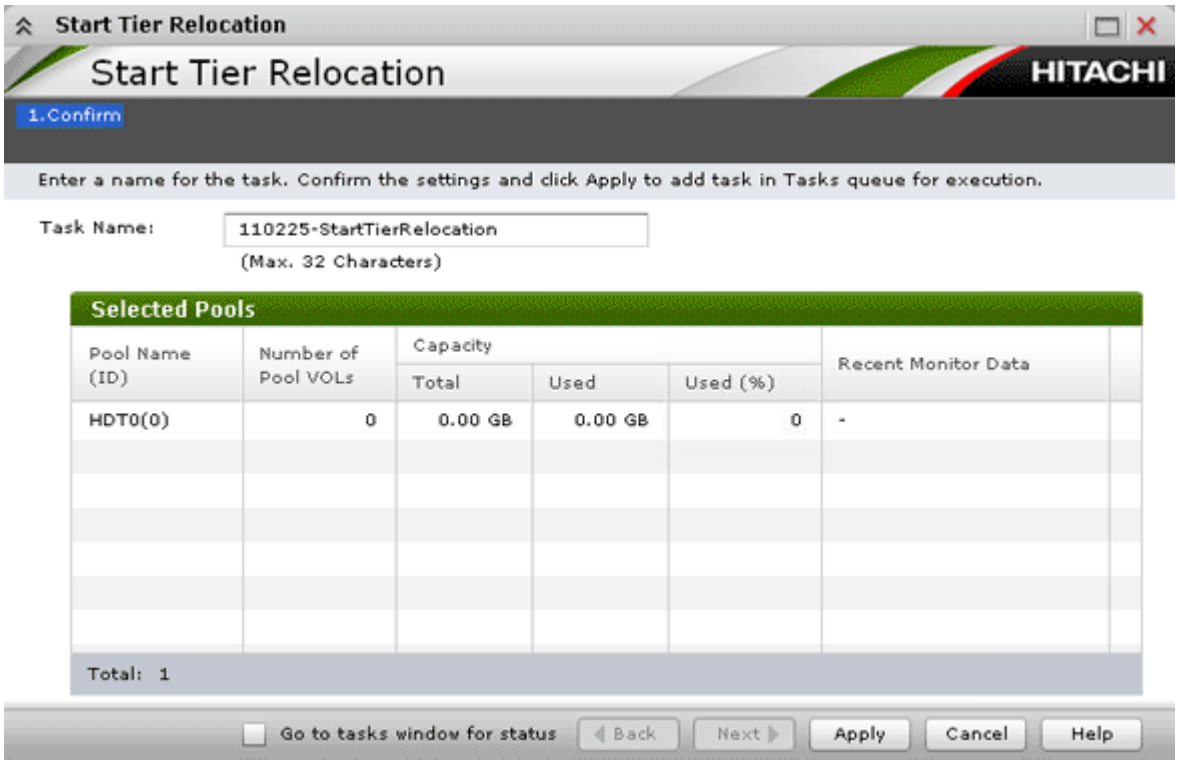


Selected Pools table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Number of Pool VOLs	Displays the number of pool-VOLs in the selected pool.
Capacity	Displays the information about the pool capacity. • Total: Total capacity of pool. Using Options, you can select unit of capacity. ○ One block equals 512 bytes and one page equals 42 megabytes in a pool capacity of Dynamic Provisioning, Dynamic Tiering, or Thin Image. ○ One block equals 512 bytes and one page equals 256 kilobytes in a pool capacity of Copy-on-Write Snapshot. ○ One block equals 512 bytes and one page equals 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. • Used: Used pool capacity. • Used (%): Pool usage rates to pool capacity. Used (%) displays the value which is truncated after the decimal point of the actual value.

Item	Description
	For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed into Cylinder.
Recent Monitor Data	Displays the period of monitoring time as follows: *Starting-time-Ending-time* If the monitoring data is being obtained, only the starting time is displayed. If the latest monitoring data does not exist, a hyphen (-) is displayed.

Start Tier Relocation window

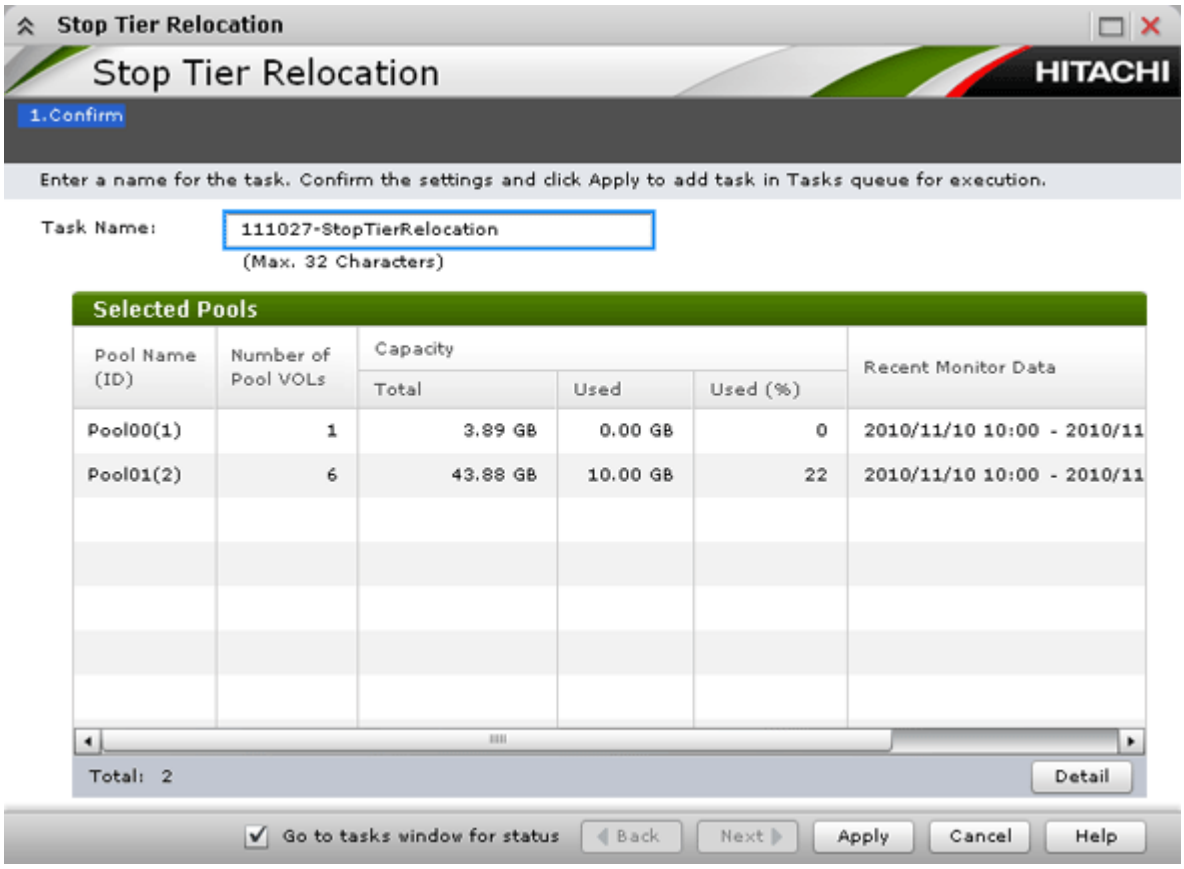


Selected Pools table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Number of Pool VOLs	Displays the number of pool-VOLs in the selected pool.
Capacity	Displays the information about the pool capacity. • Total: Total capacity of pool. Using Options, you can select unit of capacity.

Item	Description
	○ One block equals 512 bytes and one page equals 42 megabytes in a pool capacity of Dynamic Provisioning, Dynamic Tiering, or Thin Image. ○ One block equals 512 bytes and one page equals 256 kilobytes in a pool capacity of Copy-on-Write Snapshot. ○ One block equals 512 bytes and one page equals 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. • Used: Used pool capacity. • Used (%): Pool usage rates to pool capacity. Used (%) displays the value which is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed into Cylinder.
Recent Monitor Data	Displays the period of monitoring time as follows: *Starting-time-Ending-time* If the monitoring data is being obtained, only the starting time is displayed. If the latest monitoring data does not exist, a hyphen (-) is displayed.

Stop Tier Relocation window



Selected Pools table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Number of Pool VOLs	Displays the number of pool-VOLs in the selected pool.
Capacity	Displays the information about the pool capacity. • Total: Total capacity of pool. Using Options, you can select unit of capacity. ○ One block equals 512 bytes and one page equals 42 megabytes in a pool capacity of Dynamic Provisioning, Dynamic Tiering, or Thin Image. ○ One block equals 512 bytes and one page equals 256 kilobytes in a pool capacity of Copy-on-Write Snapshot. ○ One block equals 512 bytes and one page equals 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. • Used: Used pool capacity. • Used (%): Pool usage rates to pool capacity.

Item	Description
	Used (%) displays the value which is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, Thin Image, and Copy-on-Write Snapshot, a hyphen (-) is displayed if the unit of capacity is changed into Cylinder.
Recent Monitor Data	Displays the period of monitoring time as follows: *Starting-time-Ending-time* If the monitoring data is being obtained, only the starting time is displayed. If the latest monitoring data does not exist, a hyphen (-) is displayed.
Relocation Progress(%)	Displays the progress percentage of the tier relocation. 0 to 99: The relocation is performed at the indicated percentage progression. 100: The relocation operation is not in performed, or the relocation is complete. For details about the tier relocation, see the tier relocation log file. For details about the table items of the tier relocation log file, see Tier relocation log file contents on page 5-42.
Relocation Status	Displays the status of the pool tier relocation. • Status: Displays In Progress if the tier relocation is being performed. Displays a hyphen(-) if the tier relocation is not performed. • Progress (%): Displays the progress ratio of the tier relocation. 0 to 99: Shows one of the following statuses. When In Progress is displayed in the Status cell: Relocation is in progress. When a hyphen (-) is displayed in the Status cell: Relocation is suspended at the indicated percentage progression. 100: Shows if the relocation operation is not in progress, or the relocation is completed. For details about the relocation progress rate, check the tier relocation log file.

View Pool Management Status window

Pool Management Status table

Item	Description
Pool Name (ID)	Displays the pool name and pool ID.
Pool Type	Displays the pool type. For a Dynamic Provisioning pool, DP is displayed. For a Dynamic Tiering pool, DT is displayed. For a Dynamic Provisioning for Mainframe pool, Mainframe DP is displayed. For a Dynamic Tiering for Mainframe pool, Mainframe DT is displayed. For a Thin Image pool, TI is displayed.
Number of V-VOLs	Displays the number of V-VOLs associated with the pool, and the maximum number of V-VOLs that can be associated with the pool.

Item	Description
	If you select a Dynamic Provisioning, Dynamic Tiering, Dynamic Provisioning for Mainframe, or a Dynamic Tiering for Mainframe pool, this item appears.
Number of Primary VOLs	Displays the number of primary volumes of Thin Image pairs that are associated with the pool. If you select a Thin Image pool, this item appears.
Number of Pool VOLs	Displays the number of pool-VOLs set for the pool, and the maximum number of pool-VOLs that can be set for the pool.
Tier Management	If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual of performance monitoring and tier relocation is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Mode	Displays the monitoring mode that is set for the pool. If the continuous mode is enabled, Continuous Mode is displayed. If the period mode is enabled, Period Mode is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Status	Displays the status of pool monitoring. If the monitoring is being performed, In Progress is displayed. A hyphen (-) is displayed other than this case.
Pool Management Task (Status/Progress)	Displays the status and progress ratio of the pool management task being performed to the pool, and average progress ratio of the each V-VOL in the pool. Waiting for Rebalance: The rebalance process is being waited. Rebalancing: The rebalance process is being performed. Waiting for Relocation: The tier relocation process is being waited. Relocating: The tier relocation process is being performed. Waiting for Shrink: The pool shrinking process is being waited. Shrinking: The pool shrinking process is being performed. Hyphen (-): The pool management task is not being performed to the pool. Because the progress of the pool management task is calculated after the progress of the V-VOL management task was calculated, the following values displayed on the Virtual Volume table may not correspond with the value displayed on this item. • Pool Management Task - Status • Pool Management Task - Progress(%) For details about the tier relocation, see the tier relocation log file. For details about the table items of the tier relocation log file, see Tier relocation log file contents on page 5-42.
Relocation Result	Displays the status of the tier relocation processing. In Progress: The status of **Pool Management Task** is **Waiting for Relocation** or **Relocating**.

Item	Description
	Completed: The tier relocation operation is not in progress, or the tier relocation is complete. Uncompleted (n% relocated): The tier relocation is suspended at the indicated percentage progression. Hyphen (-): The pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.
Capacity - Used/Total	Displays the used and total pool capacity. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field.
Capacity - Free	Displays the free and formatted pool capacity. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field.

Virtual Volume table

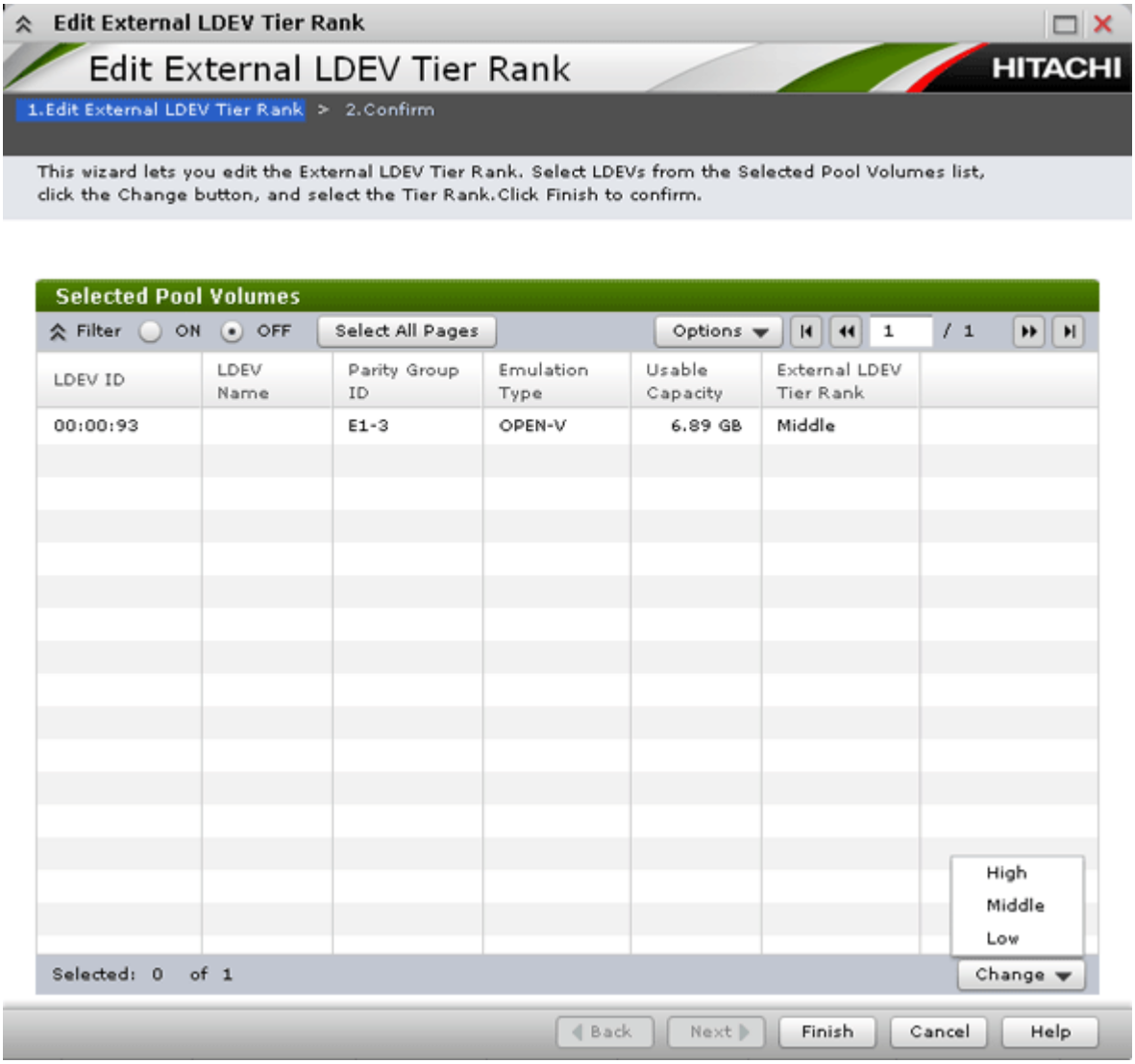
If you select a Dynamic Provisioning, Dynamic Tiering, Dynamic Provisioning for Mainframe, or a Dynamic Tiering for Mainframe pool, this table is displayed.

Item	Description
LDEV ID	Displays the LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Pool Management Task - Status	Displays the pool management task being performed to the pool. Waiting for Rebalance: The rebalance process is being waited. Rebalancing: The rebalance process is being performed. Waiting for Relocation: The tier relocation process is being waited. Relocating: The tier relocation process is being performed. Waiting for Shrink: The pool shrinking process is being waited. Shrinking: The pool shrinking process is being performed. Hyphen (-): The pool management task is not being performed to the pool.
Pool Management Task - Progress(%)	Displays V-VOL progress percentage (%) of the pool management task being performed. A hyphen (-) is displayed when the pool management task is not performed.
V-VOL Management Task - Status	Displays the V-VOL management task being performed to V-VOL. Reclaiming Zero Pages: The zero page reclaim processing that is being performed. Waiting for Zero Page Reclaiming: The zero page reclaim processing

Item	Description
	Hyphen (-): The V-VOL management task is not being performed to V-VOL.
V-VOL Management Task - Progress(%)	Displays the progress percentages (%) of the V-VOL management task being performed. A hyphen (-) is displayed when the V-VOL management task is not performed.
Emulation Type	Displays the emulation type.
Capacity - Total	Displays the V-VOL capacity.
Capacity - Used	Displays the V-VOL used capacity. The displayed value of **Total** might be larger than the displayed value of **Used** due to following reasons: • **Used** displays the used V-VOL capacity which is rounded up on each page. • If the emulation type is 3390-A, the used capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl). • If the emulation type is 3390-A and the TSE Attribute is set to Enable, the used capacity of V-VOL includes the management area capacity.
Capacity - Used(%)	Displays the V-VOL usage ratio.
Tiering Policy	Displays the tiering policy name and ID. All(0): Policy set when all tiers in the pool are used. Level1(1) - Level31(31): One of the policies from Level1 to Level31 is set. Hyphen (-): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
New Page Assignment Tier	Displays the new page assigned tier. High: High is set to V-VOL. Middle: Middle is set to V-VOL. Low: Low is set to V-VOL. Hyphen (-): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
Tier Relocation	Displays whether tier relocation is set to enable or disable. If the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL is not used, a hyphen (-) is displayed.
Relocation Priority	Displays the relocation priority. Prioritized: The priority is set to V-VOL. Blank: The priority is not set to V-VOL. Hyphen (-): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL or the tier relocation function is disabled.
Attribute	Displays the attribute of the LDEV. TSE: TSE-VOL. Hyphen (-): Volume in which the attribute is not defined.

Edit External LDEV Tier Rank wizard

Edit External LDEV Tier Rank window

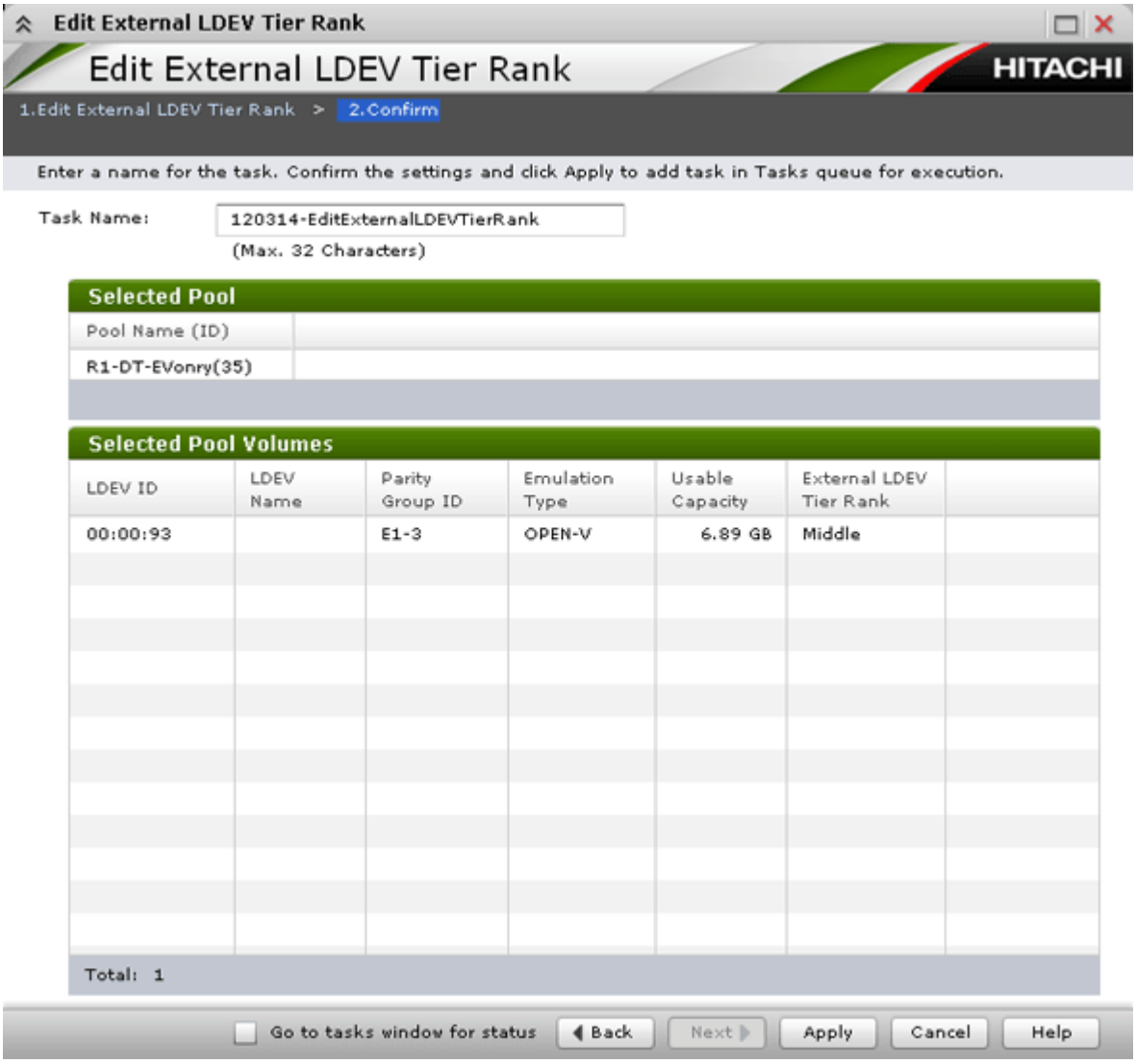


Selected Pool Volumes table

Item	Description
LDEV ID	Displays the combination of the LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Parity Group ID	Displays the parity group ID.
Emulation Type	Displays the emulation type.

Item	Description
Usable Capacity	Displays available capacity of page boundaries in a pool-VOL by the specified unit. For the pool-VOL with system area, the displayed capacity does not include the capacity of the management area.
External LDEV Tier Rank	Displays the tier rank of the external volume.
Change	Changes the tier rank of the selected pool-VOL to High, Middle, or Low.

Edit External LDEV Tier Rank Confirm window



Selected Pool table

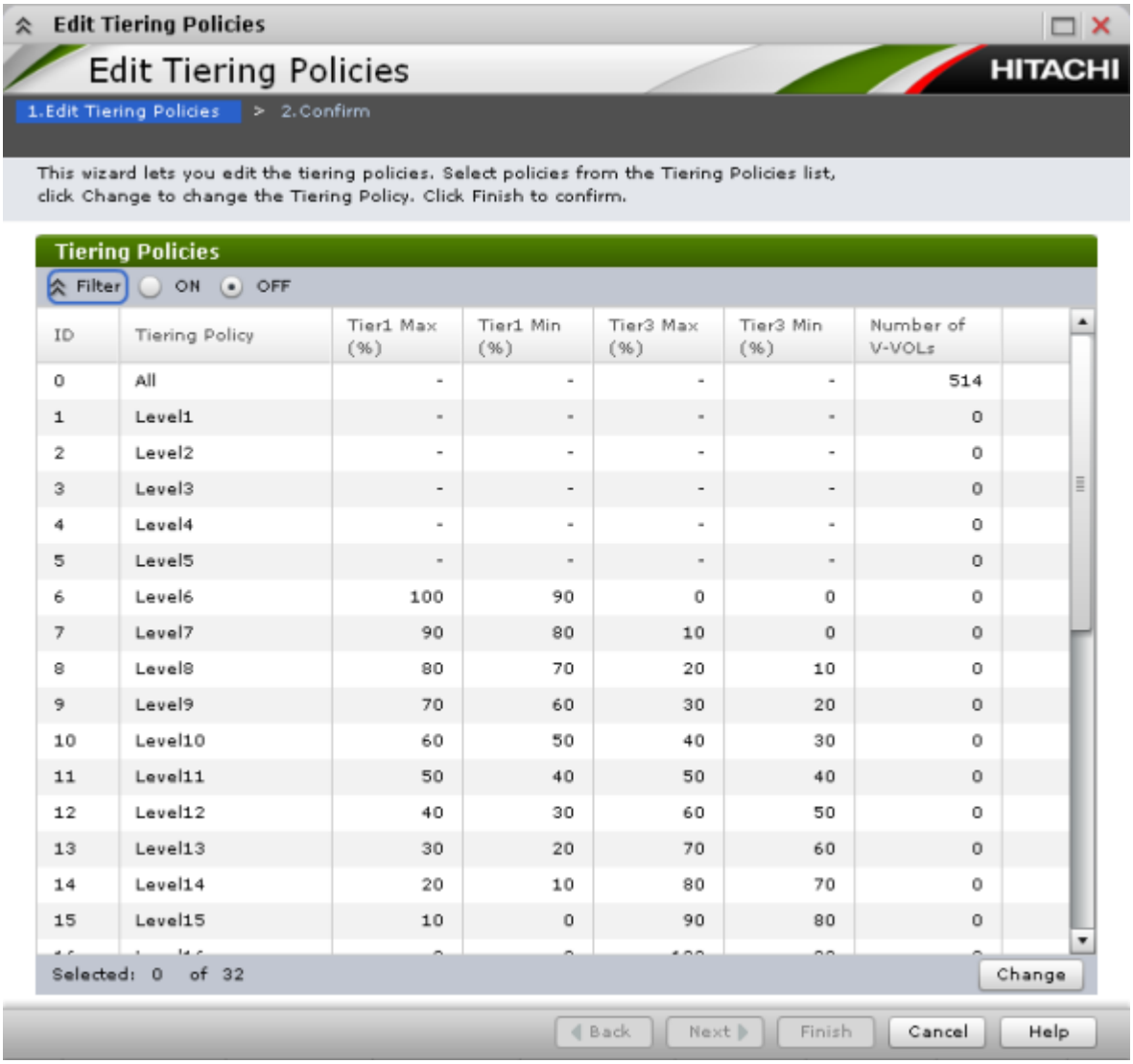
Item	Description
Pool Name (ID)	Displays the pool name and pool ID.

Selected Pool Volumes table

Item	Description
LDEV ID	Displays the combination of the LDKC, CU, and LDEV.
LDEV Name	Displays the LDEV name.
Parity Group ID	Displays the parity group ID.
Emulation Type	Displays the emulation type.
Usable Capacity	Displays available capacity of page boundaries in a pool-VOL by the specified unit. For the pool-VOL with system area, the displayed capacity does not include the capacity of the management area.
External LDEV Tier Rank	Displays the tier rank of the external volume.

Edit Tiering Policies wizard

Edit Tiering Policies window

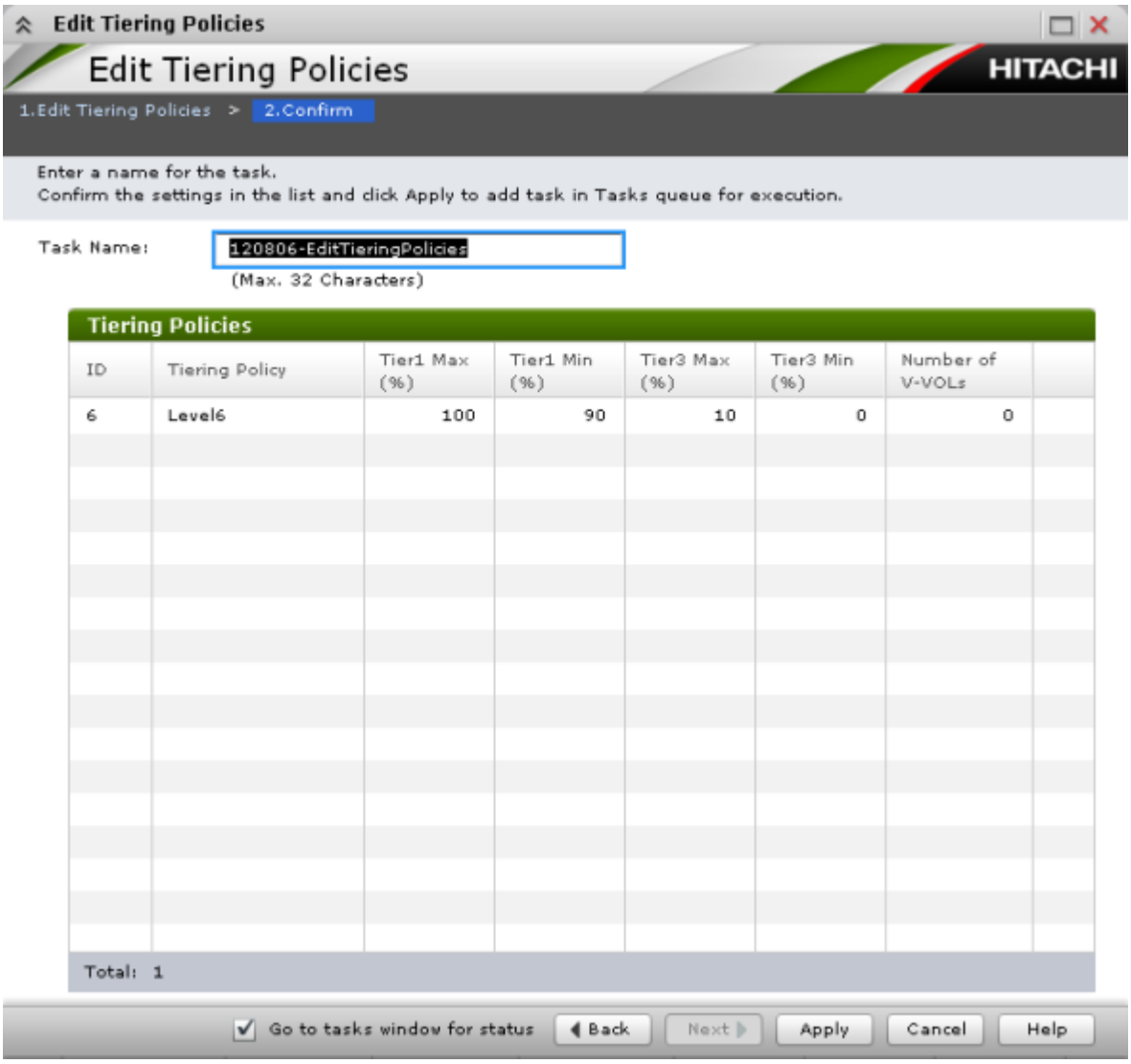


Tiering Policies table

Item	Description
ID	Displays the ID of the tiering policy.
Tiering Policy	Displays the name of the tiering policy.
Tier1 Max(%)	Displays the maximum percentage that is allocated to tier 1 in the total capacity to which tier relocation is performed. For a policy with an ID from 0 to 5, a hyphen (-) is displayed.

Item	Description
Tier1 Min(%)	Displays the minimum percentage that is allocated to tier 1 in the total capacity to which tier relocation is performed. For a policy whose ID is from 0 to 5, a hyphen (-) is displayed.
Tier3 Max(%)	Displays the maximum percentage that is allocated to tier 3 in the total capacity to which tier relocation is performed. For a policy with an ID from 0 to 5, a hyphen (-) is displayed.
Tier3 Min(%)	Displays the minimum percentage that is allocated to tier 3 in the total capacity to which tier relocation is performed. For a policy whose ID is from 0 to 5, a hyphen (-) is displayed.
Number of V-VOLs	Displays the number of V-VOLs to which the tiering policy is set.
Change	Displays the Change Tiering Policy window when you select the row and click this button. A policy with an ID is from 0 to 5 cannot be changed.

Edit Tiering Policies Confirm window

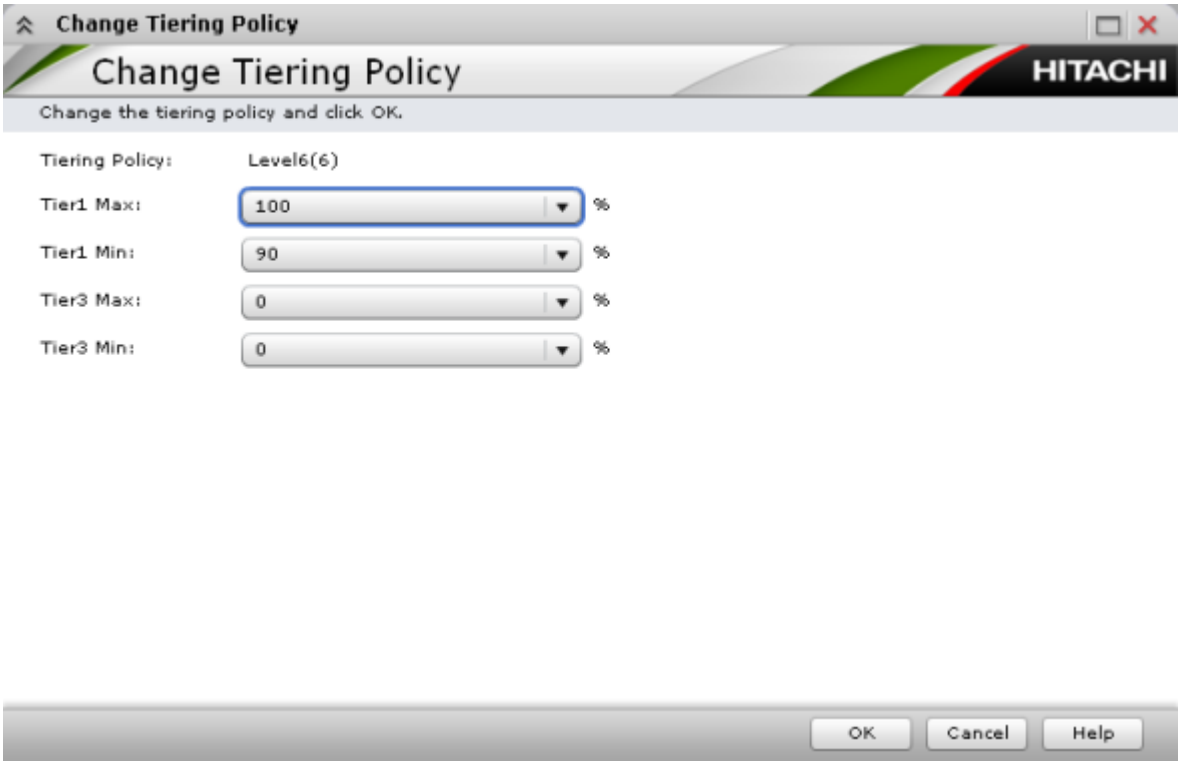


Tiering Policies table

Item	Description
ID	Displays the ID of the tiering policy.
Tiering Policy	Displays the name of the tiering policy.
Tier1 Max(%)	Displays the maximum percentage that is allocated to tier 1 in the total capacity to which tier relocation is performed. For a policy with an ID from 0 to 5, a hyphen (-) is displayed.
Tier1 Min(%)	Displays the minimum percentage that is allocated to tier 1 in the total capacity to which tier relocation is performed. For a policy whose ID is from 0 to 5, a hyphen (-) is displayed.

Item	Description
Tier3 Max(%)	Displays the maximum percentage that is allocated to tier 3 in the total capacity to which tier relocation is performed. For a policy with an ID from 0 to 5, a hyphen (-) is displayed.
Tier3 Min(%)	Displays the minimum percentage that is allocated to tier 3 in the total capacity to which tier relocation is performed. For a policy whose ID is from 0 to 5, a hyphen (-) is displayed.
Number of V-VOLs	Displays the number of V-VOLs to which the tiering policy is set.

Change Tiering Policy Window



Change Tiering Policy table

Item	Description
Tiering Policy	Displays the tiering policy name and policy ID.
Tier1 Max(%)	Select the maximum percentage that is allocated to tier 1 in the total capacity for the tier relocation from 0 (%) to 100 (%). The setting value is needed to satisfy either one of following conditions: Equal to Tier1 Min

Item	Description
	Bigger than Tier1 Min
Tier1 Min(%)	Select the minimum percentage that is allocated to tier 1 in the total capacity for the tier relocation from 0 (%) to 100 (%). The setting value is needed to satisfy either one of following conditions: Equal to Tier1 Max Smaller than Tier1 Max
Tier3 Max(%)	Select the maximum percentage that is allocated to tier 3 in the total capacity for the tier relocation from 0 (%) to 100 (%). The setting value is needed to satisfy either one of following conditions: Equal to Tier1 Min Bigger than Tier1 Min
Tier3 Min(%)	Select the minimum percentage that is allocated to tier 3 in the total capacity for the tier relocation from 0 (%) to 100 (%). The setting value is needed to satisfy either one of following conditions: Equal to Tier1 Max Smaller than Tier1 Max
* The total of Tier1 Min and Tier3 Min must be 100(%) or less.	

Data Retention Utility GUI reference

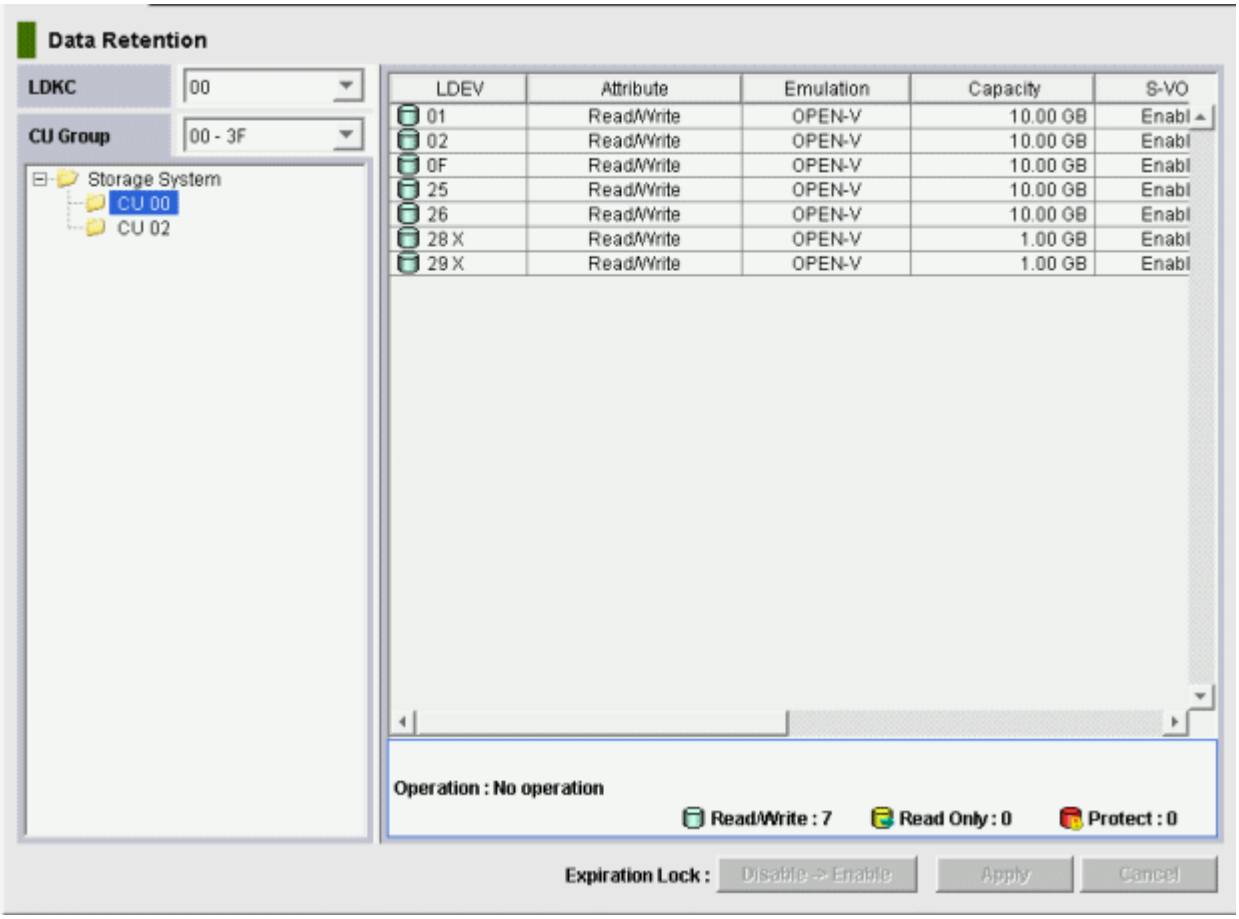
Sections in this appendix describe the windows, wizards, and dialog boxes of the Data Retention Utility used to assign access attributes to open-system volumes.

For information about common Storage Navigator operations such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

- ☐ Data Retention window
- ☐ Error Detail Dialog Box

Data Retention window

Use the Data Retention window to assign an access attribute to open-system volumes.



Item	Description
LDKC	Select the LDKC that contains the desired CU groups.
CU Group	Select the CU group that contains the desired CUs from the following: • 00-3F: CUs from 00 to 3F appear in the tree. • 40-7F: CUs from 40 to 7F appear in the tree. • 80-BF: CUs from 80 to BF appear in the tree. • C0-FE: CUs from C0 to FE appear in the tree.
Tree	A list of CUs. Selecting a CU provides the selected CU information in the volume list on the right of the tree. This tree appears only the CUs that include volumes to which access attributes can be actually set.
Volume list	Lists information about the CU selected in the tree. See the table below for details.
Expiration Lock	Enables or disables enhanced volume protection.

Item	Description
	• Disable -> Enable: Indicates the expiration lock is disabled. You can change an access attribute to read/write when the retention term is over. • Enable -> Disable: Indicates the expiration lock is enabled. You cannot change an access attribute to read/write even when the retention term is over.
Apply	Applies settings to the storage system.
Cancel	Discards setting changes.

Volume list

The volume list provides information about access attributes that are assigned to volumes.

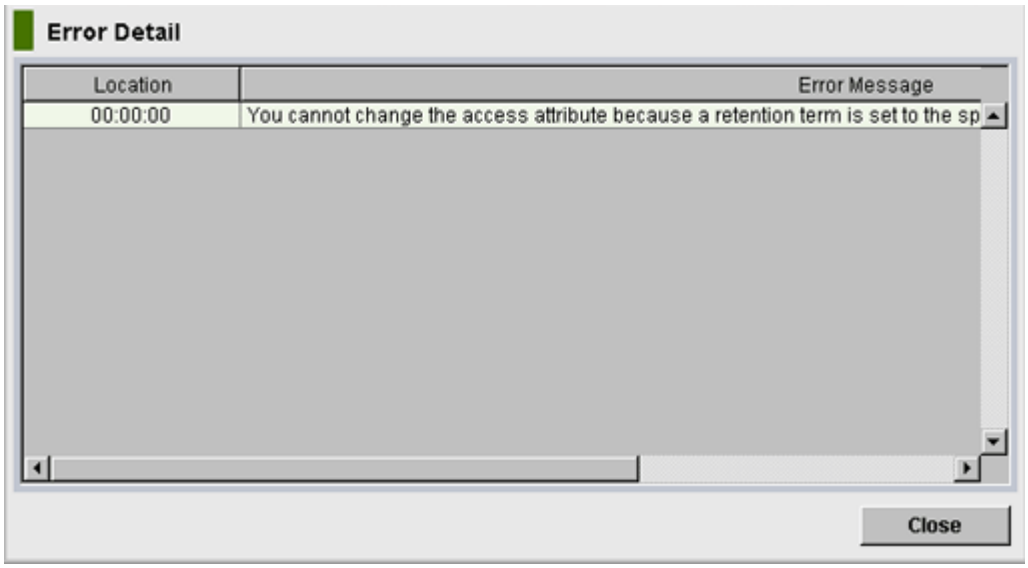
If multiple volumes are combined in a LUSE volume, the top volume appears on the volume list, but the other volumes do not appear on the list. For example, if you create a LUSE volume by combining three volumes from #03 to #05 among the volumes that belong to CU01, volume #03 appears on the volume list, but volumes #04 and #05 do not appear.

Item	Description
LDEV	LDEV number. • : Read/write • : Read-only • : Protect The symbol beside the LDEV number indicates: • *#*: an external volume • *V*: a virtual volume • *X*: a virtual volume used for Dynamic Provisioning Note that, if multiple volumes are combined in a LUSE volume, the Data Retention Utility counts these volumes as one volume. For example, if you combine five volumes into a LUSE volume, the number of these volumes is not assumed to be one but is assumed to be five.
Attribute	Access attribute assigned to this volume. These attributes can be assigned using the Command Control Interface (CCI). • Read/Write: Both read and writer operations are permitted on the logical volume. • Read-only: Read operations are permitted on the logical volume. • Protect: Neither read nor write operations are permitted.
Emulation	Volume emulation types. If an asterisk and a number appear, the volume is a LUSE volume. For example, *OPEN-3*36* indicates a LUSE volume in which 36 volumes are combined.

Item	Description
	Only the top volume appears in the list. To view all the volumes, right-click the volume and select **Volume Detail**.
Capacity	Capacity of each volume in GB to two decimal places.
S-VOL	Indicates whether the volume can be specified as a secondary volume (S-VOL). You can also use the CCI to specify whether each volume can be used as an S-VOL.
Reserved	Indicates the method that can be used to make LU path and command device settings. • Hyphen (-): Both CCI and Storage Navigator can be used to make LU path and command device settings. • CCI: Only CCI can be used to make LU path and command device settings. Storage Navigator cannot be used to do so.
Retention Term	Period (in days) when you are prohibited from changing access attribute to read/write. The retention term can be extended but cannot be shortened. During the retention term, you can change read-only to protect, or vice versa. • 500 days. Attempts to change access attribute to read/write are prohibited in the next 500 days. • Unlimited: The retention term is extended with no limits. • 0 days: You can change access attribute to read/write. **Caution:** In Data Retention Utility, you can increase the value for Retention Term, but cannot decrease the value.
Path	Number of LU paths.
Mode	Indicates the mode that the CCI user assigns to the volume. You cannot use Storage Navigator to change modes. You must use the CCI to change modes. • Zer: Zero Read Cap mode is assigned to the volume. If the Read Capacity command (which is a SCSI command) is issued to a volume in Zero Read Cap mode, it will be reported that the capacity of the volume is zero. • Inv: Invisible mode is assigned to the volume. If the Inquiry command (which is a SCSI command) is issued to a volume in Invisible mode, it will be reported that the volume does not exist. Therefore, the hosts will be unable to recognize the volume. • Zer/Inv. Both Zero Read Cap mode and Invisible mode are assigned to the volume. • Hyphen (-): No mode is assigned by CCI to the volume.
Operation	Target of the operation or the name of the operation. When no operation is performed, **No Operation** appears. Also shown are the volume icons and the total number of volumes with each access attribute.

Error Detail Dialog Box

If an error occurs with the Data Retention Utility, the Error Detail dialog box appears. The Error Detail dialog box displays error locations and error messages. For troubleshooting information related to the Data Retention Utility, see Troubleshooting Data Retention Utility on page 8-8.



The items and descriptions of the Error Detail dialog box follow.

Item	Description
Location	Shows the location where the error occurred. If the error relates to a volume, this column displays the LDKC number, the CU number, and the LDEV number.
Error Message	Displays error messages. For information on solutions, see *Hitachi Storage Navigator Messages*.
Close	Closes the Error Detail dialog box.

G

LUN Manager GUI reference

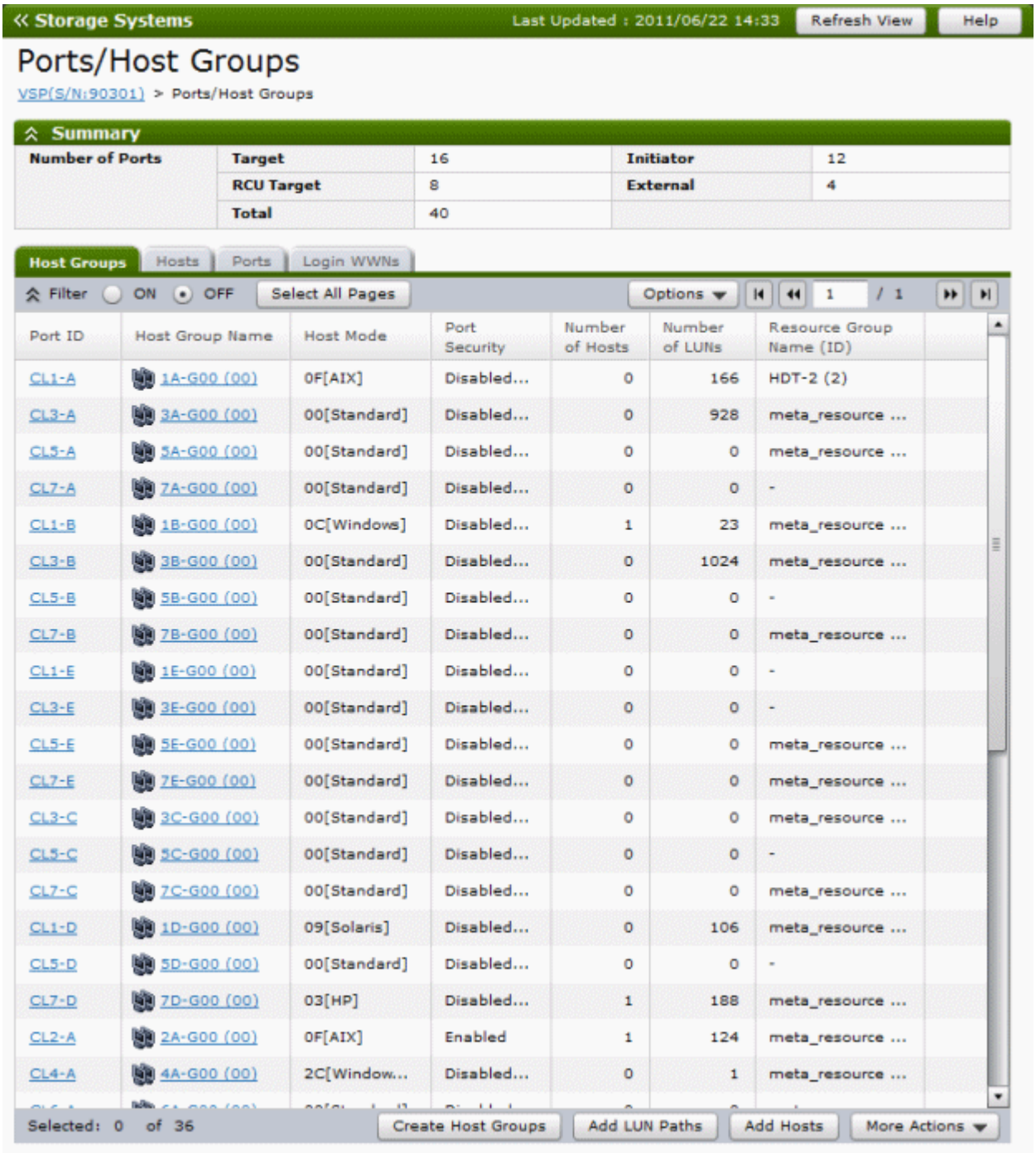
Sections in this appendix describe the LUN Manager windows, wizards, and dialog boxes used in managing logical units.

For information about common Storage Navigator operations such as using navigation buttons and creating tasks, see the *Hitachi Storage Navigator User Guide*.

- ☐ Port/Host Groups window after selecting Ports/Host Groups
- ☐ Port/Host Groups window after selecting a port under Ports/Host Groups
- ☐ Port/Hosts window when selecting a host group under the port of Ports/ Host Groups
- ☐ Add LUN Paths wizard
- ☐ Create Host Groups wizard
- ☐ Edit Host Groups wizard
- ☐ Add to Host Groups wizard (when specific host is selected)
- ☐ Add Hosts wizard (when specific hosts group is selected)
- ☐ Delete LUN Paths wizard
- ☐ Edit Host wizard
- ☐ Edit Ports wizard
- ☐ Create Alternative LUN Paths wizard

- Copy LUN Paths wizard
- Remove Hosts wizard
- Edit UUIDs wizard
- Add New Host window
- Change LUN IDs window
- Delete Host Groups window
- Delete Login WWNs window
- Delete UUIDs window
- Host Group Properties window
- LUN Properties window
- Authentication window
- Edit Command Devices wizard
- Host-Reserved LUNs window
- Release Host-Reserved LUNs wizard
- View Login WWN Status window

Port/Host Groups window after selecting Ports/Host Groups



- Summary on page G-4
- Host Groups tab on page G-4
- Hosts tab on page G-4
- Ports tab on page G-5
- Login WWNs tab on page G-6

Summary

Item	Description
Target	Total number of target ports.
RCU Target	Total number of RCU Target ports.
Initiator	Total number of Initiator ports.
External	Total number of External ports.
Total	Total number of ports.

Host Groups tab

This tab provides information about the host groups that are assigned to the logged-on user.

Item	Description
Port ID	Identifier of the port. Clicking a port ID opens the port information window.
Host Group Name	Icons and names of the host group. Clicking a host group name opens the host group information window where you can view information about that host group.
Host Mode	Host mode of the host group.
Port Security	LUN security setting (enabled or disabled) on the port.
Number of Hosts	Number of hosts set to the relevant port.
Number of LUNs	Number of logical units.
Resource Group Name (ID)	Resource group name and identifier of the host groups.
Create Host Groups	Opens the Create Host Groups window.
Add LUN Paths	Opens the Add LUN Paths window.
Add Hosts	Opens the Add Hosts window.
Delete Host Groups*	Opens the Delete Host Groups window.
Edit Host Groups*	Opens the Edit Host Groups window.
Create Alternative LUN Paths*	Opens the Create Alternative LUN Paths window.
Export*	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.
*Available by clicking **More Actions**.	

Hosts tab

This tab provides information about the HBA WWNs that are registered to the host groups assigned to the logged-on user.

Item	Description
Port ID	Identifier of the port. Clicking a port ID opens the port information window.
HBA WWN	HBA WWNs and their icons.
Host Name	Name of hosts.
Host Group Name	Name of the host group.
Add to Host Groups	Opens the Add to Host Groups window.
Edit Host	Opens the Edit Host window.
Remove Hosts	Opens the Remove Hosts window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Ports tab

This tab provides information about the ports assigned to the logged-on user.

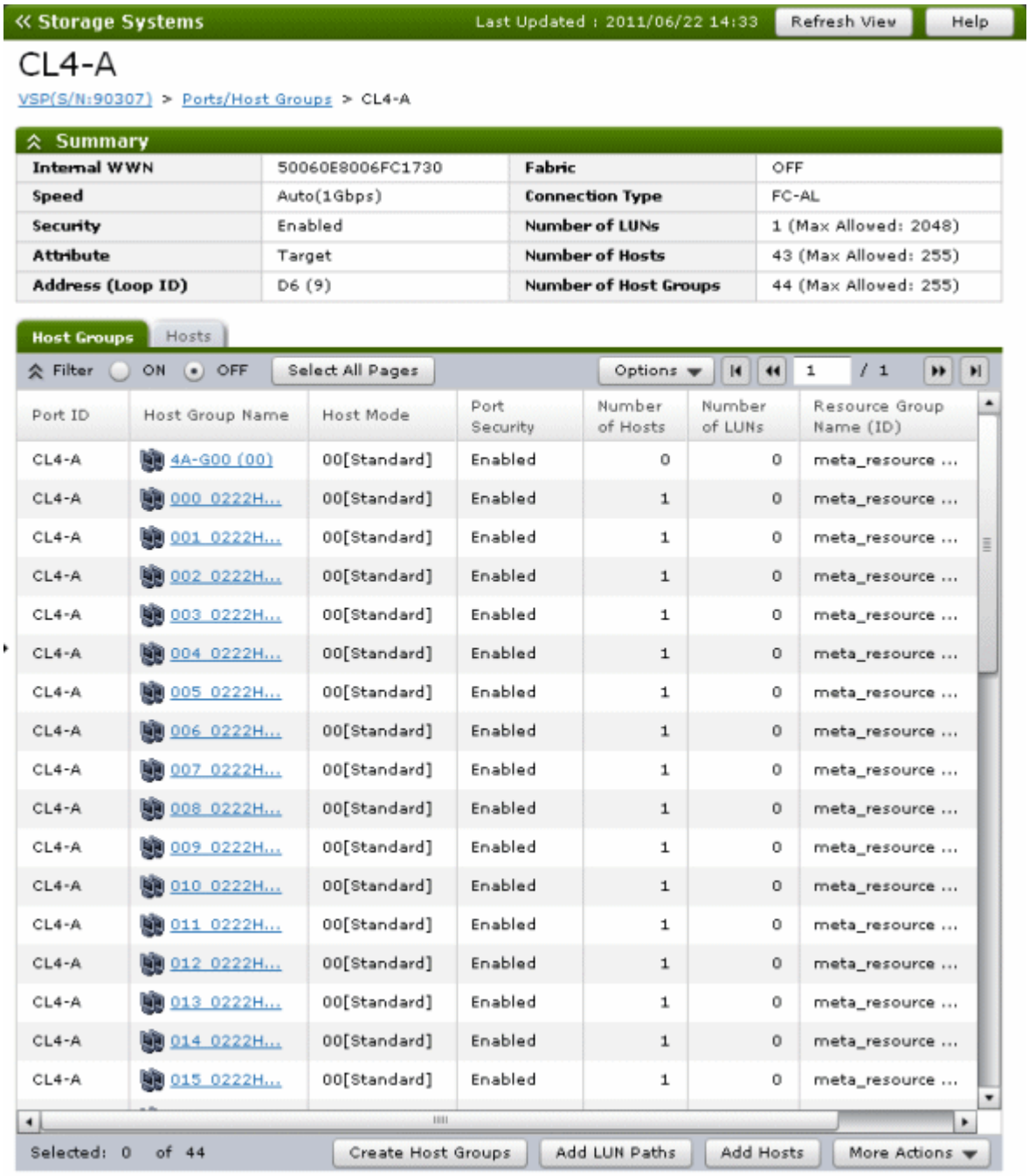
Item	Description
Port ID	Identifier of the port. Clicking a port ID opens the port information window.
Internal WWN	WWN of the port.
Speed	Data transfer speed for the selected fibre channel port in the unit of Gbps (Gigabit per second). Valid speeds are 1, 2, 4, or 8, or 10 Gbps. If Auto is set for the port speed, Auto (1, 2, 4, 8, or 10 Gbps) appears. The value enclosed in parentheses is defined by the storage system.
Security	LUN security setting (enable or disable) on the port.
Type	Type of the port.
Address (Loop ID)	Address of the port.
Fabric	Indicates whether a fabric switch is used.
Connection Type	Topology of the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.

Item	Description
Resource Group Name (ID)	Resource group names and IDS of the ports
ENode MAC address*	The static MAC address assigned by the FCoE controller.
VLAN ID*	Unique identifier of the VLAN.
FPMA*	Dynamic MAC address assigned by the FCoE switch.
VP Index*	Management number of the FCoE switch.
VP Status*	Status of the virtual ports • Link Down • Link Up (Logged In) • Link UP (Logged Out)
Edit Ports	Opens the Edit Ports window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.
*This item does not appear in the window by default. To show this item in the window, change the display settings in the **Column Settings** window for the table option. For details, see the *Hitachi Storage Navigator User Guide*.	

Login WWNs tab

Item	Description
Port ID	Identifier of the port. Clicking a port ID opens the port information window.
HBA WWN	HBA WWNs and their icons.
Host Name	Name of the host.
Host Group Name	Name of the host group.
Add to Host Groups	Opens the Add to Host Groups window.
Delete Login WWNs	Opens the Delete Login WWNs window.
View Login WWN Status	Opens the View Login WWN Status window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Port/Host Groups window after selecting a port under Ports/Host Groups



- Summary on page G-8
- Host Groups tab on page G-8
- Hosts tab on page G-9

Summary

Item	Description
Internal WWN	WWN of the port.
Speed	Data transfer speed for the selected fibre channel port in the unit of Gbps (Gigabit per second). Valid speeds are 1, 2, 4, or 8, or 10 Gbps. If Auto is set for the port speed, Auto (1, 2, 4, 8, or 10 Gbps) appears. The value enclosed in parentheses is defined by the storage system.
Security	LUN security setting (enable or disable) on the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Address (Loop ID)	Address of the selected port.
Fabric	Indicates whether a fabric switch is used.
Connection Type	Topology of the selected port.
Number of LUNs	Total number of logical units set to the relevant port, and the maximum number of logical units that can be registered to the port. When an initiator port or external port is selected, a hyphen (-) appears.
Number of Hosts	Total number of hosts set to the relevant port, and the maximum number of hosts that can be registered to the port. When an initiator port or external port is selected, a hyphen (-) appears.
Number of Host Groups	Total number of host groups set to the relevant port, and the maximum number of host groups that can be registered to the port. When an initiator port or external port is selected, the maximum number is not available.

Host Groups tab

This tab provides information about the host groups assigned to the logged-on user.

Caution: For the initiator port, only host group 0(zero) is displayed to enable you to set a host mode option. For details about host mode options, see Host mode options on page 7-11.

Item	Description
Port ID	Identifier of the port.

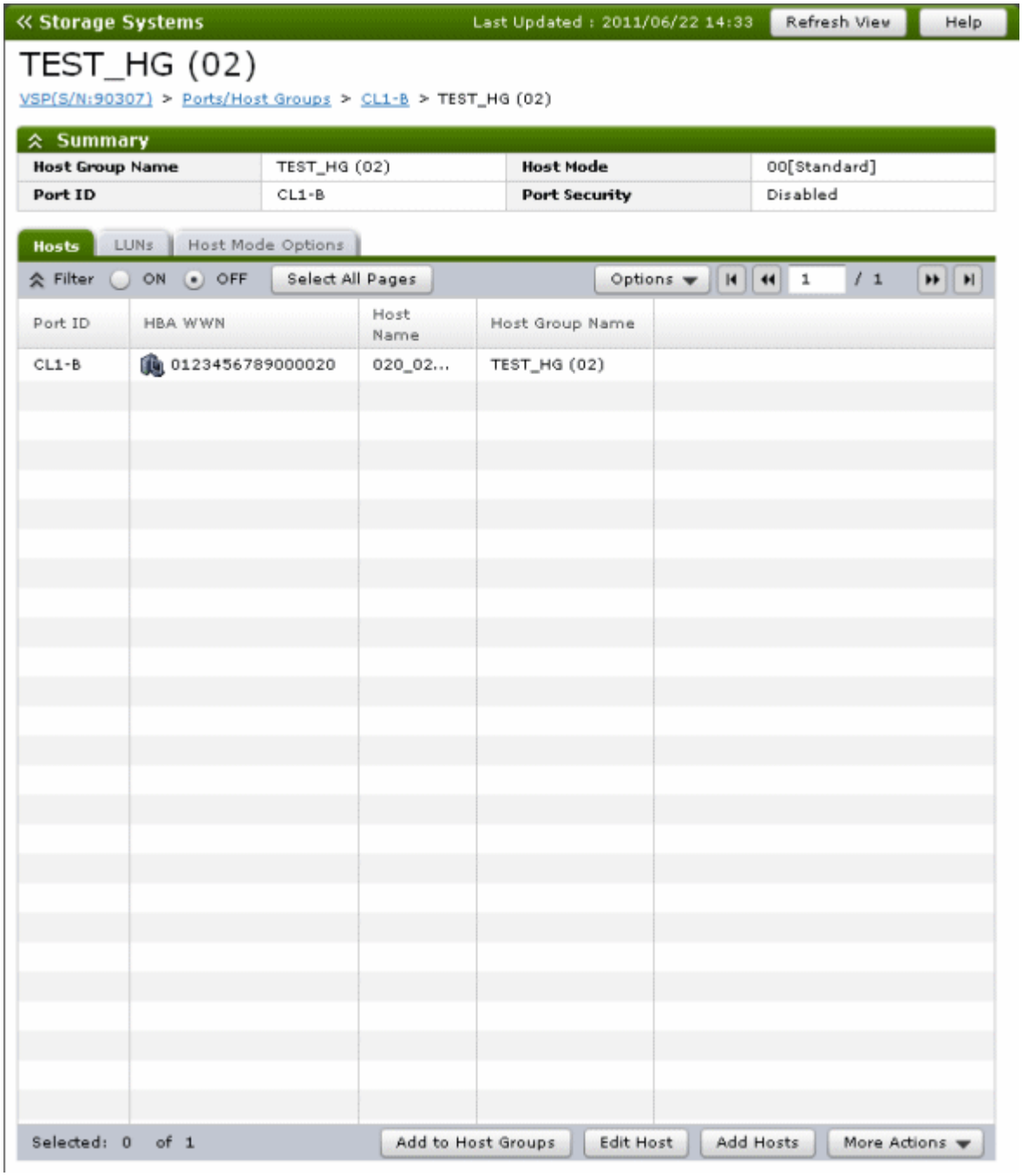
Item	Description
Host Group Name	Icons and names of host groups. Clicking a host group name opens the host group information window.
Host Mode	Host mode of the host group.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts in the host group.
Number of LUNs	Number of logical units in the host group.
Resource Group Name (ID)	Resource group name and ID of the host group. If the port is the initiator port, a hyphen (-) is displayed.
Create Host Groups	Opens the Create Host Groups window.
Add LUN Paths	Opens the Add LUN Paths window.
Add Hosts	Opens the Add Hosts window.
Delete Host Groups*	Opens the Delete Host Groups window.
Edit Host Groups*	Opens the Edit Host Groups window.
Create Alternative LUN Paths*	Opens the Create Alternative LUN Paths window.
Export*	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.
*Available by clicking **More Actions**.	

Hosts tab

This tab provides information about the HBA WWNs that are registered to the host groups assigned to the logged-on user.

Item	Description
Port ID	Identifier of the port.
HBA WWN	HBA WWNs and their icons.
Host Name	Name of the host.
Host Group Name	Name of the host group.
Add to Host Groups	Opens the Add to Host Groups window.
Edit Host	Opens the Edit Host window.
Remove Hosts	Opens the Remove Hosts window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Port/Hosts window when selecting a host group under the port of Ports/Host Groups



- Summary on page G-11
- Hosts tab on page G-11
- LUNs tab on page G-11
- Host Mode Options tab on page G-13

Summary

Item	Description
Host Group Name	Name of the host group.
Port ID	Identifier of the port.
Host Mode	Host mode of the host group.
Port Security	LUN security setting (enable or disable) on the port.

Hosts tab

Item	Description
Port ID	Identifier of the port.
HBA WWN	HBA WWNs and their icons.
Host Name	Name of the host.
Host Group Name	Name of the host group.
Add to Host Groups	Opens the Add to Host Groups window.
Edit Host	Opens the Edit Host window.
Add Hosts	Opens the Add Hosts window
Remove Hosts*	Opens the Remove Hosts window.
Add Hosts	Opens the Add Hosts window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.
Available by clicking **More Actions**.	

LUNs tab

This tab provides information about the LU paths that correspond to the LDEV assigned to the logged-in user.

Item	Description
Port ID	Identifier of the port.
LUN ID	Icons and identifiers of the logical unit. Clicking a LUN ID opens the LUN Properties window.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV. Clicking an LDEV ID takes you to the LDEV Properties window.
LDEV Name	Name of each LDEV.
Pool Name (ID)	Displays the pool name and pool ID. If the logical volume is not the volume other than V-VOL, a hyphen (-) is displayed.

Item	Description
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity - Total	Displays the logical volume capacity.
Capacity - Used	Displays the V-VOL used capacity. The Total value displayed might be larger than the Used value due to following reasons: • Used displays the used capacity of the V-VOL that is rounded up on each page. • If the emulation type is 3390-A, the used capacity of V-VOL includes the capacity of the control cylinders (7 Cyl is required per 1,113 Cyl). If the logical volume is not the volume other than V-VOL, a hyphen (-) is displayed.
Capacity - Used(%)	Displays the V-VOL usage level. If the logical volume is not the volume other than V-VOL, a hyphen (-) is displayed.
Capacity - Tier1	Displays the used capacity of tier 1. If the logical volume is not the volume other than V-VOL, a hyphen (-) is displayed.
Capacity - Tier2	Displays the used capacity of tier 2. If the logical volume is not the volume other than V-VOL, or if tier 2 does not exist, a hyphen (-) is displayed.
Capacity - Tier3	Displays the used capacity of tier 3. If the logical volume is not the volume other than V-VOL, or if tier 3 does not exist, a hyphen (-) is displayed.
Provisioning Type	Displays the type for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
CLPR	Cache logical partition number, displayed as *ID*:*CLPR*.
Tiering Policy	Displays the tiering policy name and ID. All(0): Policy specified when all tiers in the pool are used. **Level1(1)** to **Level31(31)**: Policy selected from Level1 to Level31, set to the V-VOL. -: The logical volume is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
New Page Assignment Tier	Displays the new page assignment tier of the tiering policy. See New page assignment tier on page 5-53. -: The logical volume is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.

Item	Description
Tier Relocation	Displays whether tier relocation is set to **Enable** or **Disable**. If the logical volume is not to the V-VOL of Dynamic Tiering or Dynamic Tiering for Mainframe, a hyphen (-) is displayed.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
Access Attribute[1]	Displays the access attribute of the LDEV.
Number of Paths	Displays the total number of relevant paths and alternative paths.
Add LUN Paths	Opens the Add LUN Paths window.
Copy LUN Paths	Opens the Copy LUN Path window.
Edit Command Devices	Opens the Edit Command Devices window.
View Host-Reserved LUNs[2]	Displays the Host-Reserved LUNs window.
Delete LUN Paths[2]	Opens the Delete LUN Paths window.
Edit UUIDs[2]	Opens the Edit UUIDs window.
Export[2]	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

[1] Does not appear by default. To display this item, change the **Column Settings** of the table option. For details about the **Column Settings** window, see the Hitachi Storage Navigator User Guide.

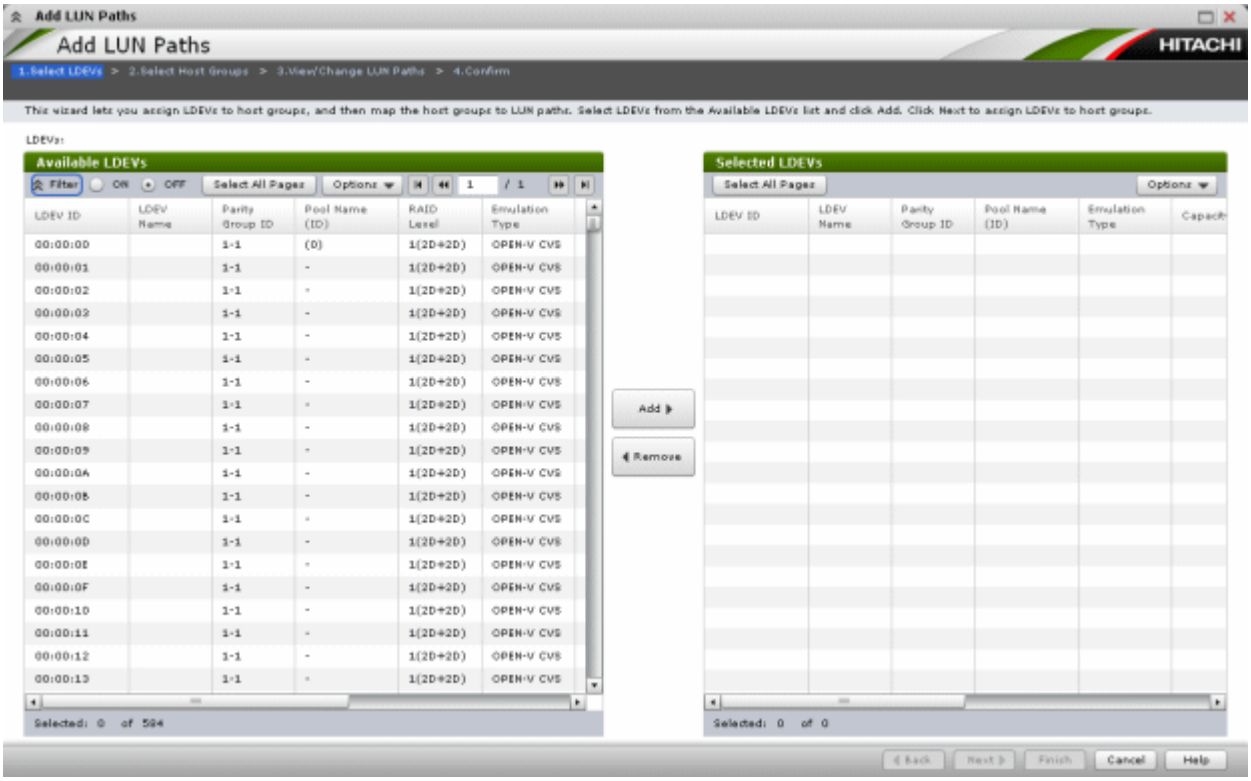
[2] Appears when you click **More Actions**.

Host Mode Options tab

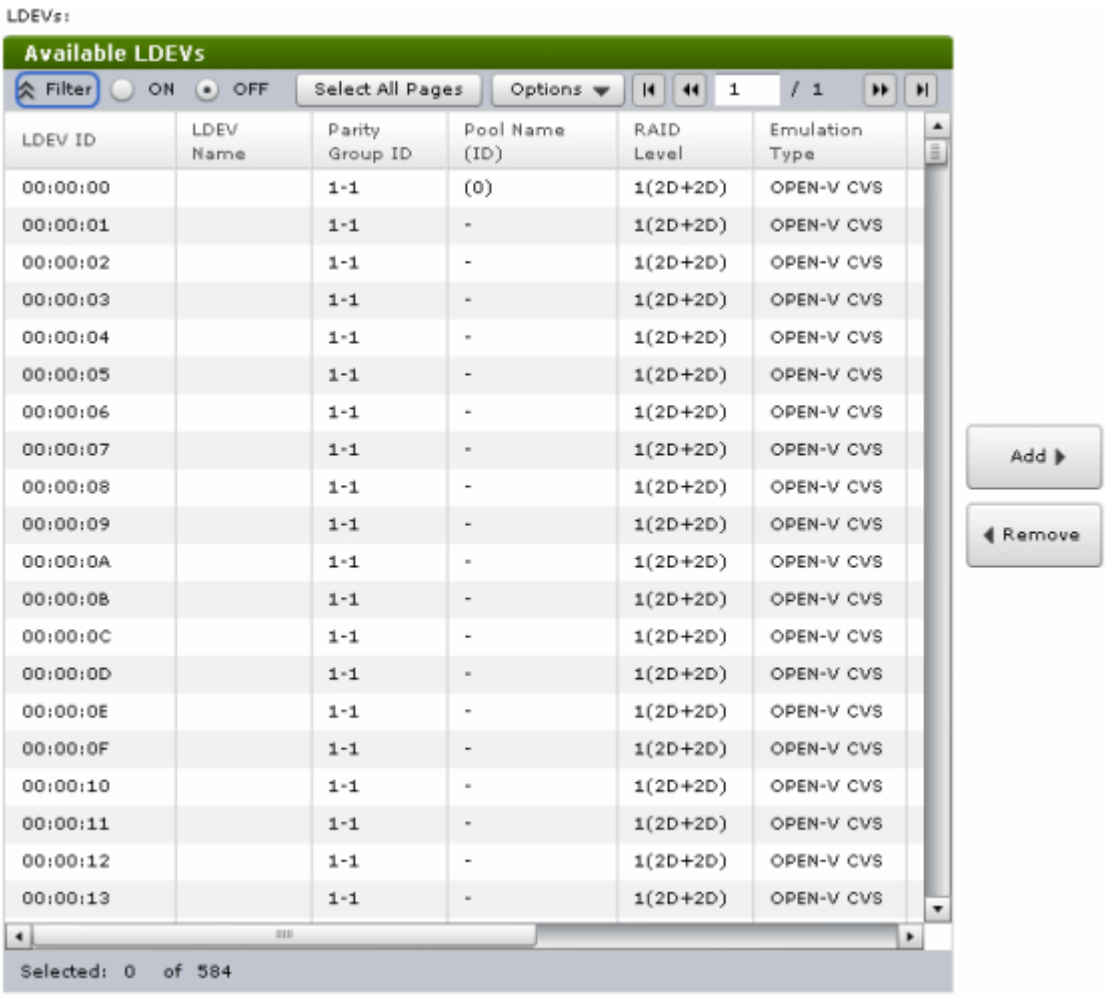
Item	Description
Mode No.	Number of the host mode option.
Option Description	Description of the host mode option.
Status	Setting (enable or disable) of the host mode option.
Edit Host Groups	Opens the Edit Host Group window.
Export	Opens a window where you can export configuration information listed in the table to a file that can be used for multiple purposes, such as backup or reporting.

Add LUN Paths wizard

Select LDEVs window



Available LDEVs table

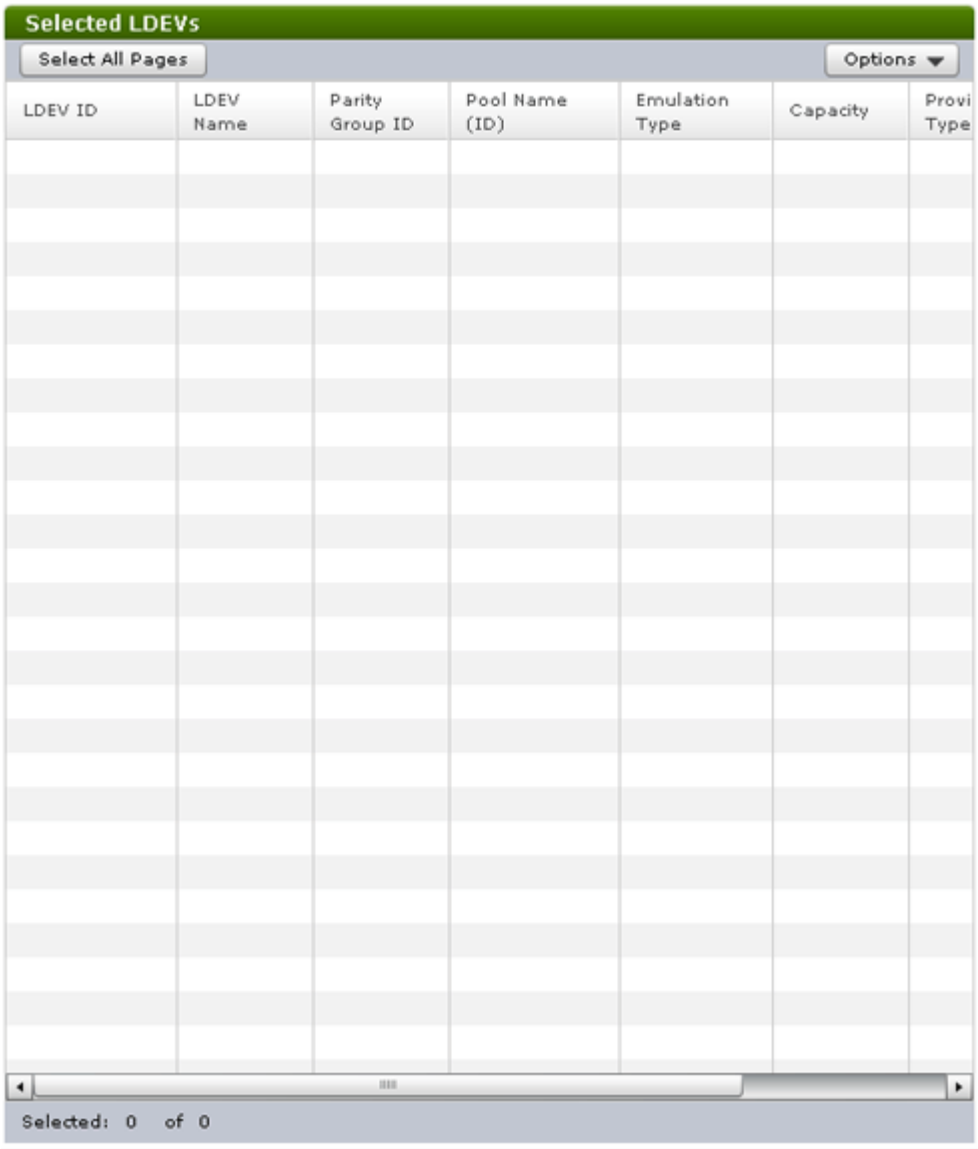


This table lists logical volumes for which LU paths can be established. Only the LDEVs available to the logged-on user are available.

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Parity Group ID	Identifier of the parity group.
Pool Name (ID)	Pool name and pool identifier. If the LDEV is not used as a pool-VOL, a hyphen (-) appears.
RAID Level	Displays the RAID level. If multiple RAID levels exist in a pool, Mixed appears in this field.

Item	Description
Emulation Type	Emulation type for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Provisioning Type	Provisioning type for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
Number of Paths	Number of paths set for the LDEV.
Resource Group Name (ID)	Resource group name and identifier of the LDEV.
Add	Adds logical volumes selected from the **Available LDEVs** table to the **Selected LDEVs** table.
Remove	Removes logical volumes from the **Selected LDEVs** table.

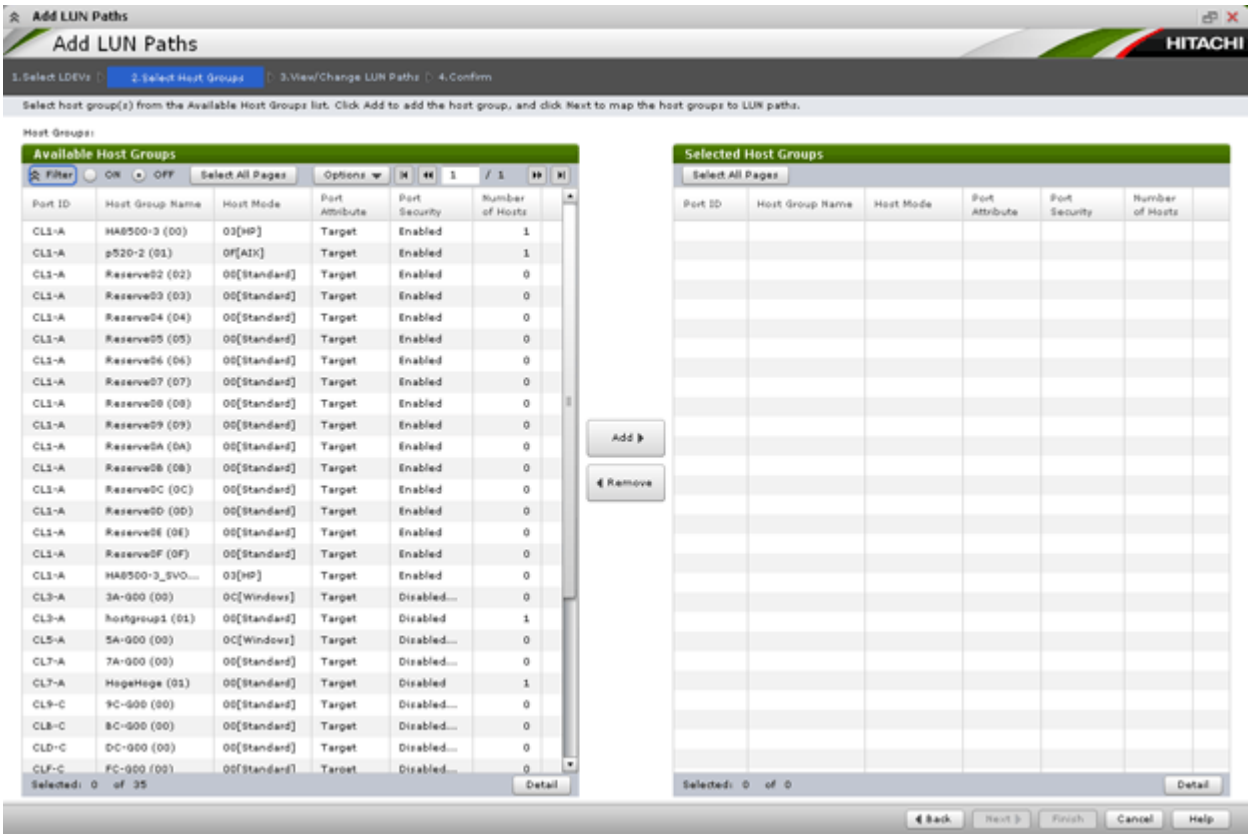
Selected LDEVs table



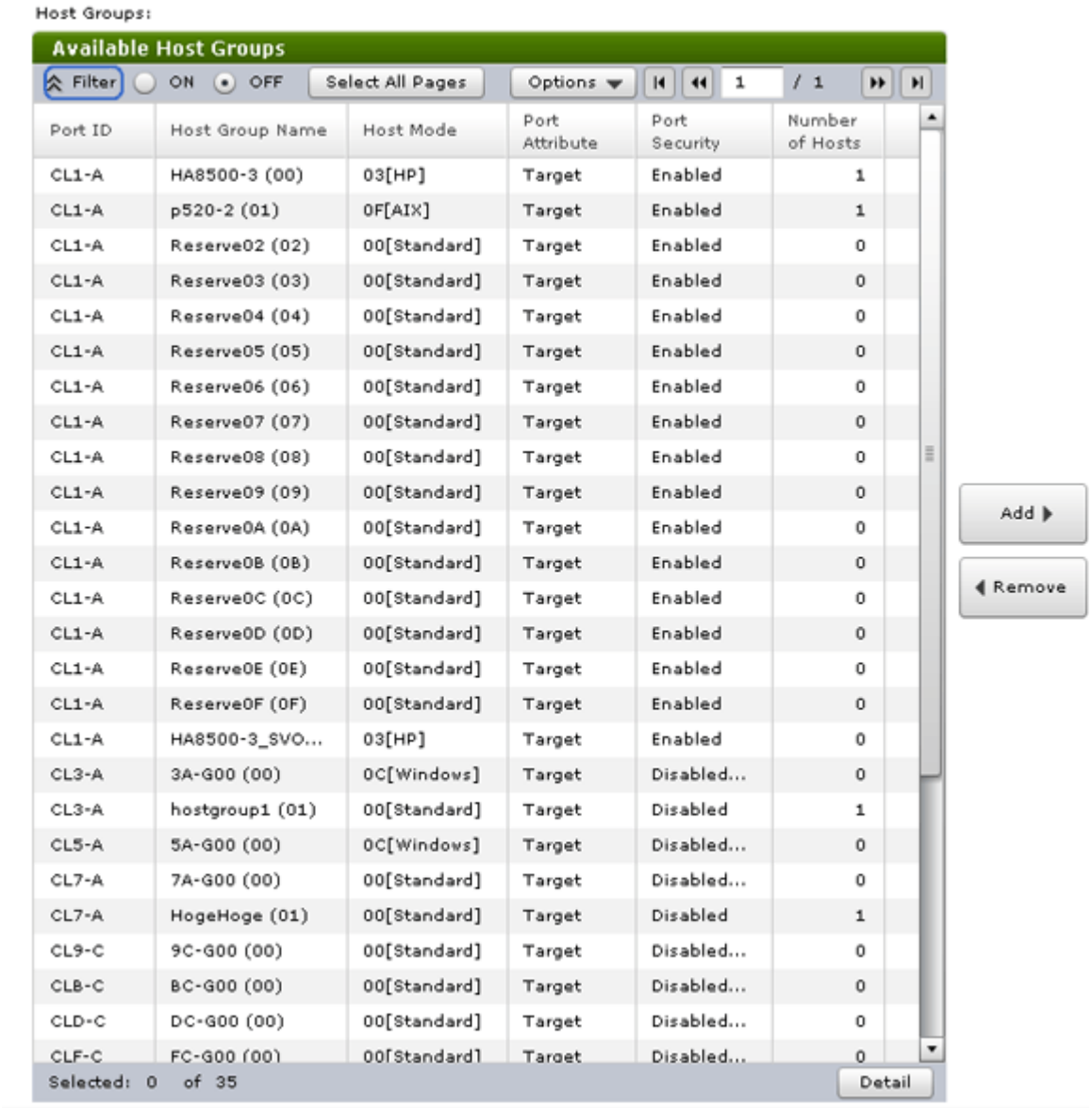
Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Parity Group ID	Identifier of the parity group.
Pool Name (ID)	Pool name and pool identifier. If the LDEV is not used as a pool-VOL, a hyphen (-) appears.

Item	Description
Emulation Type	Emulation type for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Provisioning Type	Provisioning type for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
Number of Paths	Number of paths set for the LDEV.
Resource Group Name (ID)	Resource group name and identifier of the LDEV.

Select Host Groups window



Available Host Groups table

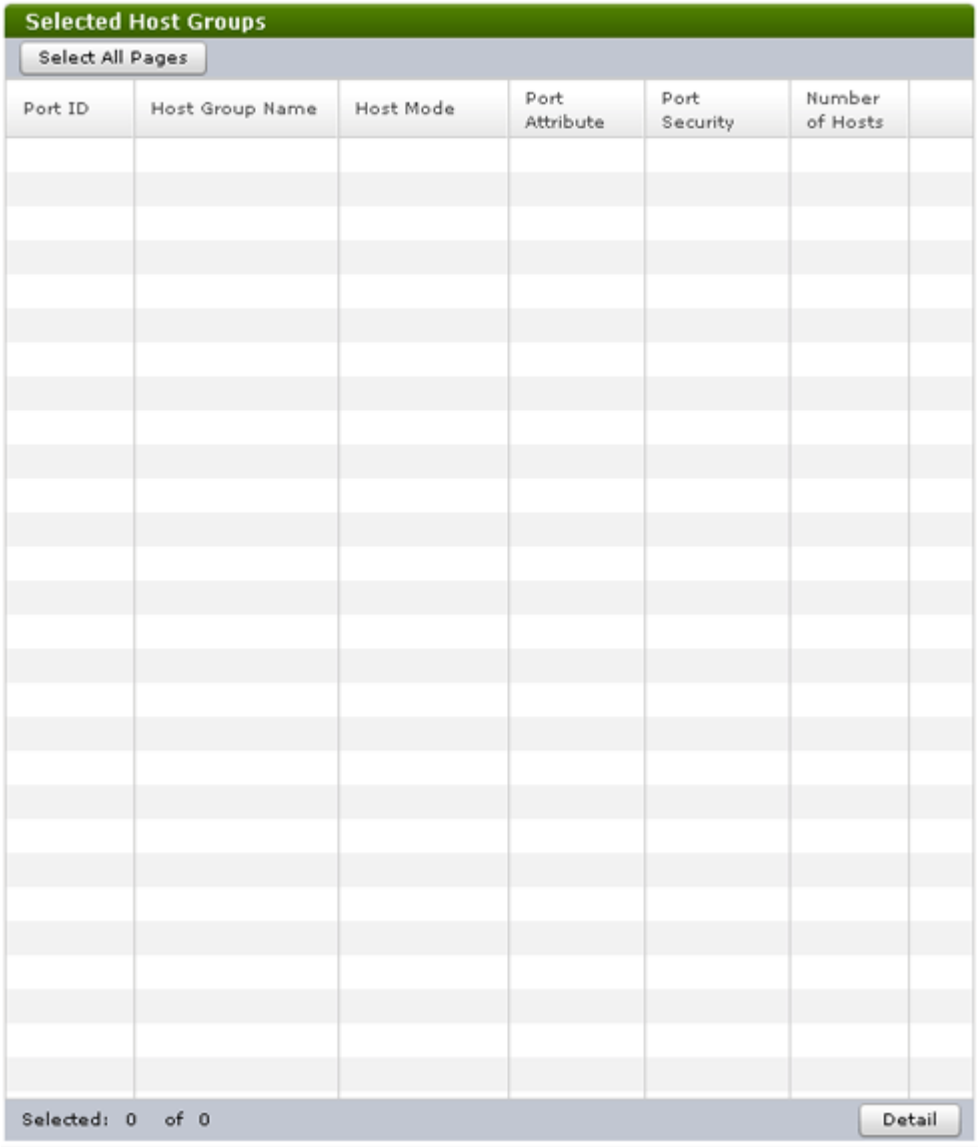


This table lists host groups for which LU paths can be established. Only the host groups assigned to the logged-on user are available.

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host.

Item	Description
	• RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Resource Group Name (ID)	Resource group name and identifier of the host group.
Detail	Details about the selected host group.
Add	Adds host groups selected from the **Available Host Groups** table to the **Selected Host Groups** table.
Remove	Removes the selected host groups from the **Selected Host Groups** table.

Selected Host Groups table

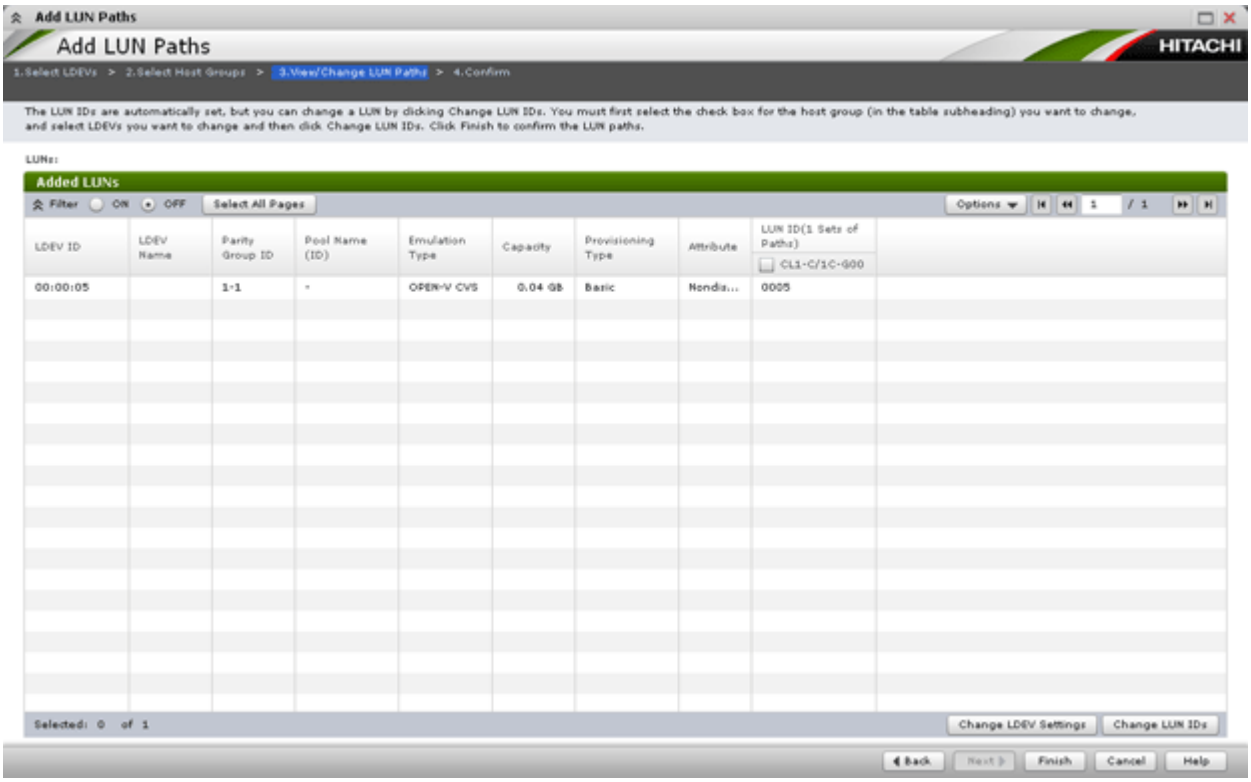


Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host.

Item	Description
	• RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Resource Group Name (ID)	Resource group name and identifier of the host group.
Detail	Details about the selected host group.

Add LUN Paths window

This window provides information about LUs that are already set. You can view information about the LUN and change the LUN ID.



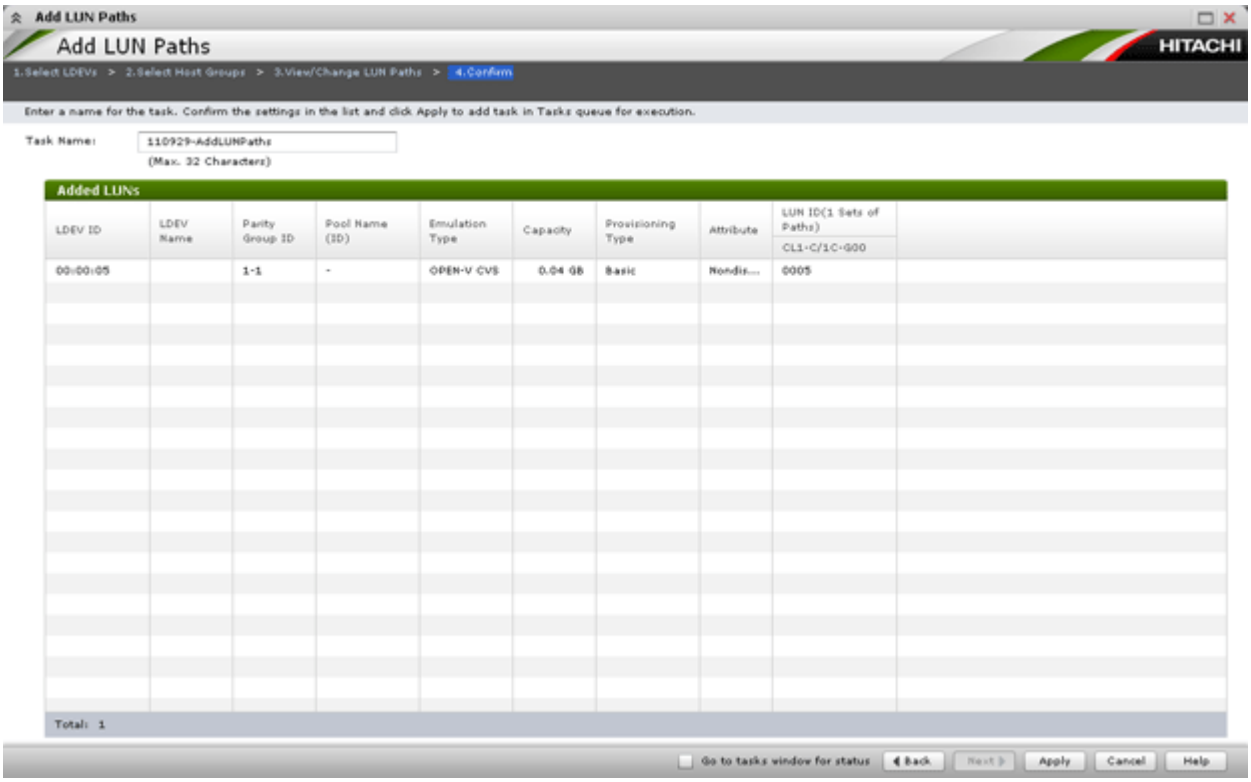
Added LUNs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.

Item	Description
Parity Group ID	Identifier of the parity group.
Pool Name (ID)	Pool names and pool identifiers. If the LDEV is not used as a pool-VOL, a hyphen (-) appears.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Provisioning Type	Provisioning types for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
LUN ID ((*number of LUNs)* Sets of Paths)	Number of assigned LUNs.
port ID/ host group name	Name of the port and the host group of assigned LUNs. This item appears according to the number of assigned LUNs.
Change LDEV Settings	To change the LDEV name setting, select an LDEV and then click this button.
Change LUN IDs	To change the LUN setting, select the check box in the table column of *port ID*/*host group name*, select the target LDEV, and then click this button.

Add LUN Paths Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



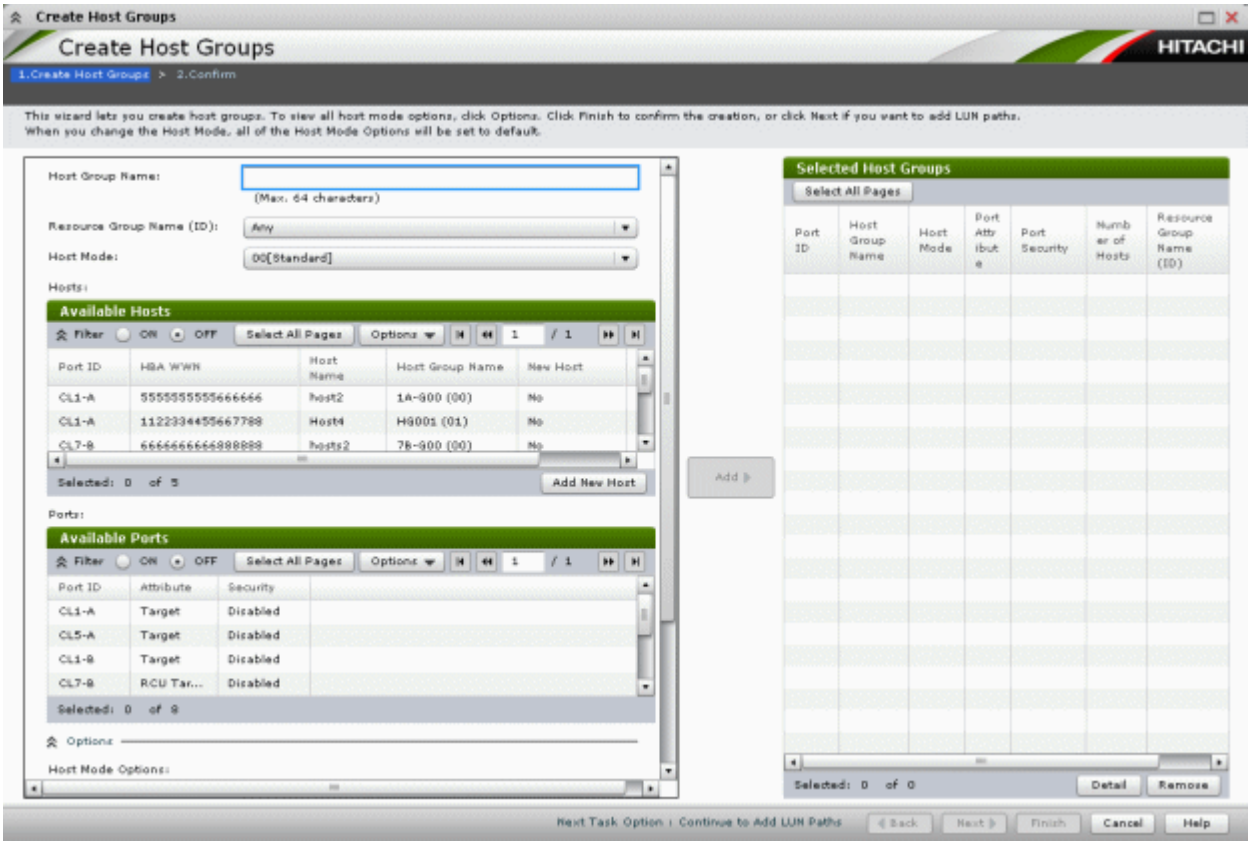
Added LUNs table

Item	Description
LDEV ID	Identifier of the LDEV.
LDEV Name	Name of the LDEV.
Parity Group ID	Identifier of the parity group.
Pool Name (ID)	Pool names and pool identifiers. If the LDEV is not used as a pool-VOL, a hyphen (-) appears.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Provisioning Type	Provisioning types for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device.

Item	Description
	• Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
LUN ID ((*number of LUNs*) Sets of Paths)	Number of assigned LUNs for the relevant LDEV.
port ID/ host group name	Name of the port and the host group of the assigned LUNs. Assigned LUN IDs also appear.

Create Host Groups wizard

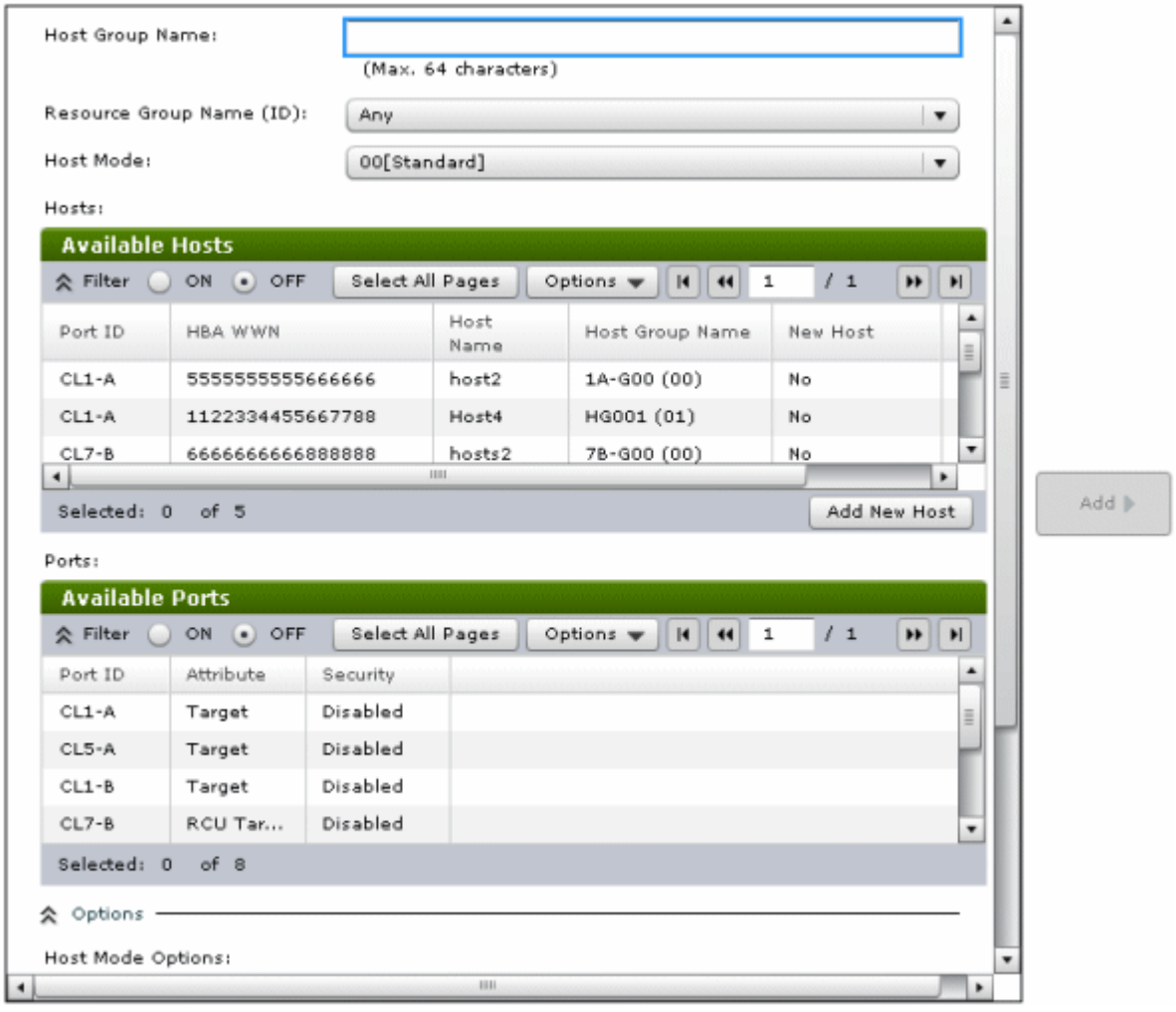
Create Host Groups window



Item	Description
Host Group Name	Enter the name of the host group. As a host group name, you can use single-byte ASCII characters (alphanumeric characters and symbols) up to 64 characters. You cannot use the following symbols: \ / : , ; * ? " < > |

Item	Description
	You cannot use blanks at the beginning or end of the host group name.
Resource Group Name (ID)	Select the resource group in which the host group is created. If **Any** is selected, among all ports being allocated to the user, ports where the host group can be add are available in the **Available Ports** table. If other than **Any** is selected, among ports assigned to the selected resource group, ports where the host group can be add are available in the **Available Ports** table.
Host Mode	Select the host mode from the list.
Add	Adds the settings to the **Selected Host Groups** table.

Available Hosts table



This table lists information about the registered hosts.

Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group.
New Host	Indicates whether this is a new host. • Yes: The host is newly added and has never been connected via a cable to any port in the storage system. • No: The host has been connected via a cable to another port.
Port Security	LUN security setting (enable or disable) on the port.
Add New Host	Adds a new host. Or, select host bus adapters and then click this button to assign a nickname to the host bus adapter.

Available Ports table

This table lists the registered ports.

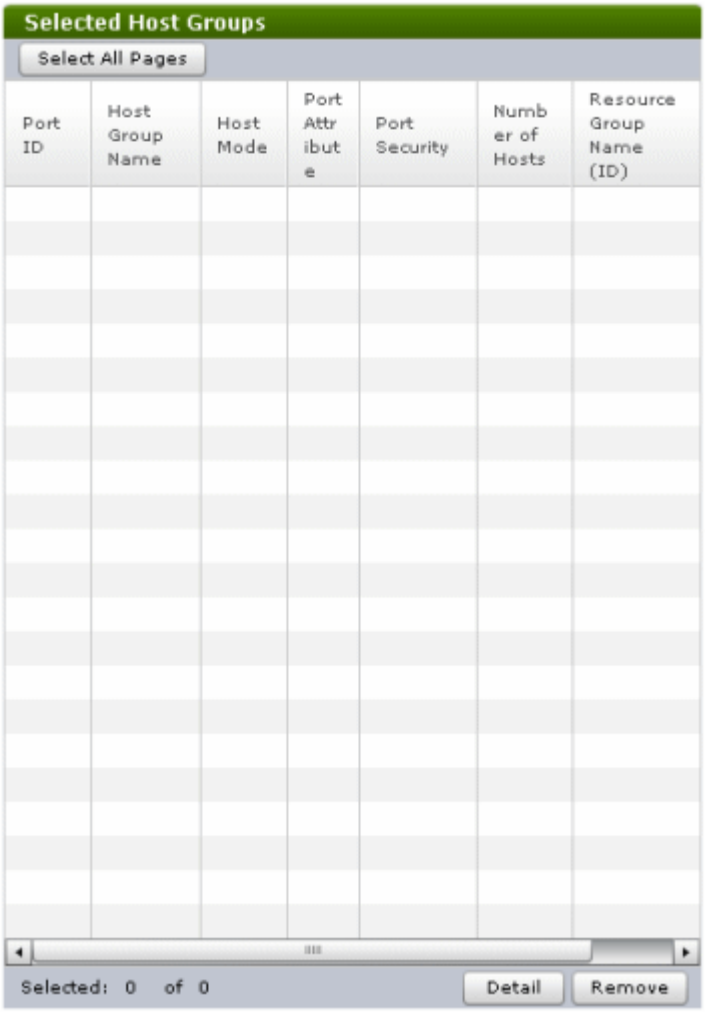
Item	Description
Port ID	Identifier of the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Security	LUN security setting (enable or disable) on the port.
Options	Click to view a list of host mode options.

Host Mode Options table

Item	Description
Mode No.	The ID number of the host mode option.
Option Description	The description of host mode option.
Status	The setting status (enable or disable) of the host mode option.

Item	Description
Enabled	Indicates that the host mode option is enabled.
Disabled	Indicates that the host mode option is disabled.

Selected Host Groups table



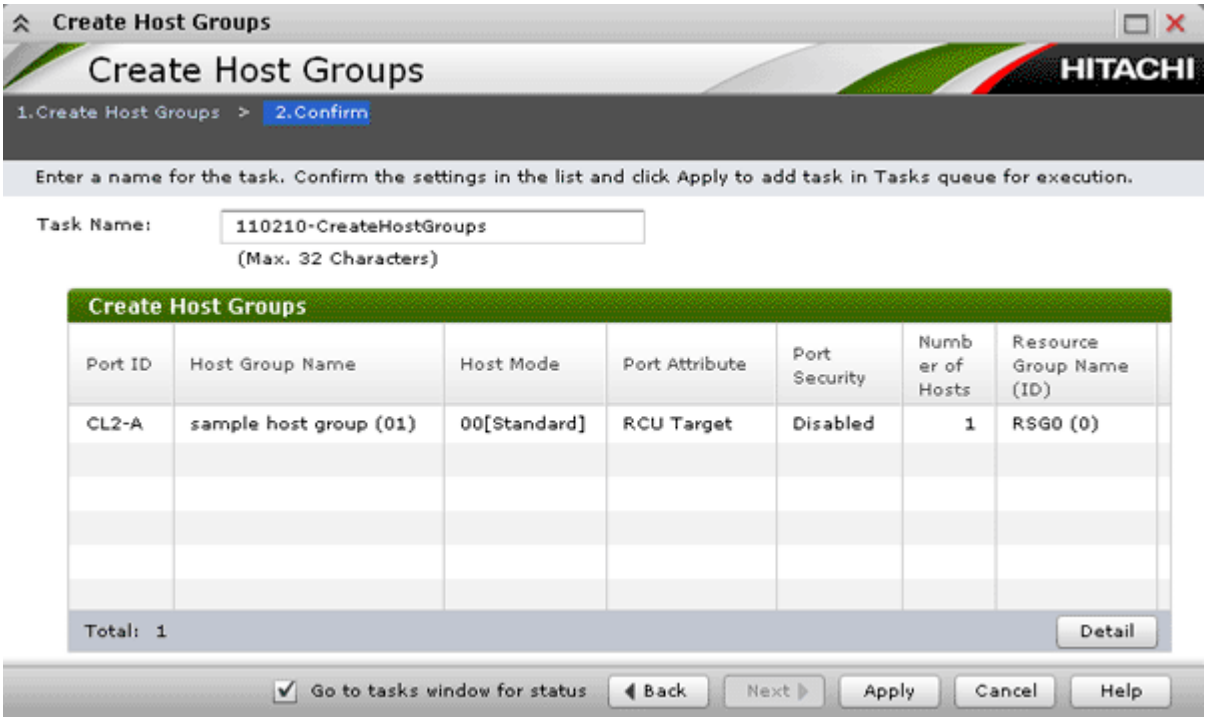
Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host.

Item	Description
	• RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Resource Group Name (ID)	Resource group name and identifier of the host group.
Detail	Details about the selected host group.
Remove	Removes the selected host groups from the **Selected Host Groups** table.
Next Task Option	Click **Next** to go to the task setting window, which is indicated in **Next Task Option**.

Create Host Groups Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

Information in this topic assumes only a single task is executed. If multiple tasks are executed, the window shows all configuration items. To check information of a configuration item, click **Back** to return to the configuration window, and then click **Help**.



Create Host Groups table

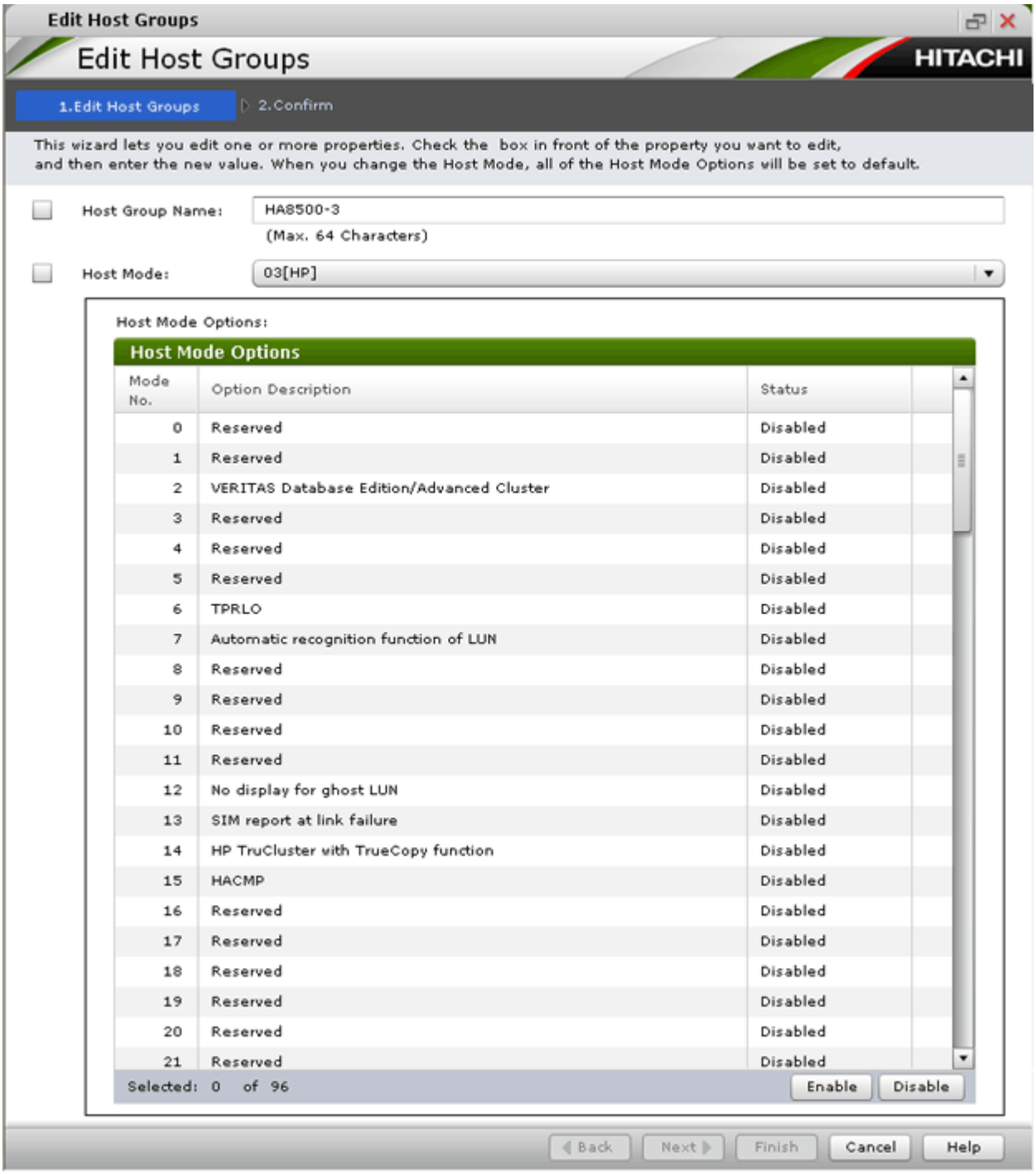
Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Resource Group Name (ID)	Resource group name and identifier of the host group.
Detail	Details about the selected host group.

Edit Host Groups wizard

Edit Host Groups window

Use this window to edit host group properties for selected host groups. Properties include host group name, host mode, or host mode options.

When you select multiple host groups to which different host modes are defined, if the host group assigned to an initiator port is included, you cannot finish the **Edit Host Groups** operation.



Item	Description
Host Group name	Specify the name of the host group. Host group name can be up to 64 single-byte ASCII characters (alpha-numerals and symbols). You cannot use the following symbols: \ / : , ; * ? " < > |

Item	Description
	You cannot use blanks at the beginning or end of the host group name. If a host group assigned to an initiator port is included in the specified host groups, this item is unavailable.
Host Mode	Select the host mode from the list. If a host group assigned to an initiator port is included in the specified host groups, this item is unavailable.

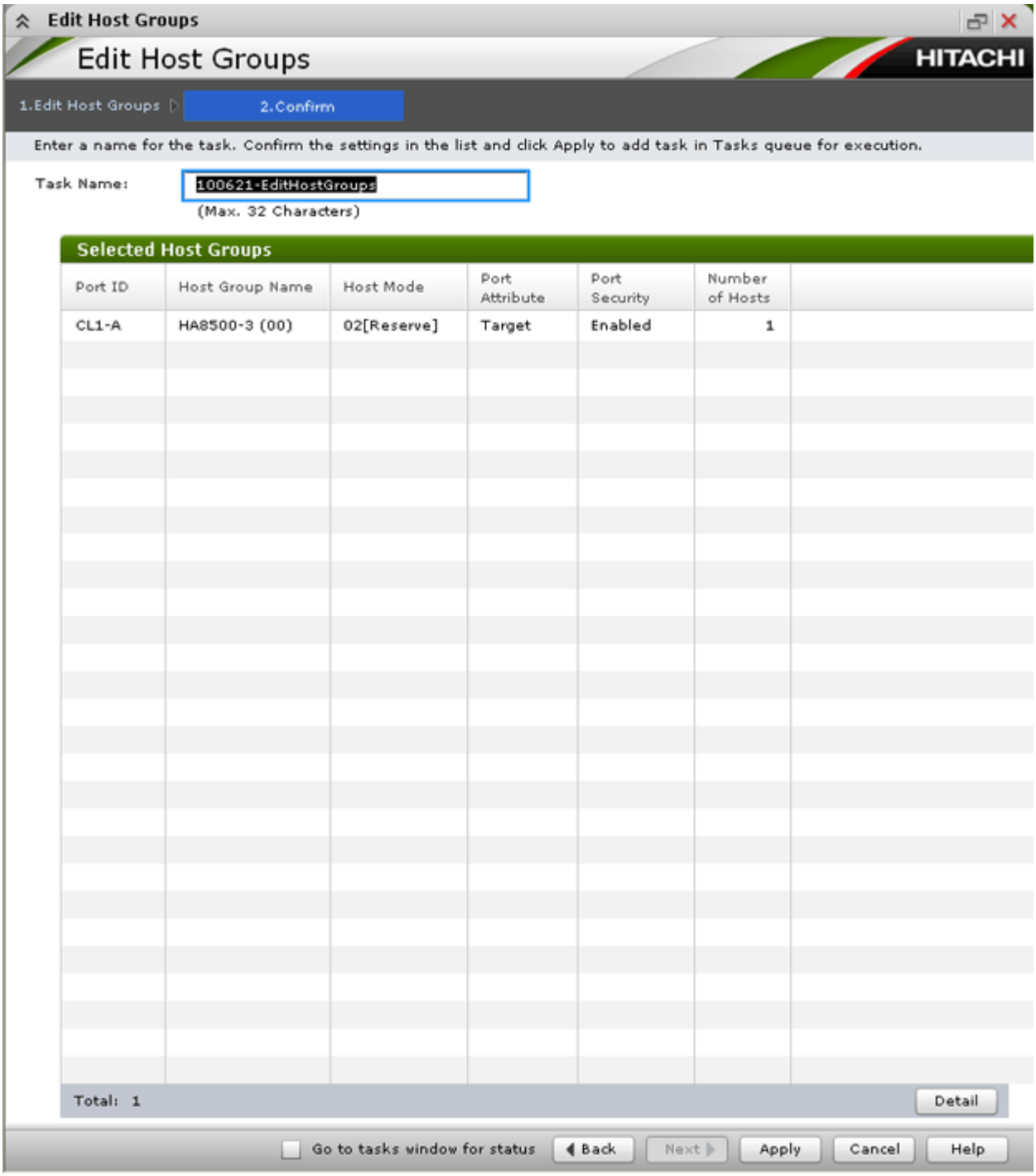
Host Mode Options table

To set the host mode option, select a host mode option, and then click **Enable**. If you do not need a host mode option, select an unnecessary host mode option, and then click **Disable**.

Item	Description
Mode No.	Number identifier of the host mode option.
Option Description	Description of the host mode option.
Status	Indicates the current status setting (enable or disable) of the host mode option on this host group.
Enable	Enables the host mode option.
Disable	Disables the host mode option.

Edit Host Groups Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



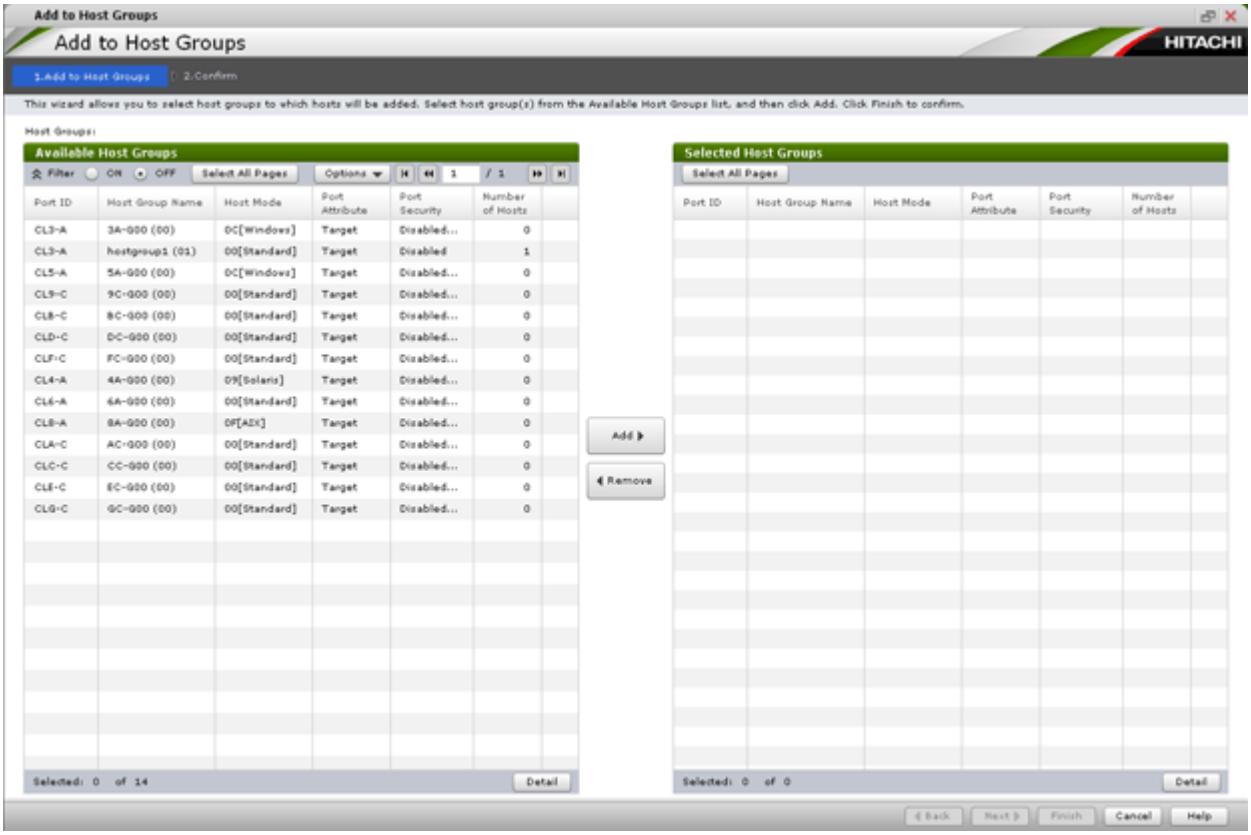
Selected Host Groups table

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.

Item	Description
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.

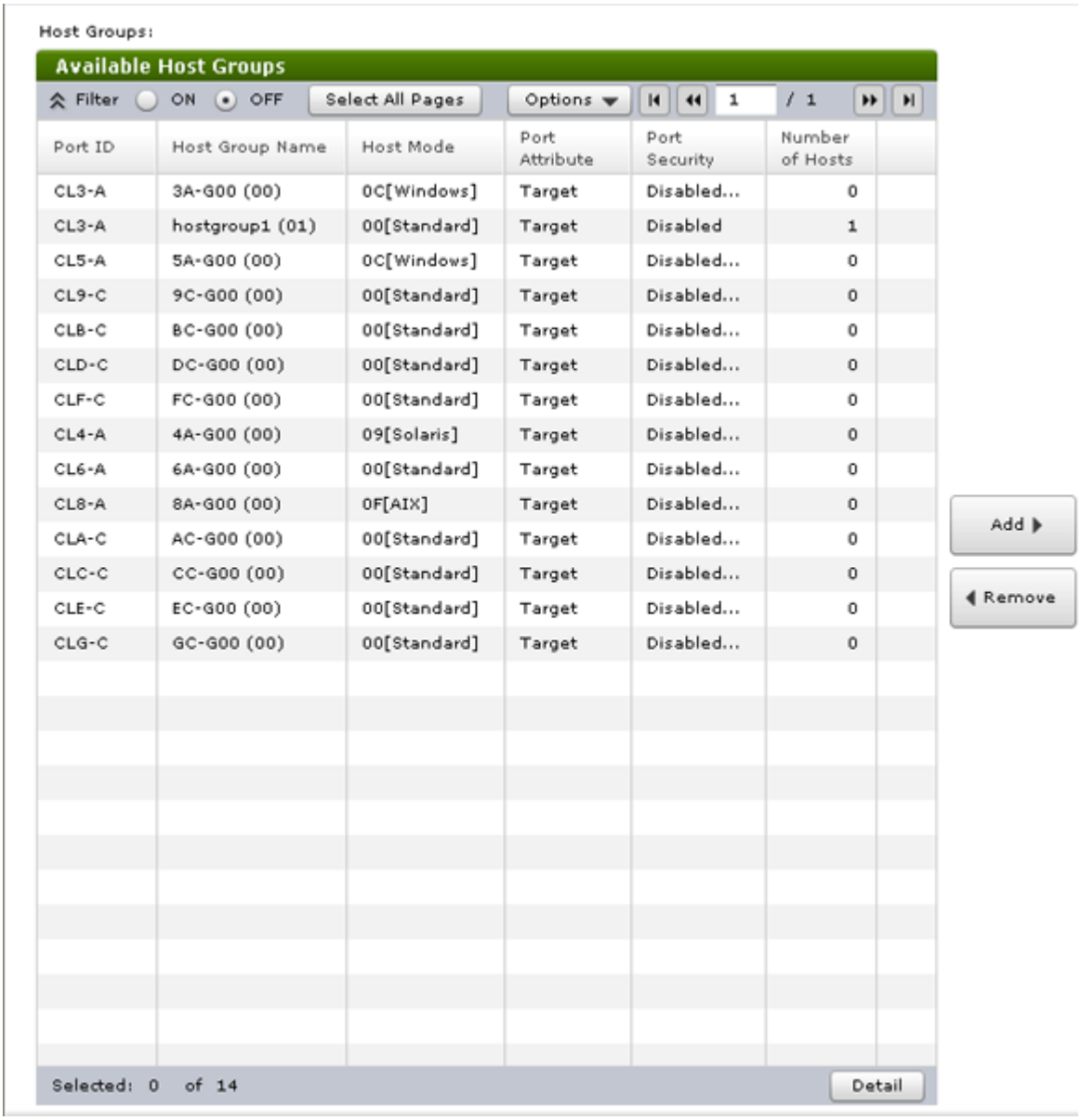
Add to Host Groups wizard (when specific host is selected)

Add to Host Groups window



Available Host Groups table

This table lists host groups in which selected hosts can be registered. Only the host groups assigned to the logged-on user are available.

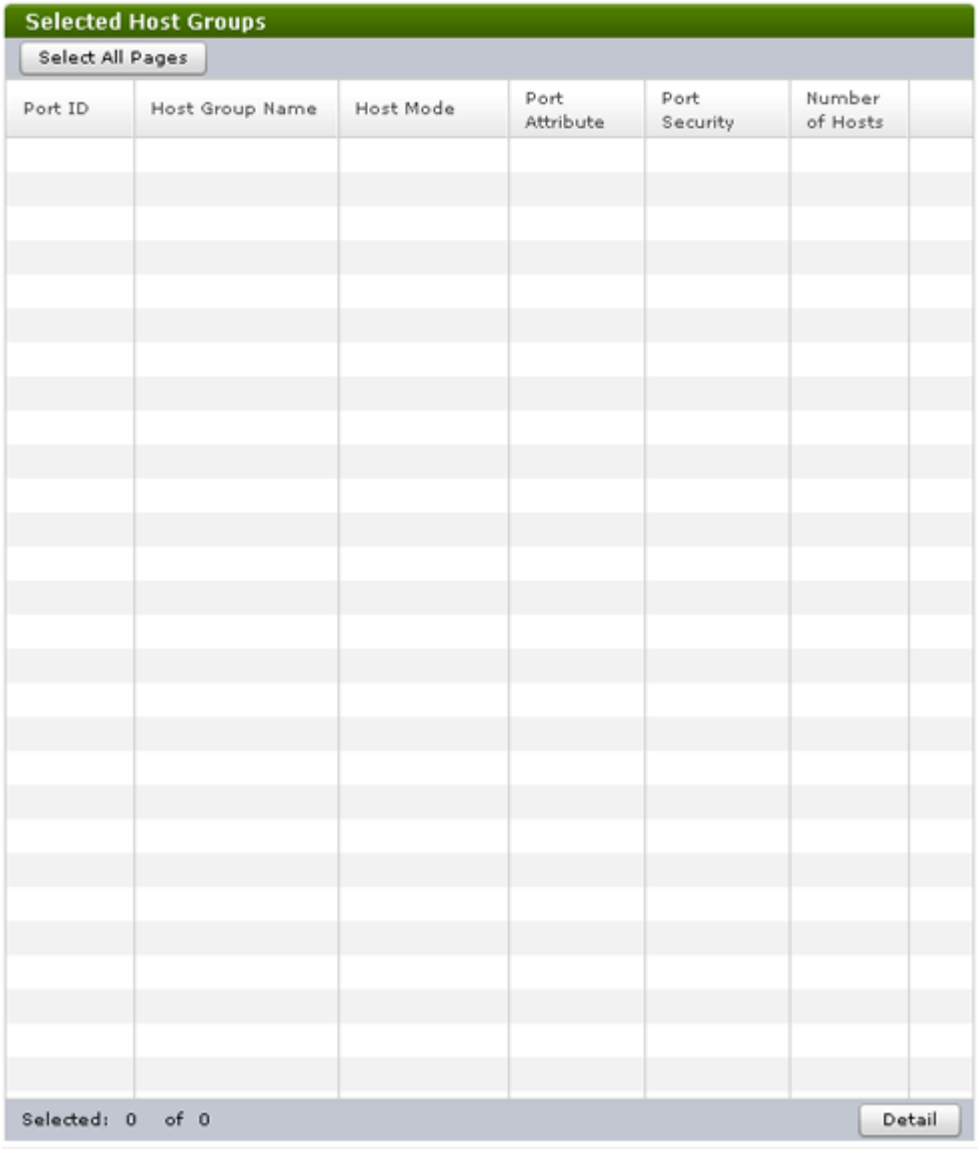


Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on.

Item	Description
	• Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.
Add	Adds host groups selected from the **Available Host Groups** table to the **Selected Host Groups** table.
Remove	Removes the selected host groups from the **Selected Host Groups** table.

Selected Host Groups table

This table lists the selected host groups.

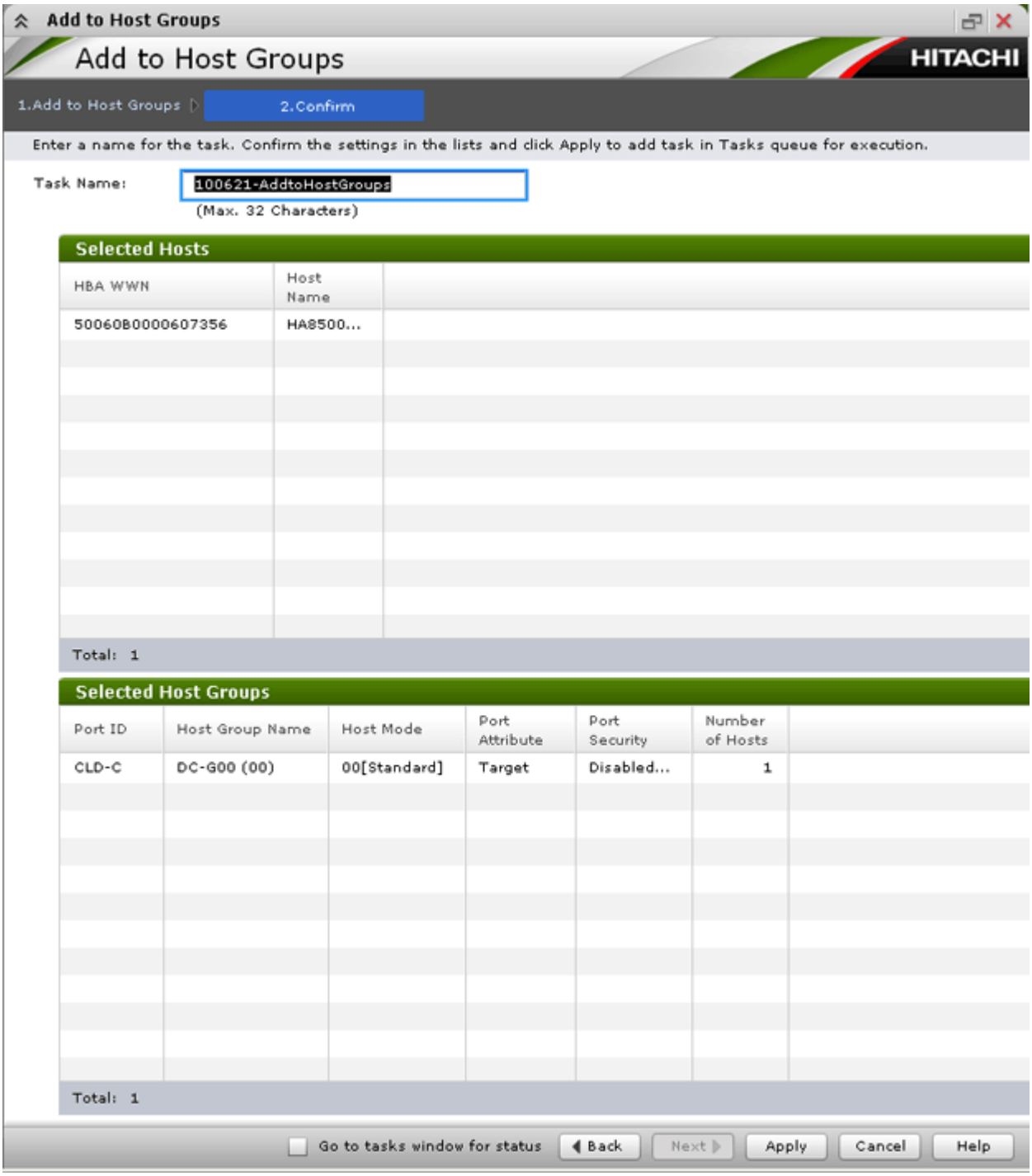


Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on.

Item	Description
	• External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.

Add Host Groups Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Hosts table

This table lists the hosts selected to be added to a host group.

Item	Description
HBA WWN	WWN of the port.

Item	Description
Host Name	Name of the host.

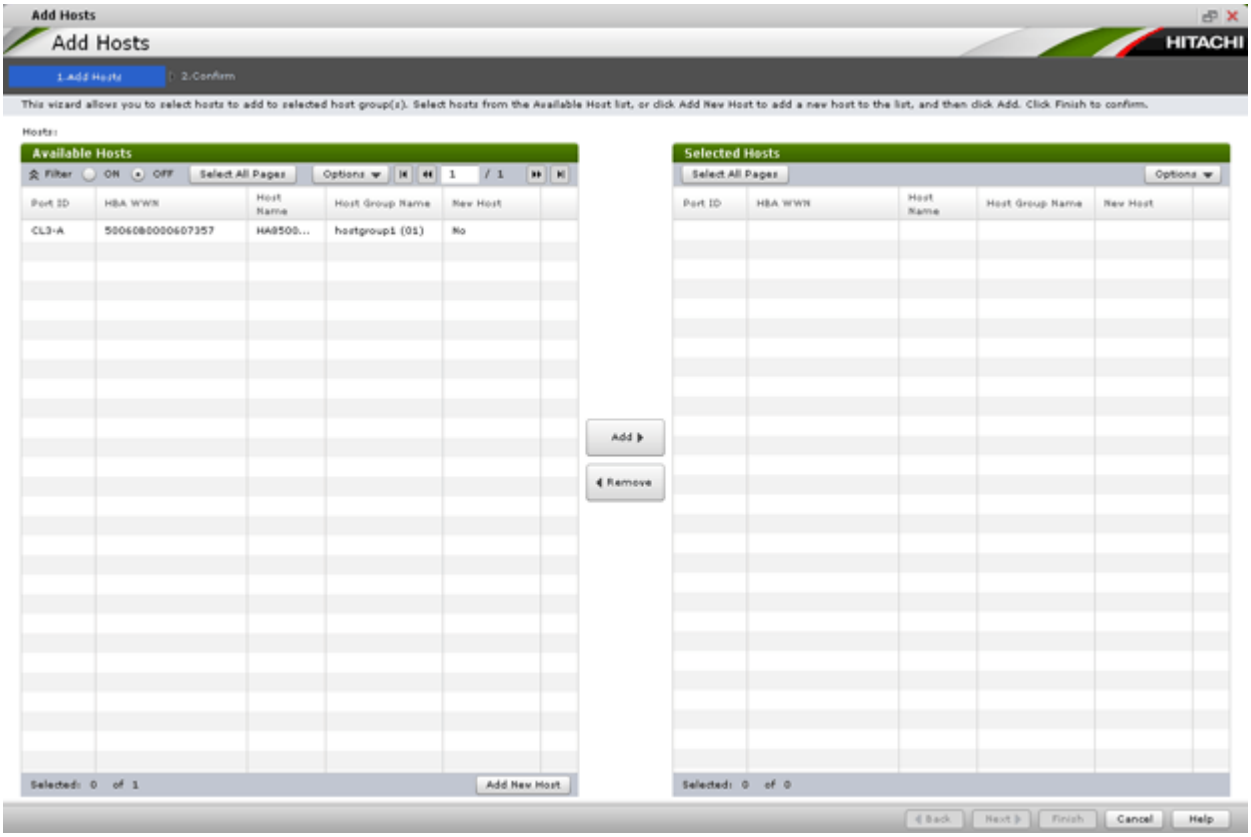
Selected Host Groups table

A list of host groups to which hosts are registered.

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.

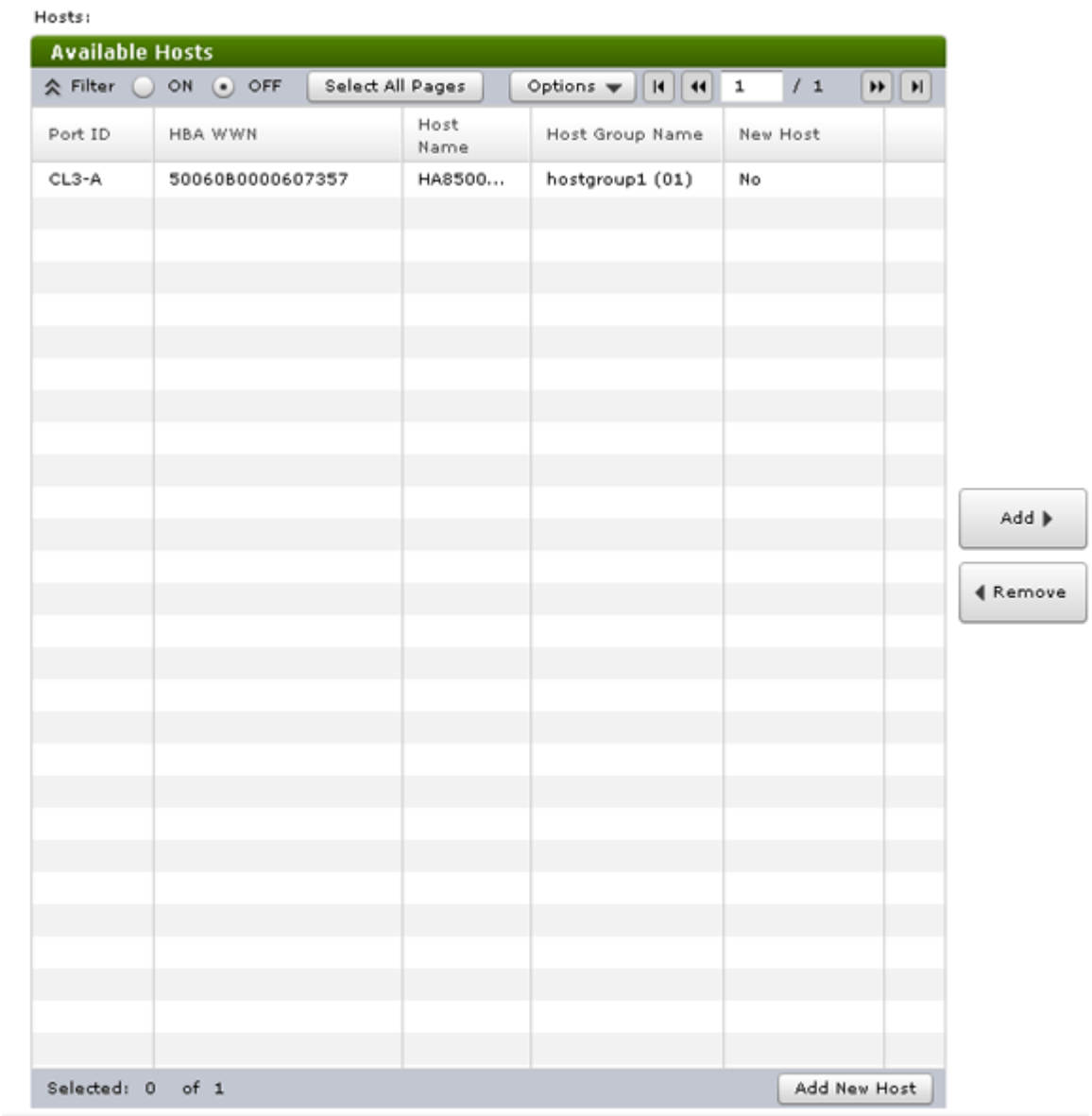
Add Hosts wizard (when specific hosts group is selected)

Add Hosts window



Available Hosts table

This table lists the hosts that can be registered in the selected host group.

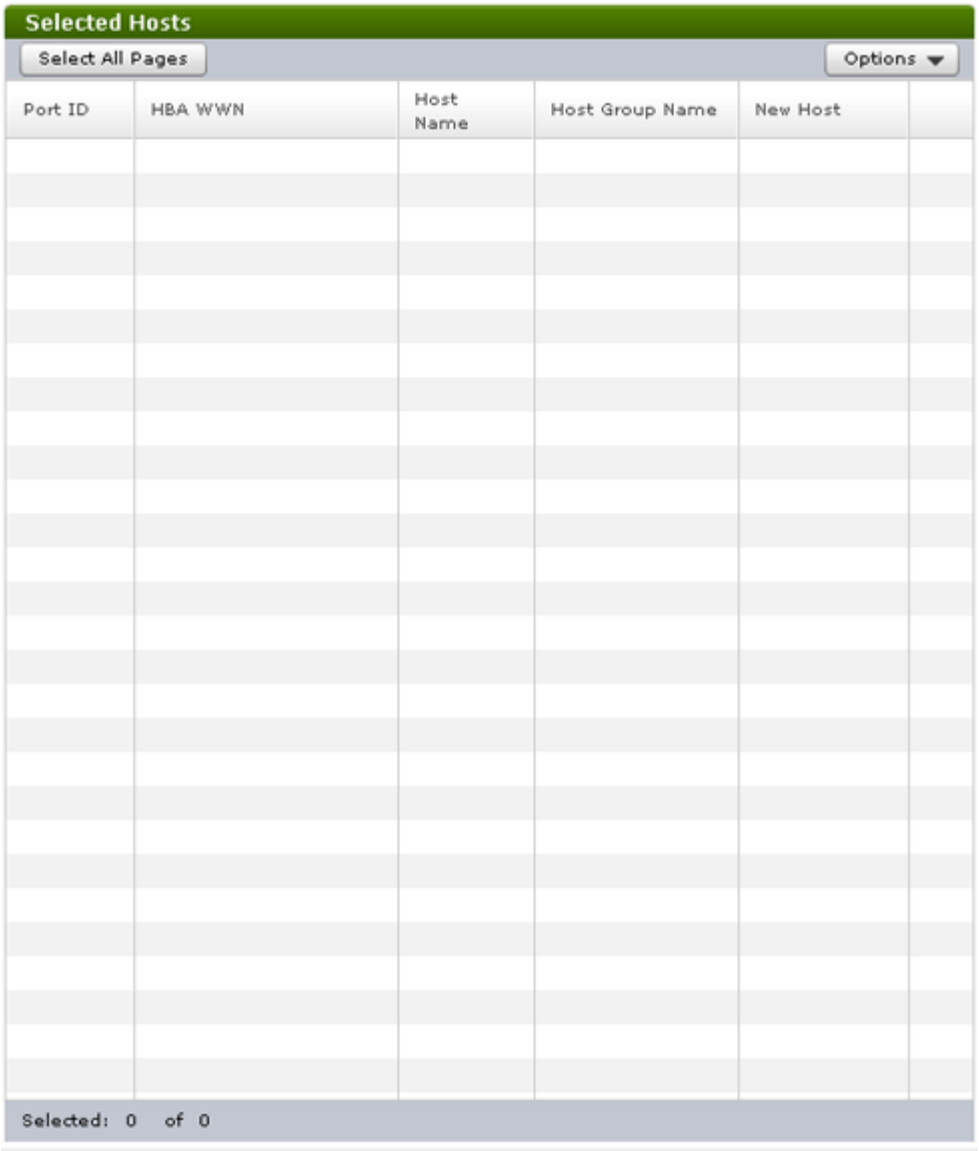


Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group.
New Host	Indicates whether this is a newly added host. • Yes: The host is newly added and has never been connected via a cable to any port in the storage system. • No: The host has been connected via a cable to another port.

Item	Description
Add New Host	Adds a new host. Note that Port ID and Host Group Name will be blank after a new host is added.
Add	Adds hosts selected from the **Available Hosts** table to the **Selected Hosts** table.
Remove	Removes hosts from the **Selected Hosts** table.

Selected Hosts table

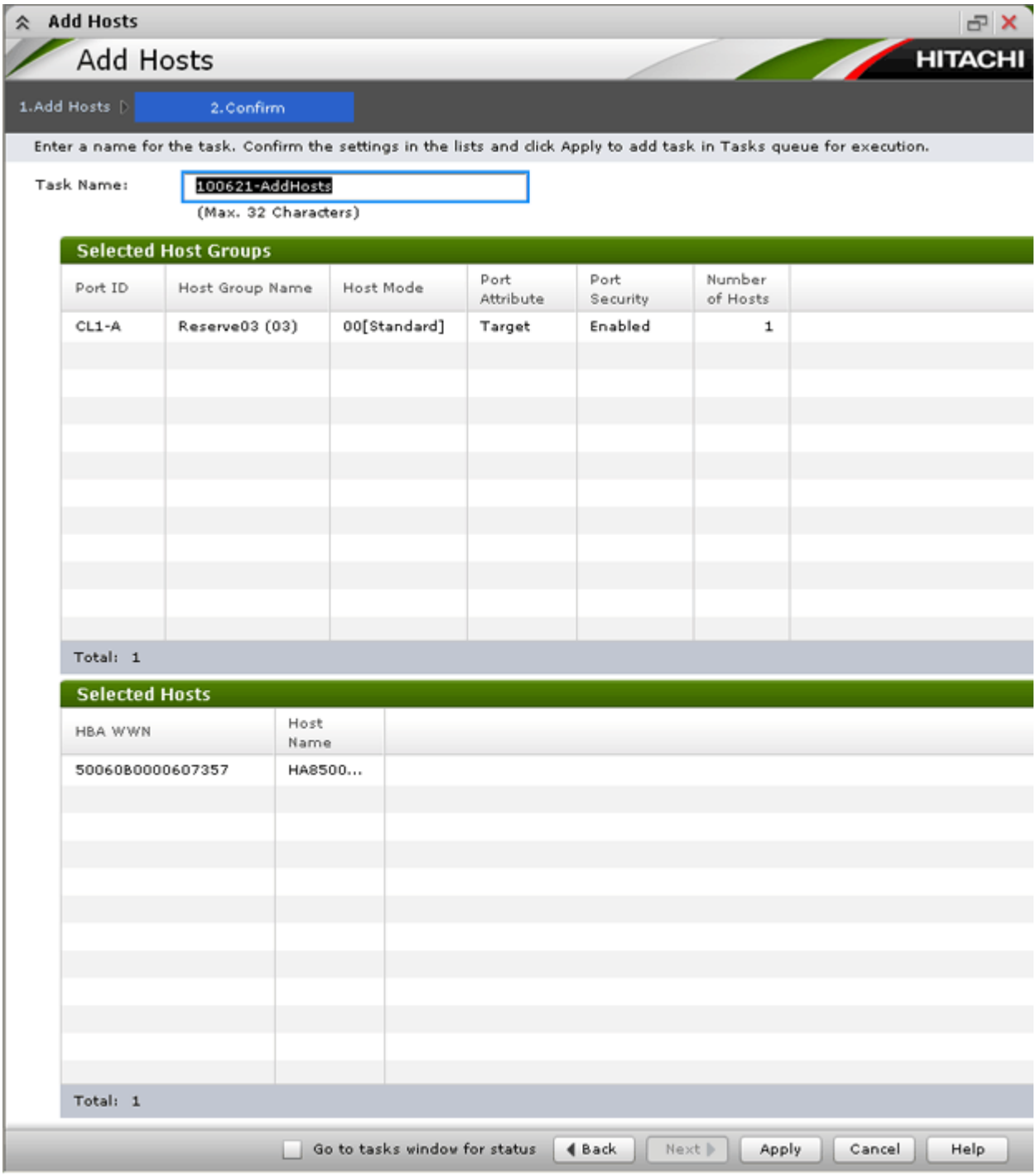
This table lists hosts selected from the **Available Hosts** table.



Item	Description
Port ID	Identifier of the port. This field is blank for the host created by clicking **Add New host**.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group. Note that this field is blank for the host created by clicking **Add New host**.
New Host	Indicates whether this is a newly added host. • Yes: The host is newly added and has never been connected via a cable to any port in the storage system. • No: The host has been connected via a cable to another port.

Add Hosts Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Host Groups table

This table lists the selected hosts.

Item	Description
Port ID	Identifier of the port.

Item	Description
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.

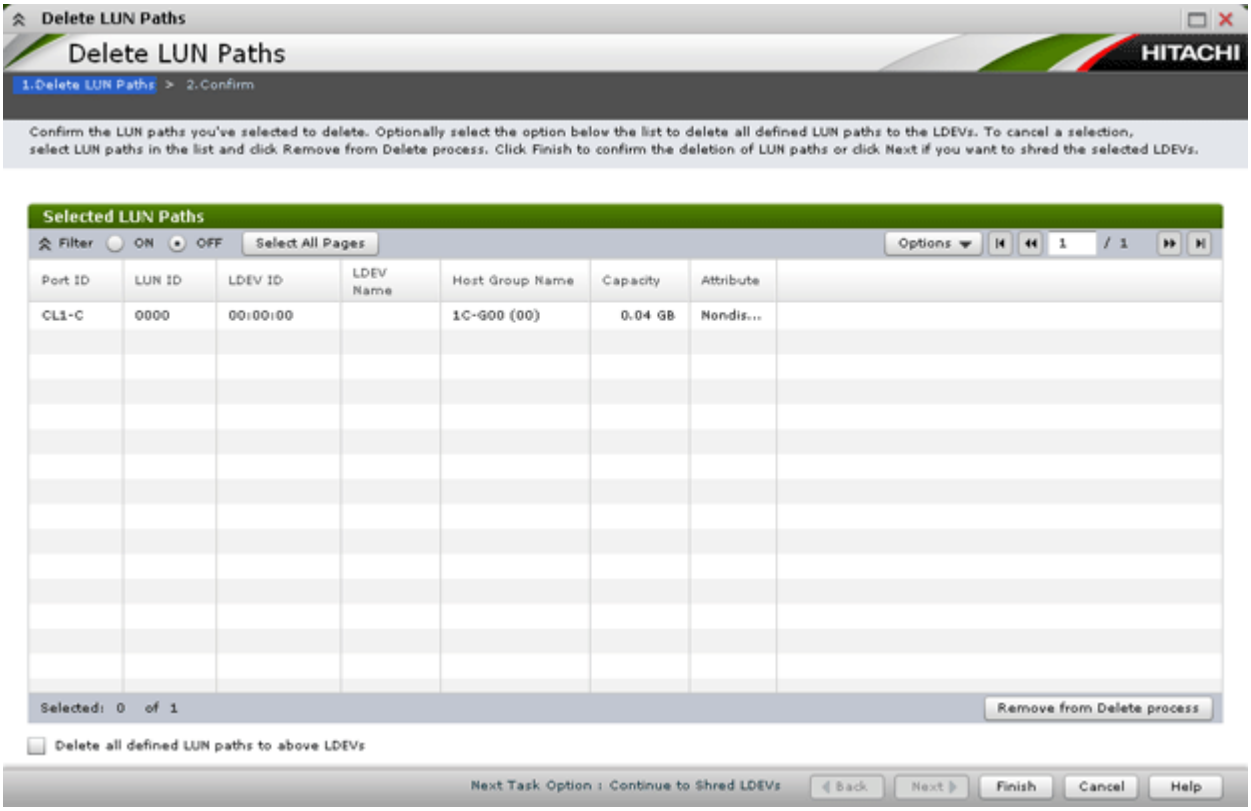
Selected Hosts table

This table contains a list of added host groups.

Item	Description
HBA WWN	WWN of the port.
Host Name	Name of the host.

Delete LUN Paths wizard

Delete LUN Paths window



Selected LUN Paths table

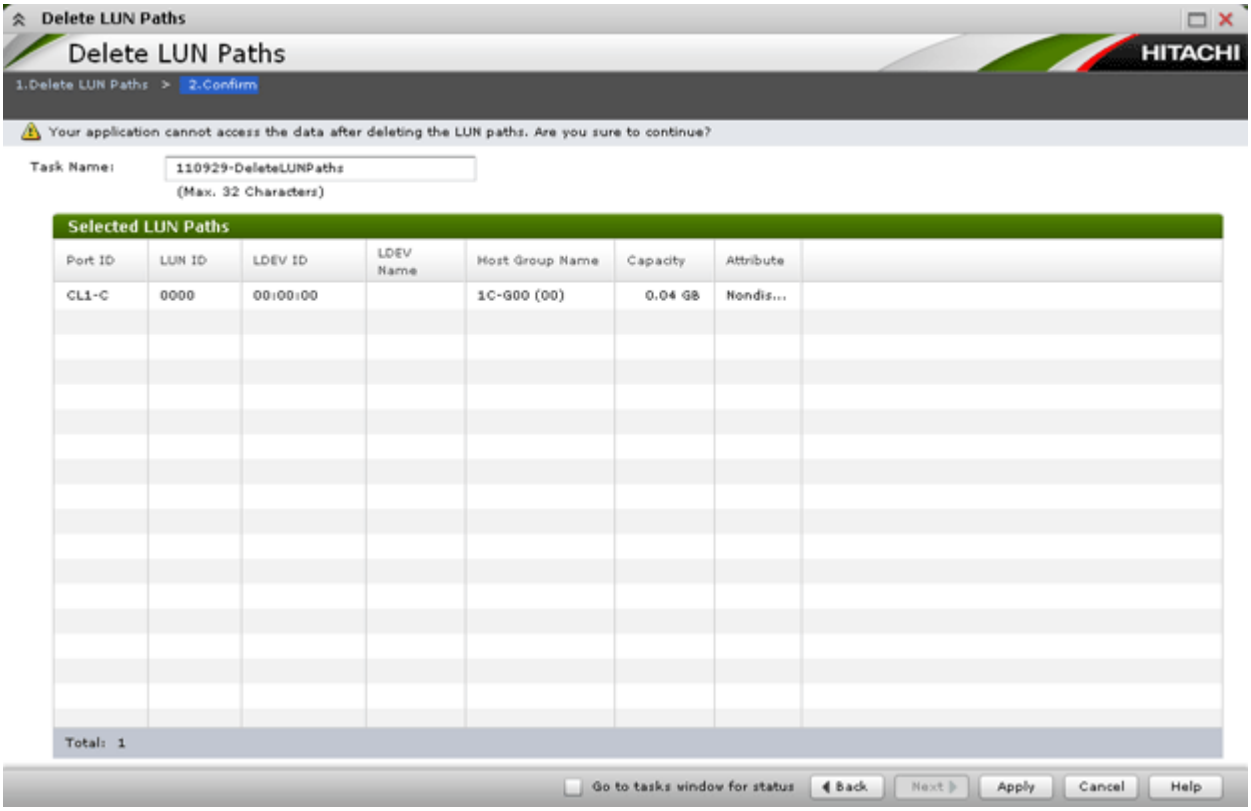
This table provides information about the selected LUN paths.

Item	Description
Port ID	Identifier of the port.
LUN ID	Identifier of the selected LUN paths.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Host Group Name	Name of the host group.
Capacity	Size of each logical volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration.

Item	Description
	• -: Volume in which the attribute is not defined.
Remove from Delete process	Removes LUN paths from the **Selected LUN Paths** table.
Delete all defined LUN paths to above LDEVs	Removes LUN paths from the **Selected LUN Paths** table. When this check box is selected, the host groups of all the alternate paths in the LDEV displayed in the Selected LUNs table must be assigned to the Storage Administrator group permitted to manage them.
Next Task Option	Click **Next** to go to the task setting window, which is indicated in **Task Next Option**.

Delete LUN Paths Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected LUN Paths table

Item	Description
Port ID	Identifier of the port.

Item	Description
LUN ID	Identifier of the selected LUN path.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Host Group Name	Name of the host group.
Capacity	Size of each logical volume.
Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.

Information in this topic assumes only a single task is executed. If multiple tasks are executed, the window shows all configuration items. To check information of a configuration item, click **Back** to return to the configuration window, and then click **Help**

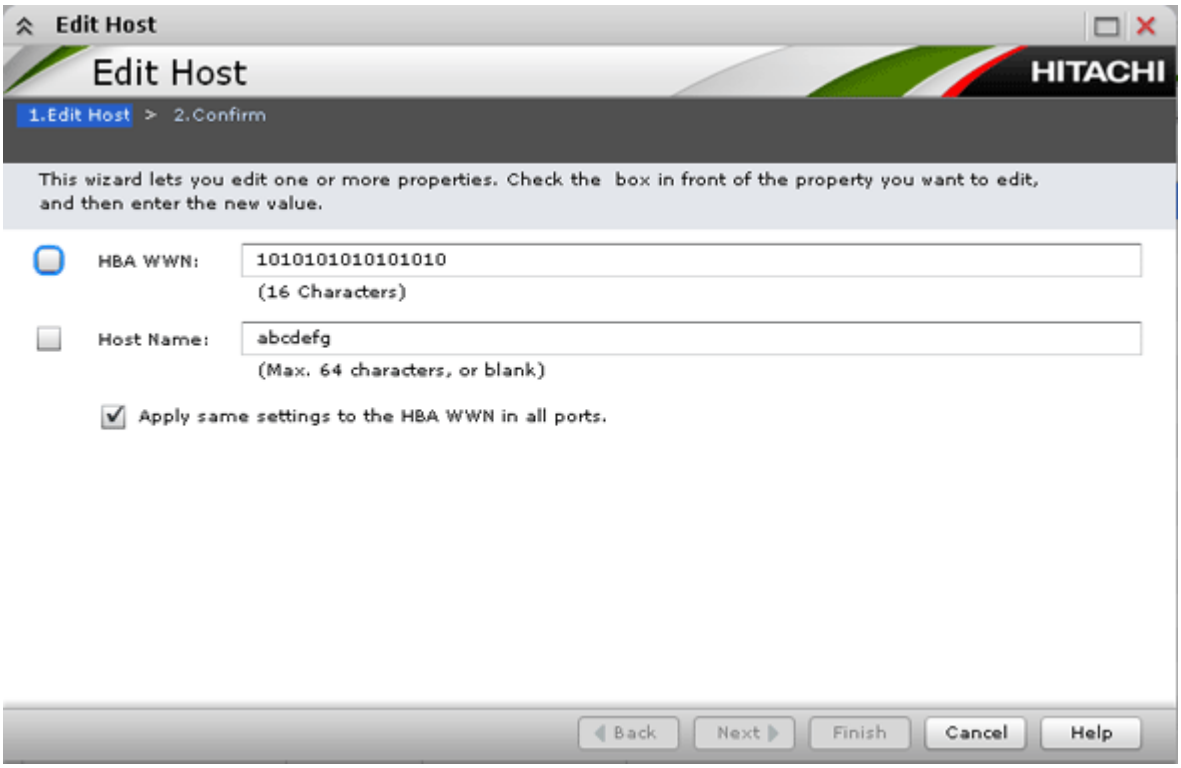
Edit Host wizard

Use this wizard to edit host parameters.

If you want to change multiple parameters for a host two or more times, wait until the current task finishes, and then change the next settings.

If you attempt to change the settings again before the current task finishes, only the setting in the second task will be applied, so the result might be different from what you expected.

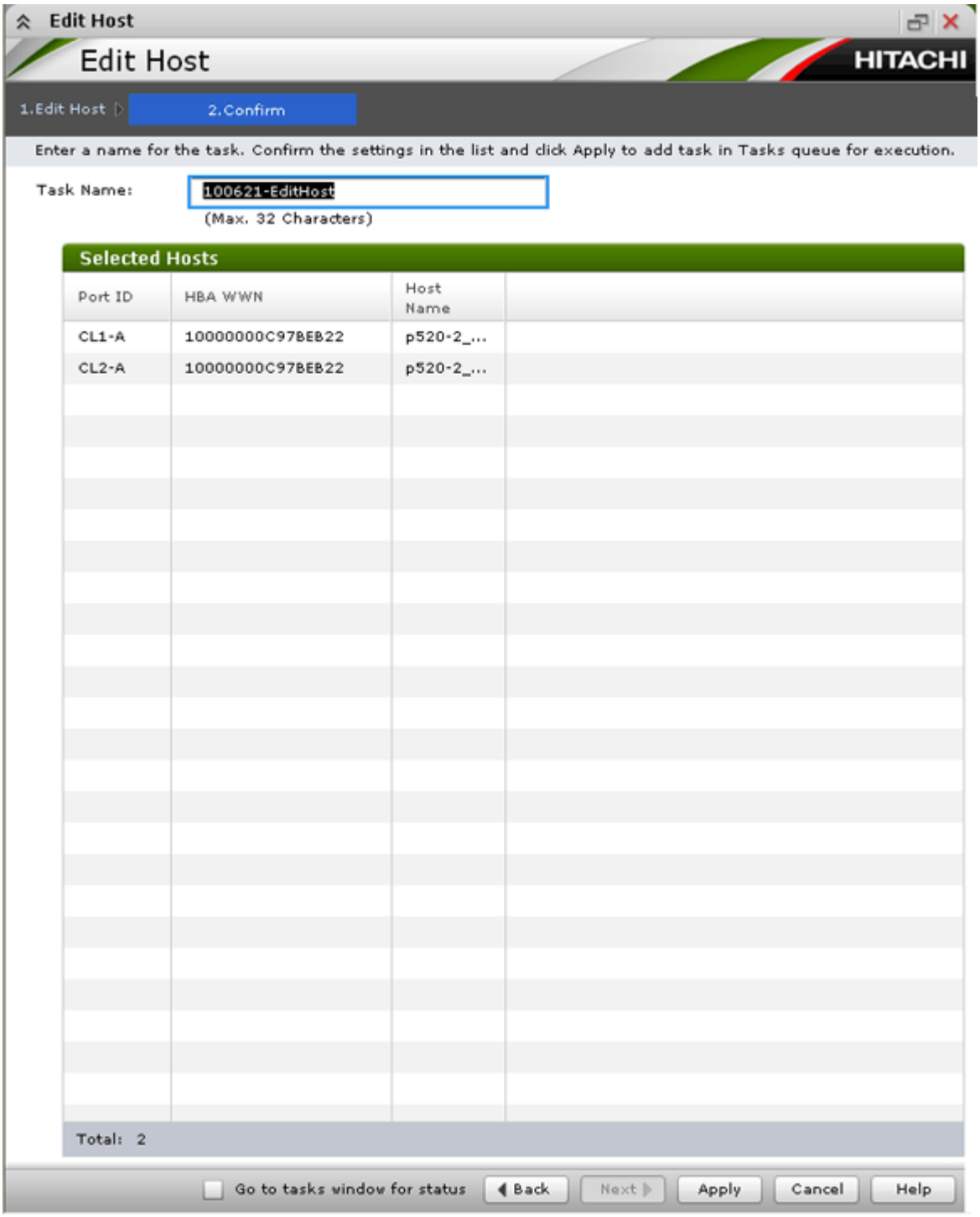
Edit Host window



Item	Description
HBA WWN	Specify the WWN of the port in 16 digits of hexadecimal numbers.
Host Name	Specify the host name. Host name can be up to 64 single-byte ASCII characters (alpha-numerals and symbols). You cannot use the following symbols: \ / : , ; * ? " < > | You cannot use blanks at the beginning or end of the host name. A host name is case-sensitive.
Apply same settings to the HBA WWN in all ports	If this check box is selected, the changes made in this dialog box will also affect other ports.

Edit Host Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Hosts table

Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.

Item	Description
Host Name	Name of the host.

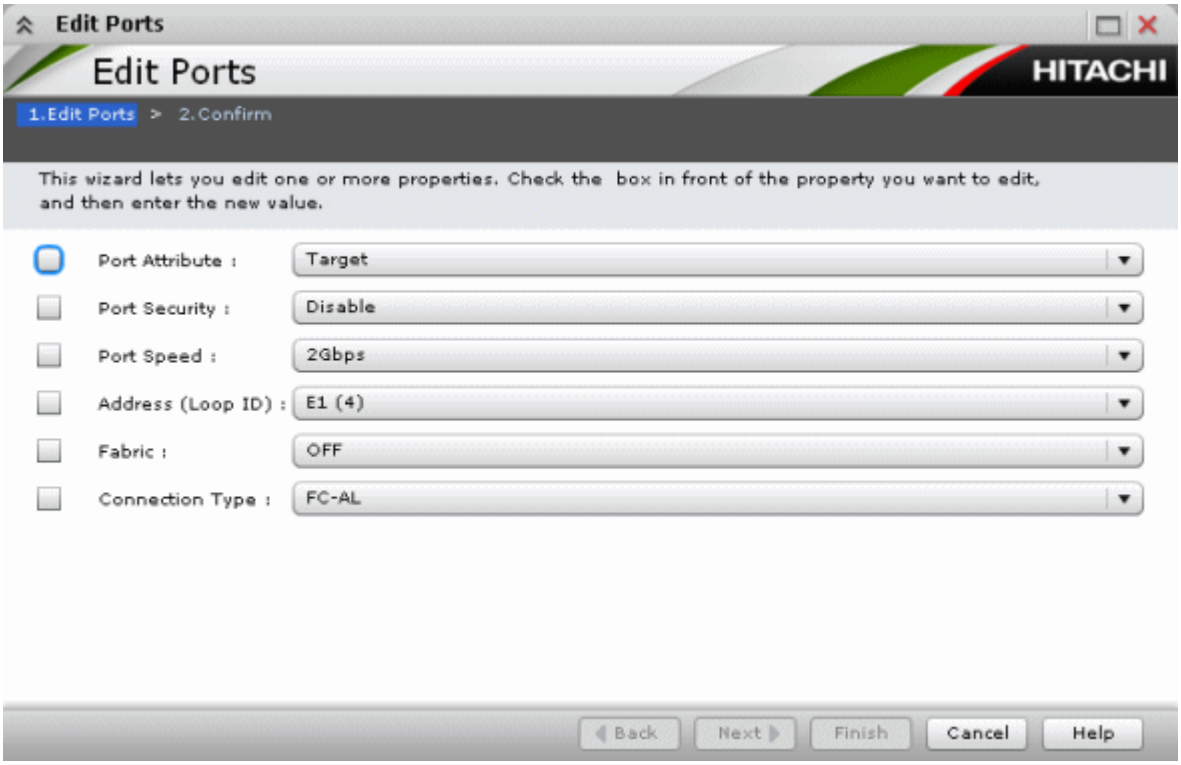
Edit Ports wizard

Use this wizard to edit port parameters.

If you want to change multiple parameters for a port two times or more, wait until the current task finishes, and then change the next settings.

If you attempt to change the settings before the current task finishes, only the setting in the second task will be applied, so the result might be different from what you expected.

Edit Ports window

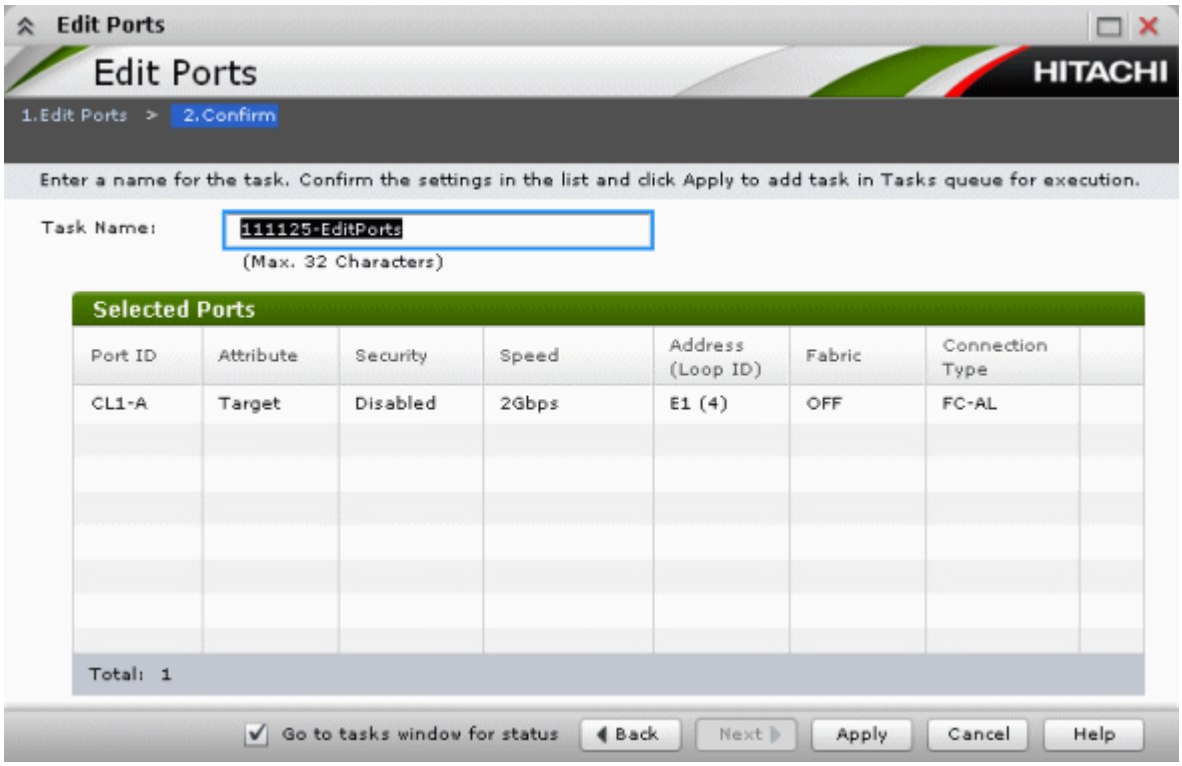


Item	Description
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on.

Item	Description
	• External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager. • If this port attribute is changed from Target or RCU Target to Initiator or to External, the host group of this port belongs to meta_resource. Therefore, the host group of this port is not displayed in windows.
Port Security	Select whether LUN security is enabled or disabled.
Port Speed	Select the data transfer speed, in Gbps, for the selected fibre channel port. If **Auto** is selected, the storage system automatically sets the data transfer speed to 1, 2, 4, 8, or 10 Gbps. **Caution**: If you are using 2-Gbps HBA and switch, set the transfer speed of the CHF (fibre channel adapter) port as 2 Gbps. If you are using 1-Gbps HBA and switch, set the transfer speed of the CHF port as 1 Gbps. If you are using 4-Gbps HBA and switch, set the transfer speed of the CHF port as 4 Gbps. If you are using 8-Gbps HBA and switch, set the transfer speed of the CHF port as 8 Gbps. However, the transfer speed of the CHF port cannot be set as 1 Gbps when the CHF is 8US. Therefore, 1-Gbps HBA and switch cannot be connected. If the Auto Negotiation setting is required, the linkup may become improper at server restart. Check a channel lamp, and if it is blinking, remove and re-insert the cable to perform the signal synchronization and linkup. When the transfer speed of the CHF port is set to **Auto**, the data might not be transferred at the maximum speed depending on the connected device. Confirm the transfer speed appearing in **Speed** in the **Ports** list when you start up the storage system, HBA, or switch. When the transfer speed is not the maximum speed, select the maximum speed from the list on the right or remove and reinsert the cable. Only 10 Gbps can be specified for the FCoE port. **Auto** cannot be specified for the FCoE port.
Address (Loop ID)	Select the address of the selected port.
Fabric	Select whether a fabric switch is set to **ON** or **OFF**. Only **ON** can be specified for the FCoE port.
Connection Type	Select the topology. • FC-AL: Fibre channel arbitrated loop • P-to-P (point-to-point). Only **P-to-P** can be specified for the FCoE port. **Caution**: Some fabric switches require that you specify point-to-point topology. If you enable a fabric switch, check the documentation for the fabric switch to determine whether your switch requires point-to-point topology.

Edit Ports Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Ports table

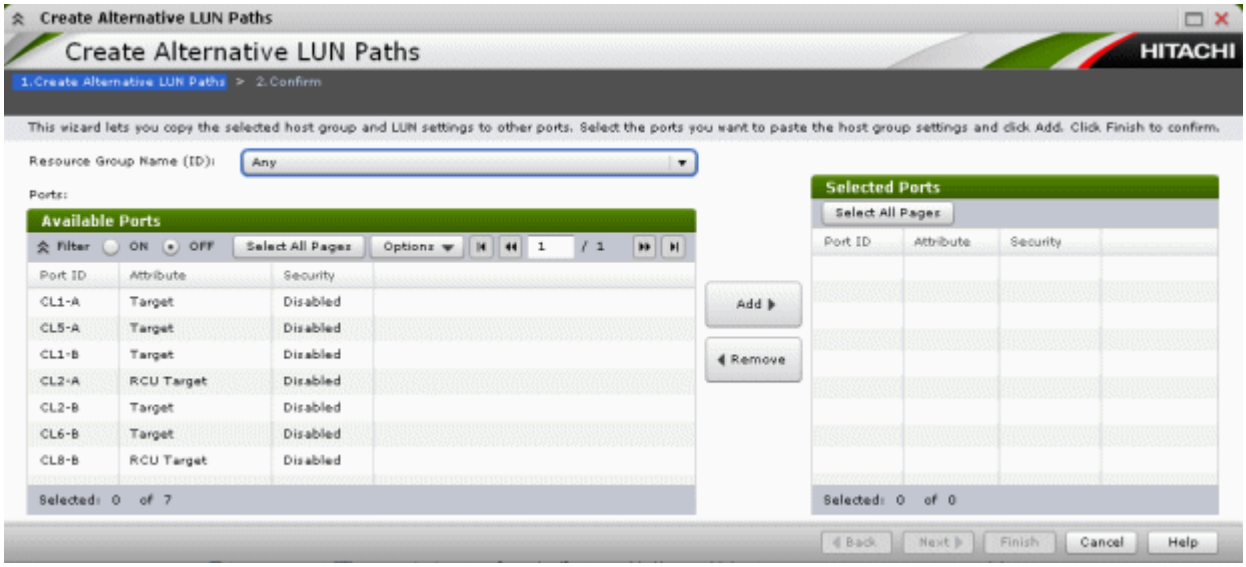
Item	Description
Port ID	Identifier of the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Security	LUN security setting (enable or disable) on the port.
Speed	Data transfer speed for the selected fibre channel port in the unit of Gbps (Gigabit per second).
Address (Loop ID)	Address of the selected port.
Fabric	Status setting (ON or OFF) for a fabric switch.

Item	Description
Connection Type	Topology of the selected port. • FC-AL: Fibre channel arbitrated loop • P-to-P: Point-to-point

Create Alternative LUN Paths wizard

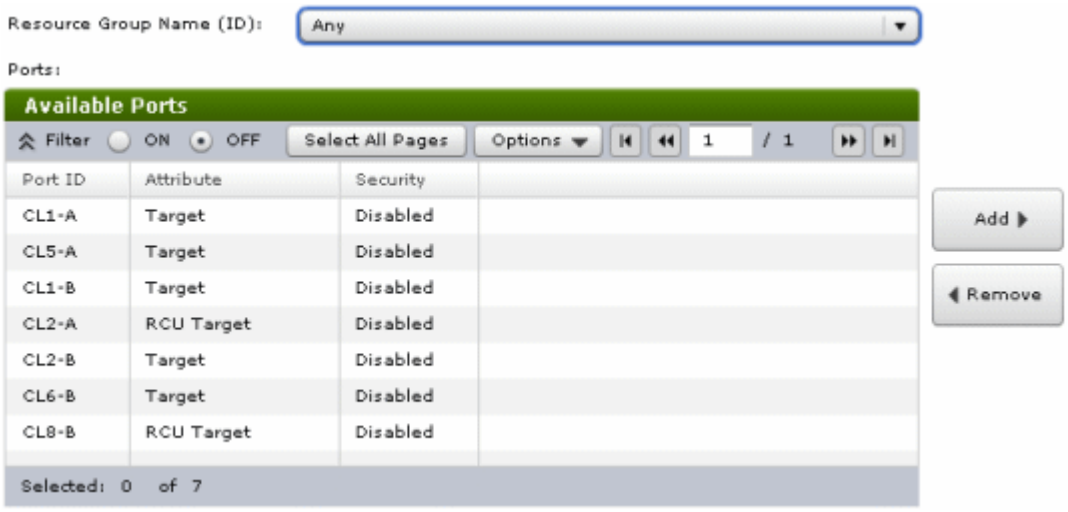
Create Alternative LUN Paths window

Item	Description
Resource Group Name (ID)	Select the resource group in which the host group is created. If **Any** is selected, among all ports being allocated to the user, ports where the host group can be add are available in the **Available Ports** table. If other than **Any** is selected, among ports assigned to the selected resource group, ports where the host group can be add are available in the **Available Ports** table.



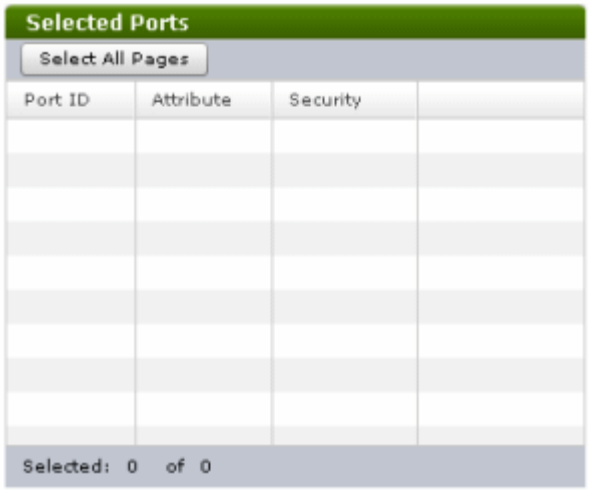
Available Ports table

This table lists the ports for which alternate paths can be created.



Item	Description
Port ID	Identifier of the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Security	LUN security setting (enable or disable) on the port.
Add	Adds ports selected from the **Available Ports** table to the **Selected Ports** table.
Remove	Removes ports from the **Selected Ports** table.

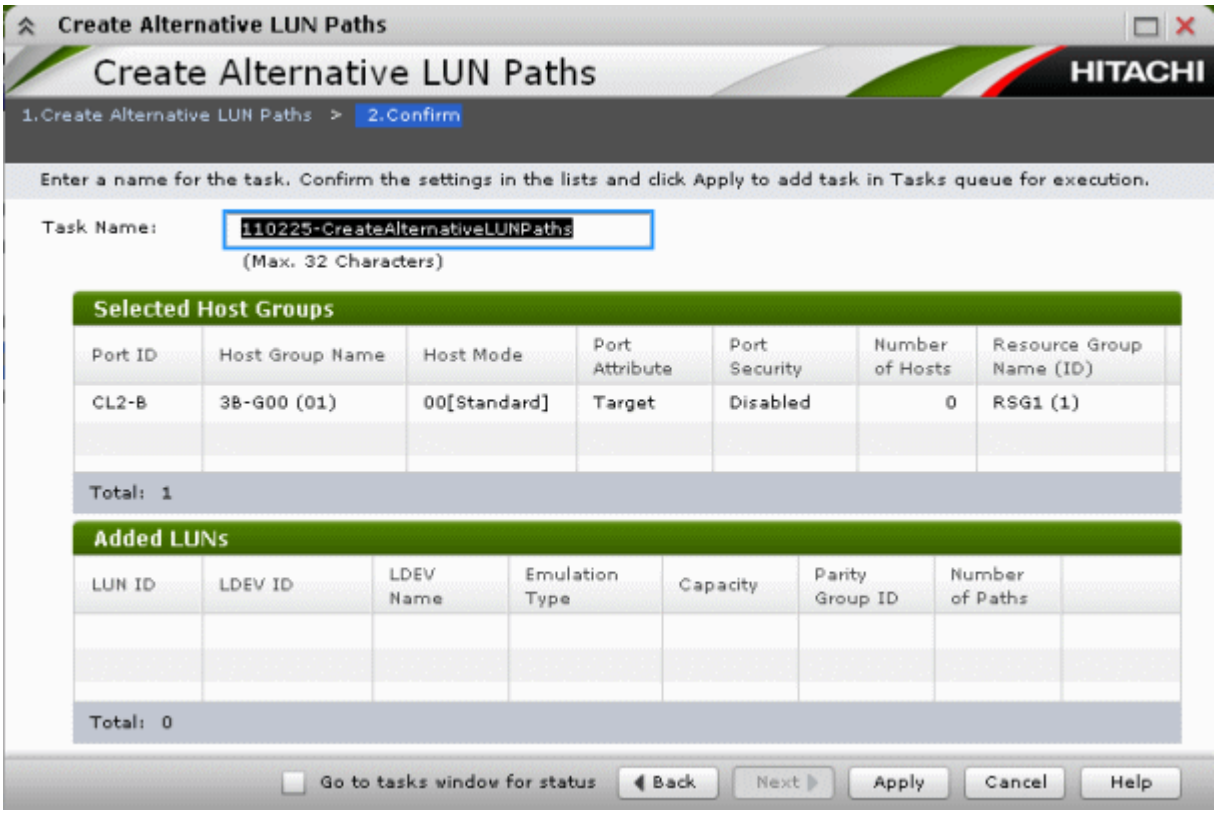
Selected Ports table



Item	Description
Port ID	Identifier of the port.
Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Security	LUN security setting (enable or disable) on the port.

Create Alternative LUN Paths Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Host Groups table

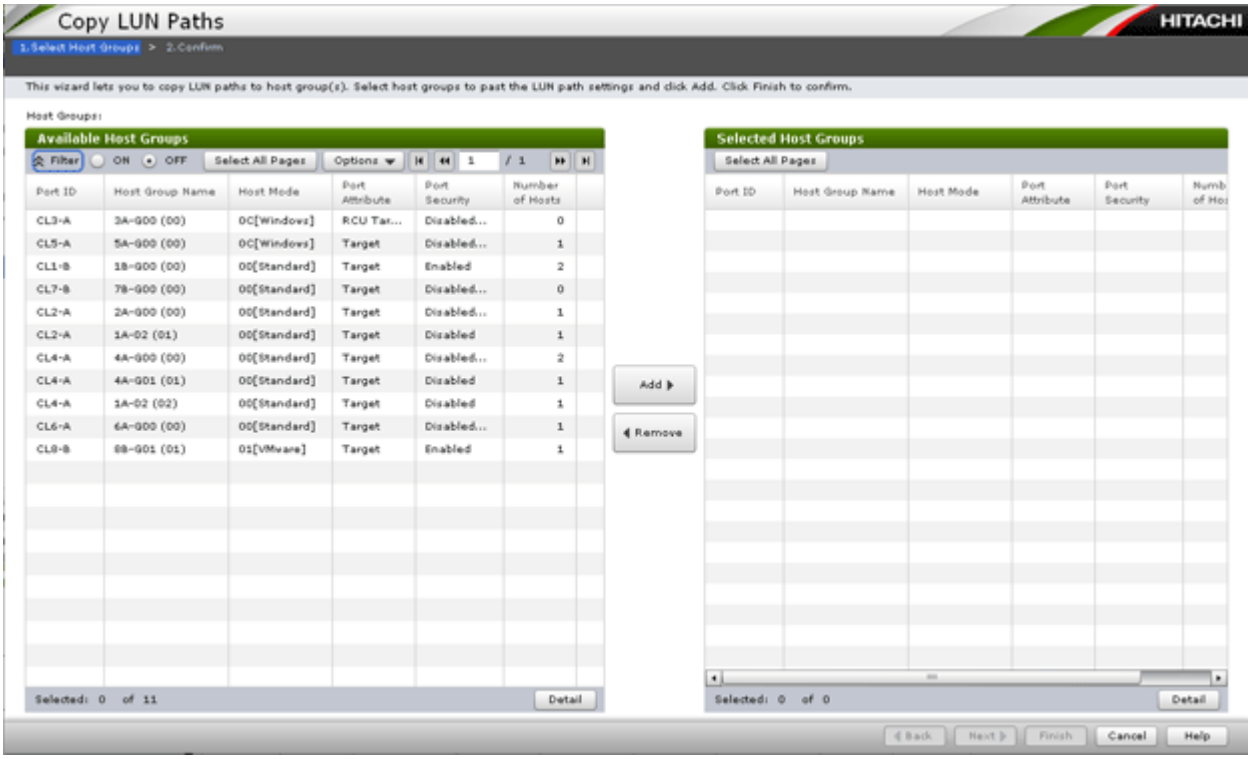
Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Resource Group Name (ID)	Resource group name and identifier of the resource group containing the host groups.

Added LUNs table

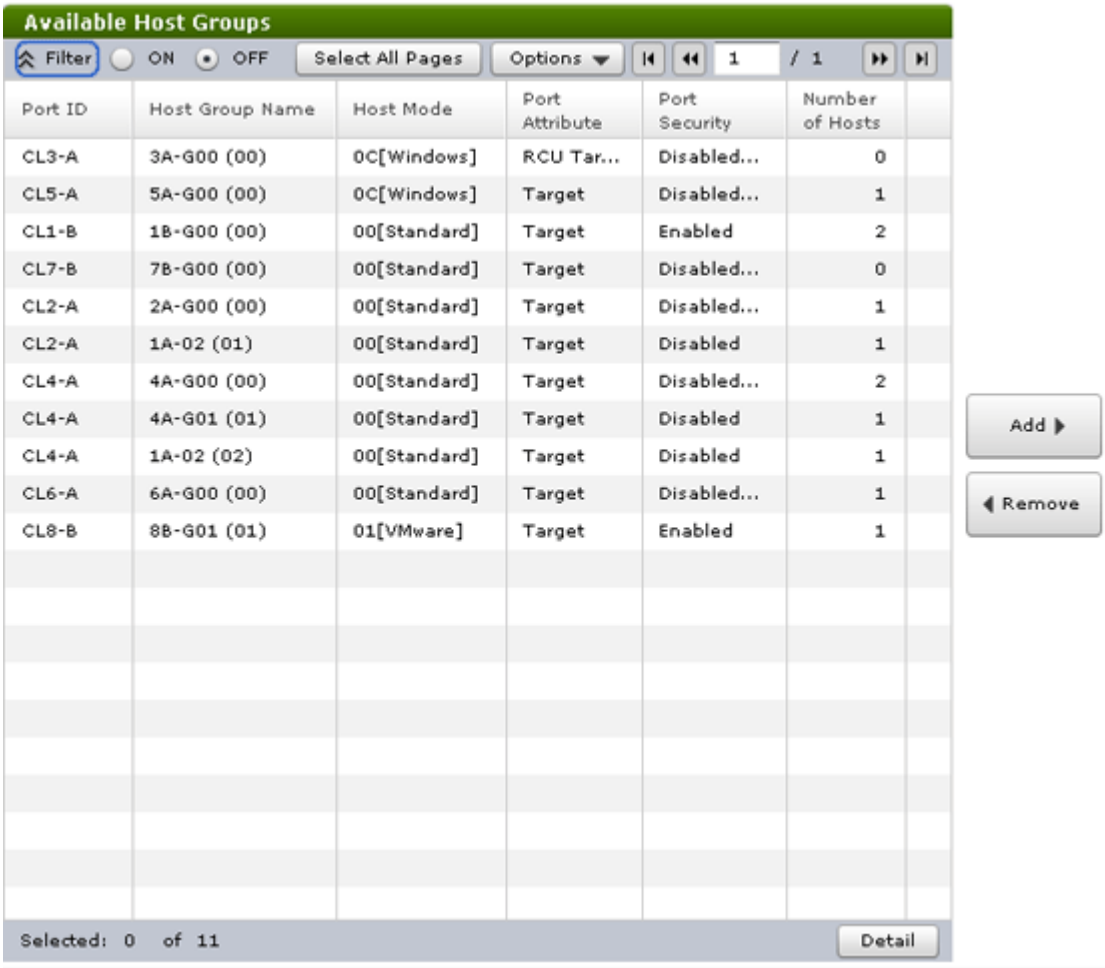
Item	Description
LUN ID	Identifier of the added logical unit.
LDEV ID	Identifier of the LDEV.
LDEV Name	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Parity Group ID	Identifier of the parity group.
Number of Paths	Number of paths set for the LDEV.

Copy LUN Paths wizard

Copy LUN Paths window



Available Host Groups table

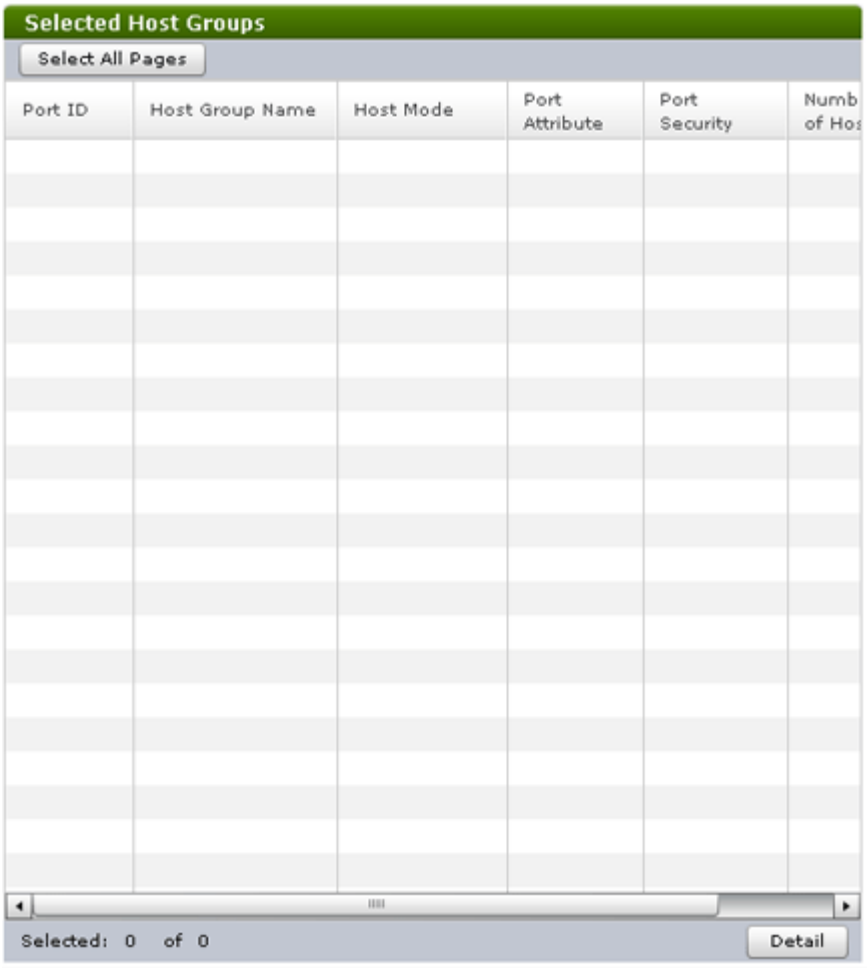


This table lists the host groups for which LU paths can be copied. Only the host group assigned to the logged-on user are available.

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.

Item	Description
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.
Add	Adds host groups selected from the **Available Host Groups** table to the **Selected Host Groups** table.
Remove	Removes the selected host groups from the **Selected Host Groups** table.

Selected Host Groups table

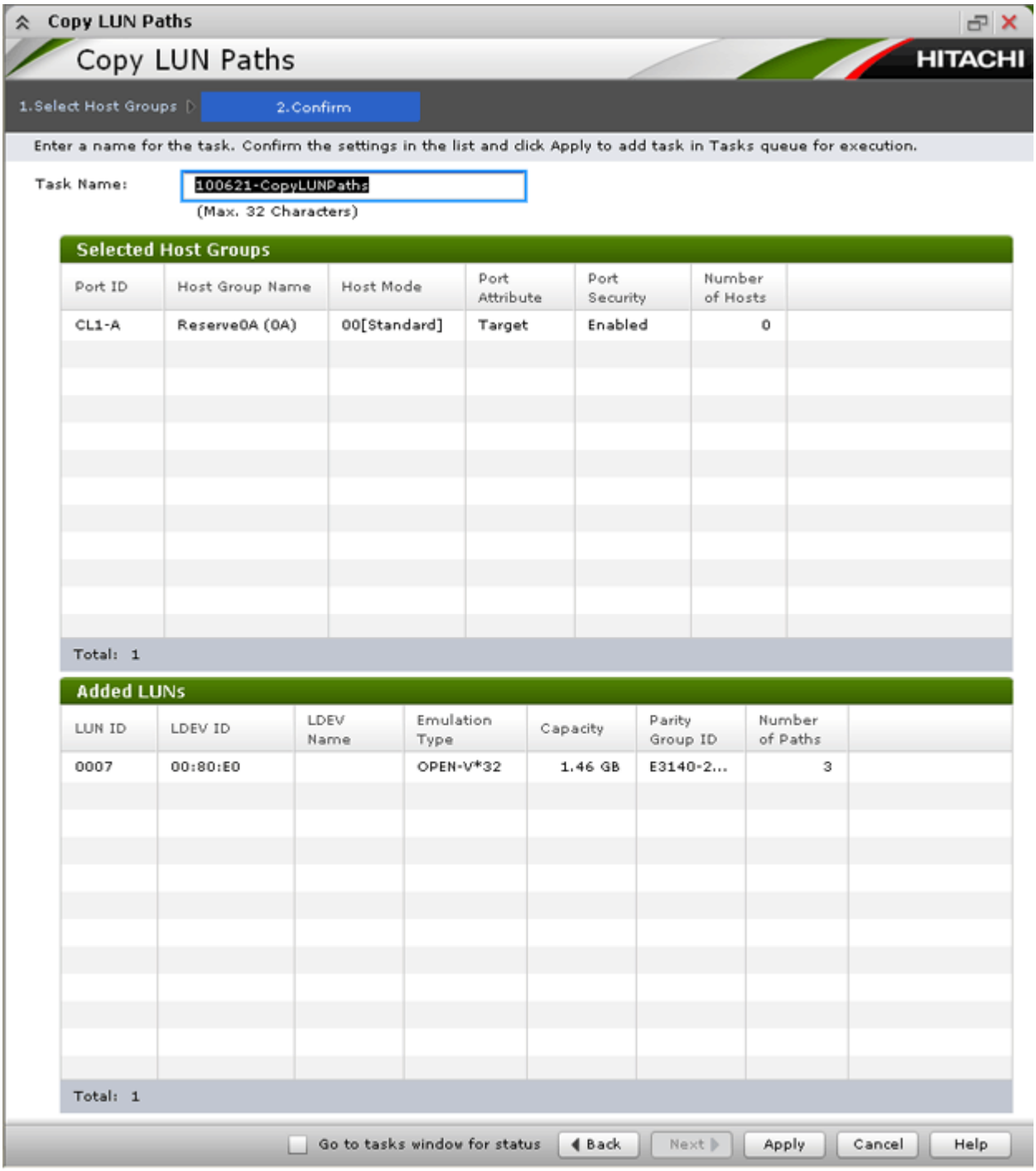


Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow.

Item	Description
	• Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.

Copy LUN Paths Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.



Selected Host Groups table

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.

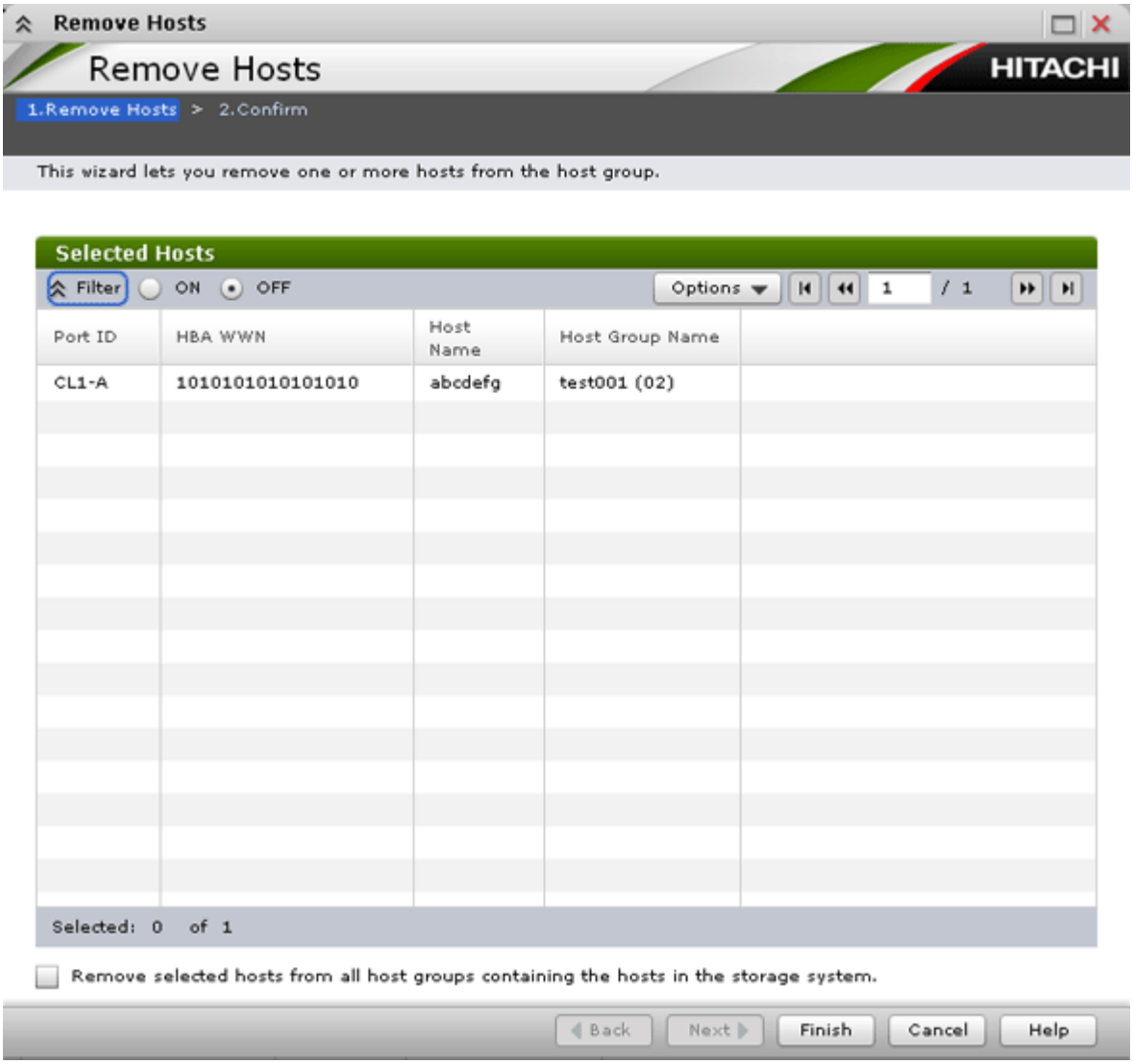
Item	Description
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.

Added LUNs table

Item	Description
LUN ID	Identifier of the added logical unit.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Parity Group ID	Displays the IDs of parity groups.
Number of Paths	Displays the number of paths set to the relevant LDEV.

Remove Hosts wizard

Remove Hosts window

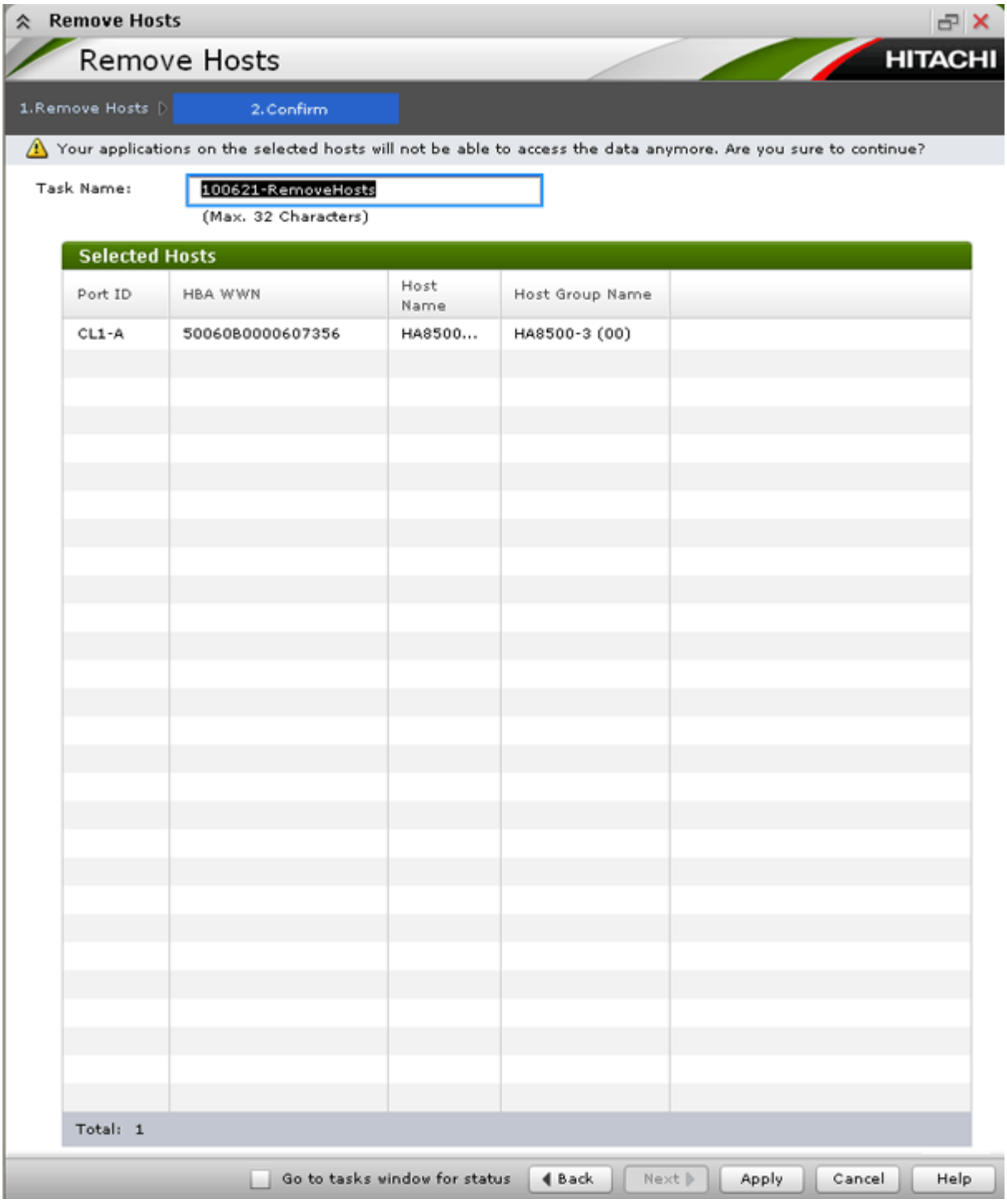


Selected Hosts table

Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group.
Remove selected hosts from all host groups containing the hosts in the storage system	If this check box is selected, selected hosts are removed from all host groups containing the hosts in the storage system.

Remove Hosts Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

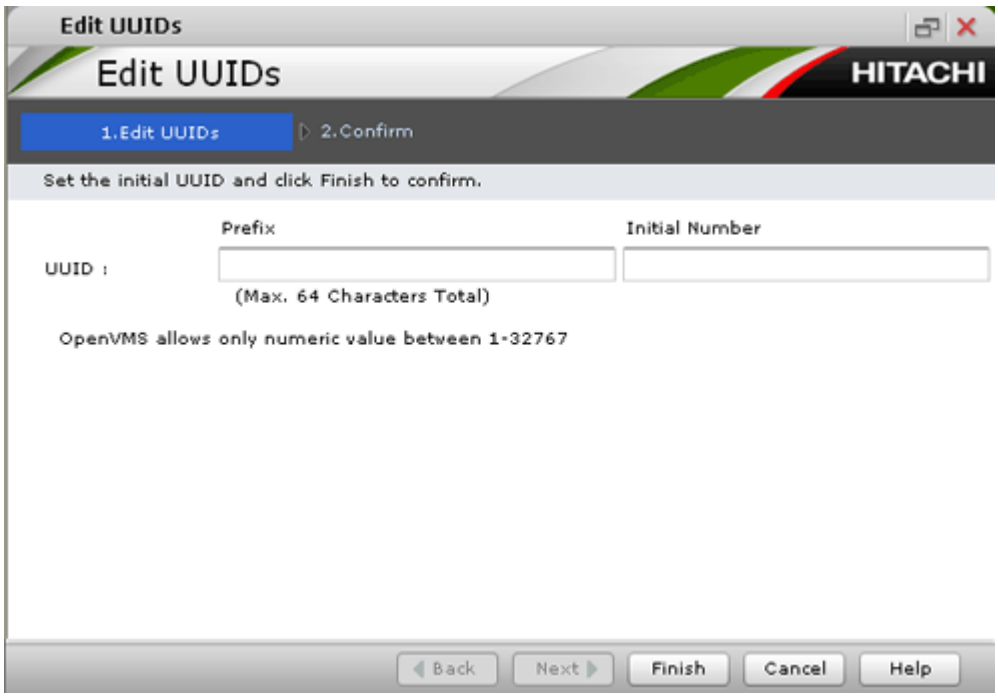


Selected Hosts table

Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group.

Edit UUIDs wizard

Edit UUIDs window



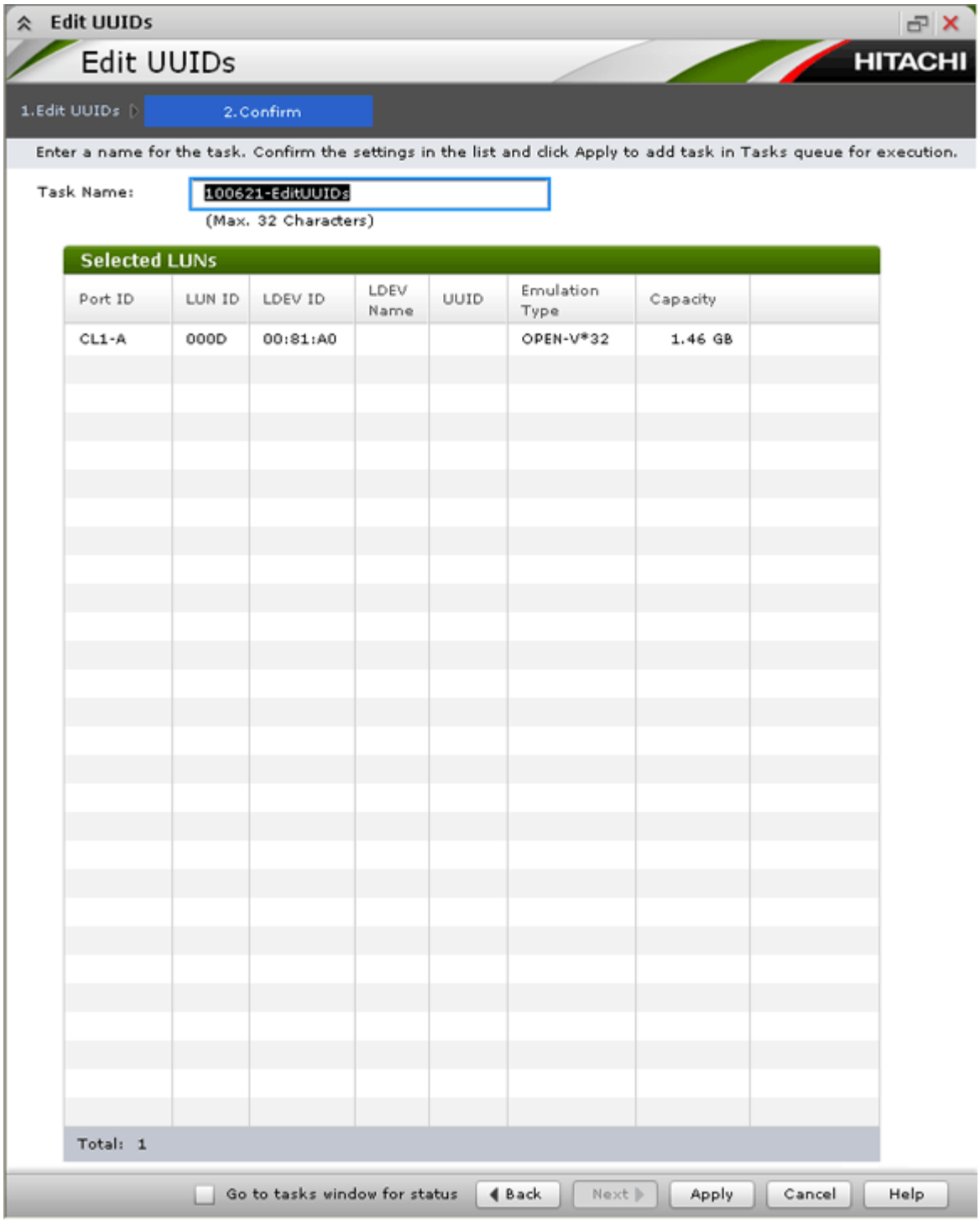
Item	Description
Prefix	For an OPEN VMS server host: The total length of the Prefix and the Initial Number may not exceed 5 characters. If the Prefix is 5 characters, you may not specify an Initial Number and vice versa. For a server host other than OPEN VMS: The total length of the Prefix and the Initial Number may not exceed 64 characters. If the Prefix is 64 characters, you may not specify an Initial Number and vice versa. The following rules apply to UUID: • These characters cannot be used: \ / : , ; * ? " < > | • A space character cannot be used for the first and the last characters.

Item	Description
	• UUIDs are case-sensitive. For example, **Abc** and **abc** are different UUIDs.
Initial Number	For an OPEN VMS server host: The total length of the Prefix and the Initial Number may not exceed 5 characters. If the Prefix is 5 characters, you may not specify an Initial Number and vice versa. For a server host other than OPEN VMS: The total length of the Prefix and the Initial Number may not exceed 64 characters. If the Prefix is 64 characters, you may not specify an Initial Number and vice versa. The following rules apply to the initial number. Example: • 1: Up to 9 numbers are added (1, 2, 3 ... 9) • 08: Up to 92 numbers are added (08, 09, 10 ... 99) (If the host mode is OpenVMS, the numbers are: 8, 9, 10 ... 99) • 23: Up to 77 numbers are added (23, 24, 25 ... 99)

Caution: If UUID is blank, the UUID setting is released.

Edit UUIDs Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

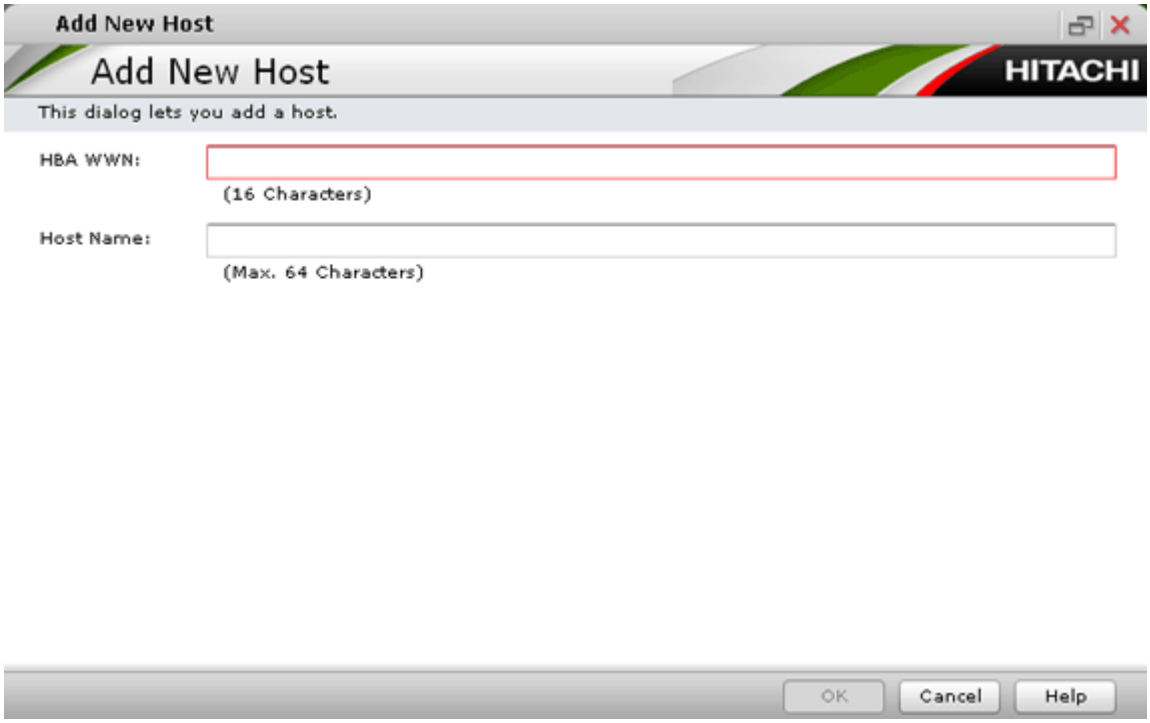


Selected LUNs table

Item	Description
Port ID	Identifier of the port.
LUN ID	Logical units whose UUID has been changed.

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
UUID	Identifies the set or changed UUID. A blank field indicates that the UUID is released.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.

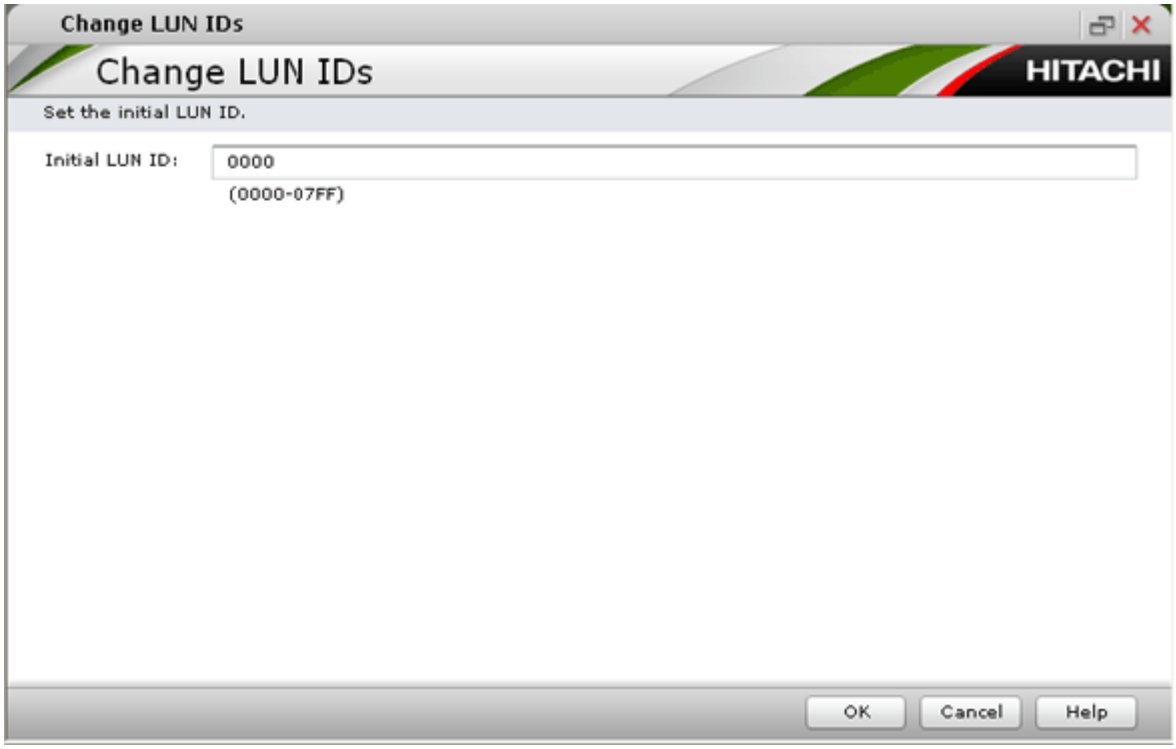
Add New Host window



Item	Description
HBA WWN	Specify the WWN of the port in 16 digits of hexadecimal numbers.
Host Name	Specify the host name. As a host name, you can use single-byte ASCII characters (alpha-numerals and symbols) up to 64 characters. You cannot use the following symbols: \ / : , ; * ? " < > |

Item	Description
	You cannot use blanks at the beginning or end of the host name. A host name is case-sensitive.

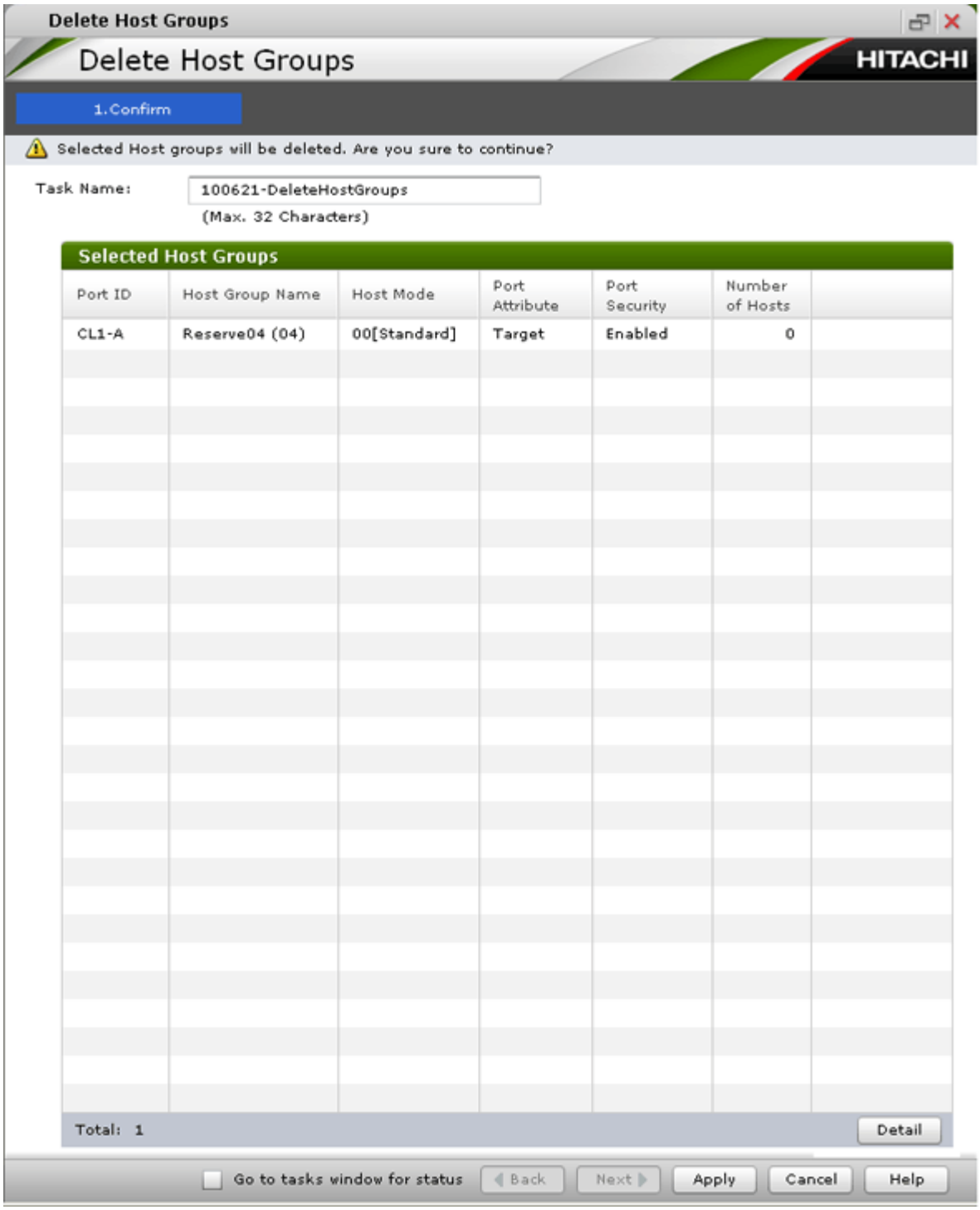
Change LUN IDs window



Setting field

Item	Description
Initial LUN ID	Specify the initial LUN ID in 4 digits of hexadecimal numbers (from 0000 to 07FF). If multiple LUs are selected, LUN IDs are set consecutively from the specified LUN ID.

Delete Host Groups window

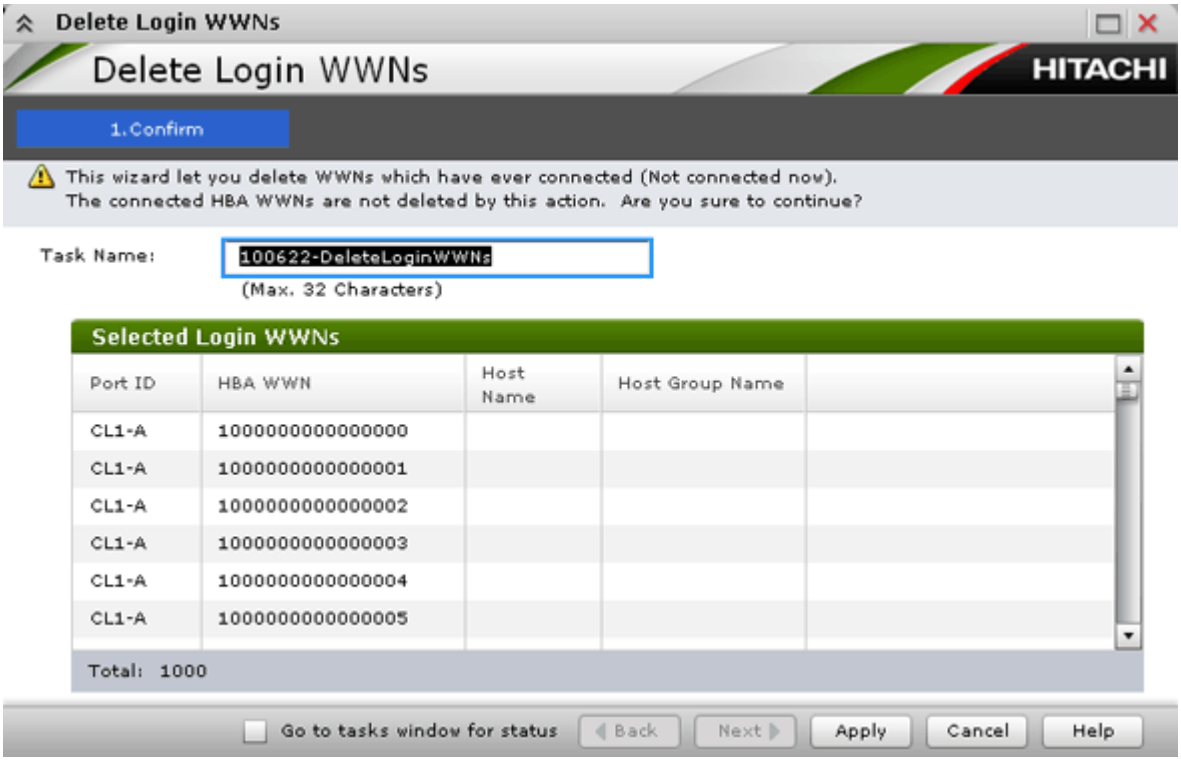


Selected Host Groups table

Item	Description
Port ID	Identifier of the port.

Item	Description
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Port Attribute	Attribute of the port indicating I/O flow. • Initiator: Issues I/O commands to a target port when I/O is executed between storage systems with TrueCopy, and so on. • Target: Receives I/O commands from a host. • RCU Target: Receives I/O commands from an initiator when I/O is executed between storage systems with TrueCopy, and so on. • External: Issues I/O commands to a target port of an external storage system with Universal Volume Manager.
Port Security	LUN security setting (enable or disable) on the port.
Number of Hosts	Number of hosts registered in the host group.
Detail	Details about the selected host group.

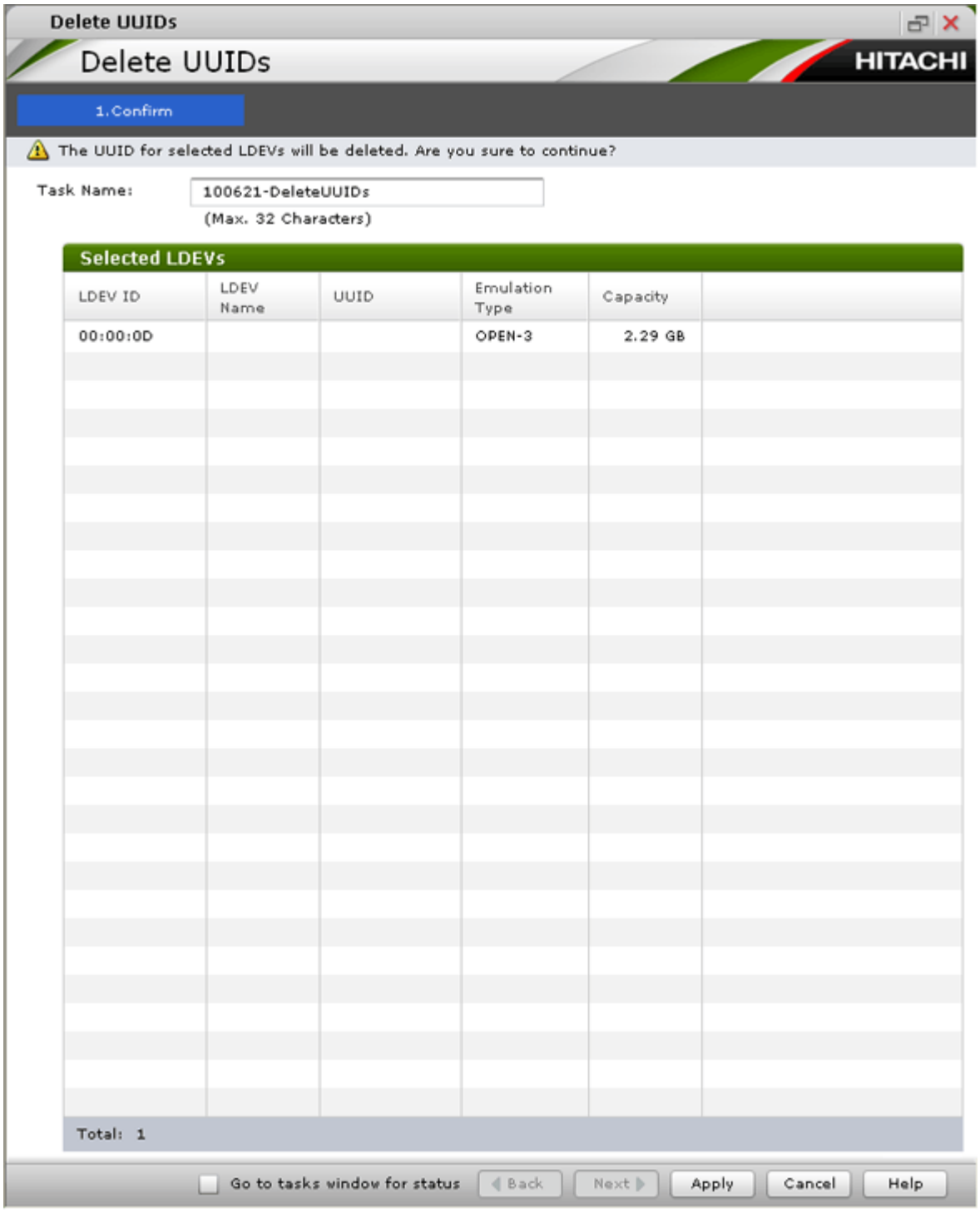
Delete Login WWNs window



Selected Login WWNs table

Item	Description
Port ID	Identifier of the port.
HBA WWN	WWN of the port.
Host Name	Name of the host.
Host Group Name	Name of the host group.

Delete UUIDs window

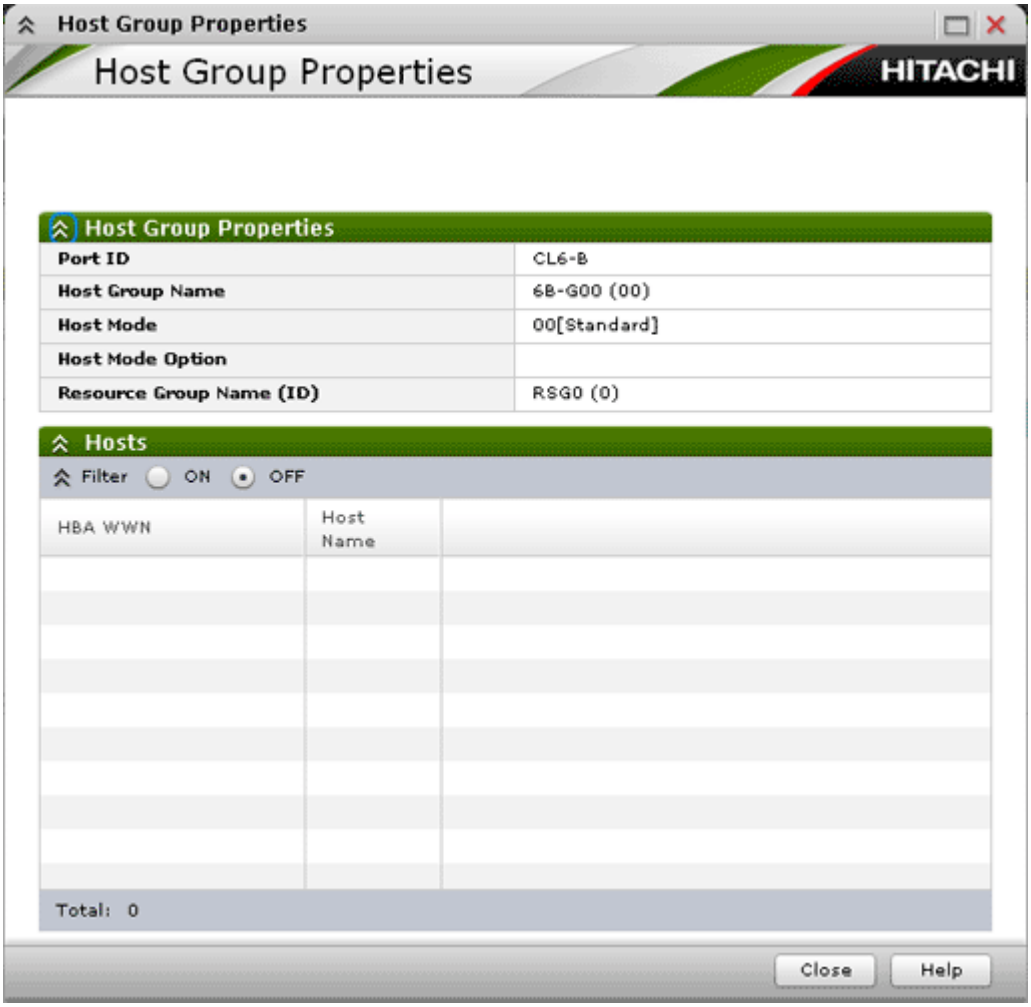


Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
UUID	This field is blank because the UUID is to be deleted.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.

Host Group Properties window

Use this window to view properties about a selected host group.



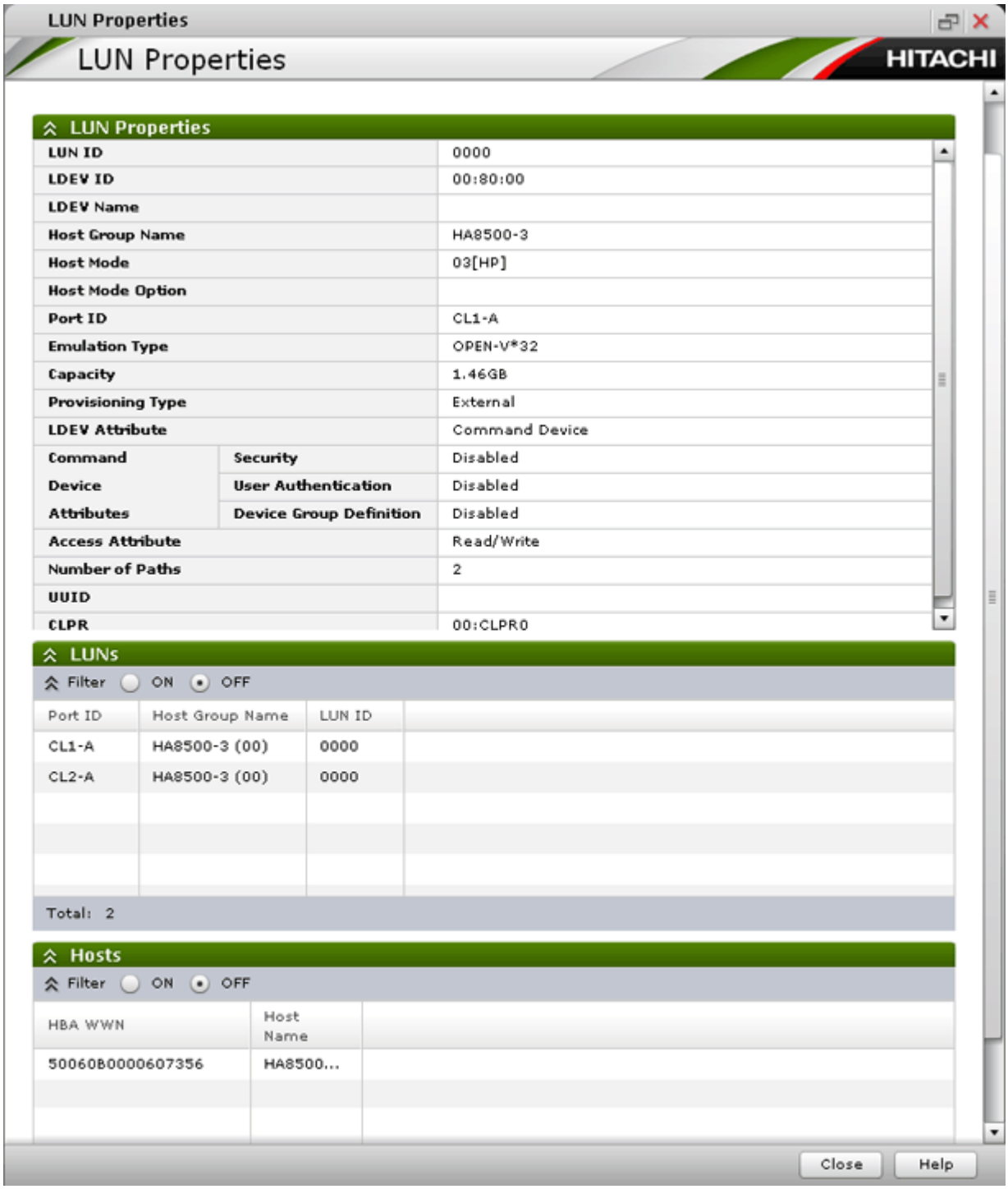
Host Group Properties table

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Host Mode Option	The number of host mode options that are enabled.
Resource Group Name (ID)	Resource group names and IDs of host groups. The ID is provided in parentheses.

Hosts table

Item	Description
HBA WWN	WWN of the port.
Host Name	Name of the host.

LUN Properties window



LUN Properties table

This table provides information about the selected LUN.

Item	Description
LUN ID	Identifier of the selected logical unit.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.
Host Group Name	Name of the host group.
Host Mode	The host mode of the host group.
Host Mode Option	The number of host mode options that are enabled.
Port ID	Identifier of the port on this volume.
Emulation Type	Emulation types for the logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of the logical volume.
Provisioning Type	Provisioning type assigned to this logical volume. • Basic: Internal volume. • DP: DP-VOL. • External: External volume. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
LDEV Attribute	Displays the attribute of the LDEV. • Command Device: Command device. • Remote Command Device: Remote command device. • Nondisruptive Migration: Volume for nondisruptive migration. • -: Volume in which the attribute is not defined.
Command Device Attributes	If the logical volume is used as a command device, indicates the status of the attributes on this LDEV. • Security: Indicates the status of command device security is (enable or disable). • User Authentication: Indicates the status of user authentication (enable or disable). • Device Group Definition: Indicates the status of device group definition (enable or disable).
Security	Indicates the setting (Enabled or Disabled) of command device security.
User Authentication	Indicates the setting (Enabled or Disabled) of the command device user authentication.
Device Group Definition	Indicates the setting (Enabled or Disabled) of the command device group definition.
Access Attribute	Access attribute assigned to this LDEV.

Item	Description
	• Read/Write: Both read and write operations are permitted on the logical volume. • Read-only: Read operations are permitted on the logical volume. • Protect: Neither read nor write operations are permitted.
Number of Paths	Number of paths set for the LDEV.
UUID	User-definable LUN identifier. This field is blank if the UUID is not set.
CLPR	Cache logical partition numbers. For detailed information about CLPRs, see the *Performance Guide*.

LUNs table

This table provides information about the LUN ID registered for the selected LDEV.

Item	Description
Port ID	Identifier of the port.
Host Group Name	Name of the host group.
LUN ID	Identifier of the logical unit.

Hosts table

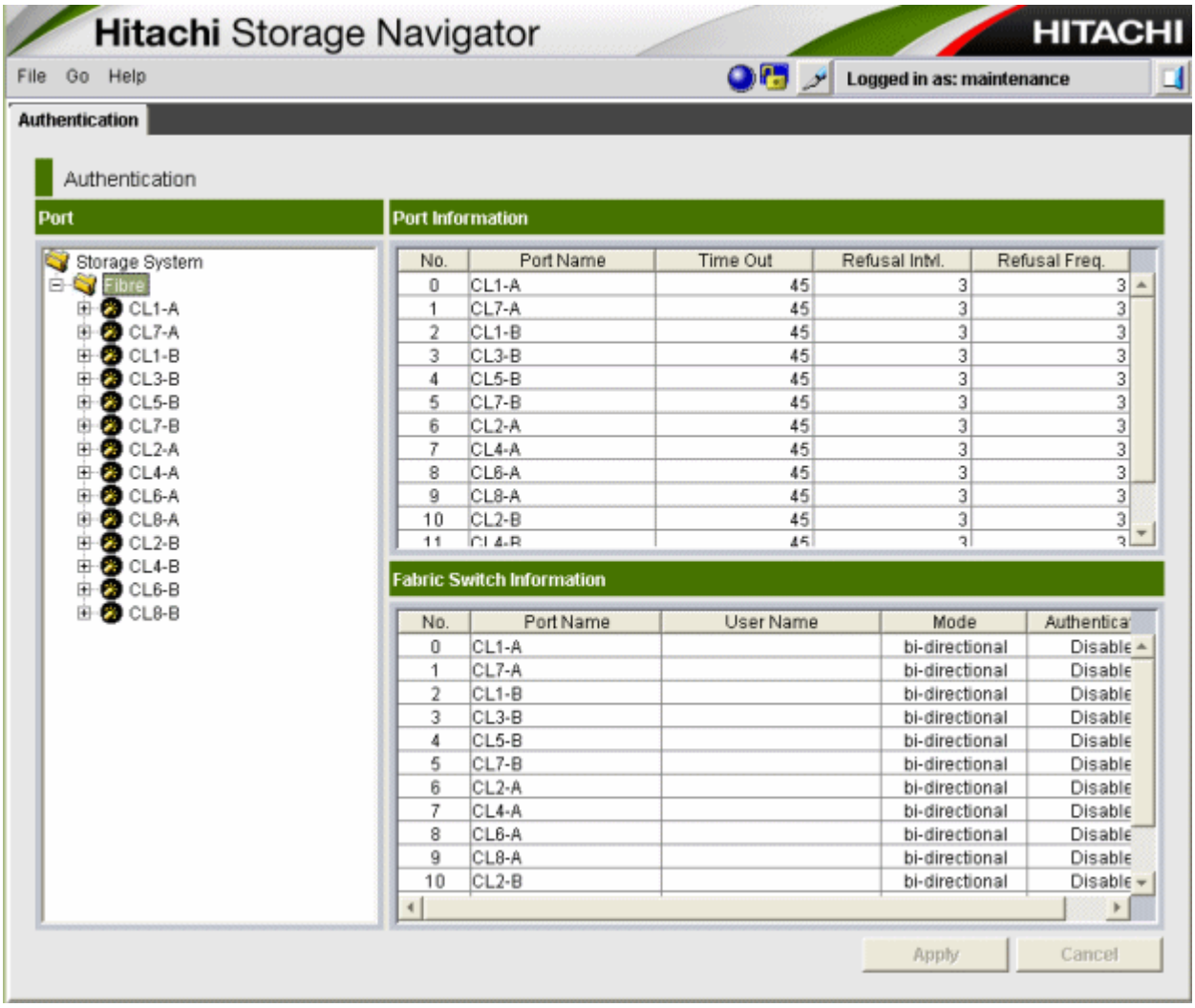
Lists the hosts that belong to the host group in which the selected LUN ID is registered.

Item	Description
HBA WWN	WWN of the port.
Host Name	Name of the host.

Authentication window

Authentication window (fibre folder selected)

On the menu bar, click **Actions**, **Port/Host Group**, and then **Authentication**. The **Authentication** window opens. Use this window to make settings for user authentication.



Port tree

The Port tree provides information about user authentication on each port.

Double-click the **Fibre** folder to show the fibre channel ports in the storage system.

If you select the **Fibre** folder, information about ports and fabric switches appears in the table on the right of the tree. The **Fibre** folder is available only if the storage system contains a fibre channel adapter.

Item	Description
CLX-Y	This icon indicates a fibre channel port.

Port information list

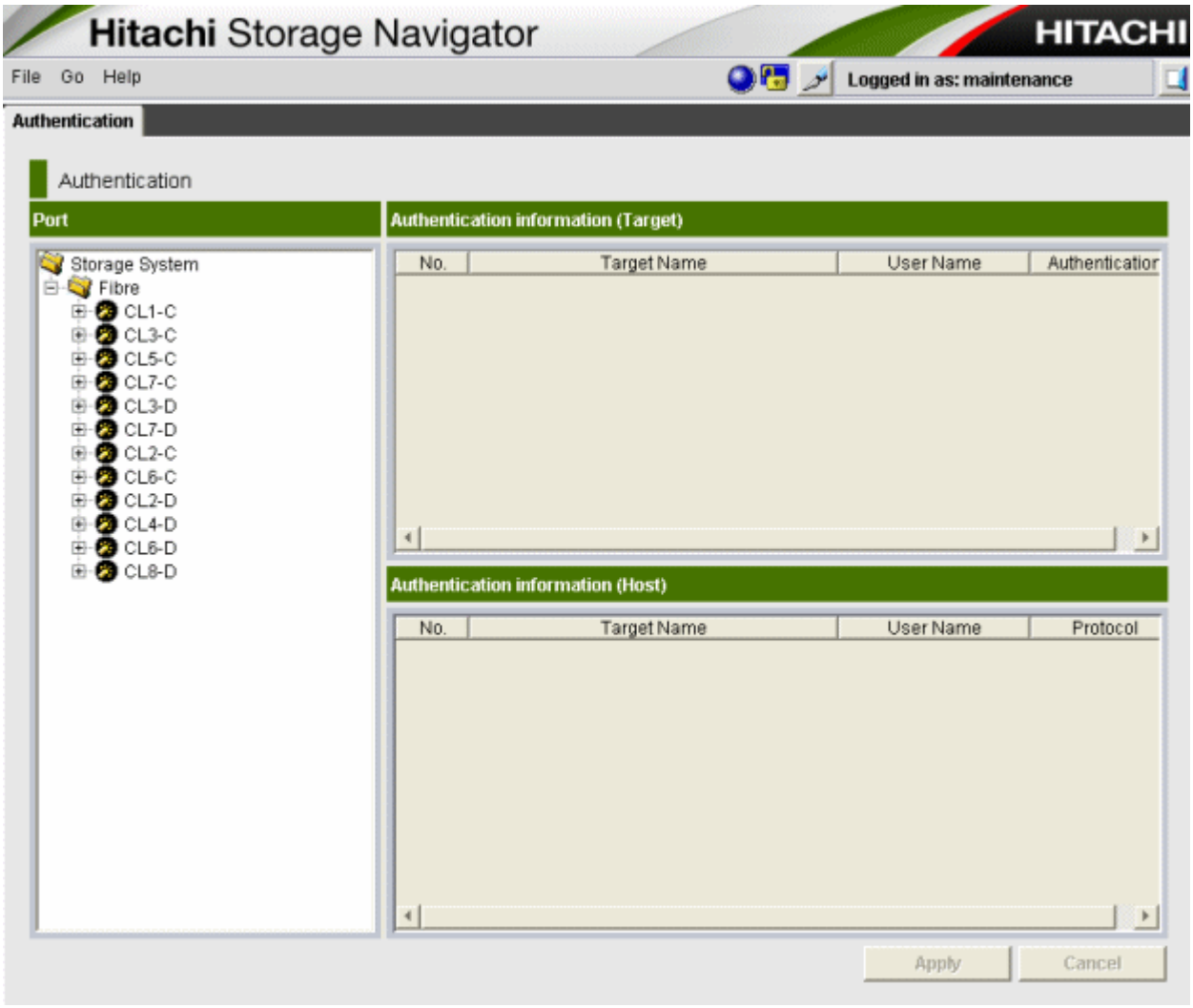
Item	Description
Port Name	Fibre channel port names.
Time out	The period of time between authentication sessions to a same port. If the previous authentication session to a port failed, the next authentication session starts after the specified period of time elapses. The unit is seconds.
Refusal Intvl.	If authentication fails for the number of times specified in Refusal Freq., connection to the port fails. Refusal Intvl. shows the interval (in minutes) from when connection to a port fails to when the next authentication session starts.
Refusal Freq.	Number of times that authentication is allowed for connection to a port. If authentication fails for the specified number of times, connection to the port fails.

Fabric Switch information list

Item	Description
Port Name	Fibre channel port name.
User Name	User name of the fabric switch.
Mode	Mode of authentication between ports and fabric switches. • bidirectional: The authentication mode is mutual. • unidirectional: The authentication mode is not mutual.
Authentication	Indicates whether to perform authentication for the fabric switch. • Enable: The fabric switch is a target of user authentication. • Disable: The fabric switch is not a target of user authentication.

Authentication window (fibre port selected)

On the menu bar, click **Actions**, **Port/Host Group**, and then **Authentication**. The **Authentication** window opens. Use this window to make settings for user authentication.



Port tree

Use this tree to find information about user authentication on each port. When you select a port from this tree, the Authentication Information (Target) list on the right provides user information of the hosts that are registered on the port. In addition, the Authentication Information (Host) list below the Authentication Information (Target) list provides the user information of the selected port.

Double-click the **Fibre** folder to view all fibre channel ports in the storage system. The **Fibre** folder is available only if the storage system contains a fibre channel adapter. Double-click the fibre channel ports to view host groups in that port. The host group name appears beside the icon.

Item	Description
CLX-Y	Indicates a fibre channel port.

Item	Description
host group name	Indicates that the host group performs authentication of hosts.
host group name	Indicates that the host group does not perform authentication of hosts.

Authentication information (target) list

The list on the right provides user information of the host groups that are allowed to connect to the port or host group specified in the tree.

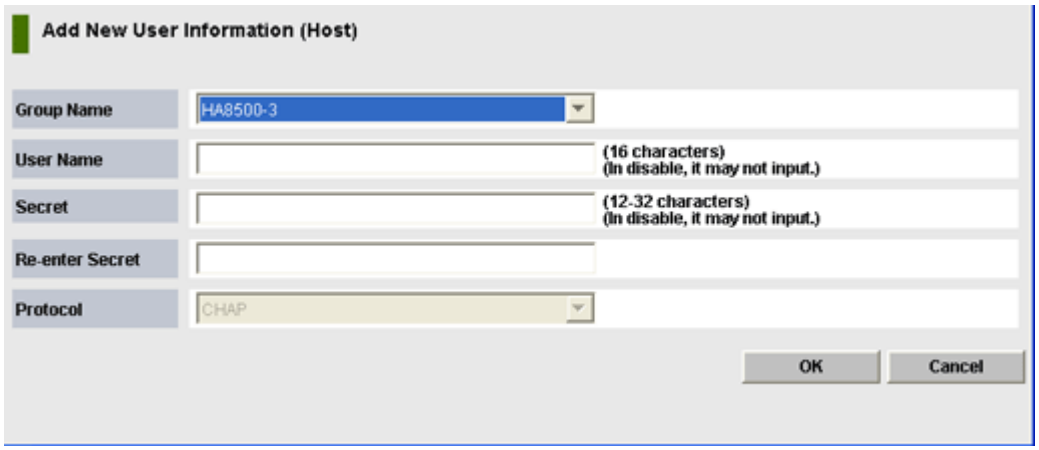
Item	Description
Group Name	Names of the host group.
User Name	User name of the host group. When the user name is not defined for a host group, this column is blank.
Authentication	Indicates whether to perform user authentication for the host. • Enable: The host is a target of user authentication. • Disable: The host is not a target of user authentication.

Authentication information (host) list

Below the User Information (Target) list appears a list that provides user information of the host selected in the port or host group in the tree. In this list, you can register up to 64 user information items.

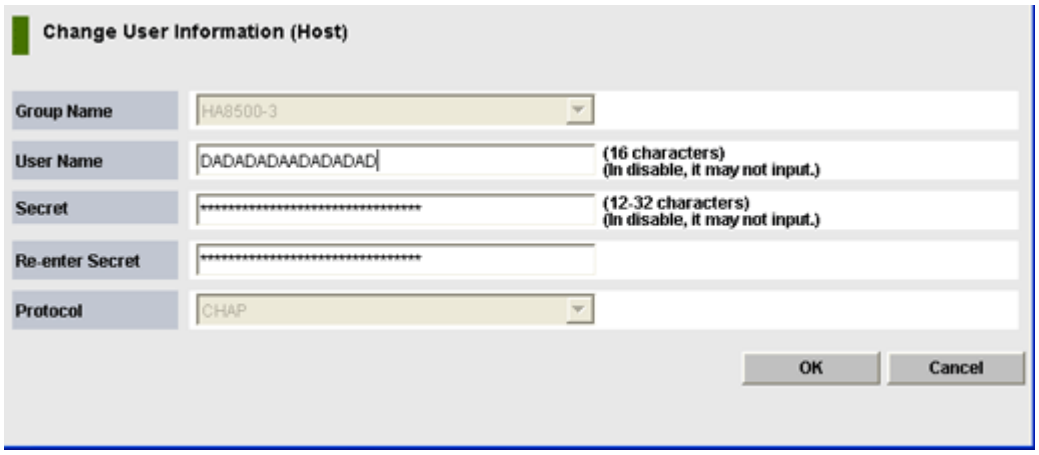
Item	Description
Group Name	Name of the host group.
User Name	User name of the host. When the user name is not defined for a host, this column is blank.
Protocol	Indicates the protocol in use for user authentication. Always CHAP.

Add New User Information (Host) window



Item	Description
Group Name	Select the group name where the user will be registered.
User Name	Specify the user name of the host. Up to 16 alphanumeric characters can be used.
Secret	Specify the secret to be used for host authentication. Use 12 to 32 characters, including alphanumerics, spaces, and the following symbols: . - + @ _ = : / [ ] , ~
Re-enter Secret	Specify the secret again for confirmation. An error occurs if you enter incorrect characters, and then click **OK**.
Protocol	Protocol to be used for user authentication. This protocol is always CHAP (Challenge-Handshake Authentication Protocol).

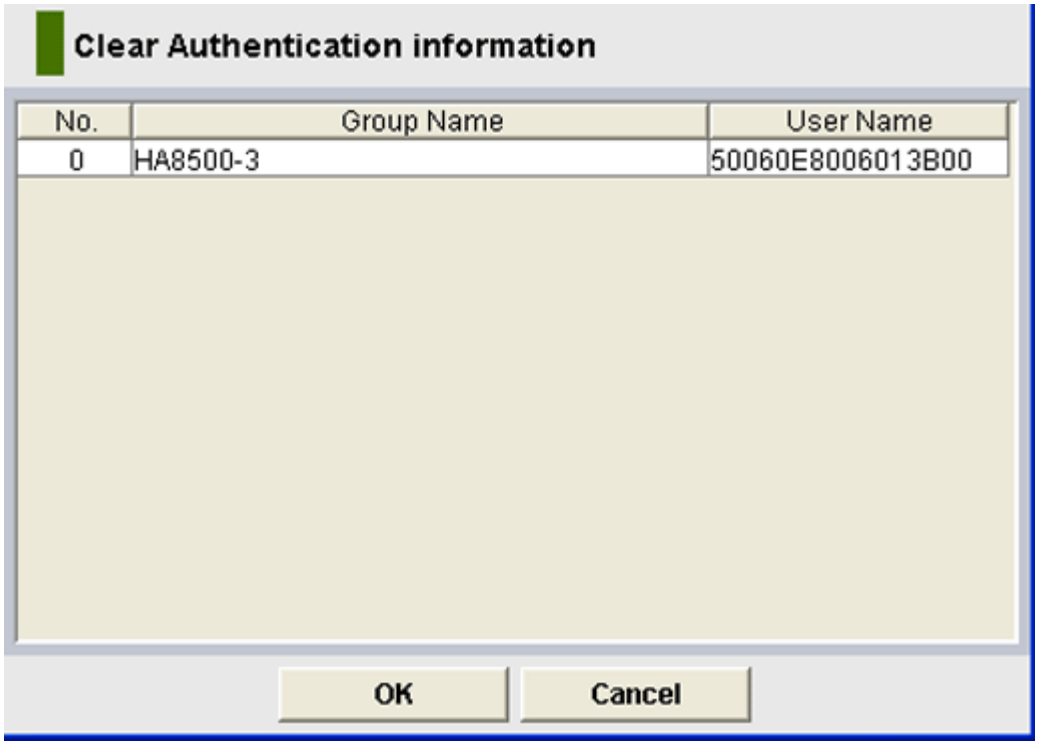
Change User Information (Host) window



Item	Description
Group Name	Group name where the user is registered.

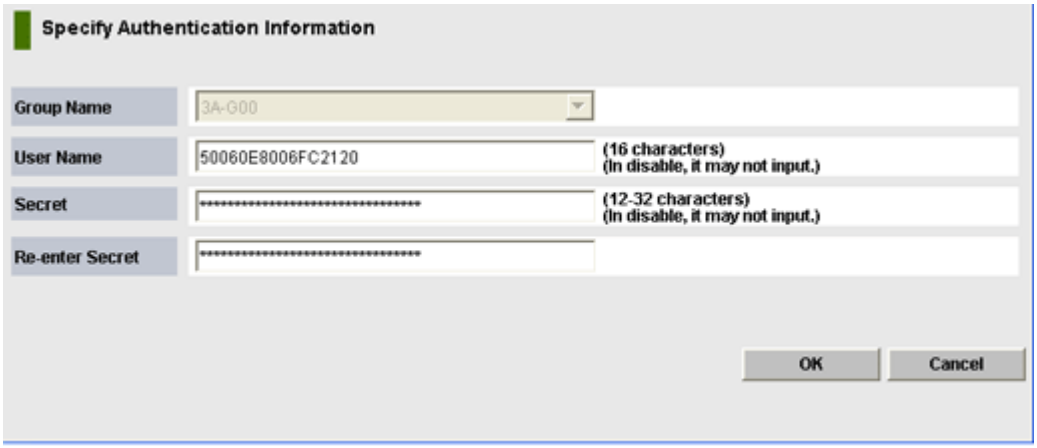
Item	Description
User Name	Specify the user name of the host. Up to 16 alphanumeric characters can be used.
Secret	Specify the secret to be used for host authentication. Use 12 to 32 characters, including alphanumerics, spaces, and the following symbols: . - + @ _ = : / [ ] , ~
Re-enter Secret	Specify the secret again for confirmation. An error occurs if you enter incorrect characters, and then click **OK**.
Protocol	Protocol to be used for user authentication. This protocol is always CHAP (Challenge-Handshake Authentication Protocol).

Clear Authentication information window



Item	Description
No	Item number.
Group Name	Group name to be deleted.
User Name	The name of the user to be deleted.

Specify Authentication Information window



Item	Description
Group Name	Group name where the user is registered.
User Name	Specify the user name of the host. Up to 16 alphanumeric characters can be used.
Secret	Specify the secret to be used for host authentication. Use 12 to 32 characters, including alphanumerics, spaces, and the following symbols: . - + @ _ = : / [ ] , ~
Re-enter Secret	Specify the secret again for confirmation. An error occurs if you enter incorrect characters, and then click **OK**.

Edit Command Devices wizard

The System Administrator can enter CCI commands from open-system hosts to perform TrueCopy or ShadowImage operations or both on logical devices. For example, CCI commands can be used to create and split pairs. If you want to allow the System Administrator to enter CCI commands from open-system hosts, you must specify at least one logical device as the command device. If desired, you must also apply command device security to other logical devices in the storage system.

Use **Edit Command Devices** window to edit command devices.

To open the Edit Command Devices window:

1. Select LDEVs in one of the following ways.
   - In the **Storage Systems** tree, click **Logical Devices** and select the **LDEVs** tab.
   - In the **Storage Systems** tree, click **Ports/Host Groups** and select a port, and then select a host group. After that, select the **LUNs** tab.
2. On the menu bar, click **Actions**, **Logical Device**, and then **Edit Command Devices**. Or, click **Edit Command Devices**. The **Edit Command Devices** window opens.

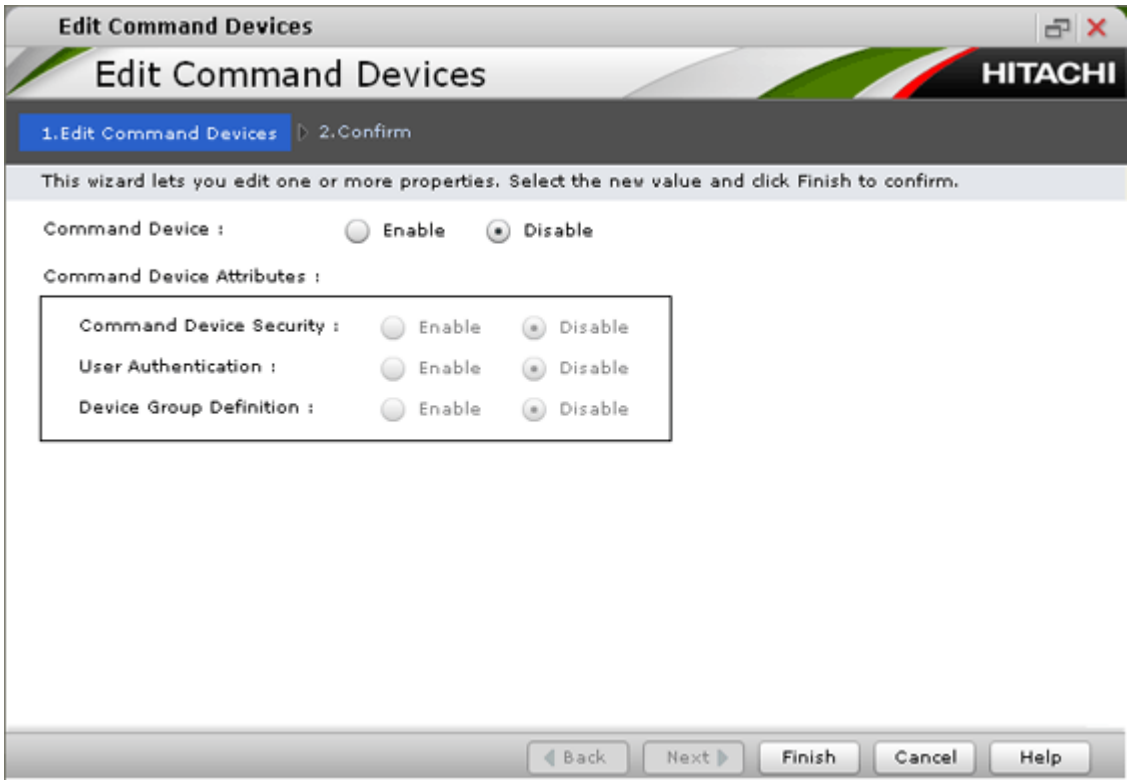
Caution: The following volumes cannot be specified as a command device:

- Volume whose access attribute is other than read/write
- Volume reserved by Volume Migration
- TrueCopy volume
- ShadowImage volume
- Universal Replicator volume
- Virtual volume (V-VOL) for Thin Image or Copy-on-Write Snapshot.
- Volume reserved by Data Retention Utility
- System disk
- Journal volume
- Pool volume
- Remote command device
- Quorum disk for High Availability Manager
- Volume for nondisruptive migration

Edit Command Devices window

If you want to enable command device security, user authentication, and device group definition, you must enable the command device in this window.

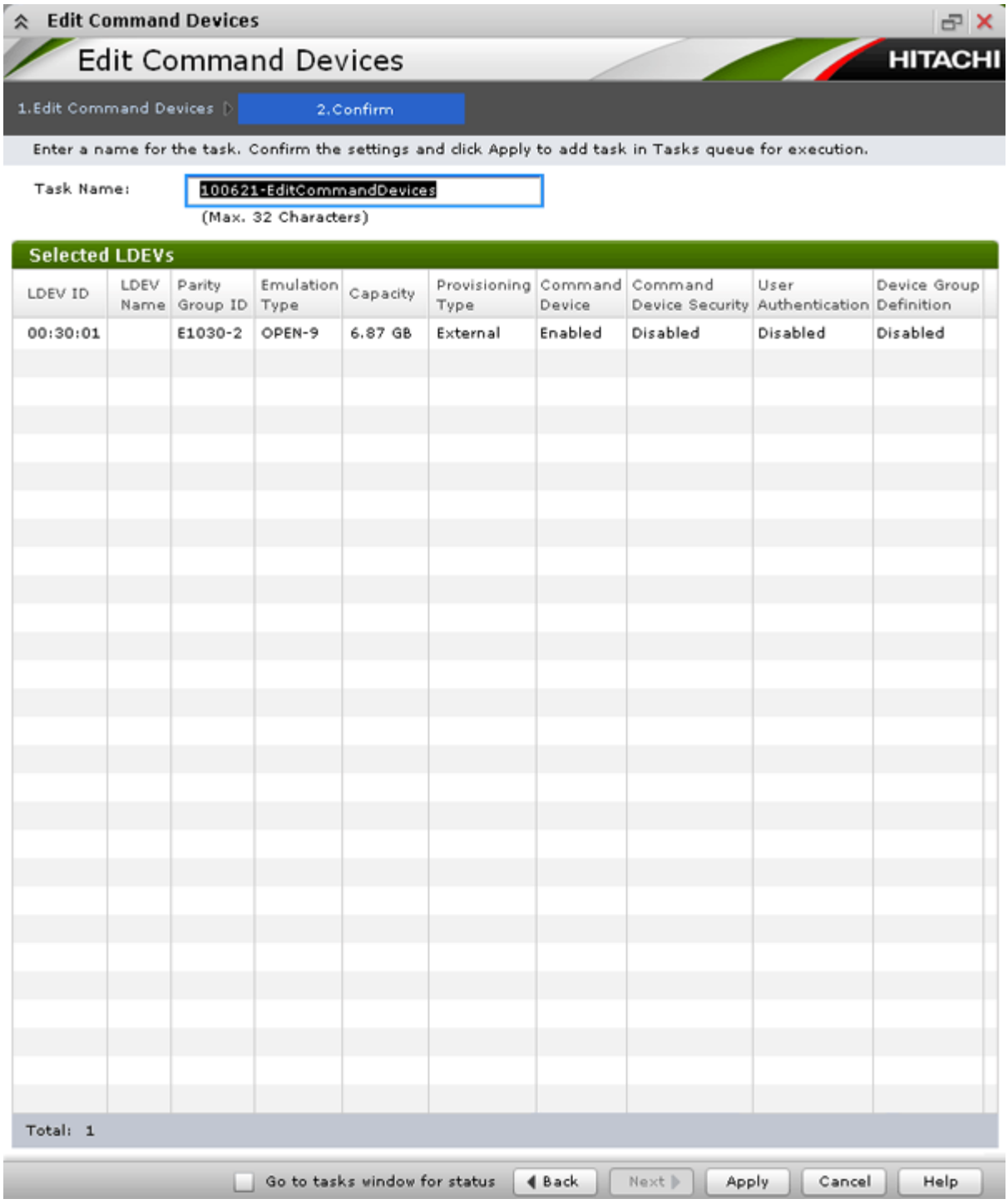
If the command device is disabled, you cannot enable command device security, user authentication, and device group definition.



Item	Description
Command Device	Select **Enable** to enable command devices. Select **Disable** to release command devices.
Command Device Security	Select **Enable** to apply command device security to a logical device in a storage system. Select **Disable** to release command device security. If you want to protect logical volumes from the use of CCI commands, you must apply command device security to the logical volumes. If command device security is applied to a logical device, the logical device will not be affected by CCI commands issued via command devices from the hosts.*
User Authentication	Select **Enable** to apply user authentication to a command device. Select **Disable** to release user authentication.*
Device Group Definition	Select **Enable** to apply device group definition to a command device. Select **Disable** to release device group definition.*
* For details about a command device attribute settings, see the *Command Control Interface User and Reference Guide*.	

Edit Command Devices Confirm window

Confirm proposed settings, name the task, and then click **Apply**. The task will be added to the execution queue.

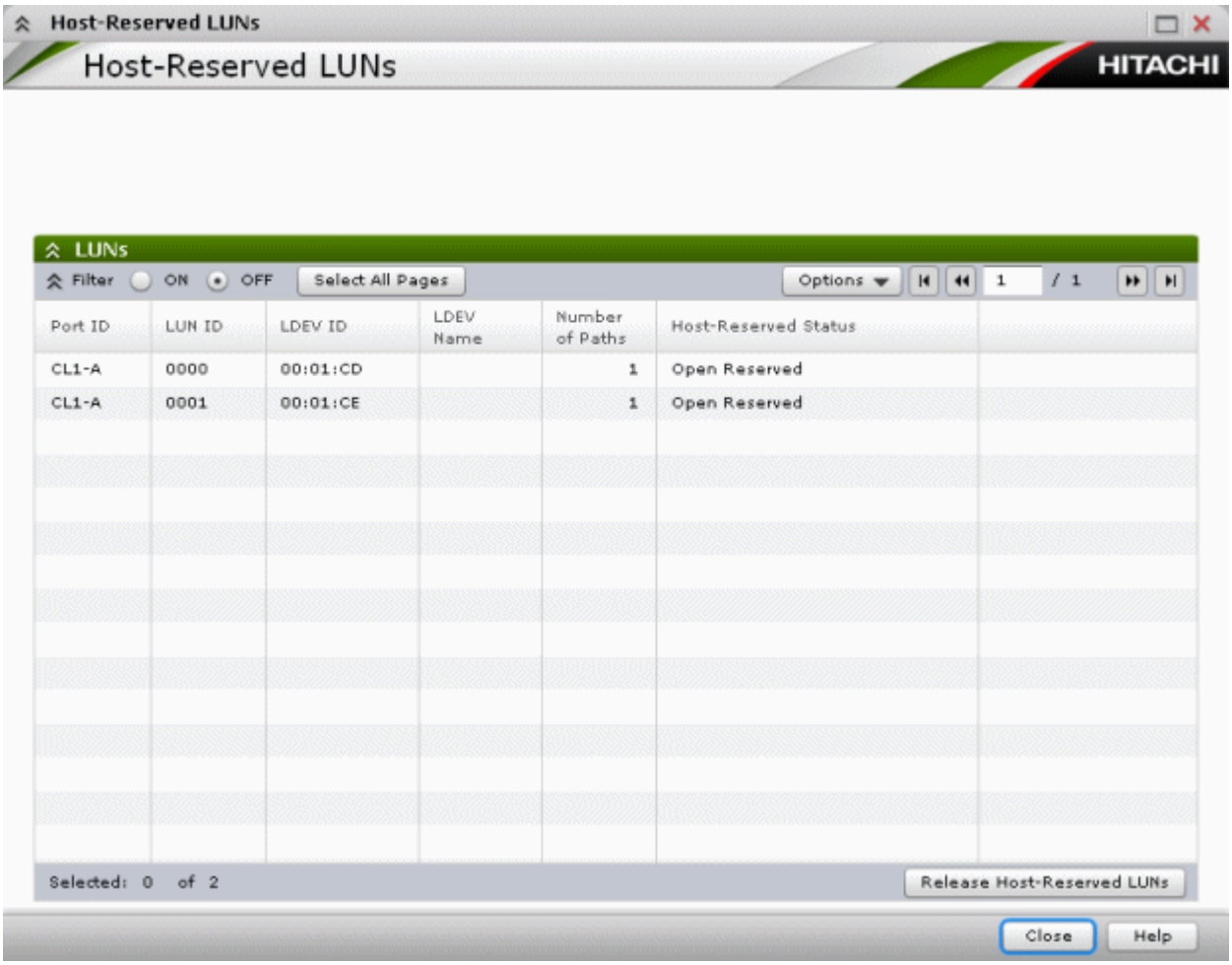


Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Name of the LDEV.

Item	Description
Parity Group ID	Identifier of the parity group.
Emulation Type	Emulation types for each logical volume (or logical device). For LUSE volumes, an asterisk (*) and a number appear on the right of the emulation type. For example, OPEN-9*3 indicates that three OPEN-9 volumes are combined.
Capacity	Size of each logical volume.
Provisioning Type	Provisioning types for each logical volume. • Basic: Internal volume. • External: External volume. • DP: V-VOL of Dynamic Provisioning. • Snapshot: Thin Image volume or Copy-on-Write Snapshot volume.
Command Device	Indicates whether the selected logical device is a command device. • Enabled: The command devices are enabled. • Disabled: The logical device is not a command device.
Command Device Security	Indicates whether command device security is applied to the selected command device. • Enabled: Command device security is applied to the command device. • Disabled: Command device security is not applied to the command device.
User Authentication	Indicates whether user authentication is applied to the selected command device. • Enabled: User authentication is applied to the command device. • Disabled: User authentication is not applied to the command device.
Device Group Definition	Indicates whether the device group definition is applied to the selected command device. • Enabled: Device group definition is applied to the command device. • Disabled: Device group definition is not applied to the command device.

Host-Reserved LUNs window



LUNs table

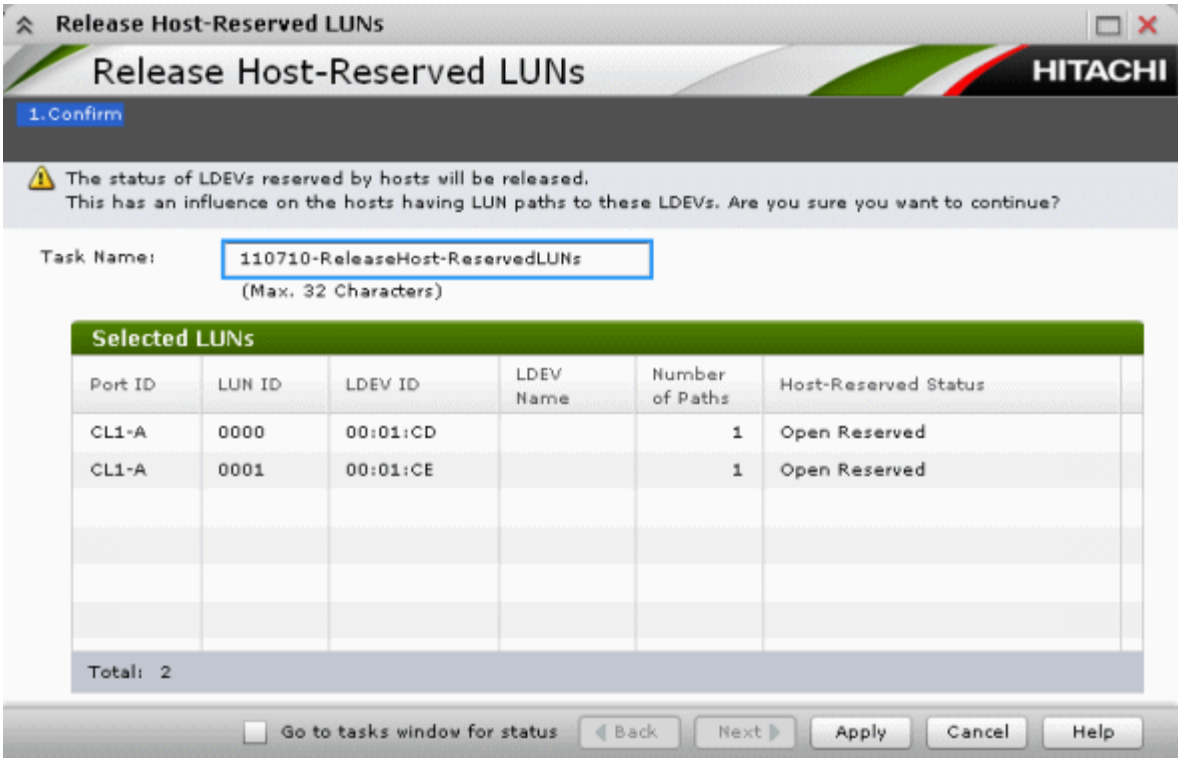
LUNs reserved by hosts are displayed.

Item	Description
Port ID	Displays names of ports.
LUN ID	Displays IDs of the LUNs.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays names of LDEVs.
Number of Paths	Displays the number of paths set for the relevant LDEV.
Host-Reserved Status	Displays the status of the host-reserved LUN. • Open Reserved: LUN is reserved by the Open Reserved command. • Persistent Reserved: LUN is reserved by the Persistent Group Reserve command.

Item	Description
	• Mainframe Reserved: LUN is reserved by the mainframe system. • ACA Active: LUN is in the ACA active status.
Release Host-Reserved LUNs	Displays the Release Host-Reserved LUNs window.

Release Host-Reserved LUNs wizard

Release Host-Reserved LUNs window



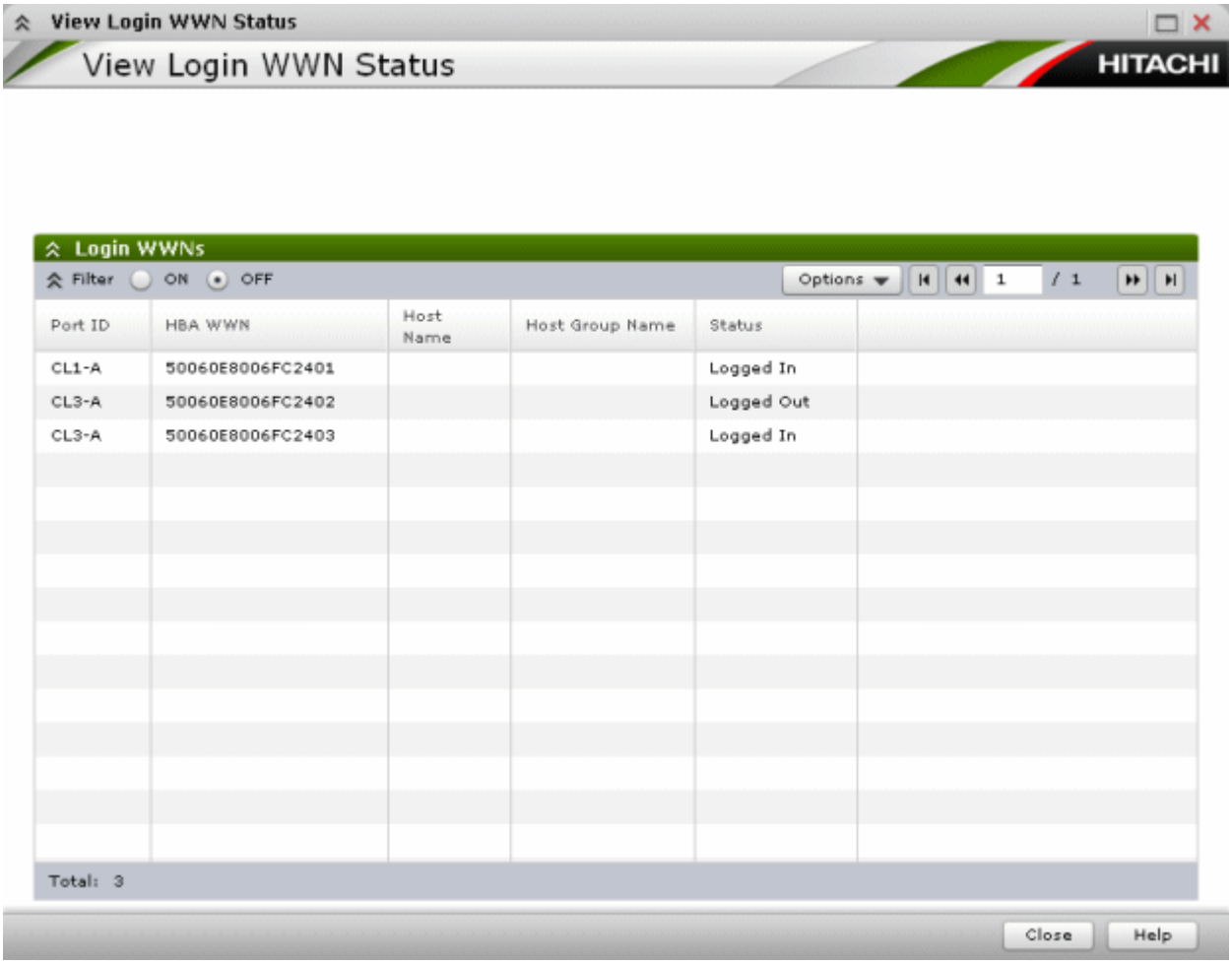
LUNs to release the reservations by hosts are displayed.

Selected LUNs table

Item	Description
Port ID	Displays names of ports.
LUN ID	Displays IDs of the LUNs.
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV.
LDEV Name	Displays names of LDEVs.
Number of Paths	Displays the number of paths set for the relevant LDEV.

Item	Description
Host-Reserved Status	Displays the status of the host-reserved LUN. • Open Reserved: LUN is reserved by the Open Reserved command. • Persistent Reserved: LUN is reserved by the Persistent Group Reserve command. • Mainframe Reserved: LUN is reserved by the mainframe system. • ACA Active: LUN is in the ACA active status.

View Login WWN Status window



Login WWNs table

Item	Description
Port ID	Displays names of ports.

Item	Description
HBA WWN	Displays the HBA WWNs and their icons.
Host Name	Displays the names of hosts.
Host Group Name	Displays the names of host groups.
Status	Displays the host login status (Logged In or Logged Out).

Glossary

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

#

2DC
two-data-center. Refers to the local and remote sites, or data centers, in which TrueCopy (TC) and Universal Replicator (UR) combine to form a remote replication configuration.
In a 2DC configuration, data is copied from a TC primary volume at the local site to the UR master journal volume at an intermediate site, then replicated to the UR secondary volume at the remote site. Since this configuration side-steps the TC secondary volume at the intermediate site, the intermediate site is not considered a data center.

3DC
three-data-center. Refers to the local, intermediate, and remote sites, or data centers, in which TrueCopy (TC) and Universal Replicator (UR) combine to form a remote replication configuration.
In a 3DC configuration, data is copied from a local site to an intermediate site and then to a remote site (3DC cascade configuration), or from a local site to two separate remote sites (3DC multi-target configuration).

A

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

ACE
Advanced Cluster Environment

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

ACP
array control processor. Another name for a back-end director (BED).

Adr
address

AdvFS
advanced file system

AES
Advanced Encryption Standard

AL
arbitrated loop

alias device
A formatted but unused mainframe logical device (LDEV) whose address can be used as an alias for a Parallel Access Volume (PAV) base device. See also *base device*.

allocated volume
A logical device (LDEV) for which one or more host paths are defined.

AL-PA
arbitrated-loop physical address

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

AMS
Hitachi Adaptable Modular Storage

ANSI
American National Standards Institute

AOU
allocation on use. Another name for Hitachi Dynamic Provisioning.

APAR
Authorized Problem Analysis Report

API
application program interface

APLB
active path load balancing

array
Another name for a RAID storage system.

array domain
All functions, paths, and drives controlled by one back-end director (BED) feature (pair of boards). An array domain can contain a mix of mainframe and open-systems volume types. RAID-level intermix (all RAID types) is also allowed within an array domain.

array frame
One of the additional cabinets that can be added to the controller frame of the floor model and that contains primarily data drives.

array group
See *RAID group*.

ASCII
American National Standard Code for Information Interchange

ASL
Array Support Library

ASTM
American Society for Testing and Materials

async
asynchronous

at-time split
Operation that allows multiple pairsplit operations to be performed at a pre-determined time.

ATA
Advanced Technology Attachment

ATM
asynchronous transfer mode

audit log
Files that store a history of the operations performed from Storage Navigator and the service processor (SVP), commands that the storage system received from hosts, and data encryption operations.

ave, avg
average

B

b
bit

B
byte

b/sec, bps
bits per second

B/sec, Bps
bytes per second

back-end director (BED)
The hardware component that controls the transfer of data between the drives and cache. A BED feature consists of a pair of boards. A BED is also referred to as a disk adapter (DKA).

base device
A formatted mainframe logical device (LDEV) that contains user data and can be accessed via alias devices using IBM Parallel Access Volume (PAV) host software. A base device must be defined to the host as a "B" device type (for example, 3390B-9). See also *alias device*.

base emulation type
Emulation type that is set when drives are installed. Determines the device emulation types that can be set in the RAID group.

BBC
buffer-to-buffer credit

BC
business continuity

BCM
Business Continuity Manager

BED
See *back-end director (BED)*.

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

BIOS
basic input/output system

BL
block length

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

BLK, blk
block

bmp
bitmap

BS
basic (power) supply

BSA
bus adapter

BTU
British thermal unit

C

C/T
See *consistency time (C/T)*.

ca
cache

cache blade
A circuit board containing random-access memory (RAM) that is a component in the Virtual Storage Platform controller.

cache logical partition (CLPR)
Consists of virtual cache memory that is set up to be allocated to different hosts in contention for cache memory.

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

cascade configuration

In a 3DC cascade configuration for remote replication, data is copied from a local site to an intermediate site and then to a remote site using TrueCopy and Universal Replicator. See also *3DC*.

In a ShadowImage cascade configuration, two layers of secondary volumes can be defined for a single primary volume. Pairs created in the first and second layer are called cascaded pairs.

cascade function

A ShadowImage function that allows a primary volume (P-VOL) to have up to nine secondary volumes (S-VOLs) in a layered configuration. The first cascade layer (L1) is the original ShadowImage pair with one P-VOL and up to three S-VOLs. The second cascade layer (L2) contains ShadowImage pairs in which the L1 S-VOLs are functioning as the P-VOLs of layer-2 ShadowImage pairs that can have up to two S-VOLs for each P-VOL.

See also *root volume*, *node volume*, *leaf volume*, *layer-1 (L1) pair*, and *layer-2 (L2) pair*.

cascaded pair

A ShadowImage pair in a cascade configuration. See *cascade function*.

CC

Concurrent Copy; channel command; cylinder-cylinder

CCA

channel connection address

CCHH

cylinder-cylinder, head-head

CCI

Command Control Interface software

CCW

channel command word

CDB

control data block

CEC

Canadian Electroacoustic Community

C-field

count-field

CFL

Configuration File Loader. A Storage Navigator function for validating and running scripted spreadsheets.

CFW
cache fast write

CG
See *consistency group (CTG)*.

CH
channel

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

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

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

CHAP
challenge handshake authentication protocol

CHIP
client-host interface processor. Another name for a front-end director.

CHL
channel

CHP
channel path; channel processor. The channel processors are the microprocessors on the front-end director features of the Universal Storage Platform V/VM.

CHPID
channel path ID

CIFS
common internet file system

CKD
count-key data

CL
cluster

CLI
command line interface

CLPR
cache logical partition

cluster
Multiple-storage servers working together to respond to multiple read and write requests.

CM
control memory

CMA
cache memory adapter

CMM
cache memory module

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

concatenated parity group
A configuration where the VDEVs corresponding to a pair of RAID 10 (2D+2D) or RAID 5 (7D+1P) parity groups, or four RAID 5 (7D+1P) parity groups, are interleaved on a RAID stripe level on a round-robin basis. A logical RAID stripe line is created as a concatenation of the individual RAID stripe lines. This has the effect of dispersing I/O activity over twice or four times the number of disks, but it does not change the number, names, or size of VDEVs, and hence it doesn't make it possible to assign larger LDEVs to them. Note that we often refer to RAID 10 (4D+4D), but this is actually two RAID 10 (2D+2D) parity groups interleaved together.

configuration definition file
A text file that defines the configuration, parameters, and options of Command Control Interface (CCI) operations. It also defines the connected hosts and the volumes and groups known to the Command Control Interface instance.

consistency group (CG, CTG)
A group of pairs on which copy operations are performed simultaneously; the pairs' status changes at the same time. See also *extended consistency group (EXCTG)*.

consistency time (C/T)
Shows a time stamp to indicate how close the target volume is to the source volume. C/T also shows the time stamp of a journal group and extended consistency group.

control chassis
The hardware component that houses the controller components of the Virtual Storage Platform storage system, including the front-end directors, virtual storage directors, cache and shared memory, switches, and back-end directors. The Virtual Storage Platform storage system can be configured with one or two control chassis.

controller
The component in a storage system that manages all storage functions. It is analogous to a computer and contains a processors, I/O devices, RAM, power supplies, cooling fans, and other sub-components as needed to support the operation of the storage system.

controller frame
The cabinet (floor model) that contains the controller components of the RAID storage system.

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

copy pair
A pair of volumes in which one volume contains original data and the other volume contains the copy of the original. Copy operations can be synchronous or asynchronous, and the volumes of the copy pair can be located in the same storage system (local copy) or in different storage systems (remote copy).
A copy pair can also be called a volume pair, or just pair.

COW
copy-on-write

COW Snapshot
Hitachi Copy-on-Write Snapshot software

PAV
Hitachi Compatible PAV

CPPL
command processor parameter list

CPC
cache path control adapter

CPU
central processing unit

CRC
cyclical redundancy checking

CRM
Hitachi Cache Residency Manager

CSA
Canadian Standards Association

CT, C/T
See *consistency time (C/T)*.

CTG
See *consistency group (CTG)*.

CTL
controller

CTQ
command tag queuing

CTRLID
controller ID

CU
control unit

currency of data
The synchronization of the volumes in a copy pair. When the data on the secondary volume (S-VOL) is identical to the data on the primary volume (P-VOL), the data on the S-VOL is current. When the data on the S-VOL is not identical to the data on the P-VOL, the data on the S-VOL is not current.

custom volume (CV)
A customized (variable-sized) volume whose size is defined by the user using Virtual LVI/Virtual LUN.

CV
See *custom volume (CV)*.

CVS
custom volume size

CXFS
clustered version of XFS file system

CYL, cyl
cylinder

cylinder bitmap
Indicates the differential data (updated by write I/Os) in a volume of a split or suspended copy pair. The primary and secondary volumes each have their own cylinder bitmap. When the pair is resynchronized, the cylinder bitmaps are merged, and the differential data is copied to the secondary volume.

D

D
delimiter

DAM
direct-access method

DASD
direct-access storage device

data consistency
When the data on the secondary volume is identical to the data on the primary volume.

data drive
A physical data storage device that can be either a hard disk drive (HDD) or a flash drive (also called a solid-state device).

data lifecyle management (DLM)
The policies, processes, practices, services, and tools used to align the business value of data with the most appropriate and cost-effective storage infrastructure from the time data is created through its final disposition.

data path
The physical paths used by primary storage systems to communicate with secondary storage systems in a remote replication environment.

data pool
One or more logical volumes designated to temporarily store original data. When a snapshot is taken of a primary volume, the data pool is used if a data block in the primary volume is to be updated. The original snapshot of the volume is maintained by storing the to-be-changed data blocks in the data pool.

DB
database

dB(A)
decibel (A-weighted)

DB2
DATABASE 2

DBMS
database management system

DBV
Hitachi Database Validator

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

DC
data center

DCR
Dynamic Cache Residency

delta resync
A disaster recovery solution in which TrueCopy and Universal Replicator systems are configured to provide a quick recovery using only differential data stored at an intermediate site.

DEV, dev
device

device
A physical or logical unit with a specific function.

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

DEVN
device number

DF600
The factory model name for the Hitachi Thunder 9500V storage system.

DF700
The factory model name for the Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage arrays.

DF800
The factory model name for the Hitachi Adaptable Modular Storage 2000 storage system.

DFDSS
Data Facility Dataset Services

DFSMS
Data Facility System Managed Storage

DFW
DASD fast write

DHCP
dynamic host configuration protocol

differential data
Changed data in the primary volume not yet reflected in the secondary volume of a copy pair.

differential table
Used to manage differential data between pairs' primary volumes and secondary volumes. In Volume Migration, it is used during volume transfer to manage differential data between a source and target volume. Used by ShadowImage, ShadowImage for Mainframe, Copy-on-Write Snapshot, Compatible FlashCopy® V2, Compatible Software for IBM® FlashCopy® SE, and Volume Migration.

differential management logical unit (DM-LU)
An exclusive volume for storing replication data when the storage system is powered down. The DM-LU is hidden from the host.

disaster recovery
A set of procedures to recover critical application data and processing after a disaster or other failure.

disk adapter (DKA)
Another name for back-end director. See *back-end director (BED)*.

disk array
Disk array, or just array, is another name for a RAID storage system.

disk controller (DKC)
The hardware component that manages front-end and back-end storage operations. The term DKC is also used to refer to the entire RAID storage system.

disk unit (DKU)
See *drive chassis*.

DKA
disk adapter. Another name for a back-end director (BED).

DKC
disk controller. DKC can refer to the RAID storage system or the controller components.

DKCMAIN
disk controller main. Refers to the microcode for the RAID storage system.

DKP
disk processor. Refers to the microprocessors on the back-end director features of the Universal Storage Platform V/VM.

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

DKU
disk unit. See *drive chassis*.

DL
data length

DLM
See *data lifecyle management (DLM)*.

DM-LU
See *differential management logical unit (DM-LU)*.

DMP
Dynamic Multi Pathing

DO
dataset organization

DNS
domain name system

DVE
dynamic volume expansion

DP
Hitachi Dynamic Provisioning

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

drive chassis
The hardware component of the Virtual Storage Platform storage system that contains data drives and no controller components. A drive chassis can also be called a disk unit (DKU).

DRR
data recovery and reconstruction

DRU
Hitachi Data Retention Utility

DS
DEVSERV

DSF
Device Support Facilities

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

DSR
Hitachi Dataset Replication for IBM® z/OS®

DTDS+
Disaster Tolerant Storage System Plus

dump
A collection of data that is saved to a file when an error or crash occurs. The data is used by support personnel to determine the cause of the error or crash.

DWL
duplex write line

dynamic provisioning
An approach to managing storage. Instead of "reserving" a fixed amount of storage, it removes capacity from the available pool when data is actually written to disk. Dynamic provisioning is also referred to as thin provisioning.

E

EB
exabyte

EBCDIC
extended binary-coded decimal interchange code

EBED
encrypting back-end director

EC
error code

ECB
entry control block; Electronic Code Book.

ECKD
extended count-key data

EDD
element data definition

EFS
extent file system (used in SGI IRIX systems)

ELB
extended long busy

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

DAR
Encryption License Key

EMI
electromagnetic interference

Emp
empty file option

EMT64T
Extended Memory 64 Technology

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

emulation group
A set of device emulation types that can be intermixed within a RAID group and treated as a group.

env.
environment

EOF
end of file; end of field

EOU
ease of use

EPO
emergency power-off

ERC
error reporting communications

EREP
Error Reporting

ERP
error recovery procedure

ESA
Enterprise Systems Architecture

ESCD
extended system configuration data; ESCON director

ESCON
Enterprise System Connection

ESD
electrostatic discharge

ESDS
entry-sequenced dataset

ESS
Enterprise Storage Server

ESW
PCI express path switch

EXCTG
See *extended consistency group (EXCTG)*.

EXG
external volume group

ExSA
Extended Serial Adapter. Another name for an ESCON front-end director.

ext.
external

extended consistency group (EXCTG)
A set of Universal Replicator for Mainframe journal groups in which data consistency is guaranteed. When performing copy operations between multiple primary and secondary systems, the journal groups must be registered in an EXCTG.

external application
A software module that is used by a storage system but runs on a separate platform.

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

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

F

F
fixed length and de- blocking

F/M
format/message

f/w
firmware

failback
The process of switching operations from the secondary path or host back to the primary path or host, after the primary path or host has recovered from failure. See also *failover*.

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

FAL
File Access Library

FAL/FCU
File Access Library/File Conversion Utility

FB
fixed length and blocking

FBA
fixed-block architecture

FC
fibre channel; FlashCopy

FCA
fibre-channel adapter

FC-AL
fibre-channel arbitrated loop

FCC
Federal Communications Commission

FCIP
fibre-channel internet protocol

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

FCP
fibre-channel protocol

FCSP
fibre-channel security protocol

FCU
File Conversion Utility

FD
floppy disk

FD Dump Tool
Downloads Storage Navigator configuration information onto a floppy disk or hard disk for backup and troubleshooting purposes.

FDR
Fast Dump/Restore

FED
See *front-end director (FED)*.

FIBARC
Fibre Connection Architecture

FICON
Fibre Connectivity

FIFO
first in, first out

flash drive
A data drive that is a solid-state memory device instead of a rotating hard disk drive. A flash drive can also be called a solid-state drive (SSD).

frame
A hardware cabinet (floor model) that contains RAID storage system hardware components. The two frame types are controller frame and array frame.

free capacity
The amount of storage space (in bytes) that is available for use by the host systems.

front-end director (FED)
The hardware component that processes channel commands from hosts and manages host access to cache. A FED is also referred to as a channel adapter (CHA).

FTP
file-transfer protocol

FV
fixed-size volume

FWD
fast-wide differential

FX
Hitachi Cross-OS File Exchange

fx
IRIX disk utility

FXmto
Hitachi Cross-OS File Exchange – mainframe to open

FXotm
Hitachi Cross-OS File Exchange – open to mainframe

FXoto
Hitachi Cross-OS File Exchange – open to open

G

Gb
gigabit

GB
gigabyte

Gb/sec, Gbps
gigabits per second

GB/sec, GBps
gigabytes per second

GbE
gigabit Ethernet

GDG
generation data group

GDS
generation dataset

GHz
gigahertz

GID
group ID

GLM
gigabit link module

GLPR
global logical partition

GT
Hitachi Graph-Track

GUI
graphical user interface

H

H.A.R.D
Hardware Assisted Resilient Data

h/w
hardware

HA
high availability

HACMP
High Availability Cluster Multi-Processing

HAM
Hitachi High Availability Manager software

HBA
host bus adapter

HCD
Hardware Configuration Definition

HCS
Hitachi Command Suite (previously called Hitachi Storage Command Suite)

HD
head

HDD
hard disk drive

HDLM
Hitachi Dynamic Link Manager

HDP
Hitachi Dynamic Provisioning

Hitachi Vantara
Hitachi Vantara

HDT
Hitachi Dynamic Tiering software

HDU
hard disk unit

HDvM
Hitachi Device Manager software

head LDEV
See *top LDEV*.

HGLAM
Hitachi Global Link Availability Manager

HH
head-head

high-speed mode
An operational mode of a fibre-channel port that improves data transfer rate but limits port usage to just one on the front-end director board.

HIHSM
Hitachi Hierarchical Storage Manager. Another name for Volume Migration.

Hi-Star
Hierarchical Star Network

HLDE
hold-error

HLQ
high-level qualifier

H-LUN
host logical unit

HMC
Hardware Management Console

HMDE
Hitachi Multiplatform Data Exchange. Another name for Hitachi Cross-OS File Exchange.

HMRCF
Hitachi Multi-RAID Coupling Feature. Another name for Hitachi ShadowImage® for Mainframe.

HODM
Hitachi Online Data Migration

HOMRCF
Hitachi Open Multi-RAID Coupling Feature. Another name for Hitachi ShadowImage®.

HORC
Hitachi Open Remote Copy. Another name for Hitachi TrueCopy®.

HORCM
Hitachi Open Remote Copy Manager. Another name for Command Control Interface.

host failover
The process of switching operations from one host to another host when the primary host fails.

host group
A group of hosts of the same operating system platform.

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

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

HPAV
Hitachi Parallel Access Volume. Another name for Hitachi Compatible PAV.

HPF
High-Performance FICON

HPtM
Hitachi Protection Manager

HPvM
Hitachi Provisioning Manager

HRC
Hitachi Remote Copy. Another name for Hitachi TrueCopy® for Mainframe.

HRCA
Hitachi Remote Copy Asynchronous

HRpM
Hitachi Replication Manager software

HRX
Hitachi RapidXchange. Another name for Hitachi Cross-OS File Exchange.

HSCS
Hitachi Storage Command Suite. This suite of products is now called the Hitachi Command Suite.

HSD
host storage domain. See *host group*.

HSN
Hierarchical Star Network

HTM
Hitachi Tuning Manager

HTnM
Hitachi Tuning Manager

HTSM
Hitachi Tiered Storage Manager

HUR
Hitachi Universal Replicator

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HVR
Hitachi Volume Relocation

HWM
high-water mark

HXRC
Hitachi Extended Remote Copy. Another name for Hitachi Compatible Replication for IBM® XRC.

Hz
Hertz

I

IBM
International Business Machines Corporation

ICF
integrated catalog facility

ICKDSF
Device Support Facility (DSF) program for media maintenance

ICP
interval control program

IDCAMS
access method services (a component of Data Facility Product)

IDE
integrated drive electronics

IEC
International Electrotechnical Commission

IEFBR14
Information Engineering Facility branch register 14

IETF
Internet Engineering Task Force

iFCP
internet fibre-channel protocol

IIS
internet information service

IML
initial microcode load; initial microprogram load

IMPL
initial microprogram load

IMS
Information Management System

in.
inch

int.
interval

initial copy
An initial copy operation is performed when a copy pair is created. Data on the primary volume is copied to the secondary volume.

initiator port
A fibre-channel port configured to send remote I/Os to an RCU target port on another storage system. See also *RCU target port* and *target port*.

in-system replication
The original data volume and its copy are located in the same storage system. ShadowImage in-system replication provides duplication of logical volumes; Copy-on-Write Snapshot in-system replication provides "snapshots" of logical volumes that are stored and managed as virtual volumes (V-VOLs).
See also *remote replication*.

inter-control chassis cable
The hardware option that connects two control chassis. Two sets of this option are required for the high-performance model.

intermediate site (I-site)
A site that functions as both a TrueCopy Synchronous secondary site and a Universal Replicator primary site in a 3-data-center (3DC) cascading configuration.

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

IO
input/output

IOCDS
I/O Configuration Dataset

IOCP
I/O configuration program

IODF
I/O definition file

IOPS
I/Os per second

IOS
internetwork operating system

IP
internet protocol

IPv4
Internet Protocol, Version 4

IPv6
Internet Protocol, Version 6

IPL
initial program load

ISAM
index sequential-access method

I-site
See *intermediate site (I-site)*.

ISL
inter-switch link

iSNS
internet storage name service

ISPF/PDF
Interactive System Productivity Facility/Program Development Facility

IZPIOCP
inter-zone path (IZP) version of IOCP

J

JCL
job control language

JFS
Journaled File System

JNL
journal

JNLG
journal group

journal group (JNLG)
In a Universal Replicator system, journal groups manage data consistency between multiple primary volumes and secondary volumes. See also *consistency group (CG, CTG)*.

journal volume
A volume that records and stores a log of all events that take place in another volume. In the event of a system crash, the journal volume logs are used to restore lost data and maintain data integrity.
In Universal Replicator, differential data is held in journal volumes on until it is copied to the S-VOL.

JRE
Java Runtime Environment

JVM
Java Virtual Machine

JWS
Java Web Start

K

kb, Kb
kilobit

KB
kilobyte

Kb/sec, Kbps
kilobits per second

KB/sec, KBps
kilobytes per second

keypair
Two mathematically-related cryptographic keys: a private key and its associated public key.

kHz
kilohertz

KL
key length

km
kilometer

KSDS
key sequential dataset

kVA
kilovolt-ampere

kW
kilowatt

L

L1 pair
See *layer-1 (L1) pair*.

L2 pair
See *layer-2 (L2) pair*.

LAN
local-area network

layer-1 (L1) pair
In a ShadowImage cascade configuration, a layer-1 pair consists of a primary volume and secondary volume in the first cascade layer. An L1 primary volume can be paired with up to three L1 secondary volumes. See also *cascade configuration*.

layer-2 (L2) pair
In a ShadowImage cascade configuration, a layer-2 (L2) pair consists of a primary volume and secondary volume in the second cascade layer. An L2 primary volume can be paired with up to two L2 secondary volumes. See also *cascade configuration*.

LBA
logical block address

LCP
link control processor

LCU
logical control unit

LD
local directory; logical device

LDAP
lightweight directory access protocol

LDEV
logical device

LDKC
See *logical disk controller (LDKC)*.

LDM
Logical Disk Manager

LDS
linear dataset

leaf volume
A level-2 secondary volume in a ShadowImage cascade configuration. The primary volume of a layer-2 pair is called a node volume. See also *cascade configuration*.

LED
light-emitting diode

LF
line feed

license key
A specific set of characters that unlocks an application and allows it to be used.

LIFO
last in, first out

LIP
loop initialization primitive

LM
local memory

loc.
location

local control port (LCP)
A serial-channel (ESCON) port configured to receive I/Os from a host or remote I/Os from a TrueCopy main control unit (MCU).

local copy
See *in-system replication*.

local site
See *primary site*.

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

logical disk controller (LDKC)
A group of 255 control unit (CU) images in the RAID storage system that is controlled by a virtual (logical) storage system within the single physical storage system. For example, the Universal Storage Platform V/VM storage system supports two LDKCs, LDKC 00 and LDKC 01.

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

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

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

logical volume
See *volume*.

logical volume image (LVI)
A logical volume that is configured for use by mainframe hosts (for example, 3390-9).

LPAR
logical partition

LRU
least recently used

LSM
Logical Storage Manager

LSS
logical subsystem

LU
logical unit

LUN
logical unit number

LUNM
Hitachi LUN Manager

LUSE
Hitachi LUN Expansion; Hitachi LU Size Expansion

LV
logical volume

LVD
Hitachi Logical Volume Divider

LVI
See *logical volume image (LVI)*.

LVM
Logical Volume Manager; logical volume management

LW
long wavelength

M

main control unit (MCU)
A storage system at a primary or main site that contains primary volumes of TrueCopy for Mainframe remote replication pairs. The MCU is configured to send remote I/Os to one or more storage systems at the secondary or remote site, called remote control units (RCUs), that contain the secondary volumes of the remote replication pairs. See also *remote control unit (RCU)*.

main site
See *primary site*.

main volume (M-VOL)
A primary volume on the main storage system in a TrueCopy for Mainframe copy pair. The M-VOL contains the original data that is duplicated on the remote volume (R-VOL). See also *remote volume (R-VOL)*.

master journal (M-JNL)
Holds differential data on the primary Universal Replicator system until it is copied to the restore journal (R-JNL) on the secondary system. See also *restore journal (R-JNL)*.

max.
maximum

MB
megabyte

Mb/sec, Mbps
megabits per second

MB/sec, MBps
megabytes per second

MBU
Hitachi Multiplatform Backup

MCU
See *main control unit (MCU)*.

MDB
master directory block

MF, M/F
mainframe

MHz
megahertz

MIB
message information block

mig.
migration

min.
minute; minimum

MIH
missing interrupt handler

mirror
In Universal Replicator, each pair relationship in and between journal groups is called a "mirror". Each pair is assigned a mirror ID when it is created. The mirror ID identifies individual pair relationships between journal groups.

M-JNL
main journal

mm
millimeter

MM
Maintenance Manual

modify mode
The mode of operation of Storage Navigator that allows changes to the storage system configuration. See also *view mode*.

MP
microprocessor

MPE
maximum physical extents

MPLF
Multi-Path Locking Facility

MPSD
multiple path storage director

MR
magnetoresistive

MRCF
Multi-RAID Coupling Feature. Another name for ShadowImage.

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ms, msec
millisecond

MSCS
Microsoft Cluster Server

MTBF
mean time between failures

mto, MTO
mainframe-to-open

MU
mirror unit

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

M-VOL
main volume

MVS
Multiple Virtual Storage

MVS/ESA
Multiple Virtual Storage/Enterprise Systems Architecture

MVS/XA
Multiple Virtual Storage/Extended Architecture

N

NAS
network-attached storage

NBU
NetBackup

NDMP
network data management protocol

NEC
National Electrical Code

NFS
network file system

NIC
network interface card

NIS
Network Information Service

NNC
network node controller

no.
number

node volume
A level-2 primary volume in a ShadowImage cascade configuration. The secondary volume of a layer-2 pair is called a leaf volume. See also *cascade configuration*.

non-prioritized
A port on which the processing has low priority. Non-prioritized ports are connected to low-priority host bus adapters.

NSC
Hitachi TagmaStore® Network Storage Controller

NTP
network time protocol

NUM
number

NVS
nonvolatile storage

O

OBID
(data) object ID

OCI
Oracle call interface

OCO
object code only

ODM
Object Data Manager

OEM
original equipment manufacturer

OFC
open fibre control

OLTR
online transaction processing

OPEN-V
A logical unit (LU) of user-defined size that is formatted for use by open-systems hosts.

OPEN-*x*
A logical unit (LU) of fixed size (for example, OPEN-3 or OPEN-9) that is used primarily for sharing data between mainframe and open-systems hosts using Hitachi Cross-OS File Exchange.

OPS
Oracle Parallel Server

ORM
online read margin

OS
operating system

OS/390
Operating System/390

OSI
open-systems interconnection

OSW
Optimized Storage Workload. Optimized Storage Workload is another name for Hitachi High Availability Manager software.

otm, OTM
open-to-mainframe

oto, OTO
open-to-open

P

PA
physical address

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

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

PAM
partitioned access method

parity group
See *RAID group*.

path failover
The ability of a host to switch from using the primary path to a logical volume to the secondary path to the volume when the primary path fails. Path failover ensures continuous host access to the volume in the event the primary path fails.
See also *alternate path* and *failback*.

PAV
Parallel Access Volume

PB
petabyte

PC
personal computer system

PCB
printed circuit board

PCI
power control interface; peripheral component interconnect.

P/DAS
PPRC/dynamic address switching

PDB
power distribution box

PDEV
physical device

PDL
Product Documentation Library

PDP
power distribution panel

PDS
partitioned dataset

PDU
power distribution unit; protocol data unit

PG
parity group. See *RAID group*.

PFM
Hitachi Performance Monitor

physical device
See *device*.

PiT
point-in-time

point-in-time (PiT) copy
A copy or snapshot of a volume or set of volumes at a specific point in time. A point-in-time copy can be used for backup or mirroring application to run concurrently with the system.

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

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

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

port block
A group of four fibre-channel ports that have the same port mode.

port mode
The operational mode of a fibre-channel port. The three port modes for fibre-channel ports on the Hitachi RAID storage systems are standard, high-speed, and initiator/ external MIX.

POSIX
portable operating system interface for UNIX

PP
program product; physical partition

P-P
point-to-point

PPC
Hitachi Prioritized Port Control

PPCgrp
Prioritized Port Control group

PPRC
Peer-to-Peer Remote Copy

Preview list
The list of requested operations on Hitachi Storage Navigator.

primary site
The physical location of the storage system that contains the original data to be replicated and that is connected to one or more storage systems at the remote or secondary site via remote copy connections. A primary site can also be called a "main site" or "local site".
The term "primary site" is also used for host failover operations. In that case, the primary site is the host computer where the production applications are running, and the secondary site is where the backup applications run when the applications at the primary site fail, or where the primary site itself fails.

primary volume (P-VOL)
The volume in a copy pair that contains the original data to be replicated. The data in the primary volume is duplicated synchronously or asynchronously on the secondary volume.
The following Hitachi products use the term P-VOL: Copy-on-Write Snapshot, ShadowImage, ShadowImage for Mainframe, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.
See also *secondary volume*.

prio
priority mode. Used in Cache Residency Manager.

prioritized port
A port on which processing has high priority. Prioritized ports are connected to high priority host bus adapters.

PS
power supply

PSID
(data) pageset ID

P-site
primary site

PTF
program temporary fix

PV
physical volume

P-VOL
Term used for the primary volume in the earlier version of the Storage Navigator GUI (still in use). See *primary volume*.

Q

QSA
Query Security Attributes

quick format
The quick format feature in Virtual LVI/LUN in which the formatting of the internal volumes is done in the background. This allows system configuration (such as defining a path or creating a TrueCopy pair) before the formatting is completed. To execute quick formatting, the volumes must be in blocked status.

quick restore
A reverse resynchronization in which no data is actually copied: the primary and secondary volumes are swapped.

quick split
A split operation in which the pair becomes split immediately before the differential data is copied to the secondary volume (S-VOL). Any remaining differential data is copied to the S-VOL in the background. The benefit is that the S-VOL becomes immediately available for read and write I/O.

R

R/W, r/w
read/write

R0
record 0

RAB
RAID Advisory Board

RAID
redundant array of inexpensive disks

RAID400
Factory model name for the Hitachi Lightning 9900storage system.

RAID450
Factory model name for the Hitachi Lightning 9900V storage system

RAID500
Factory model name for the Hitachi TagmaStore® Universal Storage Platform and Hitachi TagmaStore® Network Storage Controller storage systems.

RAID600
Factory model name for the Hitachi Universal Storage Platform V/VM storage system.

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

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

RAIN
redundant array of independent nodes

RAM
random-access memory

RBAC
role-based access control

RC
reference code (of a service information message)

RCP
remote control port

RCU
See *remote control unit (RCU)*.

RD
read

RDC
remote dual copy

RDW
record description word

RECFM
record format

RCU target port
A fibre-channel port that is configured to receive remote I/Os from an initiator port on another storage system.

remote console PC
A previous term for the personal computer (PC) system that is LAN-connected to a RAID storage system. The current term is Storage Navigator PC.

remote control port (RCP)
A serial-channel (ESCON) port on a TrueCopy main control unit (MCU) that is configured to send remote I/Os to a TrueCopy remote control unit (RCU).

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

remote copy
See *remote replication*.

remote copy connections
The physical paths that connect a storage system at the primary site to a storage system at the secondary site. Also called data path.

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

remote site
See *secondary site*.

remote volume (R-VOL)
In TrueCopy for Mainframe, a volume at the remote site that contains a copy of the original data on the main volume (M-VOL) at the main site.

reserve volume
A volume reserved either as a secondary volume for ShadowImage or ShadowImage, or as a migration destination for a Volume Migration migration plan.

restore journal (R-JNL)
Holds differential data on the secondary Universal Replicator system until it is copied to the secondary volume.

resync
resynchronize

RF
record format

RIO
remote I/O

R-JNL
restore journal

RL
record length

RM
RAID Manager. Another name for Command Control Interface.

RMI
Remote Method Invocation

rnd
random

root volume
A level-1 primary volume in a ShadowImage cascade configuration. The secondary volume of a layer-1 pair is called a node volume. See also *cascade configuration*.

RPO
recovery point objective

RRDS
relative record dataset

RSCN
registered state-change notification

R-SIM
remote service information message

R-site
remote site (used for Universal Replicator)

RSV
reserved

RTC
real-time clock

RTO
recovery time objective

R-VOL
See *remote volume (R-VOL)*.

R/W
read/write

S

S#
serial number

S/390
System/390

S/N
serial number

s/w
software

SAID
system adapter ID

SAM
sequential access method; System Administration Manager

SAN
storage-area network

SAS
serial-attached SCSI

SATA
serial Advanced Technology Attachment

SC
storage control

SCDS
source control dataset

SCI
state change interrupt

SCN
state-change notification

SCP
state change pending

scripting
The use of command line scripts, or spreadsheets downloaded by Configuration File Loader, to automate storage management operations.

SCSI
small computer system interface

SDA
symbolic device address

SDEVN
source device number

SDM
System Data Mover

sec.
second

secondary site
The physical location of the storage system that contains the primary volumes of remote replication pairs at the main or primary site. The storage system at the secondary site is connected to the storage system at the main or primary site via remote copy connections. The secondary site can also be called the "remote site". See also *primary site*.

secondary volume
The volume in a copy pair that is the copy. The following Hitachi products use the term "secondary volume": Storage Navigator, ShadowImage, ShadowImage for Mainframe, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.
See also *primary volume*.

seq.
sequential

Server Priority Manager (SPM) group
A set of host bus adapters (HBAs) managed as a group. All HBAs in an SPM group must be of the same priority. Prioritized WWNs (that is, high priority HBAs) and non prioritized WWNs (that is, low priority HBAs) cannot be mixed in the same group.

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

service processor (SVP)
The computer inside a RAID storage system that hosts the Storage Navigator software and is used by service personnel for configuration and maintenance of the storage system.

severity level
Applies to service information messages (SIMs) and Storage Navigator error codes.

SFP
small form-factor pluggable

SGI
Silicon Graphics, Inc.

SGMP
simple gateway management protocol

shared volume
A volume that is being used by more than one replication function. For example, a volume that is the primary volume of a TrueCopy pair and the primary volume of a ShadowImage pair is a shared volume.

SHRED
Volume Shredder

shredding
See *volume shredding*.

SI
Hitachi ShadowImage®

sidefile
An area of cache memory that is used to store updated data for later integration into the copied data.

SIM
service information message

SIz
Hitachi ShadowImage® for Mainframe

size
Generally refers to the storage capacity of a memory module or cache. Not usually used for storage of data on disk or flash drives.

SLCU
source logical control unit

SLES
SuSE Linux Enterprise Server

SLP
sleep

SLPR
storage logical partition; streaming line printer

SM
shared memory

SMA
shared memory adapter

SMB
server message block

SMIT
System Management Information Tool

SMS
System Managed Storage; Storage Management Subsystem

SMTP
simple mail transfer protocol

SN
serial number; Storage Navigator

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

SNMP
simple network management protocol

SOM
system option mode

SONET
synchronous optical network

source volume (S-VOL)
The volume in a copy pair containing the original data. The term is used only in the earlier version of the Storage Navigator GUI (still in use), for the following Hitachi products: ShadowImage for Mainframe, Dataset Replication, Compatible FlashCopy® V2.

space
Generally refers to the data storage capacity of a disk drive or flash drive.

SPM
Hitachi Server Priority Manager

SPUFI
SQL processor using file input

SQL
structured query language

SRA
Hitachi Storage Replication Adapter

SRM
Storage Replication Manager

SS
Hitachi Copy-on-Write Snapshot software; snapshot

SSB
sense byte

SSCH
start subchannel

SSD
solid-state drive. Another name for a flash drive. In this guide, *single level cell* (SLC), *multi level cell* (MLC), and *flash module drive* (FMD) are collectively referred to as an SSD.

SSER
source serial number

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

SSL
secure socket layer

steady split
In ShadowImage, a typical pair split operation in which any remaining differential data from the P-VOL is copied to the S-VOL and then the pair is split.

storage cluster
See *cluster*.

storage tiers
See *tiered storage*.

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

SVP
See *service processor (SVP)*.

SVPV
service processor for Microsoft Vista applications

SVS
Storage Virtualization System

SW, sw
switch; short wavelength

sync
synchronize; synchronous

syslog
The file on the SVP that includes both syslog and audit log information, such as the date, time, and

system disk
The volume from which an open-systems host boots.

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

T

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

target volume (T-VOL)
The volume in a mainframe copy pair that is the copy. The term is used only in the earlier version of the Storage Navigator GUI (still in use), for the following Hitachi products: ShadowImage for Mainframe, Dataset Replication, Compatible FlashCopy® V2.
See also *source volume (S-VOL)*.

TB
terabyte

TC
Hitachi TrueCopy®

TCz
Hitachi TrueCopy® for Mainframe

TDEVN
target device number

TGT
target; target port

THD
threshold

TID
target ID

TL
tape library

tiered storage
A layered structure of performance levels, or tiers, that match data access requirements with the appropriate performance tiers.

TLCU
target logical control unit

top LDEV
The logical device in a LUSE volume that has the lowest LDEV ID and that is used to identify the LUSE volume. For example, the top LDEV in the LUSE volume that includes LDEVs 00:00:01, 00:00:02, 00:00:03, and 00:00:04 is 00:00:01, so this LUSE volume is identified by the LDEV ID 00:00:01.

total capacity
The aggregate amount of storage space in a data storage system.

TPF
Transaction Processing Facility

TPOF
tolerable point of failure

TRK
track

TSER
target serial number

TSO
Time Sharing Option

TSV
tab-separated values

T-VOL
See *target volume (T-VOL)*.

U

UA
unit address

UCB
unit control block

UDP
user datagram protocol

UFS
UNIX file system

UL
Underwriters' Laboratories

UIM
unit information module

unallocated volume
An LDEV for which no host paths are assigned.

update copy
An operation that copies differential data on the primary volume of a copy pair to the secondary volume. Update copy operations are performed in response to write I/Os on the primary volume after the initial copy operation is completed.

UPS
uninterruptible power supply

UR
Hitachi Universal Replicator

URL
uniform resource locator

URz
Hitachi Universal Replicator for Mainframe

TagmaStore USP
Hitachi TagmaStore® Universal Storage Platform

USP/NSC
Hitachi TagmaStore® Universal Storage Platform and Hitachi TagmaStore® Network Storage Controller

USP V/VM
Hitachi Universal Storage Platform V/VM

USP VM
Hitachi Universal Storage Platform VM

USP V/VM
Hitachi Universal Storage Platform V/VM

UT
Universal Time

UTC
Universal Time-coordinated

UVM
Hitachi Universal Volume Manager

V

V
version; variable length and de-blocking (mainframe record format)

VA
volt-ampere

VAC
volts-AC

VB
variable length and blocking (mainframe record format)

VCS
VERITAS Cluster Server

VDE
Verband Deutscher Elektrotechniker

VDEV
See *virtual device (VDEV)*.

VFA
virtual file access

VIB
volume information block

view mode
The mode of operation of Storage Navigator that allows viewing only of the storage system configuration. The two Storage Navigator modes are view mode and modify mode.

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

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

virtual storage director
The virtual storage directors of the Virtual Storage Platform storage system control the front-end directors and manage front-end access to cache memory.

virtual volume (V-VOL)
The secondary volume in a Copy-on-Write Snapshot pair. When in PAIR status, the V-VOL is an up-to-date virtual copy of the primary volume (P-VOL). When in SPLIT status, the V-VOL points to data in the P-VOL and to replaced data in the pool, maintaining the point-in-time copy of the P-VOL at the time of the split operation.
When a V-VOL is used with Dynamic Provisioning, it is called a DP-VOL.

VLAN
virtual local-area network

VLL
Hitachi Virtual LVI/LUN

VLUN
Hitachi Virtual LUN

LVI
Hitachi Virtual LVI

VM
volume migration; volume manager

VMA
volume management area

VM/ESA
Virtual Machine/Enterprise Systems Architecture

VOL, vol
volume

VOLID
volume ID

VolSec, VOLSec
Volume Security

volser
volume serial number

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

volume pair
See *copy pair*.

volume shredding
Deleting the user data on a volume by overwriting all data in the volume with dummy data.

VOS3
Virtual Storage Operating System 3

VPG
virtual parity group

VPM
Hitachi Virtual Partition Manager

VRM
Hitachi Volume Retention Manager

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

VSAM
virtual storage access method

VSE
Virtual Storage Extension

VSEC
Hitachi Volume Security software

VSN
volume serial number

VSP
Hitachi Virtual Storage Platform

VSS
Microsoft Volume Shadow Copy Service

VTOC
volume table of contents

VTOCIX
volume table of contents index

V-VOL
See *virtual volume (V-VOL)*.

V-VOL management area
Contains the pool management block and pool association information for Copy-on-Write Snapshot operations. The V-VOL management area is created automatically when additional shared memory is installed and is required for Copy-on-Write Snapshot operations.

VxVM
VERITAS Volume Manager

W

WAN
wide-area network

WDM
wavelength division multiplexing

WMS
Hitachi Workgroup Modular Storage

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WORM
write once, read many

WR
write

write order
The order of write I/Os to the primary volume of a copy pair. The data on the S-VOL is updated in the same order as on the P-VOL, particularly when there are multiple write operations in one update cycle. This feature maintains data consistency at the secondary volume. Update records are sorted in the cache at the remote system to ensure proper write sequencing.

WS
workstation

WSSN
World Standards Services Network

WWN
worldwide name

WWPN
worldwide port name

X

XA
Extended Architecture

XDF
Extended Distance Feature

XFS
IRIX extended file system

XLV
extended logical volume manager

XML
extensible markup language

XRC
Extended Remote Copy

Z

zero data
The number 0 (zero). A zero-formatting operation is one that writes zero data to the entire data drive area.

zero formatting
A formatting operation that writes zero data to the entire data drive area.

z/VM
z/Virtual Machine

z/VSE
z/Virtual Storage Extension

zHPF
High-Performance FICON for System z

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