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Provisioning Guide for Mainframe Systems

Provisioning is a method or strategy of managing the logical devices (LDEVs), also called volumes, on a storage system. The provisioning software includes Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, Virtual LVI, and Volume Retention Manager.

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Preface

Provisioning is a method or strategy of managing the logical devices (LDEVs), also called volumes, on a storage system. The provisioning software includes Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, Virtual LVI, and Volume Retention Manager.

Please read this document carefully to understand how to use these products, and maintain a copy for reference purposes.

Intended audience

This document is intended for system administrators, Hitachi Vantara representatives, and authorized service providers who install, configure, and operate the storage system.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The hardware guide for your storage system model.
- The Hitachi Device Manager - Storage Navigator software and the *System Administrator Guide*.
- The concepts and functionality of storage provisioning operations.

Product version

This document revision applies to the following product versions:

- VSP 5000 series: 90-06-01 or later
- SVOS RF 9.6 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 information and support for these items:

- Added information about SSIDs of an LDEV used by mainframe hosts.

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.

Convention	Description
	{ a | b } indicates that you must choose either a or b.

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

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

Conventions for storage capacity values

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

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

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

Logical capacity unit	Value
1 block	512 bytes
1 cylinder	Mainframe: 870 KB Open-systems: ▪ OPEN-V: 960 KB ▪ Others: 720 KB
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1{,}024^2$ bytes
1 GB	1,024 MB or $1{,}024^3$ bytes
1 TB	1,024 GB or $1{,}024^4$ bytes
1 PB	1,024 TB or $1{,}024^5$ bytes
1 EB	1,024 PB or $1{,}024^6$ bytes

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Thank you!

Chapter 1: Introduction to provisioning

There are several provisioning strategies that you can implement on your storage system to solve business requirements. Provisioning your storage system requires balancing the costs of the solution with the benefits that the solution provides.

About provisioning

Provisioning is a method or strategy of managing the logical devices (LDEVs), also called volumes, on a storage system. Some provisioning methods are host-based, while other methods use inherent storage system capabilities such as concatenated parity groups. Provisioning methods can also be primarily hardware-based or software-based. Each method has its particular uses and benefits in a specific storage environment, such as optimizing capacity, reliability, performance, or cost. When used in the right scenario, each method can be cost-effective, efficient, reliable, and straightforward to configure and maintain. On the other hand, inappropriate implementations can be expensive, awkward, time-consuming to maintain, and potentially error prone. Your support representatives can help you configure the highest quality solution for your storage environment.

Provisioning strategies fall into two fundamental categories:

- *Basic provisioning (or traditional provisioning)*: Basic provisioning involves defining logical devices (LDEVs) on physical storage that are fixed-sized volumes or custom-sized volumes.
- *Thin provisioning (or virtual provisioning)*: Thin provisioning involves using virtualization to pool physical storage and provide on-demand allocation of volumes to hosts.

Key terms

Term	Description
access attributes	Security function that restricts the access to a logical volume. Using Volume Retention Manager, you can assign an access attribute to each volume: read-only, read/write, or protect.
CV	Custom-sized volume. CVs are created by dividing a fixed-sized volume (FV) into user-defined sizes.
DP pool	A group of DP-VOLs. The DP pool consists of one or more pool-VOLs.
DP-VOL	A virtual volume (V-VOL) used for Dynamic Provisioning for Mainframe.

Term	Description
FV	Fixed-sized volume. An FV is a logical volume of a specific device emulation type that constitutes a parity group immediately after installation. The FV size varies according to the emulation type. OPEN-V volumes are not fixed-sized volumes.
meta_resource	A resource group to which additional resources (other than external volumes) and the resources existing before installing Resource Partition Manager belong.
page	In Dynamic Provisioning for Mainframe, a page is 38 MB of continuous storage allocated from a DP pool to store data written to a DP-VOL.
pool	A set of volumes that are reserved for storing Dynamic Provisioning for Mainframe write data.
pool threshold	In Dynamic Provisioning for Mainframe, 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 volume (pool-VOL)	A volume that is reserved for write data for Dynamic Provisioning for Mainframe.
resource group	A group that consists of one or more resources of the storage system. The resources that can be assigned to a resource group are LDEV IDs, parity groups, external volumes, and ports.
solid-state drives	SSDs include the following: ▪ SSDs: third-party solid-state drives with SAS interface ▪ FMDs: Hitachi solid-state drives
subscription limit	In a thin-provisioned storage system, the proportion (%) of total DP-VOL capacity associated with the pool versus the total capacity of the DP pool. 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 is equal to the DP pool 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.

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 what type of storage to use or how to manually size volumes. Basic provisioning relies on carving up physical storage into logical devices. Custom-sized volumes are configured by using the Virtual LVI software.

Basic provisioning includes fixed-sized provisioning and custom-sized provisioning.

Overview of fixed-sized provisioning

Fixed-sized provisioning is a good choice for mainframe systems.

Fixed-sized provisioning is the logical choice for mainframe systems that need to be compatible with IBM systems. It is easy to define the storage system, and then get on with your business. Later, you can attach additional storage as the initial volumes fill up.

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.
- 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

Use fixed-sized provisioning in a mainframe environment in which the simplest form of provisioning is preferred at the expense of some efficiency in capacity utilization.

Overview of 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.

To create custom-sized volumes on a storage system, you create volumes of the desired size from individual array groups. These volumes are then individually mapped to one or more host ports as logical units (LUs).

Custom-sized provisioning provides advantages in these scenarios:

- In fixed-sized provisioning, when several important files are located on the same volume and one unimportant file is being accessed, users cannot access the important files because of logical device contention if Compatible PAV or Compatible Hyper PAV are not being used. If the custom-sized feature divides the volume into several smaller volumes and I/O workload is balanced (each file is allocated to a different volume), then access contention is reduced and access performance is improved.
- In fixed-sized provisioning, all of the volume's capacity might not be used. Unused capacity on the volume will remain inaccessible to other users. You can use the custom-sized feature to create smaller volumes 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.

Disadvantages

Manual intervention can become costly and tedious. For example, depending on how the data was copied to the device (for example, using software such as TDMF, or internal capability such as Compatible FlashCopy®), the old device might need to be varied offline and the new device varied online, assuming that the source and target devices have been generated into the mainframe IO configuration.

When to use custom-sized provisioning

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

Soft Fence, SPID Fence, and Query Host Access support

Soft Fence and SPID Fence are volume protection functions provided by IBM® that are used for disaster recovery operations. The Query Host Access (QHA) function provides information about DASD and storage control units on IBM® z/OS®. For details about the Soft Fence, SPID Fence, and Query Host Access host functions and related host commands, see the IBM® documentation.

- *Soft Fence*: Soft Fence is defined and canceled from the mainframe host. When you set Soft Fence to pair volumes created by using PPRC commands, the Soft Fence setting prevents unintended access to protect volumes that are needed to recover from a disaster. A volume for which Soft Fence is defined rejects host read/write requests as well as pair operations from the following software products:
  - TrueCopy for Mainframe
  - ShadowImage for Mainframe
  - Universal Replicator for Mainframe
  - Compatible FlashCopy®
  - Compatible XRC
  - Volume Migration
  - FICON® Data Migration

  You can check the Soft Fence status (enabled or disabled) of a volume by using the **Mainframe Fenced Status** window in Device Manager - Storage Navigator.
- *SPID Fence*: SPID Fence is defined and canceled from the mainframe host. When you set SPID Fence to a volume, the VARY ONLINE host command is rejected so that the volume is not allowed to be online.

  You can check the SPID Fence status (enabled or disabled) of a volume by using the **Mainframe Fenced Status** window in Device Manager - Storage Navigator.
- *Query Host Access*: The Query Host Access function enables you to display the host access information for a volume when you execute the DEVSERV command with the QHA parameter from the host.

Note: If a host cannot access a volume for which the Soft Fence or SPID Fence setting is enabled, you can forcibly disable the Soft Fence or SPID Fence setting on the volume by using Device Manager - Storage Navigator. You can forcibly disable the Soft Fence setting or SPID Fence setting only when the host cannot access the volume. For instructions on disabling the Soft Fence or SPID Fence setting from the host, see the IBM® documentation.

Using ICKDSF INIT and REFORMAT VERIFYOFFLINE

VERIFYOFFLINE is a parameter for the ICKDSF INIT or REFORMAT command running on the IBM® z/OS®. When you execute this command with this parameter, if the target volume is made online by another system, the INIT or REFORMAT command cannot be executed. To execute these commands, execute the VARY OFFLINE command from the system that is using the applicable volume, and then execute the INIT or REFORMAT command again. For details about ICKDSF INIT and REFORMAT VERIFYOFFLINE, see the documentation from IBM.

Using the QDASD option of the IBM® z/OS® DEVSERV MVS command

If the QDASD option of the IBM® z/OS® DEVSERV MVS command is used, N (No) is displayed in SOLID STATE DRIVES (SSD) and ENCRYPTION (encryption) of the ATTRIBUTE parameters regardless of the configuration of the parity group to which the target LVI belongs.

```
DEVSERV QDASD,E33D,1,ATTRIBUTE
IEE459I 18.15.40 DEVSERV QDASD 811
 UNIT VOLSER SCUTYPE DEVTYPE       CYL  SSID SCU-SERIAL DEV-SERIAL EFC
  ATTRIBUTE/FEATURE        YES/NO    ATTRIBUTE/FEATURE        YES/NO
0E33D DV1RES 2107900 2107900   1182006  8400 XX85-00010 XX85-00010 *OK
  SOLID STATE DRIVES          N      ENCRYPTION                  N
****      1 DEVICE(S) MET THE SELECTION CRITERIA
****      0 DEVICE(S) FAILED EXTENDED FUNCTION CHECKING
```

Thin provisioning

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

Thin provisioning provides automatic performance optimization and storage space savings across pools of virtual capacity. Provisioning storage from a virtual pool reduces administration costs by cutting the time to provision new storage. Capacity is allocated to an application without it being physically mapped until it is used. In this approach, it is possible to achieve overall higher rates of storage utilization with just-in-time provisioning. It also simplifies performance optimization by transparently spreading workloads across many physical devices, thereby reducing performance management concerns and self-optimizing performance and throughput.

About Dynamic Provisioning for Mainframe

While basic or traditional provisioning strategies can be appropriate and useful in specific scenarios, they can be expensive to set up, time-consuming to configure, difficult to monitor, and error prone. Dynamic Provisioning for Mainframe allows you to reserve virtual storage capacity based on anticipated future capacity needs, using virtual volumes instead of physical disk capacity. Although Dynamic Provisioning for Mainframe requires some additional setup steps, it can provide a simpler and more beneficial alternative to traditional provisioning methods.

Overall storage use rates can improve because you can potentially provide more virtual capacity to applications while using fewer physical drives. Dynamic Provisioning for Mainframe can provide lower initial cost, greater efficiency, and ease of storage management for storage administrators. The Dynamic Provisioning for Mainframe feature offers these benefits:

- Simplifies storage management
- Provides a better balance of resources and performance optimization by default than traditional provisioning
- Optimizes physical drive usage
- Reduces device address requirements over traditional provisioning by providing larger volume sizes

When to use Dynamic Provisioning for Mainframe

Dynamic Provisioning for Mainframe is a best fit in a mainframe environment in these scenarios:

- When 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.
- When device addressing constraints are a concern.

Dynamic Provisioning for Mainframe concepts

Dynamic Provisioning for Mainframe 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 for Mainframe provides three important capabilities: as-needed provisioning of storage, enhanced volume performance, and larger volume sizes.

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

DP-VOLs are of a user-specified logical size without any corresponding physical space. Actual physical space allocated (in 38-MB pool page units) is automatically assigned to a DP-VOL from the associated DP pool as that volume's logical space is written to over time. A new DP-VOL does not have any pool pages assigned to it. The pages are *loaned out* from its associated 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 for Mainframe also 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 38-MB pages. Each page is consecutively laid down on a number of RAID stripes from one pool volume. The pool's 38-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.

DP-VOLs are defined as 3390-A volumes that can be larger than traditional volumes. This volume type was created to reduce device address requirements.

Setting up a Dynamic Provisioning for Mainframe environment requires a few extra steps. Similar to basic provisioning, you still configure various array groups to a desired RAID level and create one or more 3390-V volumes (LDEVs) on each of them. Then set up a Dynamic Provisioning for Mainframe environment by creating one or more DP pools of physical storage space that are each a collection of some of these 3390-V LDEVs (DP pool volumes). This pool structure supports creation of 3390-A Dynamic Provisioning for Mainframe virtual volumes (DP-VOLs), where 38-MB pages of data are randomly assigned on demand.

Advantages of using Dynamic Provisioning for Mainframe

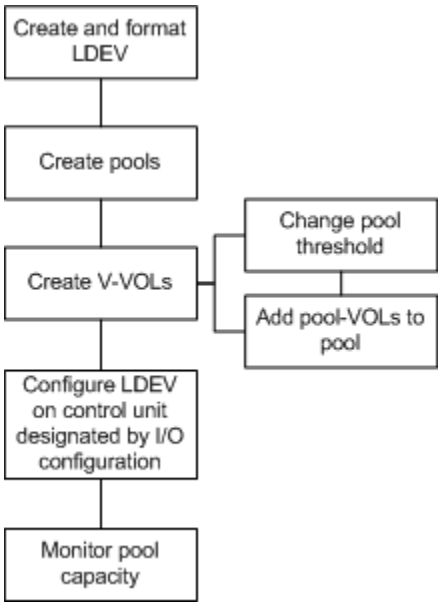
Advantages	Without Dynamic Provisioning for Mainframe	With Dynamic Provisioning for Mainframe
Reduces initial costs	You must purchase physical drive capacity for expected future use. The unused capacity adds costs for both the storage system and software products.	You can logically allocate more capacity than is physically installed. You can purchase less capacity, reducing initial costs, and you can add capacity later by expanding the pool.
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. In addition, with Dynamic Tiering, you can configure pool storage consisting of multiple types of data drives to alleviate unnecessary costs.

Advantages	Without Dynamic Provisioning for Mainframe	With Dynamic Provisioning for Mainframe
Reduces management labor and increases availability of storage volumes for replication	As the expected physical drive capacity is purchased, the unused capacity of the storage system also needs to be managed on the storage system and on licensed products.	Licenses for storage system software products are based on used capacity rather than the total defined capacity. You can allocate volumes of up to 1,182,006 cyl (980.706 GB) regardless of the physical drive capacity. This improves management flexibility.
Increases the performance efficiency of the data drive	Because physical drive 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 for Mainframe advantage example

Assume you have 12 3390-V LDEVs from 12 RAID1 (2D+2D) array groups assigned to a DP pool. All 48 drives contribute their IOPS and throughput power to all 3390-A DP volumes assigned to that pool. Instead, if more random read IOPS horsepower is desired for a pool, then the DP pool can be created with 32 3390-V LDEVs from 32 RAID5 (3D+1P) array groups, thus providing 128 drives of IOPS power to that pool. Up to 1024 LDEVs can be assigned to a single pool, providing a considerable amount of I/O capability to just a few DP volumes.

Dynamic Provisioning for Mainframe high-level workflow



Dynamic Tiering for Mainframe

Hitachi Dynamic Tiering (HDT) simplifies storage administration by automatically optimizing data placement in 1, 2, or 3 tiers of storage that can be defined and used within a single virtual volume. Tiers of storage can be made up of internal or external (virtualized) storage, and use of HDT can lower capital costs. Simplified and unified management of HDT allows for lower operational costs and reduces the challenges of ensuring that applications are placed on the appropriate classes of storage.

When you use Dynamic Provisioning to implement a thin provisioning strategy, the array has all the elements in place to offer automatic self-optimizing storage tiers provided by Hitachi Dynamic Tiering. Dynamic Tiering enables you to configure a storage system with multiple storage tiers consisting of different types of data drives (for example, SSD, FMD, HDD) to improve the speed and cost of performance. Dynamic Tiering extends and improves the functionality and value of the Dynamic Provisioning feature. Both features use pools of physical storage to define V-VOLs. Each thin provisioning pool can be configured to operate either as a DP pool or as a Dynamic Tiering pool.

Automated tiering of physical storage is the ability of the array to dynamically monitor usage and relocate data to the appropriate storage tier based on performance requirements. Data relocation focuses on data segments rather than on entire volumes. The Dynamic Tiering functionality is entirely within the array and does not require any host level involvement.

Dynamic Tiering enables you to:

- Configure physical storage into tiers based on drive performance. Host volumes are configured as usual from a common pool, but the pool consists of multiple types of drives that offer different levels of performance (for example, high-speed SSDs and lower-speed HDDs).
- Automatically migrate data to the most suitable tier according to access frequency. Data that is accessed frequently is placed on the high-performance drives, while data that is accessed infrequently is placed on the lower-performance drives.

simplifies storage administration by automating and eliminating the complexities of efficiently using tiered storage. It automatically moves data on pages in Dynamic Provisioning for Mainframe V-VOLs 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 high-cost storage tiers
- Reduced storage management effort
- More automation
- Nondisruptive storage management
- Reduced costs
- Improved overall performance

You can use Hitachi Device Manager - Storage Navigator, Command Control Interface, or Hitachi Tiered Storage Manager for Mainframe (HTSM for Mainframe) to perform Dynamic Tiering for Mainframe operations.

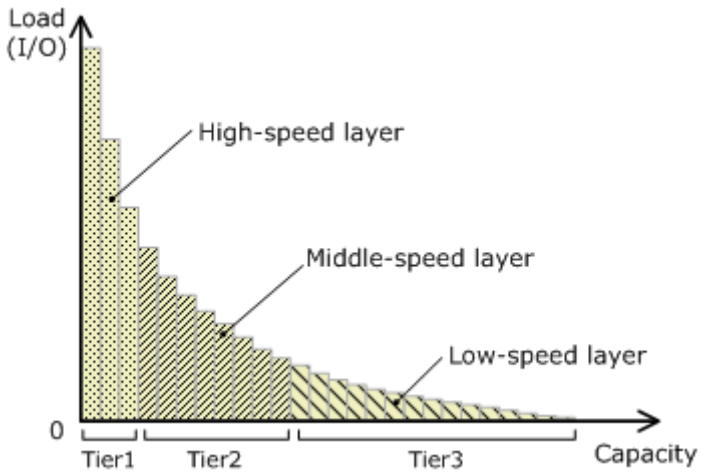
- When you use Hitachi Device Manager - Storage Navigator or Command Control Interface, the following resources assigned to the storage administrator can be used:
  - Tiers of pools
  - Tiers of DP-VOLs
- When you use HTSM for Mainframe, the following resources assigned to the mainframe administrator can be used:
  - Tiers of storage groups
  - Tiers of DP-VOLs that are assigned to a host

Overview of tiers

When not using Dynamic Tiering for Mainframe, data is allocated to only one kind of data drive (without regard to the workload) because the volumes are configured with only one kind of data drive. When using Dynamic Tiering, frequently accessed data is automatically allocated to the higher-speed HDT pool volumes and the lower speed drive to the low workload portion of a volume. 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 pages 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.

This figure shows the basic tier concept.



About active flash for mainframe

The active flash feature of Dynamic Tiering monitors page accesses over a set time frame and attempts to keep the most frequently accessed pages in Tier 1.

The active flash feature monitors a page's access frequency level real time and promotes pages that suddenly became busy from a slower media to high-performance flash media, in real time.

Requirements

The active flash feature can be enabled on any Dynamic Tiering pool as long as you have SSD or FMD drives in Tier 1 of the pool. No special configuration beyond what is needed for active flash is required.

Prompt Promotion

A primary goal of Dynamic Tiering and active flash is to have the most frequently accessed pages in Tier 1. As the workload varies in both the frequency of access and the type of access, reads or writes, the threshold for moving pages from one tier to another changes. Dynamic Tiering generates a dynamic tier range value that is used to determine which pages need to be in Tier 1 and which need to be in a lower tier.

The active flash feature compares the recent access frequency of each page to the Prompt Promotion threshold to determine whether a page should be promoted to Tier 1. The Prompt Promotion threshold is a dynamic threshold that adjusts based upon changes in workload to make most efficient use of the drives. If the recent access frequency for a page meets or exceeds the Prompt Promotion threshold, the page is relocated to Tier 1 without waiting for the next Dynamic Tiering relocation cycle.

Certain types of I/O benefit more from being served by flash media than others. To achieve the best performance gains for certain I/O, active flash gives read I/O greater weight than write I/O when calculating the total access frequency for a page.

High Prioritized Demotion

To be certain that there is always some room for active flash to do Prompt Promotion of pages to Tier 1, High Prioritized Demotion is used to demote pages out of Tier 1. Pages that have the lowest IOPH are candidates for High Prioritized Demotion. Similar to Prompt Promotion, High Prioritized Demotion does not wait for the current Dynamic Tiering cycle to end to make relocation decisions.

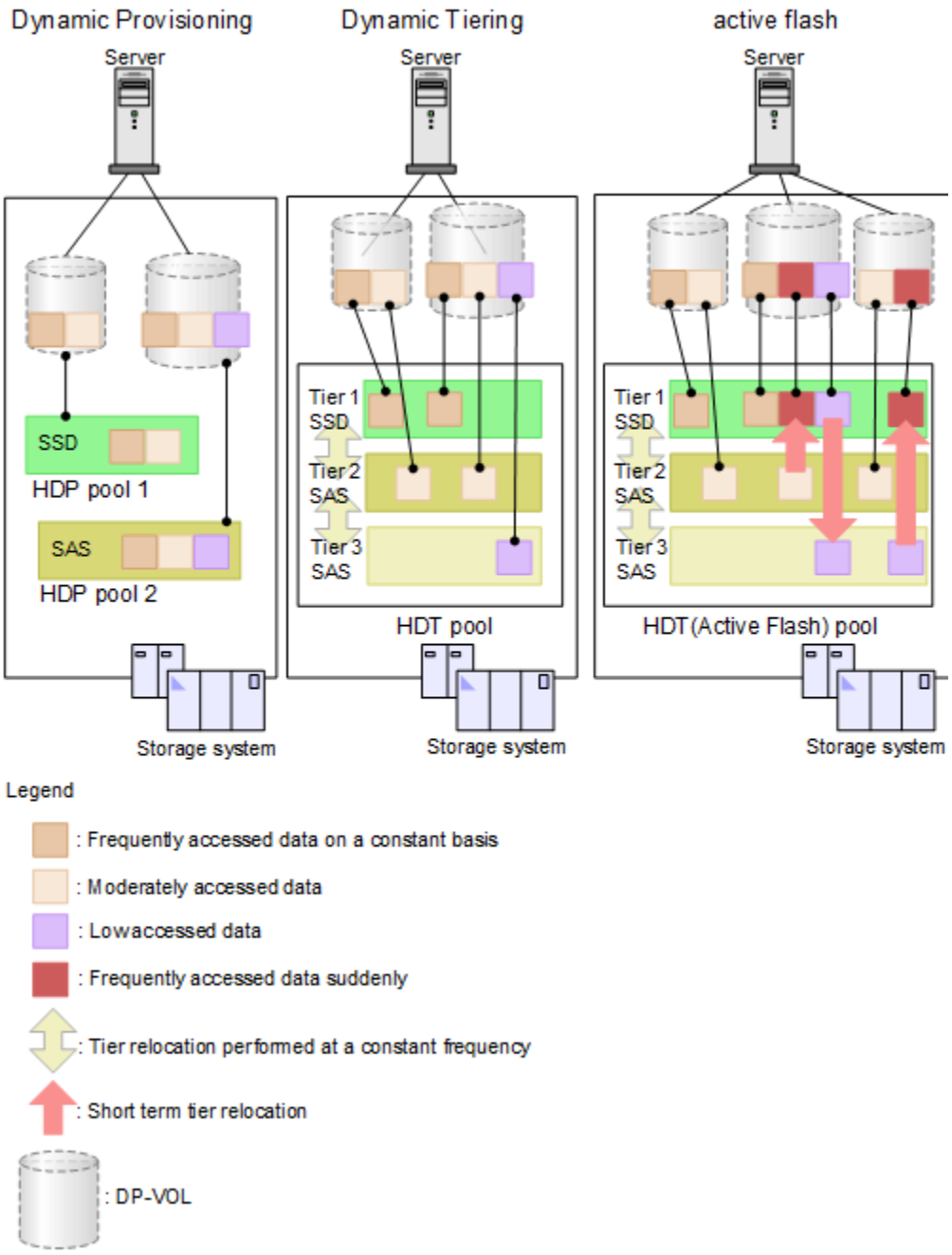
Page demotion is triggered when:

- Tier 1 free capacity is depleted.
- Performance utilization reaches 80%.

Peak performance utilization is predefined for a particular media.

Performance utilization of a tier is the maximum amount of I/O it can receive. The maximum I/O load that should be targeted to a tier depends upon the media type used to make the tier. A performance utilization of 100% means that the tier is receiving the maximum amount of I/O it can sustain. When performance utilization reaches about the 60% level, response time to the particular media becomes noticeably slower.

This diagram shows the differences in the way pools are managed between Dynamic Provisioning, Dynamic Tiering, and active flash.



System requirements for provisioning

The system requirements for provisioning include basic hardware and licensing requirements as well as additional requirements for shared memory and cache management devices.

Item	Requirements and Restrictions
Storage system hardware	Must be configured and ready for use.
Parity groups	Must be configured and ready for use.
Hitachi Device Manager - Storage Navigator or CCI	Must be configured and ready for use. For details and instructions, see the *System Administrator Guide* for your storage system.
License keys for the provisioning software	Must be enabled. For details and instructions, see the *System Administrator Guide* for your storage system.
Required amount of shared memory	Must be installed in the storage system.
Required number of cache management devices	Must be available.
Applicable system option modes (SOMs)	Must be enabled on your storage system before you begin operations. For information about SOMs, contact customer support.

Shared memory requirements

Additional shared memory is required when Dynamic Provisioning for Mainframe is used and the total capacity of Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, and Thin Image pools is 3.9 PB or more.

Caution: Before shared memory is removed, all Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe pools must be deleted.

When Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, active flash for mainframe, and Thin Image are used, the pool capacity and the V-VOL capacity that can be created are expanded according to the shared memory expansion status.

This table shows the pool capacity and the V-VOL capacity that can be created when Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, active flash for mainframe, and Thin Image are used.

Shared memory function	Pool/V-VOL capacity	
	Open system	Mainframe system
Base	Up to 4.4 PB	Up to 3.9 PB
Extension 1	Up to 8.05 PB	Up to 7.3 PB
Extension 2	Up to 12.5 PB	Up to 11.3 PB
Extension 3	Up to 16.6 PB	Up to 15.0 PB

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

Cache management device requirements

Cache management devices manage the cache associated with volumes (LDEVs). Each volume (LDEV) requires at least one cache management device. An LDEV that is not a DP-VOL requires one cache management device. For an LDEV that is a DP-VOL, you need to calculate the number of cache management devices required.

The storage system can manage up to 65,280 cache management devices.

The **View Management Resource Usage** window in Device Manager - Storage Navigator displays the number of cache management devices in use and the maximum number of cache management devices.

Number of cache management devices required for DP-VOLs

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

This table explains the relationship between the pool volume attribute and the maximum capacity of the cache management device.

Pool volume attribute of V-VOL	Maximum capacity of cache management device		
	MB (GB)	Blocks	Cylinders
Internal volume	711,768.75 MB (695.08 GB)	1,457,702,400 blocks	837,760 cylinders
External volume	949,659.37 MB (927.40 GB)	1,944,902,400 blocks	1,117,760 cylinders

Use this 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.

ceiling(*user-specified-capacity* / *max-capacity-of-cache-management-device*)

where

- ceiling: The value enclosed in ceiling( ) must be rounded up to the nearest whole number.

Mainframe system function enablement

In addition to system option modes (SOMs), mainframe system functions can be enabled or disabled by using the Device Manager - Storage Navigator **Edit Mainframe System Functions** window. You can enable the Super PAV function.

The IBM® HyperPAV function enables you to map alias devices to base devices only within the same CU. If you want to map alias devices in a different CU, you must enable the Super PAV mainframe system function on the storage system. When the Super PAV mainframe system function is enabled, you can map an entire collection of alias devices to a single base device that is in a different CU. For details about IBM® Super PAV and related host commands, see the IBM® documentation.

Caution: If the storage system restarts with volatilization (Forced outage with volatile DKC and media chassis, PS-OFF to volatile PS-ON, or Offline microcode replacement), the Super PAV function is reset to the default setting of disabled. If this function was enabled before the volatilization, you must re-enable it after the volatilization.

DB2® Cast Out Accelerator

The DB2® Cast Out Accelerator function can improve the response performances for DB2® Cast Out processing.

Overview of DB2® Cast Out Accelerator

DB2® provides instructions for destaging the data to storage when a group buffer pool (GBP), which is a coupling facility (CF) structure on z/OS, is full. This processing for writing data from GBP to storage is referred to as the *castout processing*.

The Cast Out processing operates by merging write requests to multiple tracks into one CCW chain.

In general, write requests in the CCW chain are processed sequentially to guarantee the order of data. Therefore, the I/O response time might become longer.

On the other hand, DB2® Cast Out Accelerator can handle write requests to multiple tracks as one I/O by following the instructions from DB2® Media Manager. Therefore, the processing can be performed regardless of the order of data in multiple tracks in the CCW chain, and the parallel data processing will subsequently result in significant improvement in the response time.

However, the effects on the performance improvement can be expected only for I/Os with castout requests provided by DB2® Media Manager. The response performances for all I/Os might not be improved.

In addition, by using some functions combined with the target volumes, the effects on the response performance improvement might not be expected even for I/Os with castout requests.

Functions combined with the target volumes	Improvement effects
Simplex	Expected
TrueCopy for Mainframe	Expected
Universal Replicator for Mainframe	Expected

Functions combined with the target volumes	Improvement effects
ShadowImage for Mainframe	Expected
Compatible FlashCopy® V2	Expected
Compatible FlashCopy® SE	Expected
Hitachi Compatible Replication for IBM® XRC Concurrent Copy	Not expected
FICON® Data Migration	Not expected

Enabling and disabling DB2® Cast Out Accelerator

Before you begin

The Storage Administrator (Initial Configuration) role is required to perform this task.

Procedure

1. Click **Actions** > **Mainframe Connection** > **Edit Mainframe System Functions**.
2. In the **Edit Mainframe System Functions** window, select **Db2 Castout Accelerator**, and then click **Enable** or **Disable**.
3. Click **Finish**.
4. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
5. Click **Apply** to submit the task.

Chapter 2: Configuring custom-sized provisioning

Configuring custom-sized provisioning involves creating and configuring custom-sized volumes (CVs). CVs are created by dividing a fixed-sized volume (FV) into several smaller volumes of arbitrary sizes. This provisioning strategy is suitable for use on both open and mainframe systems. The Virtual LVI software is required to configure custom-sized provisioning on mainframe systems.

Virtual LVI functions

The Virtual LVI function is used to create, configure, or delete a customized volume (LDEV).

The Virtual LVI function 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 Virtual LVI volume usually consists of at least one FV, one or more custom-sized volumes (CVs), and some free space.

Use the Virtual LVI function 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-sized 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.

The Virtual LVI function can also divide a logical volume into multiple smaller volumes to reduce unused capacity and provide a more efficient use of space for small volumes such as command devices. The Virtual LVI function can efficiently exploit the capacity of a disk by not wasting capacity using larger volumes when the extra capacity is not needed.

Spare drives and parity groups

Spare drives are mounted separately from the data drives that are used for host read and write operations. When you use spare drives, if a failure occurs in a data drive, the storage system can continue to be available to hosts in the same way as before the failure occurs. For example, if a failure occurs in a data drive, the stored data is copied to a spare drive so that you can use the spare drive.

Configuration of interleaved parity groups

If RAID configurations are RAID 1 (2D+2D) or RAID 5 (7D+1P), the interleaved parity group can be created by concatenating multiple parity groups. This table lists the RAID configurations and the number of parity groups that can be concatenated.

RAID configuration	2 concatenating	4 concatenating
RAID 1 (2D+2D)	Available	Not available
RAID 5 (7D+1P)	Available	Available

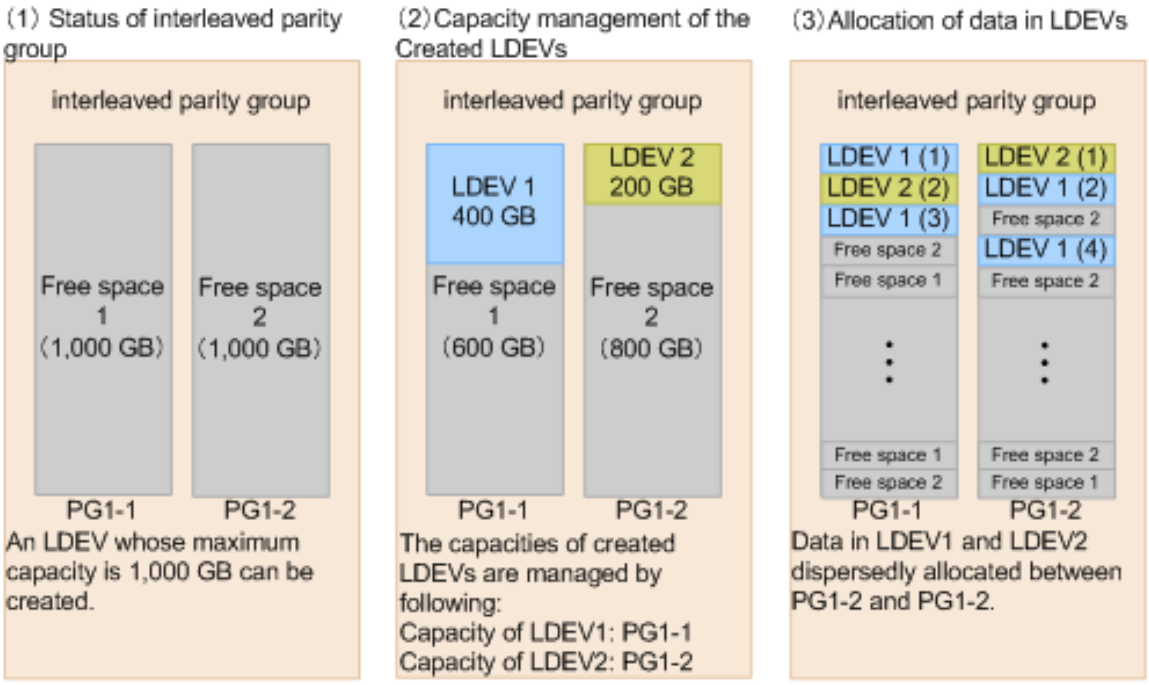
When concatenating parity groups, data in LDEVs is allocated between the interleaved parity groups. Therefore, loads are dispersed because of the parity group concatenation, and the LDEV performance is improved.

The capacity of the created LDEV is managed by each of the parity groups that is 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 this 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



Configuration of 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-sized 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.

This table shows the number of CUs and LDEVs in the storage system.

Storage system	CU		LDEV	
	Number	Range	Number	Range
VSP 5000 series	255	0x00 to 0xFE	65,280	0 to 65,279

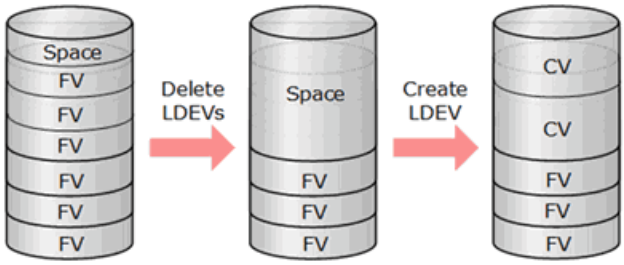
Configuration of volumes in a parity group by using Virtual LVI

Each parity group has the same configuration and is assigned the same FVs of the same size and RAID level.

The Delete LDEV and Create LDEV functions are performed by using Virtual LVI 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 creating and deleting LDEVs by using Virtual LVI, 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.

This is an example of configuring volumes in a parity group:



Specifications for custom-sized volumes

To create custom-sized volumes on a storage system, you create volumes of the desired size from individual array groups. These volumes are then individually mapped to one or more host ports as logical units (LUs).

RAID level support for CVs and pool-VOLs

This table specifies the RAID level support for custom-sized volumes (CVs) and pool volumes (pool-VOLs).

RAID level	RAID configuration that can be applied to CVs	RAID configuration that can be applied to pool volumes
RAID 1	▪ 2D+2D	▪ 2D+2D
RAID 5	▪ 3D+1P ▪ 7D+1P, or two concatenated 7D+1P parity groups, or four concatenated 7D+1P parity groups	▪ 3D+1P ▪ 7D+1P, or two concatenated 7D+1P parity groups, or four concatenated 7D+1P parity groups
RAID 6	▪ 6D+2P ▪ 14D+2P	▪ 6D+2P ▪ 14D+2P

Virtual LVI specifications for mainframe systems

Parameter	Specification
Track format	3390
Emulation type	3390-3, 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-A, 3390-V
Ability to intermix emulation type	If the track sizes of the volumes are the same, the device emulation types can be intermixed.
Maximum number of volumes (normal and Virtual LVI) 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.
Maximum number of volumes (normal and Virtual LVI per storage system	65,280
Minimum size for a Virtual LVI volume	1 user cylinder (870 KB)
Maximum size for a Virtual LVI volume	See CV capacity by emulation type for mainframe systems (on page 39).
Size increment	1 user cylinder (870 KB)

CV capacity by emulation type for mainframe systems

Emulation type	Minimum CV capacity (cyl)	Maximum CV capacity (cyl)
3390-1	1	1,113
3390-2	1	2,226
3390-3	1	3,339
3390-3A	1	3,339
3390-3B	1	3,339
3390-3C	1	3,339
3390-9	1	10,017
3390-9A	1	10,017
3390-9B	1	10,017
3390-9C	1	10,017
3390-A[1,5]	1	▪ For DP-VOLs: 1,182,006 ▪ For other volumes: 262,668
3390-L	1	32,760
3390-LA	1	32,760
3390-LB	1	32,760
3390-LC	1	32,760
3390-M	1	65,520
3390-MA	1	65,520
3390-MB	1	65,520
3390-MC	1	65,520
3390-V [2,3,4]	44	▪ For internal volumes: 837,760 ▪ For external volumes: 1,117,760
Notes:		

Emulation type	Minimum CV capacity (cyl)	Maximum CV capacity (cyl)

1. For 3390-A, the incremental unit of the CV capacity within the first 65,520 cylinders is 1 user-cylinder, and the incremented capacity between 65,521 and 1,182,006 cylinders is 1,113 user-cylinders. Therefore, if you specify a value that exceeds 65,520 cylinders, the value is changed to multiples of 1,113 cylinders. For instance, if 65,521 is specified, the value is changed to 65,667, which is 59 times 1,113 cylinders.
2. For 3390-A, for the Compatible FlashCopy® SE volume, if you specify a value between 1 and 40,068 cylinders, the free space whose size is the sum of the specified value and 252 cylinders is required. If you specify a value of 40,069 cylinders or more, the free space calculated by this formula is required:

   40,320 cylinders + *value-rounded-up-after-the-decimal-point-of-*A* × 1,120 cylinders

   where *A = (*specified-value* - 40,068) ÷ 1,113 cylinders
3. For 3390-V, the value specified in the **Create LDEVs** window is changed to a multiple of 44.8 cylinders (38,976 KB), and the resulting number of cylinders is truncated after the decimal point. For instance, if 10,000 is specified, 10,035 is displayed (224 times 44.8 cylinders is 10,035.2).
4. When the CV of 3390-V is registered to the pool of Dynamic Provisioning for Mainframe, 8 GB or more free space in the CV of 3390-V is necessary. When you create a CV of 3390-V, specify the capacity as more than 9,676 cylinders.
5. If you specify 1 cylinder to create the CV of 3390-A, 1,120 cylinders are actually used. In 1,120 cylinders, 1,113 cylinders are defined as a user-cylinder, and 7 cylinders are defined as a control cylinder. To effectively create the CV of 3390-A, specify multiples of 1,113 cylinders for the CV capacity.

SSID specifications and requirements

The storage system is configured with one Storage Subsystem ID (SSID) for each group of 64 or 256 devices to provide one or four SSIDs per CU image. Each SSID must be unique inside the individual array and also for the entire storage system. This includes across all LPARs in a sysplex. SSIDs are user-specified and are assigned during storage system installation in hexadecimal format, from 0004 to FEFF.

Caution: For the SSID of an LDEV used by mainframe hosts, set a value in the range specified as SSID requirements. If you set a value outside the specified range, mainframe hosts might not be able to use the LDEV.

This table shows the relationship between controller emulation type and SSID.

Controller emulation type	SSID requirement	Virtual LVI support
I-2107	0004 to FEFF	3390-3, 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 volumes

LDEV size calculations

When you create custom-sized volumes (CVs), 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 calculate the actual capacity of a CV, you must use a mathematical formula. These topics explain how to calculate the user area capacity and the entire capacity of a CV.

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

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

Note: When you use CCI to create a CV, the CV is created with the specified size regardless of the capacity calculation. Therefore, even if you specify the same capacity size (for example, 1 TB), the actual capacity size might be different between CVs created using CCI and CVs created using Hitachi Device Manager - Storage Navigator.

Calculation of a 3390-A volume size

To calculate the entire capacity of a CV, use this formula. For the *user-specified-CV-capacity*, specify the capacity of the user area in a CV.

The resulting CV capacity is expressed in megabytes:

```
(ceiling (user-specified-CV-capacity / 1113) * 1120
* 15 * capacity-of-a-slot ) / 1024
```

where

- The value enclosed in `ceiling( )` must be rounded up to the nearest whole number.
- The *user-specified-CV-capacity* is the capacity of the user area in a CV expressed in cylinders.
- The *capacity-of-a-slot* is 58 KB for all mainframe volume emulation types.

Tip:

- To calculate the capacity of the CV of 3390-A, apply the multiples of 1,113 cylinders to *user-specified-CV-capacity* in the formula above. For example, if you want to apply 1 cylinder to user-specified-CV-capacity, apply 1,113 cylinders. If you want to apply 1,114 cylinders to *user-specified-CV-capacity*, apply 2,226 cylinders.
- In 3390-A, if a value is specified in Device Manager - Storage Navigator in the **Create LDEVs** window that exceeds 65,520 cylinders, the value is corrected to multiples of 1,113 cylinders. For example, if 65,521 is specified, 65,667 (59 * 1,113) is displayed.

Calculation of a 3390-V volume size

To calculate the entire capacity of a CV, use this formula. For the *user-specified-CV-capacity*, specify the capacity of the user area in a CV.

The resulting CV capacity is expressed in megabytes:

```
( ceiling ( (user-specified-CV-capacity * 15) / 672)
* 672 * capacity-of-a-slot ) / 1024
```

where

- The value enclosed in `ceiling( )` must be rounded up to the nearest whole number.
- The *user-specified-CV-capacity* is the capacity of the user area in a CV expressed in cylinders.
- The *capacity-of-a-slot* is 58 KB for all mainframe volume emulation types.

Tip:

- To calculate the capacity of the CV of 3390-V, apply the multiples of 44.8 cylinders to *user-specified-CV-capacity* in the upper formula. For instance, if you want to apply 44 cylinder to user-specified CV capacity, apply 44.8 cylinders. If you want to apply 45 cylinders to *user-specified-CV-capacity*, apply 89.6 cylinders.
- In 3390-V, the value specified in the **Create LDEVs** window is corrected to multiples of 44.8 cylinders (38,976 KB) and rounded down to the nearest whole number of cylinders.

Calculation of a 3390-X volume size

Use this formula to calculate the entire capacity of a CV (emulation type 3390-X). The resulting CV capacity is expressed in megabytes.

Note: 3390-X indicates 3390-1, 3390-2, 3390-3, 3390-9, 3390-L, and 3390-M.

```
ceiling( (ceiling( (user-specified-CV-capacity + management-area-capacity)
/ 1113) * 7 * 15 + (user-specified-CV-capacity + management-area-capacity)
```

```
* 15)
/ 672) * 672 * capacity-of-a-slot) / 1024
```

where

- The value enclosed in `ceiling( )` must be rounded up to the nearest whole number.
- The *user-specified-CV-capacity* (expressed in cylinders) is the capacity of the user area in the CV.
- The *capacity-of-a-slot* is 58 KB for all mainframe volume emulation types.
- The *management-area-capacity* (expressed in cylinders) depends on the volume emulation type.

Calculation of a 3390-XA, 3390-XB, 3390-XC volume size

Use this formula to calculate the entire capacity of a CV (emulation types 3390-XA, 3390-XB, 3390-XC). The resulting CV capacity is expressed in megabytes.

Note:

- 3390-XA indicates 3390-3A, 3390-9A, 3390-LA, and 3390-MA.
- 3390-XB indicates 3390-3B, 3390-9B, 3390-LB, and 3390-MB.
- 3390-XC indicates 3390-3C, 3390-9C, 3390-LC, and 3390-MC.

```
( ceiling( ( (user-specified-CV-capacity + management-area-capacity)
* 15 * capacity-of-a-slot) / boundary-value) * boundary-value) / 1024
```

where:

- The value enclosed in `ceiling( )` must be rounded up to the nearest whole number.
- The *user-specified-CV-capacity* (expressed in cylinders) is the capacity of the user area in the CV.
- The *management-area-capacity* (expressed in cylinders) depends on the volume emulation type.
- The *capacity-of-a-slot* (expressed in kilobytes) is 58 KB for all mainframe volume emulation types.
- The *boundary-value* (expressed in kilobytes) depends on the volume emulation type and RAID level (see Boundary values of volumes (on page 44)).

Management area capacity of a mainframe volume

This table provides the management area capacity of volumes for mainframe systems. The management area capacity (expressed in cylinders) depends on the volume emulation type.

Emulation type	Management area capacity (cyl per 1,113 cyl)
3390-A	7
3390-1	5
3390-2, 3390-3, 3390-3A, 3390-3B, 3390-3C	6
3390-V	0
3390-9, 3390-9A, 3390-9B, 3390-9C	25
3390-L, 3390-LA, 3390-LB, 3390-LC	23
3390-M, 3390-MA, 3390-MB, 3390-MC	53

Boundary values of volumes

This table provides the boundary values (expressed as kilobytes) for internal volumes. The boundary value for an external volume is always one kilobyte, regardless of emulation type and RAID level.

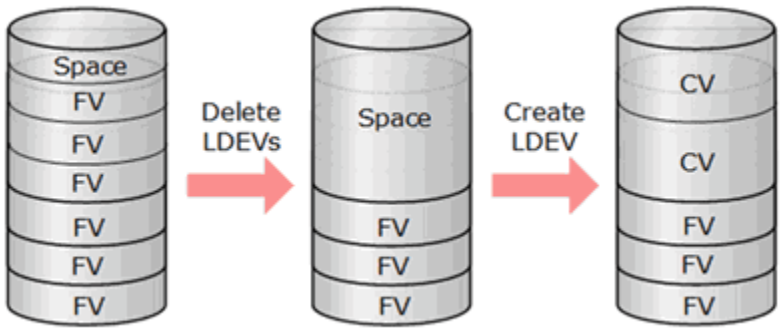
Emulation type	Boundary value (KB)				
	RAID 1 (2D +2D)	RAID 5 (3D +1P)	RAID 5 (7D +1P)	RAID 6 (6D +2P)	RAID 6 (14D +2P)
3390-*xx* *xx* indicates one or more numbers or letters (for example, 3390-9).	928	1,392	3,248	2,784	6,496

Creating LDEVs

There are several ways to create LDEVs.

About creating LDEVs

This diagram shows how custom-sized volumes (CVs) are created. First you delete fixed-sized volumes (FVs) to create free space, and then you can create one or more CVs of any size in that free space.



You can create LDEVs using any of these tabs in Device Manager - 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 is displayed in Total Selected Free Space in the Parity Group Selection section on the **Create LDEVs** window. 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 is displayed 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.

- In the **Select Free Spaces** window by default, all free spaces in the parity group are displayed.

  In this case, if LDEVs are created by the initial setting without confirming the number of free spaces, more LDEVs than necessary can be created. When you create LDEVs, confirm the number of free spaces displayed on the **Select Free Spaces** window in the **Create LDEVs** window.

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

Creating one or more LDEVs

Use this procedure to create one or more internal or external logical volumes (also called LDEVs). 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.

Note: Creating a mainframe volume on a SCM drive is not supported.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- Before you can create an LDEV in a storage system, you might need to create free space. Before deleting volumes to create free space, make sure that the selected mainframe volumes are disconnected from the host and do not contain data that might be required later.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Open the **Create LDEVs** window using one of these methods:
   - To create LDEVs in specific parity groups, click **Parity Groups**.
   - To create LDEVs in any parity groups, click **Logical Devices**.
3. On the **Parity Groups** or the **LDEVs** tab, click **Create LDEVs**.

   Caution: If the drive type-code for the installed drive is NFHA*x*-Q*xxx*SS, select the check box for a parity group in which an LDEV is created using this procedure, and then create an LDEV.
4. In the **Create LDEVs** window, from the **Provisioning Type** list, select the provisioning type for the LDEV to be created.
5. In **System Type**, select **Mainframe** to create mainframe volumes.
6. From the **Emulation Type** list, select the device emulation type for the LDEVs to be created.
7. If you are creating an internal volume, select the parity group and free spaces to be assigned to the volume:
   a. In **Parity Group Selection**, select a drive.
      - Select from **Drive Type/RPM**.
   b. In **Parity Group Selection**, select the desired **RAID Level**, and then click **Select Free Spaces**.
   c. In the **Select Free Spaces** window, select the free spaces to be assigned to the volume.

      Tip:
      - To confirm where the selected free space is physically located, click **View Physical Location**.
      - To apply filter conditions to the table, click **Filter**, specify the desired conditions, and then click **Apply**.
      - To select all free spaces in the table, click **Select All Pages**. To cancel the selection, click **Select All Pages** again.
      - To change the capacity unit or the number of rows to view, click **Options**.
   d. In the **Select Free Spaces** window, if the selected free spaces have no issues, click **OK**.

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

   Enter the capacity within the range of figures displayed below the text box. The capacity unit is fixed to **Cyl**.
9. In **Number of LDEVs**, type the number of LDEVs to be created.
   - If you create an internal volume, **Number of LDEVs per Free Space** is displayed.
   - If you create an external volume, **Number of LDEVs per External Volume** is displayed.
10. 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.
11. In **Format Type**, select the desired format type for the LDEV.
    - For an internal volume, select **Normal Format**, **Quick Format**, **Parity Group Format**, or **No Format**.

      If you select **Quick Format**, host I/O performance might be affected during quick formatting.

      Parity Group Format can only be selected when there are no existing LDEVs in a parity group.

      Caution: If the drive type-code for the installed drive is NFHA*x*-Q*xxx*SS, select **Parity Group Format** for the format type if available.

      If you select **No Format**, format the volume after creating the LDEV.
    - For an external volume for mainframe, select **Write to Control Block**, **Normal Format**, or **No Format**.

      If you select **No Format**, format the volume after creating the LDEV.

    Caution: In some cases, Quick Format operations can affect host performance because shared resources such as MP units and cache paths are used during Quick Format. If you select **Quick Format** while Quick Format operations are already in progress, host I/Os might be affected. For details, see Quick Format function (on page 51).
12. Click **Options** to show more options.
13. 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.

    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 are displayed in blue, unavailable numbers are displayed in gray, and unused numbers are displayed in white. LDEV numbers that are unavailable might be already in use, or already assigned to another emulation group (group by 32 LDEV numbers).

Note: When a mainframe volume or multiplatform volume is created, corresponding LDEV numbers cannot be specified if these values are not identical:

- Model/serial numbers of the virtual storage machine and the storage system
- LDEV ID and the virtual LDEV ID

14. In the **Create LDEVs** window, in **SSID**, type four digits, in hexadecimal format (0004 to FEFF), for the SSID.

Caution: For the SSID of an LDEV used by mainframe hosts, set a value in the range specified as SSID requirements. If you set a value outside the specified range, mainframe hosts might not be able to use the LDEV.

15. 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**.
16. In the **Create LDEVs** window, from the **MP Unit** list, select an MP unit to be used by the LDEVs.
    - If you assign a specific MP unit, select the ID of the MP unit.
    - If you can assign any MP unit, click **Auto**.
17. Click **Add** to add the LDEVs to the **Selected LDEVs** table.
18. For the LDEVs in the **Selected LDEVs** table, you can change these LDEV settings: SSID, LDEV name, initial LDEV ID, and MP unit.
    - To change the SSID, select the LDEV, and then click **Edit SSIDs**. If the first LDEV in a CU is specified as part of the current operation, the SSID value can be changed. If an LDEV already exists in the CU, the SSID value cannot be changed.
    - To change the LDEV name, initial LDEV ID, or MP unit, select the LDEV, and then click **Change LDEV Settings**.
    - If you need to change other settings, you must delete the LDEV from the **Selected LDEVs** table and then reselect the desired settings.
19. When the information in the **Selected LDEVs** table is correct, click **Finish**.
20. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.
       You can enter up to 32 letters, numbers, and symbols, except these:
       \ / : , ; * ? " < > |
    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
21. Click **Apply** to submit the task.

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. This procedure looks at allocations in the array. The LDEV IDs used must also be configured in the mainframe IO GEN with a device number.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. In the **LDEVs** window, click **Create LDEVs**.
4. In the **Create LDEVs** window, scroll down to **Initial LDEV ID** and click **View LDEV IDs**.
5. 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.

   In the matrix, used LDEV numbers are displayed in blue, unselectable LDEV numbers are displayed in gray, and unused LDEV numbers are displayed in white. The LDEV numbers corresponding to any one of these conditions cannot be specified:

   - The LDEV is already in use.
   - The LDEV is already assigned to another emulation group (grouped every 32 LDEVs).
   - The LDEV is not assigned to the user.
   - If these values are not identical when a mainframe volume or multiplatform volume is created:
     - The LDEV ID and the virtual LDEV ID
     - The model and serial number of the storage system and the virtual storage machine
6. Click **Close**.

Finding an LDEV SSID

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. In the **LDEVs** pane of the **Logical Devices** window, click **Create LDEVs**.
4. In the **Create LDEVs** window, scroll down to **Initial SSIDs**, and then click **View SSIDs**.
5. In the **View SSIDs** window, review the list to confirm the LDEV SSIDs. The **SSIDs** table shows the SSIDs in use in the system.
6. Click **Close**.

Blocking LDEVs

Use this procedure to block internal and external volumes (LDEVs). A volume must be blocked before you can format it or shred it.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Locate and select the volumes to be blocked:
   - To block one or more volumes in a specific parity group, expand **Parity Groups**, expand **Internal** or **External**, select the desired parity group in the tree, and then select the desired volumes on the **LDEVs** tab.
   - To block all volumes in a specific parity group, click **Parity Groups**, and then select the desired parity group on the **Parity Groups** tab.
   - To block one or more volumes in a specific pool, expand **Pools**, select the desired pool, select the **Virtual Volumes** tab, and then select the desired volumes.
   - To select the volumes from a list of all volumes in the storage system, click **Logical Devices**, and then select the desired volumes. You can sort the volume list as needed by clicking on the desired column.
3. Find the target LDEV ID or parity group to be blocked, and then verify the LDEV status in the table.

   If **Blocked** is displayed, the LDEV is blocked.
4. Select the LDEV or parity group for which **Blocked** is not displayed.
5. Click **More Actions** > **Block LDEVs**.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Formatting LDEVs

If you initialize LDEVs that are being used, you need to format the LDEVs.

About formatting LDEVs

The LDEV formatting function, which includes Normal Format, Quick Format, and Write to Control Blocks, enables you to format volumes (LDEVs). Volumes must be in the blocked status to be formatted.

This table lists the formatting functions and specifies the LDEV types on which each formatting function can be performed.

Formatting function	Corresponding volume	Note
Normal Format	Internal volume Virtual volume External volume	If you use Normal Format in multiple applications to format LDEVs or parity groups for the same storage system, the LDEV formatting performed later fails. For example, while one Normal Format operation is in progress on the maintenance PC, another Normal Format operation cannot be performed on the SVP.
Quick Format	Internal volume, except for a volume in a parity group with accelerated compression enabled	You can perform LDEV formatting with Quick Format by using multiple applications if the target parity groups are different. While one Quick Format operation is in progress, another Quick Format operation can be performed. These operations can be performed concurrently on the storage system.
Write to Control Blocks	External volume	-

When an LDEV is added, the storage system performs one of the following actions depending on the setting:

- The storage system automatically formats the added LDEV. This is the default setting.
- The storage system blocks the LDEV and does not automatically format it.

To confirm or change the formatting setting on the storage system, contact the administrator. Users who have the Storage Administrator (Provisioning) role can change the formatting setting.

Quick Format function

The Quick Format function allows you to format internal volumes (LDEVs) in the background. While Quick Format operations are in process, you can perform other tasks to configure the storage system. The Quick Format functions enable you to set the system configurations such as path definition, file system creation, TrueCopy pair creation, before the completion of formatting. I/O operations from hosts are allowed during Quick Format, but performance might be affected because shared resources such as MP units and cache paths are used during Quick Format operations.

In the following specific situations, host I/O performance might decrease during Quick Format due to the load concentration on a specific component at the same time:

- Many Quick Format operations are started at the same time when there are only one or two modules and each module is configured with minimum CPEX (Cache Path control adapter and PCI EXpress path switch), back-end modules (BEMs), and front-end modules (FEMs).
- Quick Format operations are started at the same time when there are more than two modules but the number of CPEXs, BEMs, and FEMs installed in the modules is extremely unbalanced, for example:
  - One module contains many CPEXs, BEMs, and FEMs, and another module contains the minimum number of CPEXs, BEMs, and FEMs.
  - In one of the modules, CPEX (Basic) is connected with many BEMs, FEMs, or other devices, and CPEX (Option) is connected with the minimum number of BEMs, CHAs, or other devices.

For these specific configurations, start the Quick Format operation on one LDEV first to confirm that the host I/O performance does not decrease. After that, increase the number of concurrent Quick Format operations and verify host performance after each additional operation has started.

For other than these specific configurations, you should not start more than eight Quick Format operations at the same time. After eight or fewer Quick Format operations have started, you should not start more than four Quick Format operations at the same time, and you should monitor host I/O performance.

Quick Format specifications

Item	Description
Preparation for executing the Quick Format feature	The internal volume must be in blocked status.
Maximum number of parity groups that can undergo Quick Format	Up to 72 parity groups can concurrently undergo Quick Format. There is no limit on the number of volumes that can undergo Quick Format.
Concurrent Quick Format operations	While one Quick Format operation is in progress, another Quick Format operation can be performed. A maximum of 72 parity groups can concurrently undergo Quick Format.
Preliminary processing	At the beginning of the Quick Format operation, preliminary processing is performed to generate management information. If a volume is undergoing preliminary processing, the status of the volume is `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

Item	Description
	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: 72 - *X* - *Y* where: *X* = number of parity groups on which Quick Format is being performed. *Y* = number of parity groups for which 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 an LDEV in the parity group with accelerated compression enabled, external volumes, virtual volumes, or journal volumes of Universal Replicator for Mainframe. ▪ 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.
SIM output after completion of Quick Format operation	When a Quick Format operation is performed, the SIM code 0x410100 is output after completion of the formatting. If multiple Quick Format operations are performed, the SIM code 0x410100 is output after completion of all format operations.

Write to Control Blocks function

The Write to Control Blocks function writes the mainframe system management area to an external volume.

If the LDEV with the mainframe system emulation type is created on the formatted external volume, it is recommended that the Write to Control Blocks is set to the format type. If the Write to Control Blocks is set to the format type, in comparison with the case of the Normal Format setting, the format time is shortened.

Before using this function, make sure that the external volumes have been formatted by the external storage system.

Caution: When it is uncertain whether the external LDEV has been formatted by an external storage system, select Normal Format to perform the format operation. If an option other than Normal Format is selected, the host might not have access to the formatted external LDEV.

To format the following LDEVs, select Normal Format as the format type:

- LDEV which was accessed by hosts
- LDEV on which the Write to Control Blocks function was performed

Formatting a specific LDEV

Use this procedure to perform Normal or Quick formatting on a volume.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- The status of the LDEV to be formatted must be Blocked.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. In the **Logical Devices** window, select the **LDEV ID** of the LDEV you want to format.
4. Click **More Actions** > **Format LDEVs**.
5. In the **Format LDEVs** window, select the desired format type (**Normal** or **Quick**), and then click **Finish**.

   You can select **Quick** only when the **Provisioning Type** of the selected LDEV is Basic and the parity group to which it belongs does not have accelerated compression enabled.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Formatting all LDEVs in a parity group

Use this procedure to perform Normal formatting on all of the volumes (LDEVs) in the parity group you select.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- Before you format the LDEVs in the selected parity group, make sure that all the LDEVs in the parity group have been blocked. See Blocking LDEVs (on page 50) for blocking an internal volume. See the *Hitachi Universal Volume Manager User Guide* for blocking an external volume.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Parity Groups**.
3. In the **Parity Groups** window, select a **Parity Group ID** of the parity group with the LDEVs you want to format.

   You can select multiple parity groups that are listed together or separately.
4. Block the LDEVs to be formatted.
5. Click **More Actions** > **Format LDEVs**.
6. In the **Format LDEVs** window, select the format type from the **Format Type** list, and then click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Restoring blocked LDEVs

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Locate and select the blocked volumes to be restored:
   - To restore one or more volumes in a specific parity group, expand **Parity Groups**, expand **Internal** or **External**, select the desired parity group in the tree, and then select the desired volumes on the **LDEVs** tab.
   - To restore all volumes in a specific parity group, click **Parity Groups**, and then select the desired parity group on the **Parity Groups** tab.

- To restore one or more volumes in a specific pool, expand **Pools**, select the desired pool, click the **Virtual Volumes** tab, and then select the desired volumes.
- To select the volumes from a list of all volumes in the storage system, click **Logical Devices**, and then select the desired volumes. You can sort the volume list as needed by clicking on the desired column.

3. Find the target LDEV ID or parity group to be restored, and then verify the LDEV status in the table.
   If **Blocked** is displayed, the LDEV is blocked.
4. Select the LDEV or parity group for which **Blocked** is displayed.
5. Click **More Actions** > **Restore LDEVs**.
6. In the **Restore LDEVs** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Editing an LDEV name

Use this procedure to edit the name of a registered internal volume.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. Select the **LDEV ID** of the LDEV you want to edit.
4. Click **Edit LDEVs**.
5. In the **Edit LDEVs** window, edit the **LDEV Name**.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Deleting an 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.

Caution:

- Deleting LDEVs erases your data. Back up your data before deleting LDEVs.
- The amount of used pool capacity cannot be reduced by deleting LDEVs. To reduce the amount of used pool capacity, format the target LDEVs.
- If you try to delete a volume soon after you perform any of the following operations on that volume, deletion of the volume might fail. If deletion of the volume fails, use Performance Monitor to confirm that the write-pending rate (%) for the MP unit to which the volume to be deleted is assigned is lower than 70%, and then try the operation again after waiting for about 10 minutes.
  - Changing MP unit assignment for a volume
  - Deleting a ShadowImage for Mainframe pair
  - Migrating a volume by using Volume Migration
  - Deleting a journal volume of Universal Replicator for Mainframe

These LDEVs cannot be deleted:

- Pair volumes (for example, TrueCopy for Mainframe and Hitachi Universal Replicator software for Mainframe)
- Pool-VOLs
- Journal volumes
- LDEVs that have the Read/Write access attribute

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 an external volume, see the *Hitachi Universal Volume Manager User Guide*.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- Back up your data before deleting LDEVs.

Caution: Deleting many LDEVs at the same time might impact host I/O performance. You should not delete more than approximately 200 LDEVs at the same time.

Procedure

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

Assigning an MP unit

You can automatically assign an MP unit to resources in the storage system (logical devices, external volumes, and journal volumes). For details about how MP units are assigned to resources, contact customer support.

Enabling and disabling MP unit auto assignment

When auto assignment is enabled, the MP unit can be automatically assigned to resources in the storage system (logical devices, external volumes, and journal volumes). When auto assignment is disabled, the MP unit cannot be automatically assigned to resources in the storage system. For details about how MP units are assigned to resources, contact customer support.

Before you begin

The Storage Administrator (System Resource Management) role is required to perform this task.

Caution: Enabling and disabling MP unit auto assignment can have a significant impact on storage system performance. Contact customer support for assistance before enabling or disabling auto assignment of an MP unit.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.

2. Expand **Components**, and click the controller (DKC) containing the MP unit that you want to change.
3. On the **Controller Boards and MP Units** tab, select the **MP Unit ID** of the MP unit that you want to change, and then click **Edit MP Units**.
4. In the **Edit MP Units** window, select **Enable** to enable auto assignment for the selected unit, or select **Disable** to disable auto assignment for the selected unit.
5. Click **Finish**.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Changing the MP unit assigned to an LDEV

Caution:

- If the LDEV is used as a utility volume for Compatible XRC, you can change the MP unit assigned to the LDEV only when the XRC session is suspended and the number of the side files of the target session is zero.
- Changes to the MP unit 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, the cache write-pending rate (%) for all CLPRs should be lower than 50%. Do not change the MP unit ID when the I/O load is high, for example, during initial copy of ShadowImage for Mainframe, TrueCopy for Mainframe, or Universal Replicator for Mainframe.
- When you change the MP unit 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 MP unit 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 MP unit IDs assigned to the same MP unit ID at the same time.
- After you change the MP unit for an LDEV, wait more than 30 minutes before you try to change the ID again for the same LDEV.

Before you begin

The Storage Administrator (System Resource Management) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.

3. In the **Logical Devices** window, select the **LDEV ID** of the LDEV that has the MP unit you want to change.
4. Click **More Actions** > **Assign MP Unit**.
5. In the **Assign MP Unit** window, specify the MP unit in **MP Unit**.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Viewing cache management device resources

Procedure

1. Click **Actions**.
2. Select **View Management Resource Usage** window.

   The **View Management Resource Usage** window displays the current number of cache management devices in use and the maximum number of cache management devices.

Making external mainframe volumes usable

To use external mainframe volumes, you can perform external volume mapping using Universal Volume Manager and then format the volumes. However, formatting external mainframe volumes in this way can take a lot of time.

If you want to make external mainframe volumes usable more quickly, you can perform zero-formatting on the external volumes first, map the external volumes, and then use the write to control blocks option to format the volumes. When you specify the write to control blocks option, the format operation is completed more quickly.

Registering external volumes

With this procedure, you can make the external mainframe system volumes usable more quickly.

You cannot register the external volume when it is disconnected.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Perform zero-formatting on the external mainframe system volumes.

   Zero-formatting writes 0's in the entire disk area, formatting the entire disk area. For information about how to perform zero-formatting, see the documentation for your mainframe system or external storage system.
2. Map the zero-formatted external volumes using Universal Volume Manager to register the volume in the external volume group. For more information, see the *Hitachi Universal Volume Manager User Guide*.

   Non-zero-formatted external volumes must not be registered in the external groups. If the external volumes are registered, performing the next step (step 3) will block and disable the volumes to be read and written from the host. To make the non-zero-formatted external volumes usable with the storage system, use the **`Format`** command of Virtual LVI.
3. Specify the external volumes to overwrite the control blocks of the external volumes in the group (see Overwriting control blocks in specific external volumes (on page 61)). A control block, which is a kind of volume area, is used to store information other than the user's data. Only the storage administrator is authorized to overwrite the control blocks.

   After overwriting completes, the external volumes are available for use in the storage system.

   Note: You can perform the following tasks while the LDEV is formatted, but only when the storage system is, by default, set to making the increased volumes blocked instead of formatting them automatically. For information about default settings of the storage system, see Overwriting control blocks in specific external volumes (on page 61).

   - Deleting LDEVs (converting LDEVs to the free space)
   - Creating LDEVs

Overwriting control blocks in specific external volumes

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Perform zero-formatting on the mainframe system volumes you want to register (see steps 1 and 2 in Registering external volumes (on page 60)).
2. Click **Storage Systems**, and then expand the **Storage Systems** tree.
3. Click **External Storage**.
4. On the **External Storage Systems** tab, click **Add External Volumes**.
5. Click the value of **Vendor / Model / Serial Number** of the external storage.
6. On the **External Path Groups** tab, click the value of **External Path Group ID**.
7. On the **Mapped Volumes** tab, select the parity group that contains the external volume to be blocked, and then click **More Actions** > **Disconnect External Volumes**.

   For more details about using **Disconnect External Volumes**, see the *Hitachi Universal Volume Manager User Guide*.

8. In the **Storage Systems** tree, click **Parity Groups** and **External**, and then select the parity group that contains the blocked external volume.
9. On the **LDEV** tab, confirm that `Blocked` displays in the **Status** column.
10. Select the target volumes from among the volumes with a status of `Blocked`, and then click **Format LDEVs**.
11. In the **Format LDEVs** window, select **Format Type** from the format list, select **Write to Control blocks**, and then click **Finish**.
12. In the confirmation window, click **Apply**.

    If **Go to tasks window for status** is checked, the **Tasks** window opens.
13. When the processing is complete, click **OK**.
14. Select the external volumes, and then click **More Actions** > **Reconnect External Volumes** to restore them.

    The **Status** column of the target volumes shows `Normal`.

Chapter 3: 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 your storage systems. Thin provisioning is implemented by creating one or more Dynamic Provisioning for Mainframe pools (DP pools) of physical storage space.

Dynamic Provisioning for Mainframe overview

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

You can use Device Manager - Storage Navigator and Command Control Interface to perform Dynamic Provisioning for Mainframe operations.

Dynamic Tiering for Mainframe overview

Dynamic Tiering for Mainframe 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.

Active flash for mainframe overview

The active flash for mainframe feature of Dynamic Tiering for Mainframe automatically promotes pages when their access frequency suddenly becomes high.

Based on functions for Dynamic Tiering for Mainframe , active flash for mainframe can promote pages to Tier 1 if their latest access frequency suddenly becomes high. The active flash for mainframe feature can improve Tier 1 I/O performance by reallocating Tier 2 pages if their I/O loads have increased suddenly.

Thin provisioning requirements

The requirements for thin provisioning include license requirements, pool requirements, pool-VOL requirements, DP-VOL requirements, and page reservation requirements.

License requirements

Before you use Dynamic Tiering for Mainframe, Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, and Dynamic Tiering for Mainframe must be installed on the storage system.

You need the Dynamic Tiering for Mainframe license to access the total capacity of the pool with the tier function enabled.

The license capacity of Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe and active flash for mainframe is the total value of pool capacities.

The license capacity of Dynamic Tiering for Mainframe and active flash for mainframe is the total value of pool capacities.

The license capacity of active flash for mainframe is the total value of pool capacities.

Before you use active flash for mainframe, the Dynamic Provisioning for Mainframe, and Dynamic Tiering for Mainframe software must be installed on the storage system. For this, you will need to purchase the Storage Virtualization Operating System (SVOS) license and the Dynamic Tiering for Mainframe and active flash for mainframe license. You will need the Dynamic Tiering for Mainframe and active flash for mainframe licenses for the total capacity of the pool with the tier function enabled.

You will need the Dynamic Tiering for Mainframe license for the total capacity of the pool with the tier function enabled. You will need the active flash for mainframe license for the total capacity of the pool with the tier function enabled. If the DP-VOLs of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe or active flash for mainframe are used for the primary volumes and secondary volumes of ShadowImage for Mainframe, Compatible FlashCopy® V2, TrueCopy for Mainframe, or Universal Replicator for Mainframe, you will need the ShadowImage for Mainframe, TrueCopy for Mainframe, Compatible FlashCopy® V2, and Universal Replicator for Mainframe licenses for the total pool capacity in use. In addition, if you assign a DP-VOL of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe to the primary volume of Compatible XRC, you will need the Compatible XRC license for the total pool capacity in use by the related DP-VOL.

If you exceed the licensed capacity, you will be able to use the additional unlicensed capacity for 30 days. For more information about temporary license capacity, see the *System Administrator Guide*.

Pool specifications and requirements

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

Items	Requirements

Pool capacity	Calculate pool capacity using this formula:
	`Capacity of the pool (MB) = total-number-of-pages * 38 - 3800.`
	3800 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 / 116) / 672)) for each pool-VOL.`
	floor( ): Truncates the value calculated from the formula in parentheses after the decimal point (that is, round down to nearest whole number).
	However, the capacity of a pool is 3.9 GB to 4.0 GB, and the upper limit of total capacity of all pools is 15.0 PB on each storage system if shared memory is installed.
	Because pools are limited to 1024 pool-VOLs, and pool-VOLs (LDEVs) are limited to 2.99TiB when created on internal storage (4 TiB when external), pools made from internal pool-VOLs are limited to 2.99PiB.

Maximum 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. The 128 pools include these pool types: ▪ Dynamic Provisioning (including Dynamic Tiering) ▪ Dynamic Provisioning for Mainframe (including Dynamic Tiering for Mainframe) Pool IDs (0 to 127) are assigned as pool identifiers.
Increasing capacity	You can increase pool capacity dynamically. Best practice is to add pool-VOLs to increase capacity by one or more parity groups.
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	0 through 65534 (%). You can set the subscription limit to Unlimited by leaving this field blank.

Items	Requirements
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%. If the pool used-capacity is equal to or greater than the warning threshold or the depletion threshold, a service information message (SIM) is issued by the storage system. Thresholds cannot be defined for a pool with data direct mapping enabled.
Data allocation unit	38 MB The 38-MB page corresponds to a 38-MB continuous area of the DP-VOL. Pages are allocated for the pool volumes only when data has been written to the area of the DP-VOL.
Tier (Dynamic Tiering for Mainframe and active flash for mainframe)	Defined based on the media type. Maximum 3 tiers.
Maximum capacity of each tier (Dynamic Tiering for Mainframe and active flash for mainframe)	927 TB (Total capacity of the tiers must be within 927 TB

Pool-VOL requirements

Pool-VOLs make up a DP pool.

Item	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.

Item	Requirements
	Pool-VOLs cannot be used for any other purpose. For instance, you cannot specify these volumes as pool-VOLs: ▪ Volumes used by ShadowImage for Mainframe, TrueCopy for Mainframe, or Universal Replicator for Mainframe ▪ Volumes already registered in Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe pools ▪ LDEVs whose status is other than Normal, Correction Access, or Copying. ▪ Command devices These pool-VOLs cannot exist in the same pool: ▪ Internal volumes with external volumes whose cache mode is disabled. ▪ External volumes whose cache mode is enabled and external volumes whose cache mode is disabled.
Emulation type	3390-V
RAID level for a Dynamic Provisioning for Mainframe pool	You can use one of these RAID levels: ▪ RAID 1 (2D+2D, or concatenated 2 of 2D+2D) ▪ RAID 5 (3D+1P, 4D+1P, 6D+1P, 7D+1P, concatenated 2 of 7D +1P, or concatenated 4 of 7D+1P) ▪ RAID 6 (6D+2P, 12D+2P, or 14D+2P) Pool-VOLs of RAID 5, RAID 6, RAID 1, and external volumes can coexist in the same pool. For pool-VOLs in the same pool: ▪ It is best practice to use RAID 6 for pool-VOLs, especially for a pool where the recovery time of a pool failure due to a drive failure is not acceptable. ▪ Pool-VOLs of the same drive type with different RAID levels can coexist in the same pool. It is best practice to set one RAID level for pool-VOLs. If you register pool-VOLs with multiple RAID levels to the same pool, the I/O performance depends on the RAID levels of pool-VOLs to be registered. In that case, note the I/O performance of the drives.
RAID level for a Dynamic Tiering for Mainframe pool	You can use one of these RAID levels: ▪ RAID 1 (2D+2D, or concatenated 2 of 2D+2D) ▪ RAID 5 (3D+1P, 4D+1P, 6D+1P, 7D+1P, concatenated 2 of 7D +1P, or concatenated 4 of 7D+1P) ▪ RAID 6 (6D+2P, 12D+2P, or 14D+2P)

Item	Requirements
	Pool-VOLs of RAID 5, RAID 6, RAID 1, and external volumes can coexist in the same pool. For pool-VOLs in the same pool: ▪ It is best practice to use RAID 6 for pool-VOLs, especially for a pool where the recovery time of a pool failure due to a drive failure is not acceptable. ▪ Pool-VOLs of the same drive type with different RAID levels can coexist in the same pool. Set one RAID level for pool-VOLs. If you register pool-VOLs with multiple RAID levels to the same pool, the I/O performance depends on the RAID levels of pool-VOLs to be registered. In that case, note the I/O performance of the drives. ▪ If pool-VOLs are external volumes, set the cache mode to `Enable`.
Data drive type for a Dynamic Provisioning for Mainframe pool	All drive types can coexist in the same pool with the following considerations. **Caution**: ▪ Pools should be built from pool-VOLs of the same capacity, type, and RAID level. 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. ▪ If multiple data drives coexist in the same pool, avoid using data drives that are *different* capacities.
Data drive type for a Dynamic Tiering for Mainframe or active flash for mainframe pool	Dynamic Tiering supports all drive types. If active flash is used, SSD and FMD drives must be installed in advance. If multiple data drives coexist in the same pool, it is best practice not to use data drives that are the same types and different capacity sizes.
Volume capacity	Internal volume: From 8 GB to 695 GB (from 9,676 cyl to 837,760 cyl). External volume: From 8 GB to 927 GB (from 9,676 cyl to 1,117,760 cyl). A volume whose capacity is less than 8 GB (9,676 cylinders) cannot be a pool volume.

Item	Requirements
LDEV format	The LDEV format operation can be performed on pool-VOLs only when all of these conditions are satisfied: ▪ There are no DP-VOLs defined for the pool, or all DP-VOLs defined for the pool are blocked.

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	3390-A
Maximum number of DP-VOLs	Up to 63,232 per pool. Any number of available DP-VOLs can be associated with a pool. Up to 63,232 volumes per system. If external volumes and V-VOLs are used, the total number of external volumes and V-VOLs must be 63,232 or fewer.
Volume capacity	For 3390-A, volume capacity from 1 cyl to 1,182,006 cyl per volume. Total maximum volume capacity of 11.1 PB per storage system.
LDEV format	When you format a DP-VOL, the storage system releases the allocated page area in the DP-VOL. The quick format operation cannot be performed. If the LDEV format is applied to V-VOLs that are enabled for full allocation, the used capacity of the pool is not changed before the LDEV format is applied.

V-VOL full allocation requirement

The V-VOL full allocation is performed in a range less than the depletion threshold size of the pool. If the capacity of V-VOLs is larger than the depletion threshold size, the full allocation operation is rejected.

Use these formulas to calculate the reserved page capacity for each pool. In the formulas, the value enclosed in ceiling( ) must be rounded up to the nearest whole number.

Emulation type	TSE attribute	***reserved-capacity-for-each-pool-in-blocks* =**
3390-A	Disabled	(ceiling((*CV-capacity-of-V-VOL-in-Cyl* * 15 + ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) * 7 * 15) / 672) - ceiling(*used-capacity-of-V-VOL-in-blocks* / 116) / 672)) * 672 * 116
3390-A	Enabled	If CV capacity of V-VOL is between 1 (Cyl) and 113,525 (Cyl): (ceiling ((*CV-capacity-of-V-VOL-in-Cyl* * 15 + ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) * 7 * 15) / 672) + 102 - ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) - ceiling(ceiling(*used-capacity-of-V-VOL-in-blocks* / 116) / 672)) * 672 * 116 If CV capacity of V-VOL is between 802,473 (Cyl) and 914,885 (Cyl): (ceiling((*CV-capacity-of-V-VOL-in-Cyl* * 15 + ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) * 7 * 15) / 672) + 822 - ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) - ceiling(ceiling(*used-capacity-of-V-VOL-in-blocks* / 116) / 672)) * 672 * 116 If CV capacity of V-VOL is between 113,526 (Cyl) and 802,472 (Cyl), or 91,4886 (Cyl) or more: (ceiling ((*CV-capacity-of-V-VOL-in-Cyl* * 15 + ceiling(*CV-capacity-of-V-VOL-in-Cyl* / 1113) * 7 * 15) / 672) - ceiling(ceiling(*used-capacity-of-V-VOL-in-blocks* / 116) / 672)) * 672 * 116

Use of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe with other software products

There are a number of restrictions and limitations for using Dynamic Provisioning or Dynamic Provisioning with other software products. Certain operations are not supported.

Interoperability of DP-VOLs and pool-VOLs

DP-VOLs and pool-VOLs can be used in conjunction with other software products with certain limitations and restrictions. The following table lists the software products and indicates the operations that are permitted and not permitted for each product.

Software product (*user guide*)	**Permitted**	**Not permitted**
Compatible FlashCopy® V2 and Compatible FlashCopy® SE (*Hitachi Compatible FlashCopy/ FlashCopy SE User Guide*)	Using a DP-VOL as a source volume or target volume. Using a TSE-VOL as a target volume.	▪ Using a pool-VOL as a source volume or target volume. ▪ Using a TSE-VOL as a source volume. ▪ Increasing the capacity of a DP-VOL used by Compatible FlashCopy® V2 and Compatible FlashCopy® SE.
Compatible PAV (*Hitachi Compatible PAV User Guide*)	Defining base devices to DP-VOLs Defining base devices to TSE-VOLs.	▪ Defining base devices to pool-VOLs. ▪ Defining alias devices to pool-VOLs. ▪ Defining alias devices to DP-VOLs. ▪ Defining alias devices to TSE-VOLs.
ShadowImage for Mainframe (*Hitachi ShadowImage® for Mainframe User Guide*)	▪ Using a DP-VOL as a ShadowImage for Mainframe primary volume (P-VOL) or secondary volume (S-VOL). ▪ Reclaiming zero pages (the pair status must be PSUS).	▪ Using a pool-VOL as a ShadowImage for Mainframe P-VOL or S-VOL. ▪ Using a TSE-VOL as a ShadowImage for Mainframe P-VOL or S-VOL. ▪ Expanding the capacity of a DP-VOL used in ShadowImage for Mainframe.
TrueCopy for Mainframe (*Hitachi TrueCopy® for Mainframe User Guide*)	▪ Using a DP-VOL as a TrueCopy for Mainframe primary volume (P-VOL) or secondary volume (S-VOL).	▪ Using a pool-VOL as a TrueCopy for Mainframe P-VOL or S-VOL. ▪ Using a TSE-VOL as a TrueCopy for Mainframe P-VOL or S-VOL. ▪ Expanding the capacity of a DP-VOL used in TrueCopy for Mainframe.
Universal Replicator for Mainframe (*Hitachi Universal Replicator for Mainframe User Guide*)	▪ Using a DP-VOL as a Universal Replicator for Mainframe primary volume (P-VOL), secondary volume (S-VOL), or journal volume. The journal volume must be an OPEN-V emulation DP-VOL.	▪ Using a DP-VOL as a journal volume that has a mainframe emulation type. ▪ Using a DP pool-VOL as a Universal Replicator for Mainframe P-VOL, S-VOL, or journal volume.

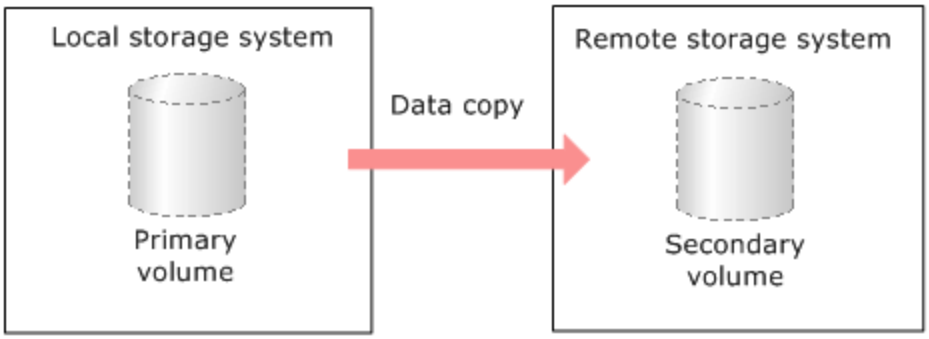
Software product (*user guide*)	**Permitted**	**Not permitted**
		▪ Using a TSE-VOL as a P-VOL, S-VOL, or journal volume of Universal Replicator for Mainframe. ▪ Expanding the capacity of a DP-VOL used as a P-VOL or a S-VOL in Universal Replicator for Mainframe.
Universal Volume Manager (*Hitachi Universal Volume Manager User Guide*)	Using Universal Volume Manager volumes as pool-VOLs.	▪ Increasing the capacity of a DP-VOL that is mapped to the Universal Volume Manager. If you try to increase the capacity of a DP-VOL with the conventional LDEV operation, the capacity of the DP-VOL will not be changed. In this case, remove the mapping between the DP-VOL and Universal Volume Manager, increase the capacity of the external volume used as a pool-VOL, and then perform the mapping between the DP-VOL and Universal Volume Manager again.
Virtual LVI (Provisioning Guide for Mainframe Systems)	Registering Virtual LVI volumes in Dynamic Provisioning for Mainframe pools.	▪ Performing Virtual LVI 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 available
Volume Migration (For details, contact customer support.)	Using a DP-VOL as a migration source or a migration target. The maximum capacity of a DP-VOL used as a migration source or target is the same as the maximum capacity of a DP-VOL.	▪ Using on pool-VOLs. ▪ Increasing the capacity of DP-VOL used by Volume Migration. ▪ Using on an external volume with data direct mapping enabled. ▪ Using an external volume with data direct mapping enabled as a target volume.
Volume Shredder (*Hitachi Volume Shredder User Guide*)	Use on DP-VOLs.	▪ Using on pool-VOLs. ▪ Using on TSE-VOLs.

Software product (*user guide*)	Permitted	Not permitted
		▪ Increasing the capacity of DP-VOL used by Volume Shredder. ▪ Reclaiming zero pages of V-VOL used by Volume Shredder.
Compatible XRC (*Hitachi Compatible XRC User Guide*)	Using a DP-VOL as a Compatible XRC primary volume or secondary volume.	▪ Using a DP pool-VOL as a Compatible XRC primary volume or secondary volume. ▪ Using a TSE-VOL as a Compatible XRC primary volume or secondary volume. ▪ Increasing the capacity of DP-VOL used by Compatible XRC.

TrueCopy for Mainframe

You can use Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, or active flash for mainframe in combination with TrueCopy for Mainframe to replicate V-VOLs.

This figure shows the interaction when the TrueCopy for Mainframe primary volume and secondary volume are also V-VOLs.



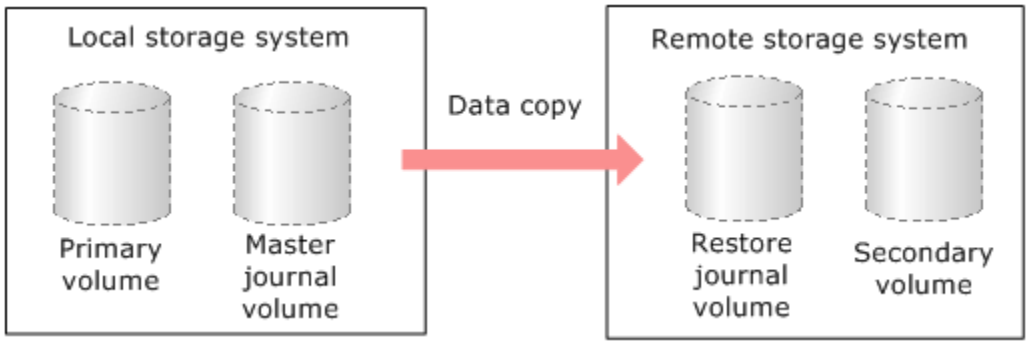
TrueCopy P-VOL	TrueCopy S-VOL	Explanation
DP-VOLs	DP-VOLs	Supported
DP-VOLs	Normal (ordinary) volumes*	Supported
Normal (ordinary) volumes*	DP-VOLs	Supported. Note that this combination consumes the same amount of pool capacity as the original normal volume (primary volume).

TrueCopy P-VOL	TrueCopy S-VOL	Explanation
* Normal volumes include the internal volumes and external volumes that are mapped to the volumes of the external storage system using Universal Volume Manager.		

You cannot specify a Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe pool-VOL as a primary volume or secondary volume. For more information, see the *Hitachi TrueCopy® for Mainframe User Guide*.

Universal Replicator for Mainframe

You can use Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, or active flash for mainframe in combination with Universal Replicator for Mainframe to replicate DP-VOLs.



This table lists the supported Universal Replicator for Mainframe and Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe volume combinations.

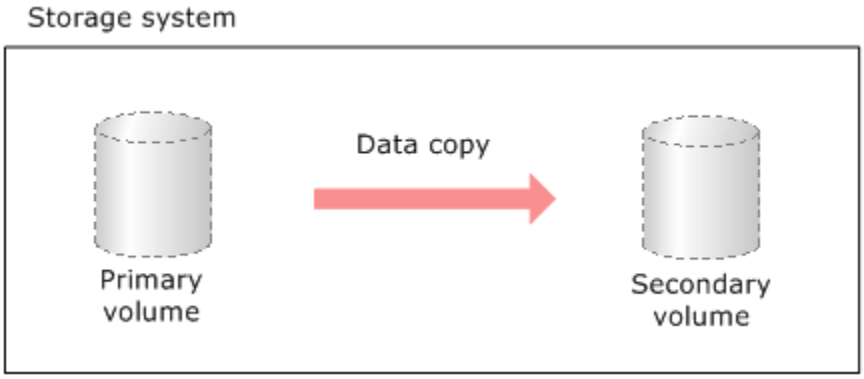
Universal Replicator for Mainframe P-VOL	Universal Replicator for Mainframe S-VOL	Universal Replicator for Mainframe journal volume	Explanation
DP-VOLs	DP-VOLs	DP-VOL that has the OPEN-V emulation type[2]	Supported
DP-VOLs	Normal (ordinary) volumes[1]	DP-VOL that has the OPEN-V emulation type[2]	Supported
Normal (ordinary) volumes[1]	DP-VOLs	DP-VOL that has the OPEN-V emulation type[2]	Supported. Note that this combination consumes the same amount of pool capacity as the original normal volume (primary volume).

Universal Replicator for Mainframe P-VOL	Universal Replicator for Mainframe S-VOL	Universal Replicator for Mainframe journal volume	Explanation
Notes: 1. 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 about external volumes, see the *Hitachi Universal Volume Manager User Guide*. 2. DP-VOL that has a mainframe emulation type cannot be used.			

You cannot specify a Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe pool-VOL as a primary volume, secondary volume, or journal volume. For more information, see the *Hitachi Universal Replicator for Mainframe User Guide*.

ShadowImage for Mainframe

You can use Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, or active flash for mainframe in combination with ShadowImage for Mainframe to replicate DP-VOLs.



This table lists the interaction when the ShadowImage for Mainframe primary volume and secondary volume are also DP-VOLs.

ShadowImage for Mainframe primary volume	ShadowImage for Mainframe secondary volume	Explanation
DP-VOLs	DP-VOLs	Supported
DP-VOLs	Normal (ordinary) volumes*	Supported. The Quick Restore function is unavailable.

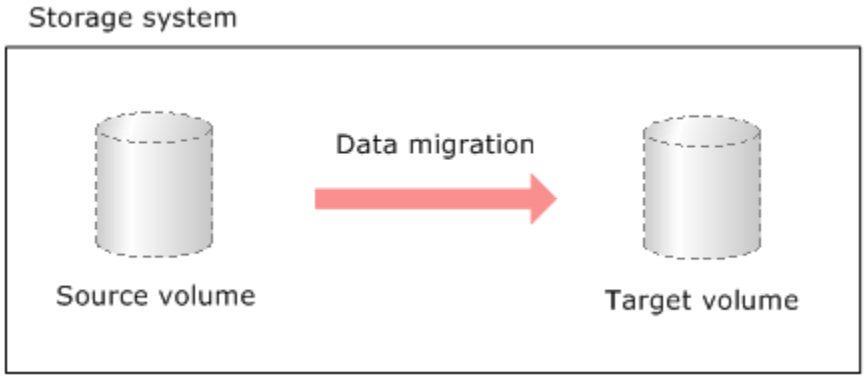
ShadowImage for Mainframe primary volume	ShadowImage for Mainframe secondary volume	Explanation
Normal (ordinary) volumes*	DP-VOLs	Supported. Note that this combination consumes the same amount of pool capacity as the normal volume. The Quick Restore function is unavailable.
* Normal volumes include the internal volumes and external volumes that are mapped to the volumes of the external storage system using Universal Volume Manager.		

You cannot specify a Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe pool-VOL as a primary volume or secondary volume. For more information, see the *Hitachi ShadowImage® for Mainframe User Guide*.

Volume Migration

You can use Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe in combination with Volume Migration to migrate DP-VOLs.

This figure shows the interaction when the Volume Migration source volume and target volume are also DP-VOLs.



Volume Migration source volume	Volume Migration target volume	Explanation
DP-VOLs	DP-VOLs	Supported
DP-VOLs	Normal (ordinary) volumes*	Supported

Volume Migration source volume	Volume Migration target volume	Explanation
Normal (ordinary) volumes*	DP-VOLs	Supported. Note that this combination consumes the same amount of pool capacity as the normal volume.
*Normal volumes include the internal volumes and external volumes that are mapped to the volumes of the external storage system by Universal Volume Manager.		

You cannot specify a Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe pool-VOL as a Volume Migration source volume and target volume.

If you specify the DP-VOL as the source volume, you must not specify the DP-VOL that uses the same pool of the source volume.

- ShadowImage for Mainframe
- Universal Replicator for Mainframe

Virtual Partition Manager CLPR setting

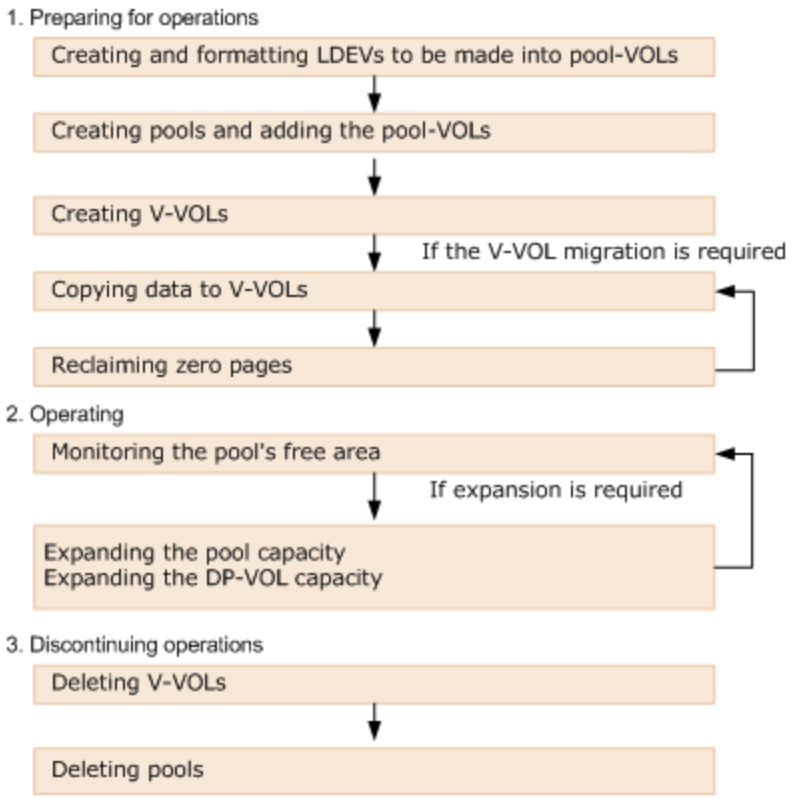
If DP-VOLs and pool-VOLs related to the same pool are assigned to a CLPR, the DP-VOLs and pool-VOLs in the same pool should be assigned to the same CLPR.

For details about CLPRs, see the *Performance Guide*.

Dynamic Provisioning for Mainframe workflow

This diagram shows the workflow for setting up Dynamic Provisioning for Mainframe on the storage system.

Use Device Manager - Storage Navigator or Command Control Interface to create pools and DP-VOLs.



Dynamic Tiering for Mainframe and active flash for mainframe

Hitachi Dynamic Tiering (HDT) simplifies storage administration by automatically optimizing data placement in 1, 2, or 3 tiers of storage that can be defined and used within a single virtual volume. Tiers of storage can be made up of internal or external (virtualized) storage, and use of HDT can lower capital costs. Simplified and unified management of HDT allows for lower operational costs and reduces the challenges of ensuring that applications are placed on the appropriate classes of storage.

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, FMD, HDD, 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.

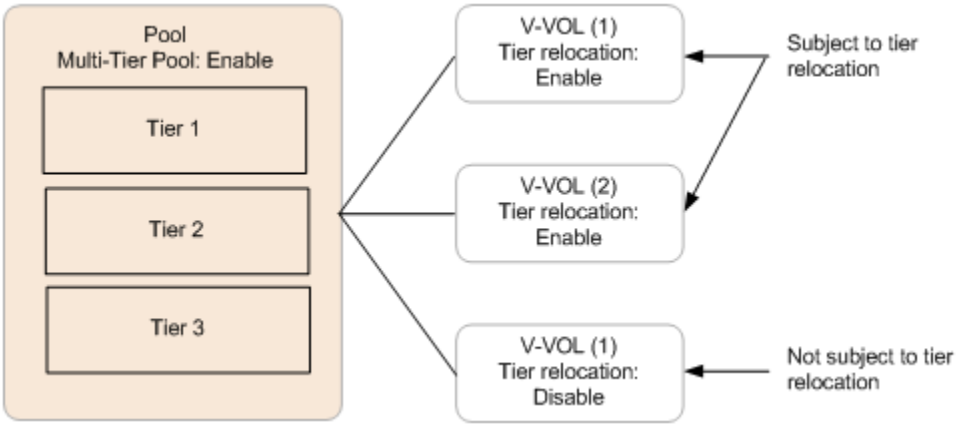
Tier monitoring and data relocation

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.

This figure illustrates the relationship between multi-tier pool and tier relocation.

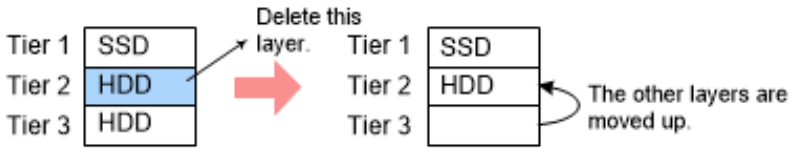


Example of adding a tier

If the added pool-VOL 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. This figure illustrates the process of adding a tier.

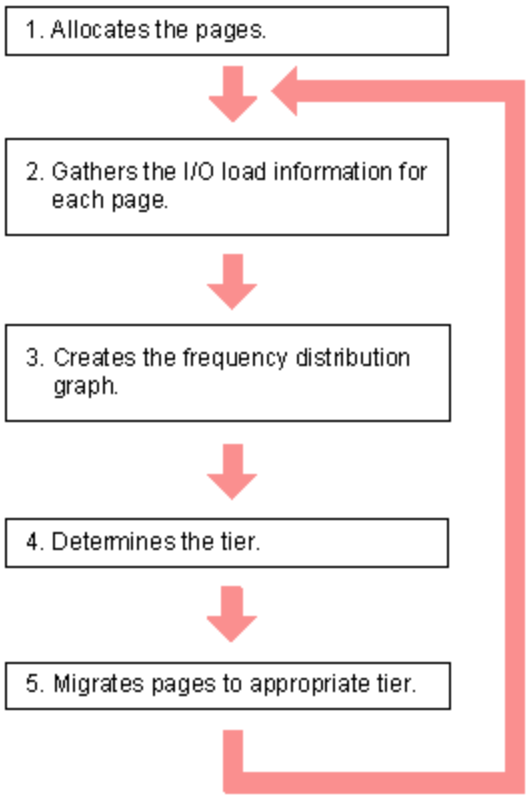
Example of deleting a tier

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



Tier relocation process workflow

The term *tier relocation* refers to the process of determining the appropriate storage tier and migrating the pages to that tier. This figure shows the tier relocation process.



Explanation of the tier relocation process:

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 (SIM=622xxx) 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 **Tier Properties** window 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.

   Monitoring modes of Period or Continuous influence the values shown on the performance graph. Period mode reports the most recent completed monitor cycle I/O data on the performance graph. Continuous mode reports 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

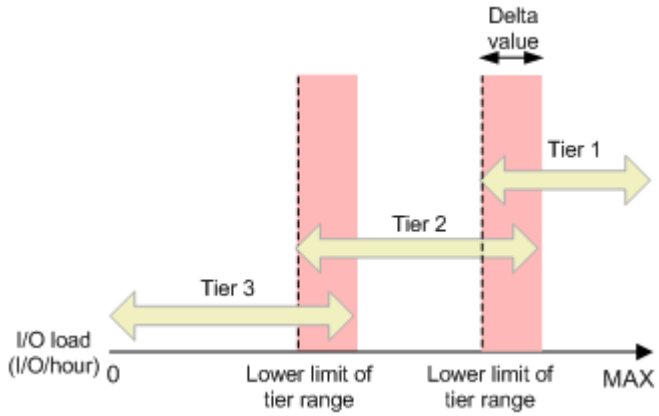
      The tier range value of a tier is calculated using the frequency distribution graph. This acts as a boundary value that separates tiers.

      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. A performance utilization of 100% 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 are moved to the appropriate tier. After migration, the page usage rates are averaged out in all tiers. I/Os that occur in the page migration are not monitored.

Tier monitoring and relocation cycles

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

In Auto execution mode, monitoring and relocation are continuous and automatically scheduled. In Manual execution mode, these 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: every 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, after the monitoring finish time shown in this table.

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.

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

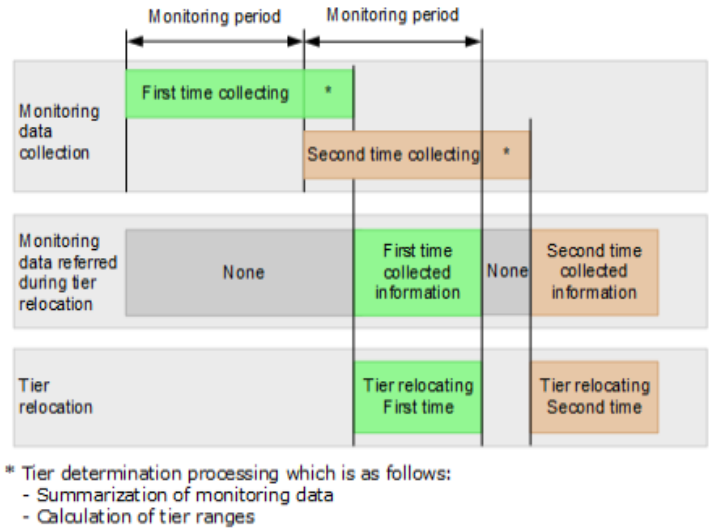
- Data while monitoring is in progress in the next cycle.
- Fixed monitoring information used in the tier relocation.

Example 1

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. From 04:00 AM, the collection of monitoring information and tier relocation operations are started again. These operations are then performed at 4-hour intervals.

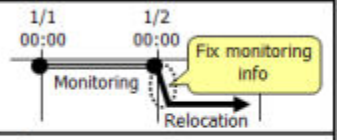
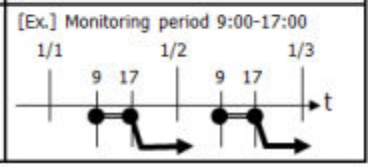
Example 2

If the monitoring cycle is changed from 4 hours to 1 hour at 01:30 AM, the collection of monitoring information and tier relocation in progress at 01:30 AM continues. From 04:00 AM, the collection of monitoring information and tier relocation operations are started again. These operations are then performed at 1-hour intervals.



Example 3 (Using a 24-hour cycle)

If you set the monitoring period to 05:00 - 04:59, the monitoring calculations and relocation begin after 04:59. If you set the monitoring period to 09:00-17:00, the monitoring calculations and relocation begin after 17:00. Monitoring calculations only consider the I/O usage between the start and end of the monitoring period.

Execution mode	Execution cycle	Performance monitoring		Relocation		Monitoring/relocation cycle
		Start	End	Start	End	
Auto execution	24 hours [Monitoring time not specified]	After setting Auto execution to ON, the next 0:00 is reached	After monitoring started, the next 0:00 is reached	Start immediately after monitoring info is fixed	One of the following - Relocation of entire pool is completed - Next relocation is started - Auto execution is set to OFF	
	24 hours [Monitoring time specified]	After setting Auto execution to ON, the specified start time is reached	The specified end time is reached	↑	↑	

Manual execution mode

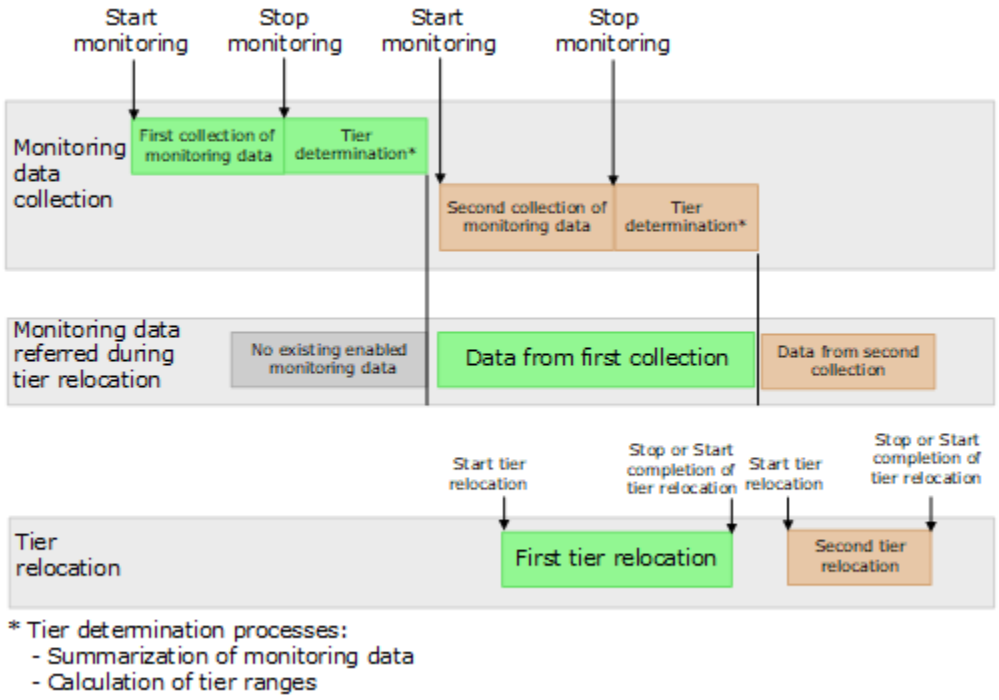
You can start and stop performance monitoring and tier relocation at any time. You should keep the duration of performance monitoring to less than 7 days (168 hours). If performance monitoring exceeds 7 days, then monitoring stops automatically.

Manual execution mode starts and ends monitoring and relocation at the time the command is issued. 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.

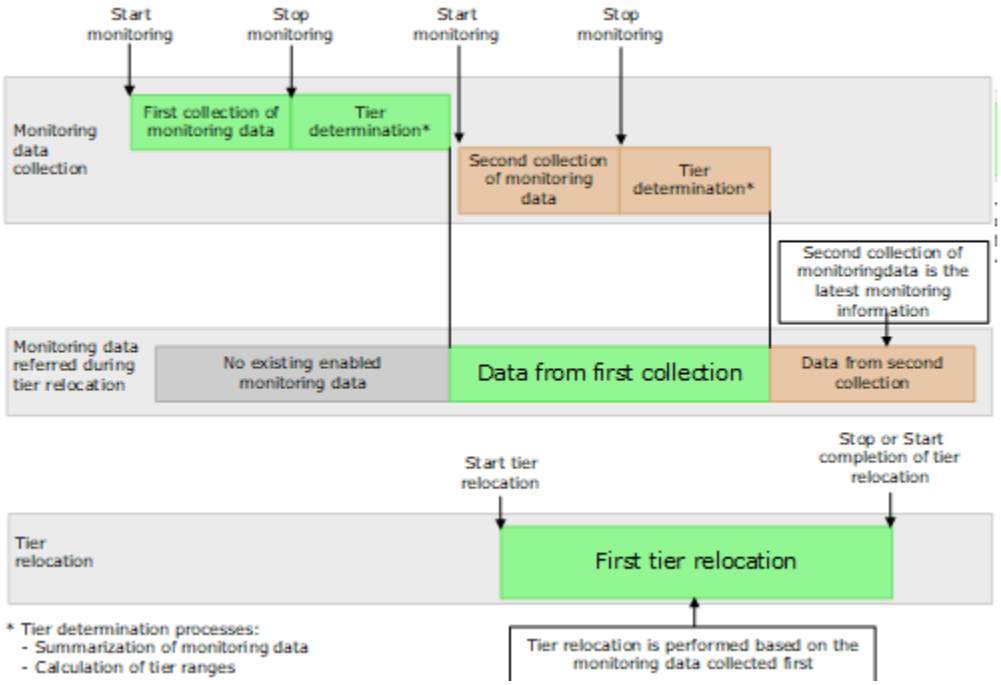
- Data while monitoring is in progress in the next cycle
- Fixed monitoring information used in the tier relocation

This figure shows the collection of monitoring data to tier relocation workflow in Manual execution mode.



Example 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.



Example 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 to store collected monitoring information, the third collection cannot be overwritten.

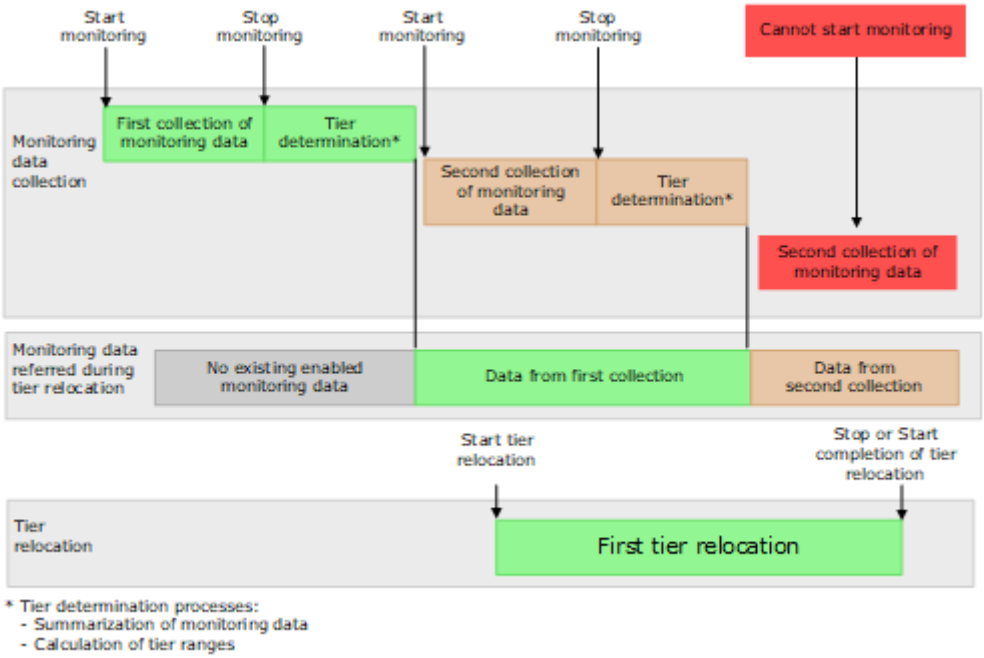
In that case, the third collection of the monitoring information is started after the first tier relocation is stopped or tier relocation has completed.

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.

This figure shows the third collection of monitoring information while tier relocation is performed.



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 might 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 might end before all relocation can be handled. If tier relocation does not finish completely within the cycle, relocation to appropriate pages is executed in the next cycle.
- Calculating the tier range values is 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 parity groups, rebalancing might be performed after several tier relocation operations. If rebalancing is in progress, the next cycle of tier relocation might be delayed.

Performance monitoring or tier relocation conditions

The following table lists monitoring and execution conditions and specifies the data collection status, fixed monitoring status, and tier relocation operations for each condition. 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 about 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 about 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 about the volume is valid.	If the tier relocation setting is being disabled at the performance monitoring finish time, tiers of the volume are not relocated.	N/A
When V-VOLs are deleted.	Volume is not monitored.	Only monitoring information about the volume is invalid.	Tier relocation of the volume is suspended.	N/A

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 execution mode is changed to `Manual` from `Auto` or vice versa.	Suspended.	Monitoring information collected before suspension is valid.	Suspended.	Collect the monitoring information again if necessary.[1]
When the power switch is power ON or OFF.	Monitoring is suspended by powering OFF and is not resumed even after powering ON.[1]	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.[1]
▪ When Volume Migration is performed. ▪ When Quick Restore of ShadowImage for Mainframe is performed.	The monitoring information of the volume is not collected at the present moment. In the next monitoring period, the monitoring information will be collected.	Monitoring information is invalid and the volumes need to be monitored.	Tier relocation to volumes is suspended.	Collect the monitoring information again if necessary.[1]
S-VOL of these products when the initial copy operation is performed: ▪ TrueCopy for Mainframe ▪ Universal Replicator for Mainframe	Monitoring information is collected continuously, but the monitoring of the volumes is reset.[2]	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Tier relocation to volumes is suspended.	Collect the monitoring information again if necessary.[1]

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 number of tiers increases by adding pool-VOLs. ▪ When the pool-VOLs of the tiers are switched by adding pool-VOLs.[3] ▪ When tier rank of the external LDEV is changed.	Continued.	Fixed monitoring information is invalid because the monitoring information was discarded. If monitoring is set to the continuous mode, weighted data calculated by using the monitoring information in past periods is also discarded.	Suspended.	Relocate tiers again.[1]
When pool-VOLs are deleted.	Continued.	Monitoring information is invalid temporarily. The monitoring information is calculated again after deleting pool-VOLs.[4]	Deleting the pool-VOL stops the tier relocation. The process resumes after the pool-VOL is deleted.	N/A
When cache is blocked.	Continued.	No effect on the fixed monitoring information. The monitoring information collected during the previous cycle continues to be valid.	Suspended.[5]	After recovering the faulty area, relocate tiers again.[1]
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.[5]	After recovering the faulty area, relocate tiers again.[1]

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 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.[5]	Unnecessary. The relocation is performed automatically in the next cycle.
When execution mode is `Manual` and 7 days elapse after monitoring starts.	Suspended.	The monitoring information collected before suspension is valid.	Continued.	Collect the monitoring information again if necessary.[1]

Notes:

1. The execution mode is Auto or the script is written in Manual execution mode, information is monitored again, and tiers are relocated automatically.
2. 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.
3. Example: Pool-VOLs of HDD/15 krpm are added to this Configuration 1:
   - Configuration 1 (before change): Tier 1 is SSD or FMD, Tier 2 is HDD/10 krpm, and Tier 3 is HDD/7.2 krpm.
   - Configuration 2 (after change): Tier 1 is SSD or FMD, Tier 2 is HDD/15 krpm, and Tier 3 is HDD/10 krpm and HDD/7.2 krpm.
4. The monitoring information status is changed from invalid or FMD (INV) to calculating (PND). After completion of calculating, the monitor information status changes from calculating (PND) to valid (VAL).
5. The SIM code 641xxx is displayed if "Notify an alert when tier relocation is suspended by system" is enabled on the **Edit Advanced System Settings** window.

Buffer area of a tier

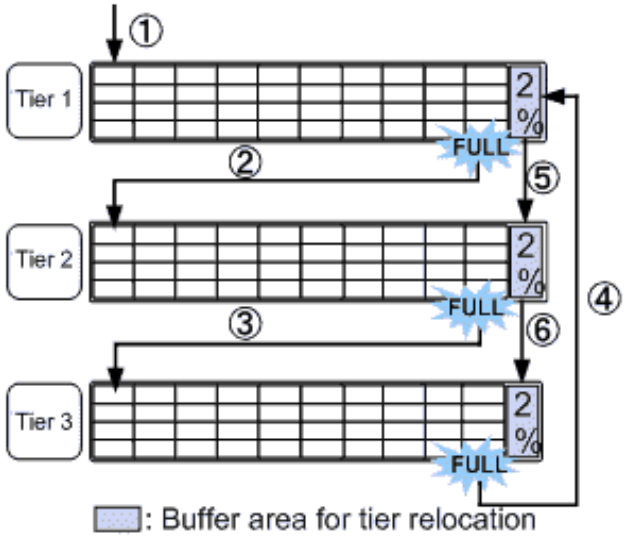
Dynamic Tiering uses buffer percentages to reserve pages for new page assignments and allow the tier relocation process. Areas necessary for processing these operations are distributed corresponding to settings used by Dynamic Tiering. This item describes how processing takes place to handle the buffer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

Buffer space: This 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.

Drive type	Buffer area for tier relocation	Buffer area for new page assignment	Total
SSD or FMD	2%	0%	2%
HDD/15 krpm	2%	8%	10%
HDD/10 krpm	2%	8%	10%
HDD/7.2 krpm	2%	8%	10%
Non-SSD	2%	8%	10%

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. After 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.

This figure shows the workflow of a new page assignment.



External volumes in tiers

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 these three types: High, Middle, and Low. These examples describe how tiers may be configured:

Example 1: Configuring tiers by using external volumes only

Tier 1: External volumes (High)

Tier 2: External volumes (Middle)

Tier 3: External volumes (Low)

Example 2: 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 using the **Edit External LDEV Tier Rank** window. This table explains the performance priority (from the top) of data drives.

Priority	Data drive type
1	SSD, FMD, or NVMe
2	HDD/15 krpm
3	HDD/10 krpm
4	HDD/7.2 krpm
5	External volume* (High)
6	External volume* (Middle)
7	External volume* (Low)
* Displays as External Storage in Drive Type/RPM in the **Create Pools** window.	

Note: NVMe SSD, SAS SSD, and FMD are all treated as the same tier when in the same Dynamic Tiering for Mainframe pool.

However, with SCM in Dynamic Tiering for Mainframe, the only supported configuration is SCM in the upper tier and NVMe SSD in the lower tier (that is, only two tiers and no SAS or external media in the pool with SCM).

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.

Tier relocation workflow: Tier relocation is performed taking advantage of the buffer space allocated for tier relocation. 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 for Mainframe reserves buffer spaces for relocation and new page assignment.

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

Execution modes for tier relocation

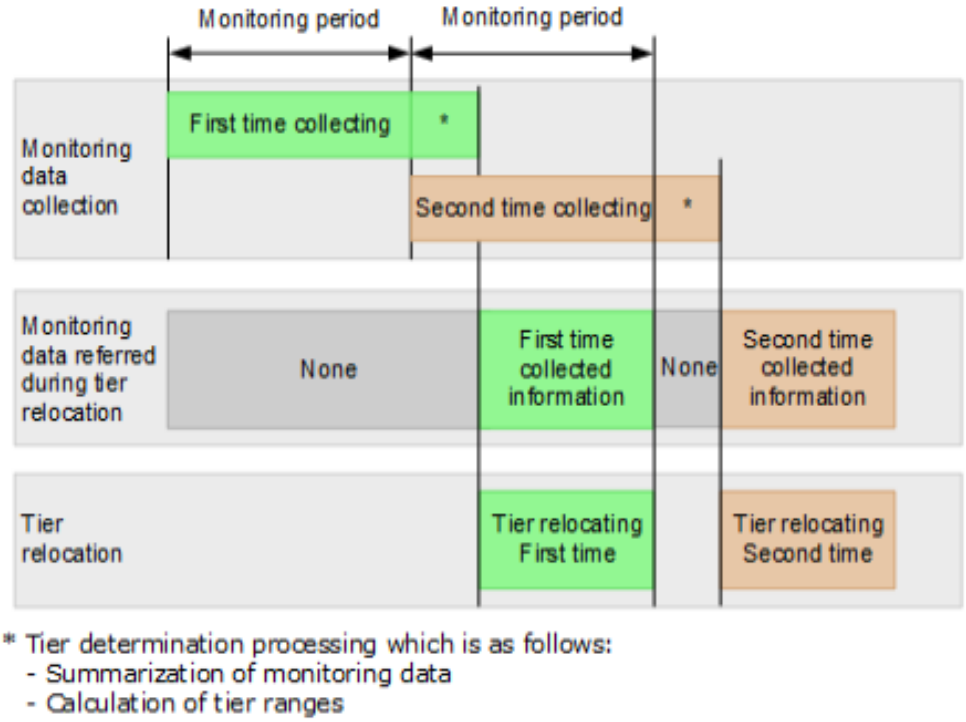
Performance monitoring and tier relocation can be set to execute in one of two execution modes: Auto or Manual. You can set up execution modes, or switch between modes by using either Hitachi Device Manager - Storage Navigator or Command Control Interface.

Execution modes when using Hitachi Device Manager - 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.

This figure shows tier relocation processing in a 2-hour Auto execution mode:

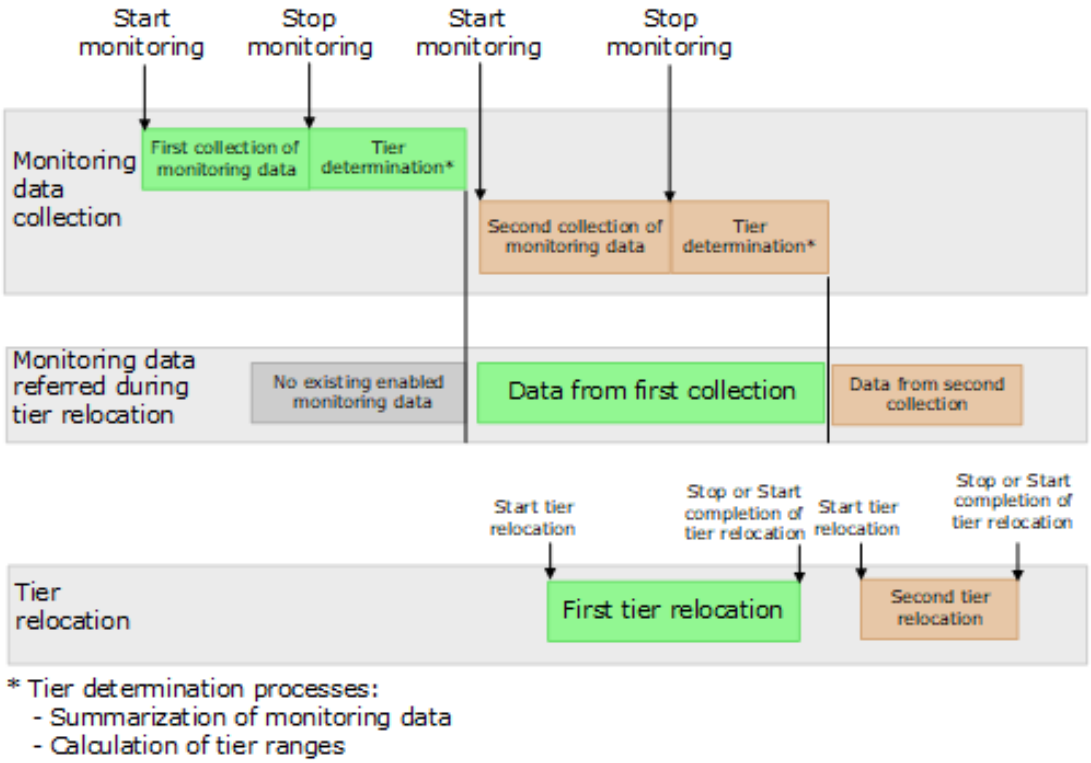


Manual execution mode

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

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

This figure shows 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.

Monitor and tier relocation information in HDvM - SN

Hitachi Device Manager - Storage Navigator (HDvM - SN) displays this information about monitor and tier relocation.

Field	Windows	Details
Monitoring Status	▪ **Pools** window ▪ Pool Volumes tab ▪ **View Pool Management Status** window	Displays the status of pool monitoring. ▪ In Progress: The monitoring is being performed. ▪ During Computation: The calculating is being processed.

Field	Windows	Details
		Other than these cases, a - (hyphen) is displayed.
Recent Monitor Data	▪ **Pools** window ▪ Pool Volumes tab	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	▪ **Pools** window ▪ Pool Volumes tab	Displays the pool management task being performed to the pool. ▪ Waiting for Relocation: The tier relocation process is waiting. ▪ Relocating: The tier relocation process is being performed. For details about the relocation progress rate, check the tier relocation log.
Pool Management Task (Status/ Progress)	**View Pool Management Status** window	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 waiting. ▪ Relocating: The tier relocation process is being performed. For details about the relocation progress rate, check the tier relocation log.

Field	Windows	Details
Relocation Result	▪ **Pools** window ▪ Pool Volumes tab ▪ **View Pool Management Status** window	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.
Relocation Speed	▪ **Pools** window ▪ **View Pool Management Status** window ▪ **Create Pools** window ▪ **Edit Pools** window ▪ **Start Tier Relocation** window ▪ **Stop Tier Relocation** window	Displays the tier relocation speed settings. ▪ 1(Slowest) ▪ 2(Slower) ▪ 3(Standard) ▪ 4(Faster) ▪ 5(Fastest)
Relocation Priority	▪ Pool Volumes tab ▪ **View Pool Management Status** window	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 a Dynamic Tiering for Mainframe V-VOL, or the tier relocation function is disabled.
Performance Graph	**Tier Properties** window	The performance graph for the available monitor information is displayed in the **Tier Properties** window.

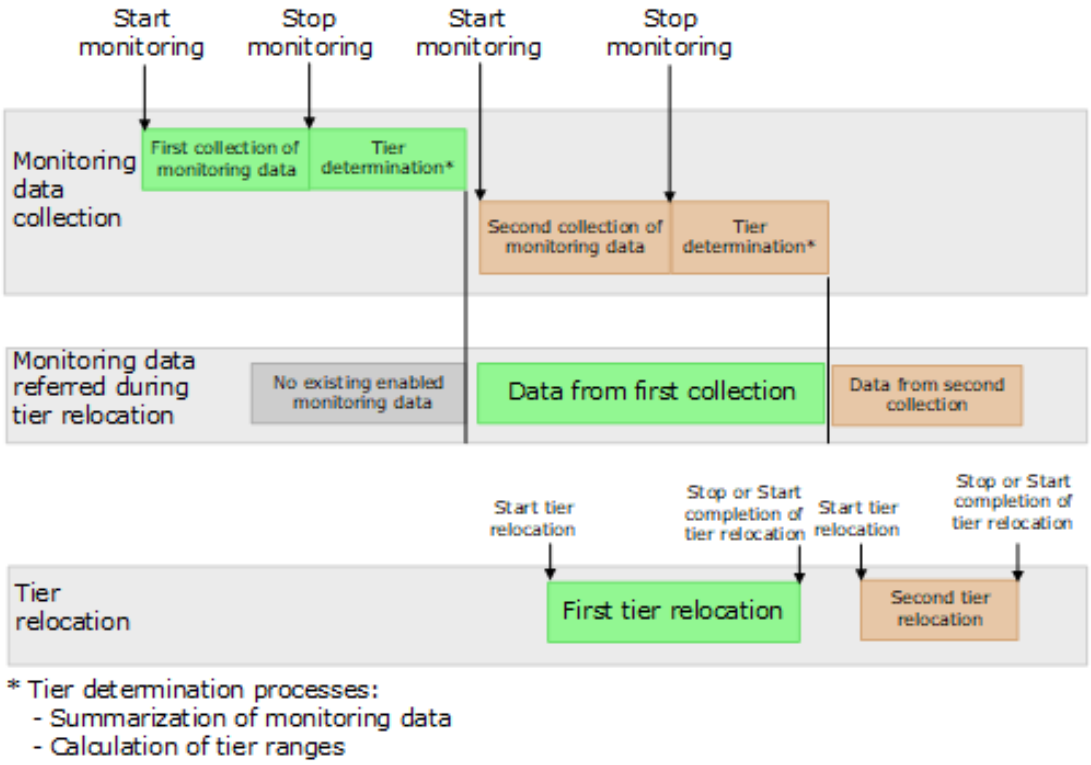
Execution modes when using Command Control Interface

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.

This figure shows tier relocation processing when 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.

Monitor and tier relocation information using CCI

To view the monitoring information and tier relocation information, execute the `raidcom get dp_pool` command with the `-key opt` option specified. For details, see the *Command Control Interface Command Reference*.

These items are displayed:

- 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 these 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.

Relocation speed

Based on the number of the parity groups that constitute a pool, the page relocation speed function adjusts the number of V-VOLs for which tier relocation can be performed at one time. Tier relocation can be performed on as many as 32 V-VOLs in a storage system at once.

The function can be set to 1(Slowest), 2(Slower), 3(Standard), 4(Faster), and 5(Fastest). The default is 3(Standard). If you want to perform tier relocation at high speed, use the 5(Fastest) setting. If you set a speed that is slower than 3(Standard), the load to data drives is low when tier relocation is performed.

After changing the setting, the relocation speed does not change and the data drive load may not change in these cases:

- The number of parity groups is very few.
- The number of V-VOLs associated with the pool is very few.
- Tier relocations are being performed on the multiple pools.

Monitoring modes

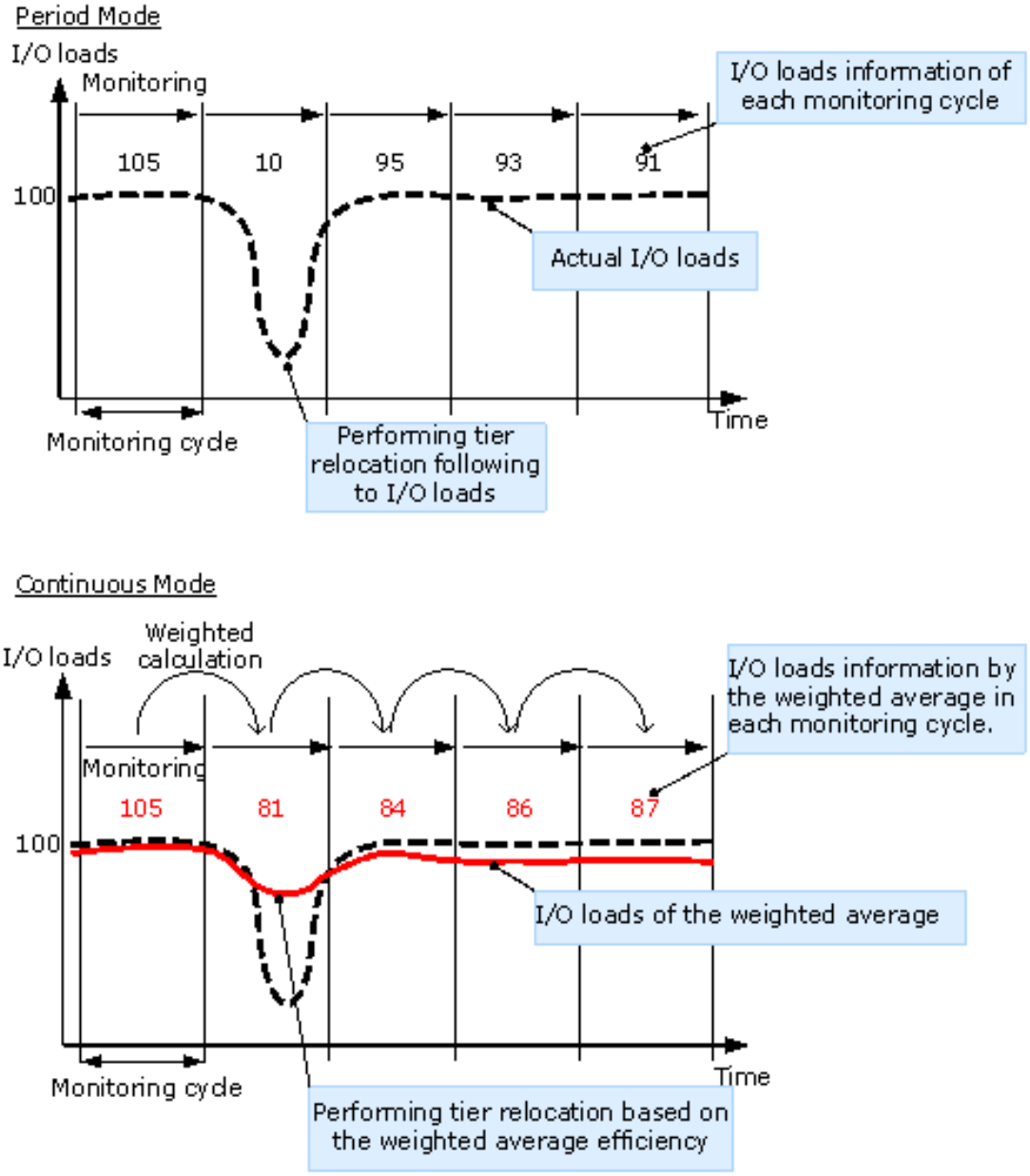
When you create or edit a pool, you set the Dynamic Tiering for Mainframe monitoring mode: Period mode, or Continuous mode. When you change the monitoring mode, the new monitoring setting becomes effective when the next monitoring period starts.

Period mode

When 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 might not finish in one cycle.

Continuous mode (default)

When Continuous mode is enabled, the weighted average efficiency is calculated by weighting the latest monitoring information and the collected monitoring information in the past cycles. 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

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

  If Manual execution mode is used without scripts, Continuous monitoring mode can be set. However, in this case, unexpected results might 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 Continuous monitoring mode is used, the frequency distributions are displayed for 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 might differ from an actual monitoring result when they are displayed.

  In Performance Utilization of each tier, regardless of the type of the monitoring mode setting, the monitor values that were already collected in the current cycle are displayed.

  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.

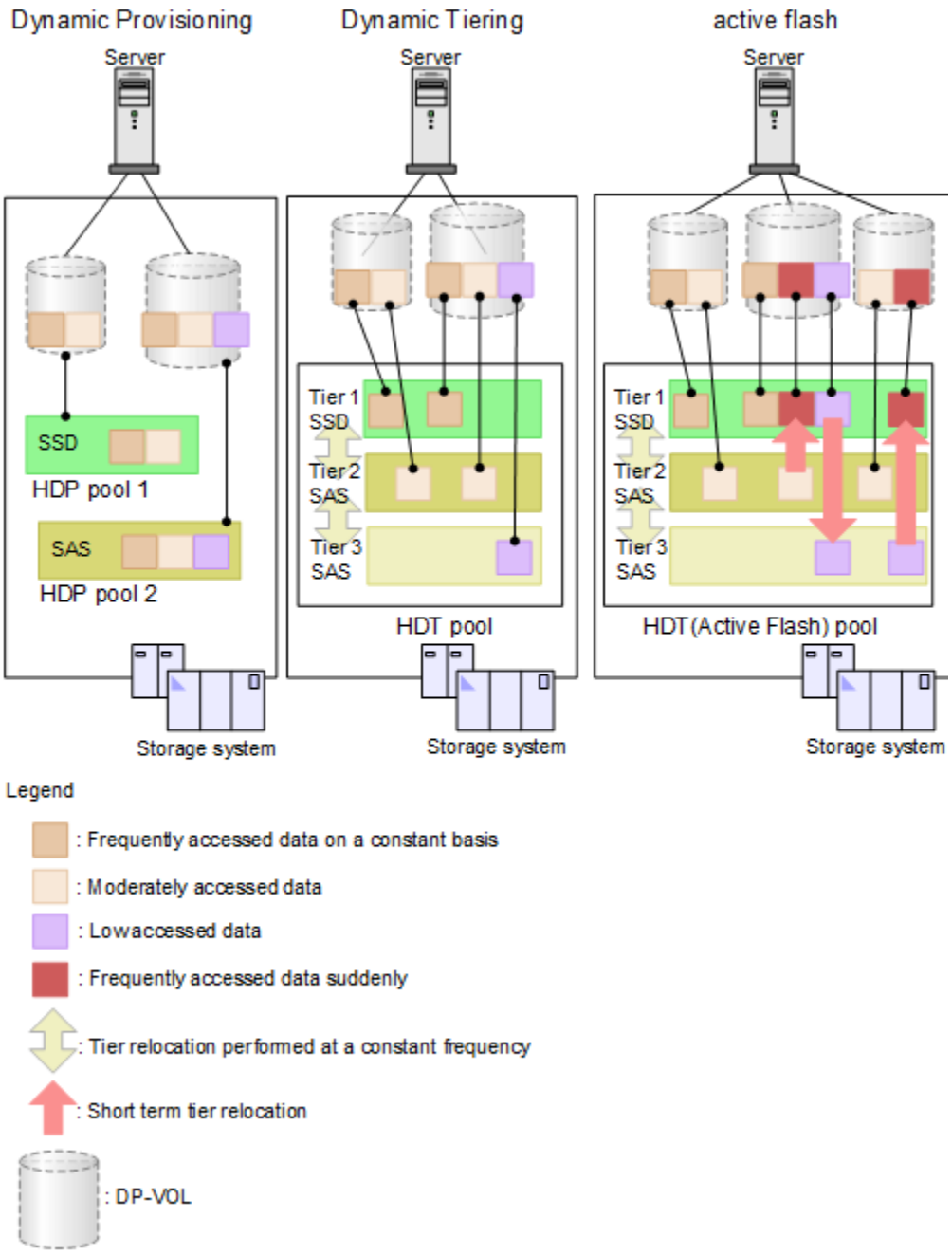
Functions overview for active flash for mainframe and Dynamic Tiering for Mainframe

Tier management is performed by both active flash for mainframe and Dynamic Tiering for Mainframe. The differences in supported functionality are included in the table below.

Category	Functions	Active flash for mainframe	Dynamic Tiering for Mainframe
Initial page allocation	Assigning new pages to the write data of the host	Supported	Supported
Monitoring of performance	Monitoring tiers based on the specified cycle time	Supported	N/A
Tier relocation	Promoting pages to the tier that is determined by the scheduled performance monitoring	Supported	Supported

Category	Functions	Active flash for mainframe	Dynamic Tiering for Mainframe
	Promoting pages from the tier 2 or 3 to tier 1, the pages where the latest access frequency is suddenly high	Supported	N/A
	To maintain capacity in the tier 1, demoting pages from the tier 1 to tier 2 or 3, the pages where the latest access frequency is low	Supported	N/A

This diagram shows the differences between the functions of Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, and active flash for mainframe.



Downloading the tier relocation log file

Use this procedure to download the log file that contains the results of past tier relocations. For information about the contents of the log file, see Tier relocation log file contents (on page 104).

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. From the **Actions** menu, select **Pool** > **Export Tier Relocation Log**.
2. In the dialog box, specify a folder for the log file, and then click **Save**.

   If you change the file name from the default, make sure the file name is appended with the `.tsv` extension before saving the file.

Tier relocation log file contents

In every cycle in which tier relocation is performed, information about each pool and V-VOL is exported to the tier relocation log. The time required to incorporate the latest tier relocation results might be approximately 30 minutes. The tier relocation log file is tab-delimited and contains this information.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Cycle ID	Yes	Yes	Common	ID of each cycle of a tier relocation. A common ID is allocated to pool logs and V-VOL logs that are collected in one cycle.
Log Format Version	Yes	Yes	Common	Version number of the tier relocation log format.
DKC Serial Number	Yes	Yes	Common	Serial number of the storage system.
Log Type	Yes	Yes	Common	Following log types are displayed: ▪ POOL: Log information of each pool. ▪ V-VOL: Log information of each V-VOL.
LDEV ID	No	Yes	Common	LDEV ID of a V-VOL exported to a log.
Pool ID	Yes	Yes	Common	Pool ID of a pool exported to a log.
Num of V-VOLs	Yes	No	Common	The number of V-VOLs to be processed when tier relocation is performed.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Tiering Policy	No	Yes	Tier relocation result	Value of the tiering policy. Values from All(0) to Level31(31) can be displayed. From Level6(6) to Level31(31), the names of tiering policies can be changed. If these names have changed, the new names are displayed.
Tier1 Total	Yes	No	Capacity information	Total pages of tier 1.
Tier2 Total	Yes	No	Capacity information	Total pages of tier 2.
Tier3 Total	Yes	No	Capacity information	Total pages of tier 3.
Tier1 Used	Yes	Yes	Capacity information	Pages assigned to tier 1 at the start of tier relocation.
Tier2 Used	Yes	Yes	Capacity information	Pages assigned to tier 2 at the start of tier relocation.
Tier3 Used	Yes	Yes	Capacity information	Pages assigned to tier 3 at the start of tier relocation.
Start Relocation Date	Yes	Yes	Common	Starting date of the tier relocation.
Start Relocation Time	Yes	Yes	Common	Starting time of the tier relocation.
End Relocation Date	Yes	Yes	Common	Ending date of the tier relocation.
End Relocation Time	Yes	Yes	Common	Ending time of the tier relocation.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Result Status	Yes	Yes	Tier relocation result	Statuses of a tier relocation: ▪ Normal End: Tier relocation and optimization ended normally. ▪ Normal End (Optimization remains): Tier relocation ended normally, but tier optimization terminated in the middle of processing. ▪ Suspend: Tier relocation suspended.
Detail Status	Yes	Yes	Tier relocation result	If the Result Status is Suspend, one of these reasons is displayed: ▪ Monitor discarded: Suspended due to the discard of monitoring data.* ▪ End of cycle: Suspended due to incomplete tier relocation during a monitoring cycle. ▪ Requested by user: Suspended due to request by a user. ▪ Threshold exceeded: Suspended because the used capacity of pools reaches a threshold due to a tier relocation. When the used capacity of a pool reaches the depletion threshold, this reason is logged. ▪ Cache blocked: Suspended because a cache memory is blocked. ▪ Volume blocked: Suspended because an LDEV which is pool-VOL or V-VOL is blocked.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
				▪ The tier management changed (Auto/Manual): Suspended because the tier management mode is changed from Auto to Manual, or Manual to Auto. ▪ Other reasons: Suspended for reasons other than the above, such as: • A V-VOL was specified as the secondary volume of the TrueCopy for Mainframe pair and an initial copy operation was performed. • A V-VOL was specified as the secondary volume of the Universal Replicator for Mainframe pair, and an initial copy operation was performed.
Completed Rate (%)	Yes	Yes	Tier relocation result	Progress percentage rate at the time tier relocation ends or is suspended.
Remediation Rate (%)	Yes	Yes	Tier relocation result	IOPH (I/O per hour) remediation rate at the time tier relocation ends or is suspended. The remediation rate = ((Total IOPH of pages after the promotion) / (Total IOPH of all pages to be performed of promotion)) * 100 1: Promotion is the page migration from a lower to higher tier.
Planned Tier1->Tier2	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 1 to tier 2.
Planned Tier1->Tier3	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 1 to tier 3.
Planned Tier2->Tier1	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 2 to tier 1.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Planned Tier2->Tier3	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 2 to tier 3.
Planned Tier3->Tier1	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 3 to tier 1.
Planned Tier3->Tier2	Yes	Yes	Tier relocation	Number of pages that are planned to move from the tier 3 to tier 2.
Moved Tier1->Tier2	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 1 to tier 2.
Moved Tier1->Tier3	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 1 to tier 3.
Moved Tier2->Tier1	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 2 to tier 1.
Moved Tier2->Tier3	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 2 to tier 3.
Moved Tier3->Tier1	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 3 to tier 1.
Moved Tier3->Tier2	Yes	Yes	Tier relocation	Number of pages that are moved from the tier 3 to tier 2.
IOPH	Yes	Yes	Monitoring result	IOPHs of all pools or V-VOLs.
IOPH Tier1 (%)	Yes	Yes	Monitoring result	Percentage of IOPH for tier 1.
IOPH Tier2 (%)	Yes	Yes	Monitoring result	Percentage of IOPH for tier 2.
IOPH Tier3 (%)	Yes	Yes	Monitoring result	Percentage of IOPH for tier 3.
Performance Util Tier1 (%)	Yes	No	Monitoring result	Performance utilization of tier 1. The performance utilization is the current I/O percentage based on the maximum performance of tier 1.
Performance Util Tier2 (%)	Yes	No	Monitoring result	Performance utilization of tier 2. The performance utilization is the current I/O percentage based on the maximum performance of tier 2.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Performance Util Tier3 (%)	Yes	No	Monitoring result	Performance utilization of tier 3. The performance utilization is the current I/O percentage based on the maximum performance of tier 3.
Tier1 Low Range	No	Yes	Monitoring result	Lower limit in a range for tier 1.
Tier2 High Range	No	Yes	Monitoring result	Higher limit in a range for tier 2.
Tier2 Low Range	No	Yes	Monitoring result	Lower limit in a range for tier 2.
Tier3 High Range	No	Yes	Monitoring result	Higher limit in a range for tier 3.
Reclaim Zero Page Num	Yes	Yes	Tier relocation	Number of pages processed in an operation to reclaim zero pages.
Non Compliant Tiering Policy Number	Yes	No	Monitoring result	Number of a tiering policy that does not conform to the current tier configuration. A non-compliant policy prevents tier relocation.
Realtime Moved Tier2->Tier1 (Unplanned)	Yes	Yes	Tier relocation	Number of pages moved from tier 2 to tier 1 by active flash for mainframe while performing the tier relocation by Dynamic Tiering for Mainframe . However, the pages migration is not planned by Dynamic Tiering for Mainframe .
Realtime Moved Tier3->Tier1 (Unplanned)	Yes	Yes	Tier relocation	Number of pages moved from tier 3 to tier 1 by active flash for mainframe while performing the tier relocation by Dynamic Tiering for Mainframe . However, the pages migration is not planned by Dynamic Tiering for Mainframe .

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Realtime Moved Tier2->Tier1 (Planned)	Yes	Yes	Tier relocation	Number of pages moved from tier 2 to tier 1 by active flash for mainframe while performing the tier relocation by Dynamic Tiering for Mainframe . The pages migration is planned by Dynamic Tiering for Mainframe .
Realtime Moved Tier3->Tier1 (Planned)	Yes	Yes	Tier relocation	Number of pages moved from tier 3 to tier 1 by active flash for mainframe while performing the tier relocation by Dynamic Tiering for Mainframe . The pages migration is planned by Dynamic Tiering for Mainframe .
Realtime Moved Tier1->Tier2	Yes	Yes	Tier relocation	Number of pages moved from tier 1 to tier 2 by active flash for mainframe while performing the tier relocation for Dynamic Tiering for Mainframe .
Realtime Moved Tier1->Tier3	Yes	Yes	Tier relocation	Number of pages moved from tier 1 to tier 3 by active flash for mainframe while performing the tier relocation for Dynamic Tiering for Mainframe .
Realtime Moved Tier2->Tier1 (Non Compliant)	Yes	Yes	Tier relocation	In the total pages moved from tier 2 to tier 1 by active flash for mainframe, the number of migrated pages that do not conform to the plan of Dynamic Tiering for Mainframe page migration.
Realtime Moved Tier3->Tier1 (Non Compliant)	Yes	Yes	Tier relocation	In the total pages moved from tier 3 to tier 1 by active flash for mainframe, the number of migrated pages that do not conform to the plan of Dynamic Tiering for Mainframe page migration.

Item	Does each pool output the log information?	Does each V-VOL output the log information?	Type of information	Description
Realtime Moved Tier1->Tier2 (Non Compliant)	Yes	Yes	Tier relocation	In the total pages moved from tier 1 to tier 2 by active flash for mainframe, the number of migrated pages that do not conform to the plan of Dynamic Tiering for Mainframe page migration.
Realtime Moved Tier1->Tier3 (Non Compliant)	Yes	Yes	Tier relocation	In the total pages moved from tier 1 to tier 3 by active flash for mainframe, the number of migrated pages that do not conform to the plan of Dynamic Tiering for Mainframe page migration.
* When deleting pool-VOLs, previously valid monitor information is discarded, so that the tier relocation is interrupted. After the pool-VOLs are deleted, the tier determination calculation performs again and completes. Processed in this way, the valid monitor information is re-created.				

Tiering policy

The tiering policy function is used to assign a specific storage tier to a specific DP-VOL. A tiering policy specifies a 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.

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 levels (on page 114) and Tiering policy setting on a DP-VOL (on page 114).

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).

Custom policies

You can change the settings of the tiering policy. Tiering policies changed by a user are called custom policies. Custom policies can be defined for IDs of tiering policies from 6 to 31 (from Level6(6) to Level31(31)). These items can be set in the custom policy:

- Rename custom policy.
- Change allocation threshold.

Custom policy name

A custom policy name can be changed arbitrarily. You can change the names of custom policies from Level6(6) to Level31(31). For example, if you change the name of Level6(6) to Policy06, Policy06(6) will then be displayed.

Allocation threshold

You can define allocation thresholds in new policies from Level6(6) to Level31(31).

For all DP-VOLs that have the tiering policy in a pool, Dynamic Tiering performs the relocation of pages to each tier based on the tiering policy setting.

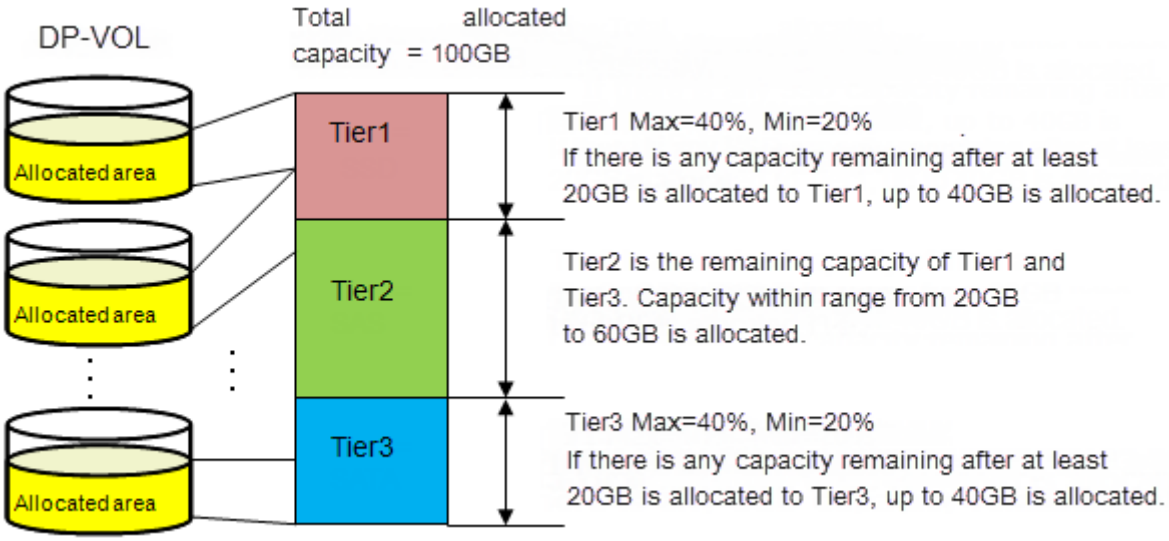
Max(%) and Min(%) parameters: When a tiering policy is created, 4 types of parameters can be set: Tier1 Max and Tier 1 Min, Tier 3 Max and Tier 3 Min. Each parameter is a ratio that corresponds to the total capacity of the allocated area of DP-VOLs that have the same tiering policy set for a pool.

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

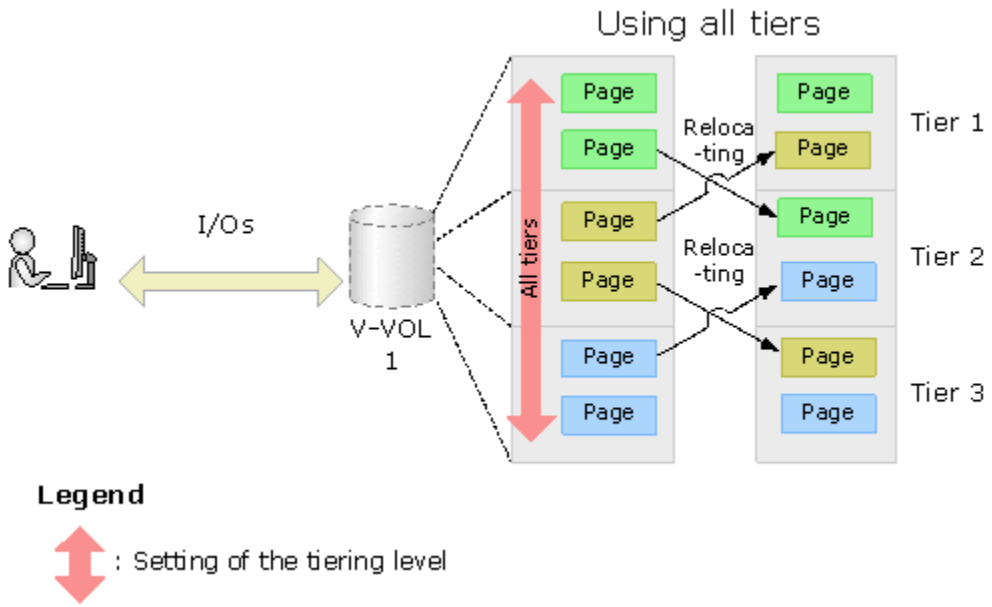
- Excess allocation of SSD capacity for unimportant applications
- Degradation in average response time for high performance operations

Tiering policy examples

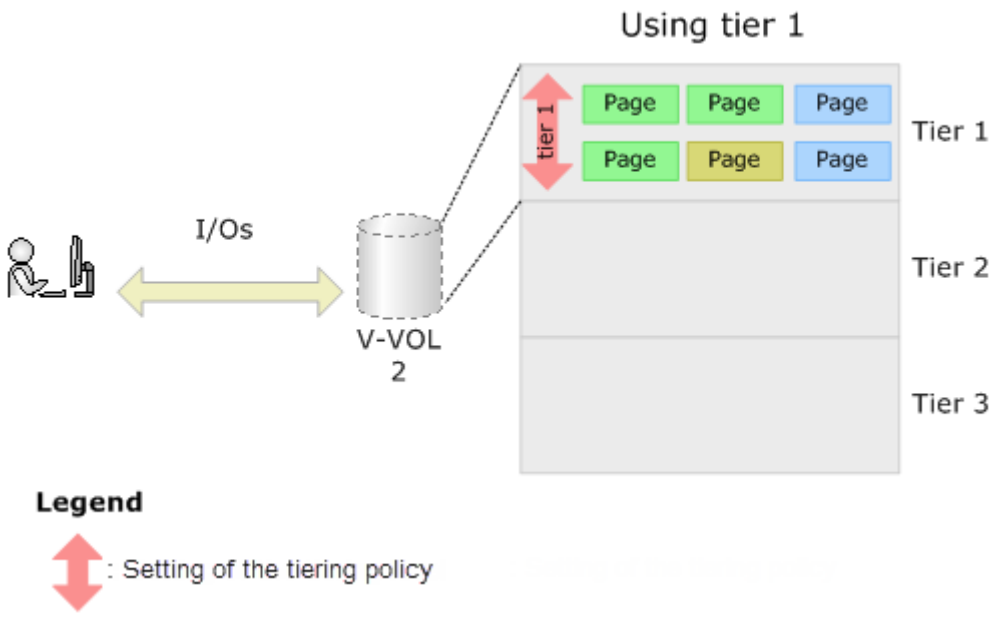
This figure shows the allocation threshold settings Tier1 Max=40%, Tier1 Min=20%, Tier3 Max=40%, and Tier3 Min=20% for a DP-VOL with a Level6(6) setting when the initial mapped capacity is 100GB.



This 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.



This figure shows an example of data allocation when setting the tiering policy to Level1(1) (see Level1(1) in Tiering policy levels (on page 114)). In this case, pages in the DP-VOL are relocated to tier 1 and are not relocated to other tiers.



Tiering policy setting 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. 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.

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.

Tiering policy	1 tier pool	2 tier pool	3 tier pool	Note
Level2(2)	Same as All(0)	Same as All(0)	Tier 1 and Tier 2 See examples	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 examples	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 examples	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 examples	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	--
* If these names have changed, the new names are displayed instead.				

Examples

If additional capacity is added to the pool and the capacity defines a new Tier 1 or new Tier 2, the DP-VOLs with a Level 5(5) assignment will not physically move but Level 5(5) will be associated with Tier 3.

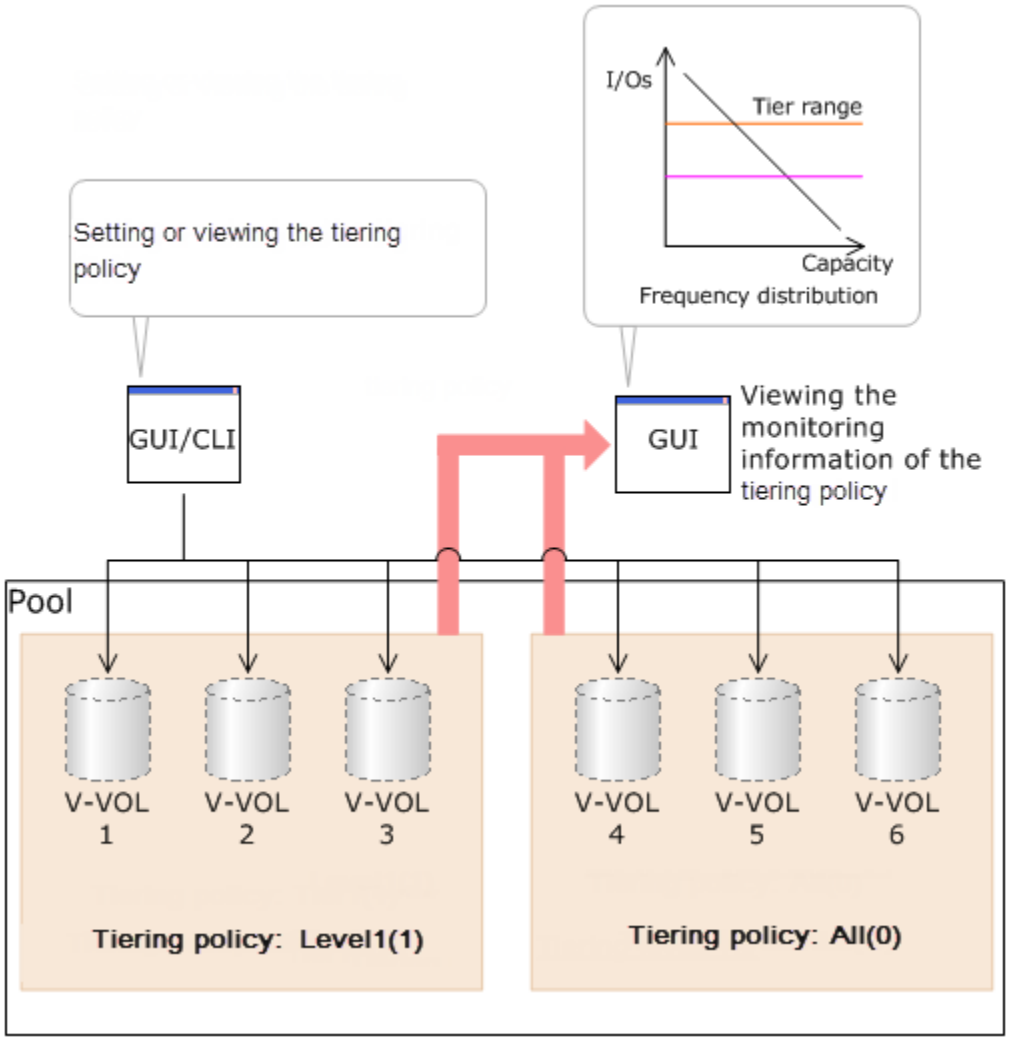
If additional capacity is added to the pool and the capacity defines a new Tier 3, the DP-VOLs with a Level 5(5) assignment will physically move to the new Tier 3 and Level 5(5) will be associated with Tier 3.

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 **Tier Properties** window.

The following table shows how tiering policy is shown in the performance graph. How the graph is displayed depends on the number of tiers set in a pool and the 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.
* If these names have changed, the new names are displayed instead.	

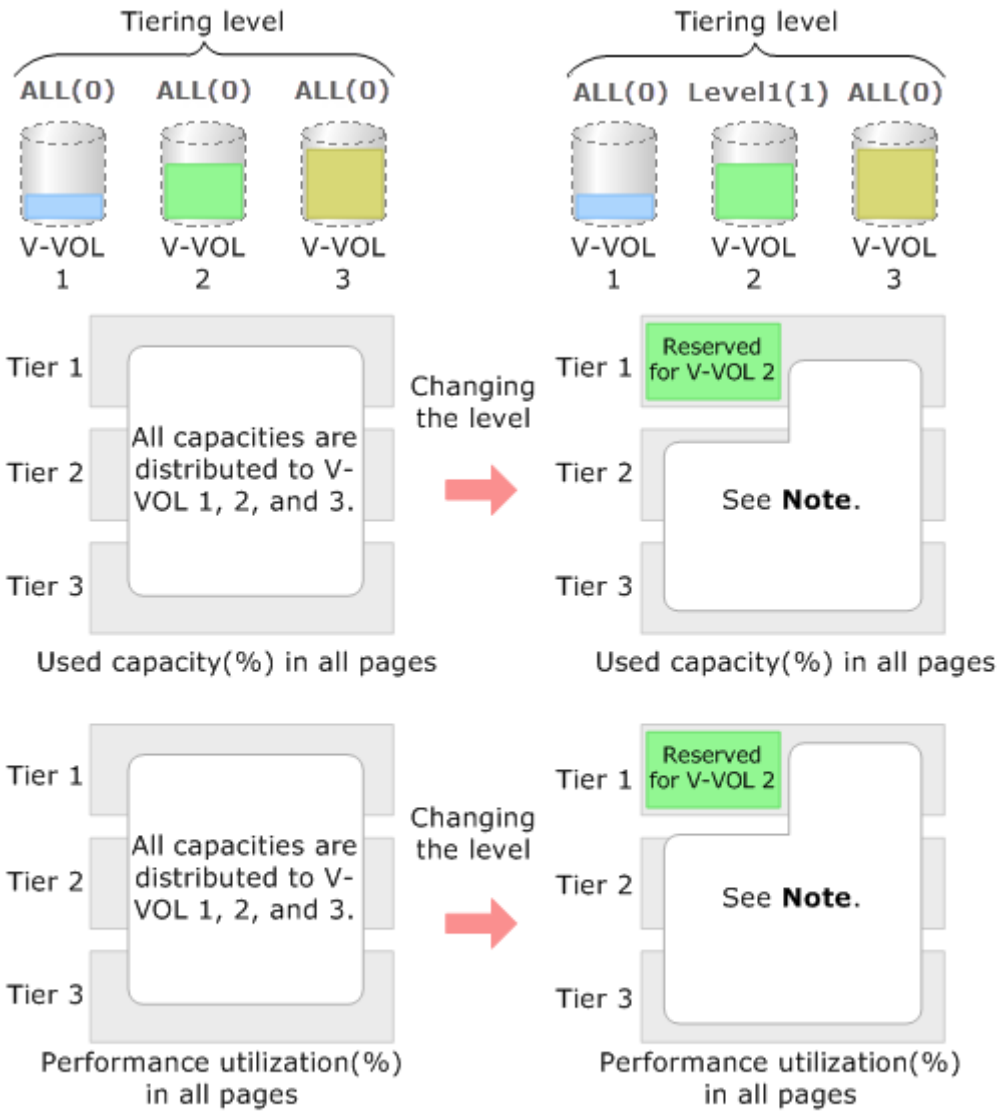


Tier capacity reservation when setting a tiering policy

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)*.

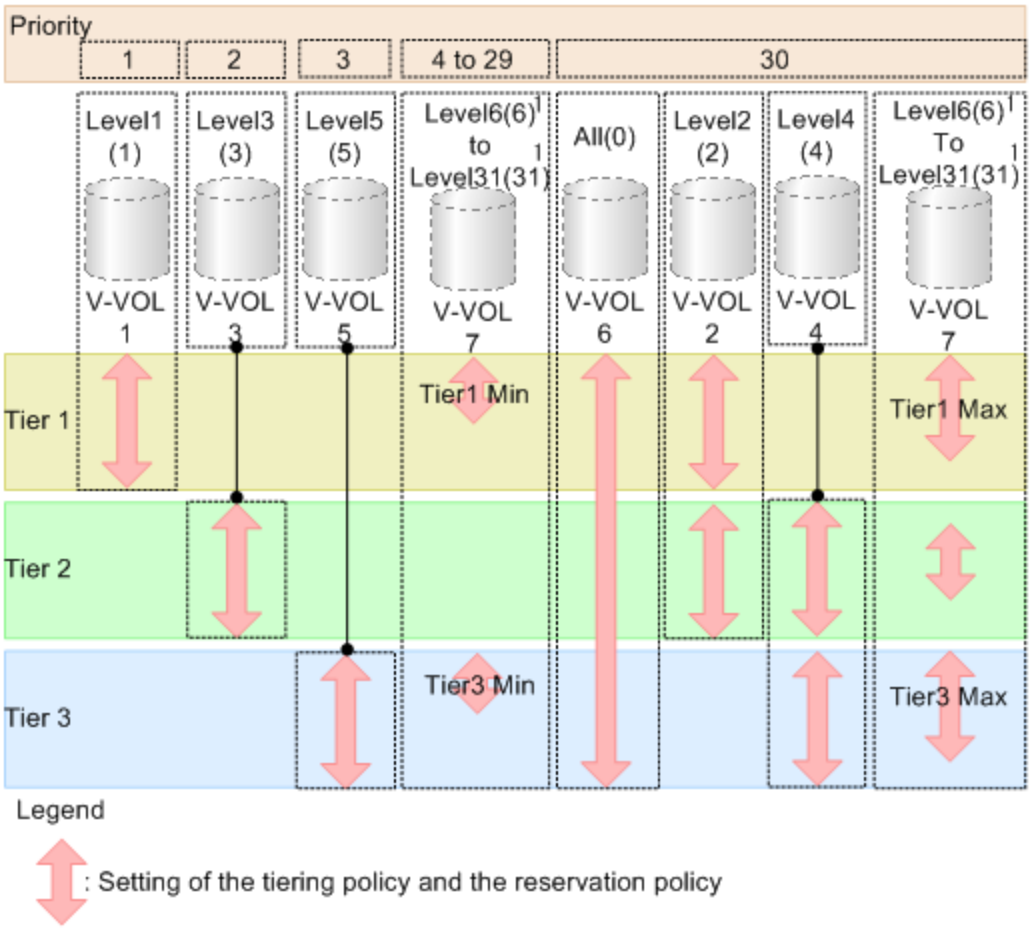
A DP-VOL without a tiering policy setting uses the unreserved area in the pool.



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 120).



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 smaller 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 the 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

Tier reservation priority	Tiering policy	Reserved tier
	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.
* If these names have changed, the new names are displayed instead.		

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 122).
- 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 122)). 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 122)). Therefore, you do not need to perform new monitoring.

- If a capacity shortage exists in the tier being set, a message might be displayed in the **Tier Properties** 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 is not displayed 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 or they are allocated to the tier that has free space. From Level 6 (6) to Level 31 (31), the names of tiering policies can be changed. If these names have changed, the new names are displayed.

- 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.

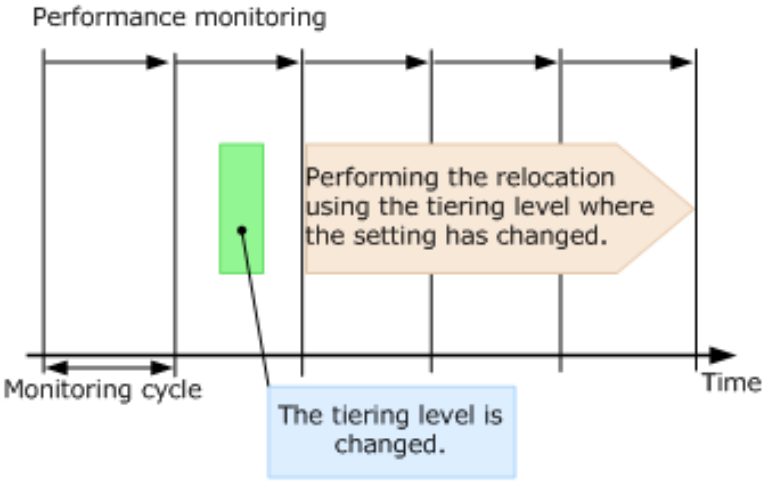
  As shown in the following table, allocation capacity considerations are based on the tiering policy.

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.

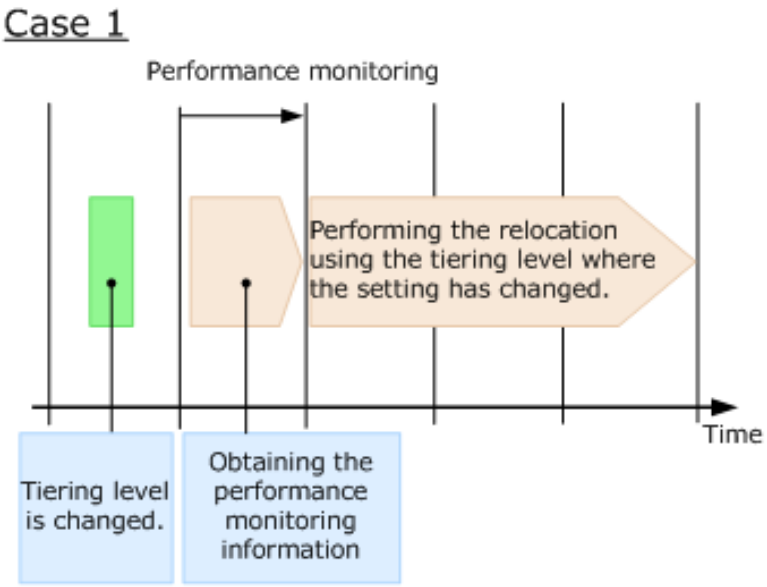
Tiering Policy	Allocation capacity considerations
	Allocation capacities in each tier. ▪ Tier1: The setting value(%) in Tier1 Min. ▪ Tier2: The value deducted Tier1 Max(%) and Tier3 Max(%) from 100(%). ▪ Tier3: The setting value(%) in Tier3 Min.
	Second phase: Tier range and I/O performance. Capacities deducted from the mapped capacities of the first phase from the total used capacity, are mapped to each tier.
* If these names have changed, the new names are displayed instead.	

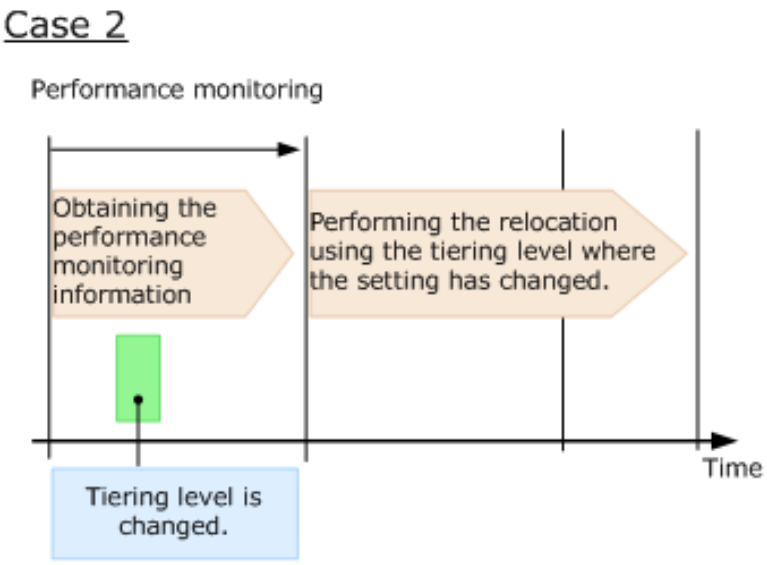
Execution mode settings and tiering policy

This figure shows how tier relocation is performed after changing the tiering policy setting while Auto execution mode is used.



This figure shows two cases of how tier relocation is performed after changing the tiering policy setting while Manual execution mode is used.





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 initially set this function only by using Device Manager - Storage Navigator when creating a DP-VOL. To change the setting, you can use either Device Manager - Storage Navigator or Command Control Interface. The function takes effect immediately.

This table shows the 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 Hitachi Device Manager - 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
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.

This table shows 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.

This table shows 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

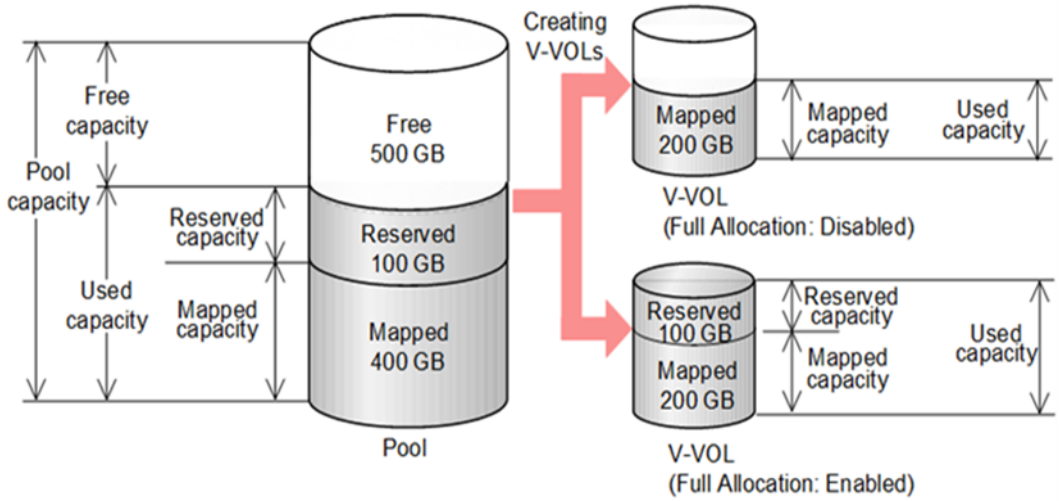
The formatted pool capacity equals the capacity of the initialized free space and the reserved capacity of a pool, but not the capacity of all free space and reserved capacity of the pool. The free space of the pool is monitored by a storage system. Space is formatted automatically if needed. You can confirm the formatted pool capacity in the **View Pool Management Status** window. Dependent on the load of the storage system, the format speed of free space and reserved capacity 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. 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 customer support.

Used capacity, mapped capacity, and reserved capacity

The used capacity is the total capacity of pages that are assigned and reserved for each V-VOL. The mapped capacity is the total of pages that contain user data and control information of each V-VOL. The reserved capacity is the total of pages reserved in each V-VOL for which the full allocation function is enabled.



Usage level rebalancing among parity groups

If multiple parity groups that contain LDEVs used as pool volumes exist, rebalancing can improve unequal usage rates in parity groups. Rebalancing is performed as if each parity group were a single pool volume. After rebalancing, the usage rates of LDEVs in a parity group may not be balanced, but the usage rate in the entire pool is balanced.

The usage level among parity groups is automatically rebalanced when these operations are in progress:

- Expanding pool capacity
- Reclaiming zero pages

- Reclaiming zero pages in a page release request issued by the host with the Write Same command, for example.
- Performing tier relocations

If you expand the pool capacity, Dynamic Provisioning moves data to the added space on a per-page basis. When the data is moved, the usage rate among parity groups of the pool volumes is rebalanced.

Host I/O performance might decrease when data is moved. If you do not want to have the usage level of parity groups automatically balanced, call customer support.

You can see the rebalancing progress of the usage level among parity groups in the **View Pool Management Status** window. Dynamic Provisioning automatically stops balancing the usage levels among parity groups if the cache memory is not redundant.

Changing the tiering policy level of a DP-VOL

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. In the **LDEVs** pane of the **Logical Devices** window, select the LDEV ID of the LDEV with the tiering policy you want to change.
4. Click **Edit LDEVs**.
5. In the **Edit LDEVs** window, click **Tiering Policy**, and then select a tiering policy.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Changing new page assignment tier of a V-VOL

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. In the **LDEVs** pane of the **Logical Devices** window, select an LDEV ID.
4. Click **More Actions** > **Edit LDEVs**.
5. In the **Edit LDEVs** window, select **New Page Assignment Tier**, and select the new page assignment tier you want to use.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Changing a tiering policy name

From Level6(6) to Level31(31), the names of tiering policies can be changed. However, for tiering policies from All(0) to Level5(5), names cannot be changed.

Before you begin

The Storage Administrator (System Resource Management) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** window, click **Edit Tiering Policies**.
4. In the **Edit Tiering Policies** window, select the tiering policy that you want to change, and then click **Change**.
5. In the **Change Tiering Policy** window, select **Change Tiering Policy**.
6. Enter the name of the tiering policy.
   You can enter up to 32 alphanumeric characters.
7. Click **OK**.
8. In the **Edit Tiering Policies** window, click **Finish**.
9. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Changing an allocation threshold

From Level6(6) to Level31(31), allocation thresholds can be changed. However, for tiering policies from All(0) to Level5(5), allocation thresholds cannot be changed.

Before you begin

The Storage Administrator (System Resource Management) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** window, click **Edit Tiering Policies**.
4. In the **Edit Tiering Policies** window, select the tiering policy that you want to change and click **Change**.
5. In the **Change Tiering Policy** window, select **Allocation Threshold**.
6. Change thresholds, and click **OK**.
7. Return to the **Edit Tiering Policies** window.
8. Click **Finish**.
9. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
10. Click **Apply** to submit the task.

Changing the relocation priority of a V-VOL

Before you begin

To perform this task, these roles are required:

- Storage Administrator (System Resource Management) role
- Storage Administrator (Provisioning) role

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.

2. Click **Logical Devices**.
3. In the **Logical Devices** window, select the **LDEV ID** of the volume with the relocation priority you want to change.
4. Click **Edit LDEVs**.
5. In the **Edit LDEVs** window, select **Relocation Priority** and click **Default** or **Prioritize**.

   If you chose **Prioritize**, the LDEV is relocated preferentially.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

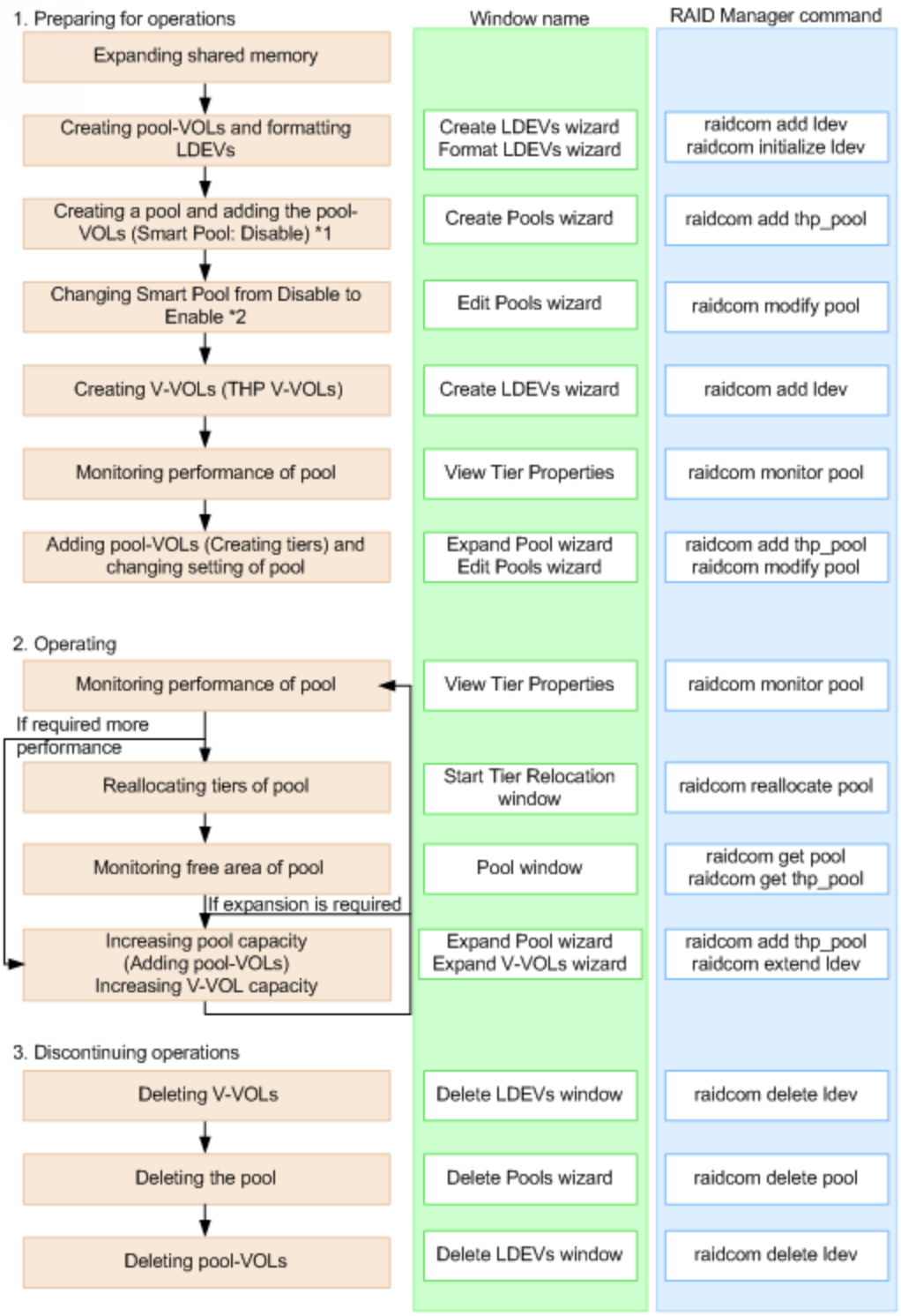
Page relocation by active flash for mainframe

The active flash for mainframe feature identifies the frequently accessed pages by counting the number of I/Os to specific pages. As shown in this figure, pages that are accessed frequently are promoted to tier 1, and pages whose latest access frequency is low are allocated to lower tiers.

Dynamic Tiering for Mainframe workflow

The following figure shows the workflow for setting up Dynamic Tiering for Mainframe on the storage system.

As shown in the figure, Hitachi Device Manager - Storage Navigator and Command Control Interface (CCI) have different workflows. This document describes how to set up Dynamic Tiering using Hitachi Device Manager - Storage Navigator . Use Hitachi Device Manager - Storage Navigator to create pools and DP-VOLs.



- When you create a pool using CCI, you cannot enable the multi-tier pool option or register multiple media as pool-VOLs. Before making tiers, enable the multi-tier pool option.
- Enabling the multi-tier pool option from CCI automatically sets Tier Management to Manual. You must use Hitachi Device Manager - Storage Navigator to change Tier Management to Auto.

Caution: When you delete a pool, its pool-VOLs (LDEVs) are blocked, and you must format the blocked LDEVs before using them.

Active flash for mainframe workflow

The active flash feature of Dynamic Tiering can be set up using either Device Manager - Storage Navigator or Command Control Interface.

The following illustration shows the workflow for a Storage Administrator to set up active flash on the storage system. As shown in the illustration, Device Manager - Storage Navigator and Command Control Interface have different workflows. The details about how to set up active flash using Device Manager - Storage Navigator are covered in subsequent topics. Use Device Manager - Storage Navigator to create pools and DP-VOLs.

- 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 Device Manager - Storage Navigator.

Caution: When you delete a pool, its pool-VOLs (LDEVs) are blocked, and you must format the blocked LDEVs before using them.

User interface specifications for Dynamic Tiering tasks

These tables list the Dynamic Tiering tasks and indicate whether the tasks can be performed using Device Manager - Storage Navigator or CCI or both.

Tasks and parameter settings

Task			GUI	CCI
DP pool	Create (Setting item)	Create	Yes	Yes
		Pool Name	Yes	Yes
		Threshold	Yes	Yes
		Multi-Tier Pool: Enable/Disable	Yes	No[1]
		active flash for mainframe: Enable/ Disable	Yes	No[1]
		Tier Management: Auto mode	Yes	No
		Tier Management: Manual mode	Yes	No
		Rate of space for new page assignment	Yes[3]	No
		Buffer Space for Tier relocation	Yes	No
		Cycle Time	Yes	No
		Monitoring Period	Yes	No
		Monitoring Mode	Yes	No
		External LDEV Tier Rank	Yes	No
		Relocation speed	Yes	No
	Delete		Yes	Yes
	Change Settings (Setting item)	Change Settings	Yes	Yes
		Pool Name	Yes	Yes[2]
		Threshold	Yes	Yes
		Multi-Tier Pool: Enable/Disable	Yes	Yes
		Active flash for mainframe: Enable/ Disable	Yes	Yes

Task			GUI	CCI
		Tier Management: Auto to Manual	Yes	Yes
		Tier Management: Manual to Auto	Yes	No
		Buffer Space for New page assignment	Yes[3]	Yes[3]
		Buffer Space for Tier relocation	Yes	Yes
		Cycle Time	Yes	No
		Monitoring Period	Yes	No
		Monitoring Mode	Yes	Yes
		External LDEV Tier Rank	Yes	No
		Relocation speed	Yes	No
DP pool	Add pool-VOLs		Yes	Yes
	Delete pool-VOLs		Yes	Yes
	Restore Pools		Yes	Yes
	Monitoring start/end		Yes	Yes
	Tier relocation start/stop		Yes	Yes
DP-VOL	Create (Setting item)	Create	Yes	Yes
		DP-VOL Name	Yes	Yes
		Multi-Tier Pool relocation: Disable	No	No
		Tiering Policy	Yes	No
		New page assignment tier	Yes	No
		Relocation priority	Yes	No
	Expand		Yes	Yes
	Reclaim zero pages		Yes	Yes
	Delete		Yes	Yes
	Change Settings (Setting item)	Change Settings	Yes	Yes
		Tier relocation: Enable/Disable	Yes	Yes
		Tiering Policy	Yes	Yes
		New page assignment tier	Yes	Yes

Task			GUI	CCI
		Relocation priority	Yes	No
Relocation log	Download relocation log		Yes	No

Notes:

1. Set to Disable if the pool is created by Command Control Interface.

   Command Control Interface cannot be used to create Dynamic Tiering pools initially. You can use the **`raidcom modify pool`** command to modify Dynamic Provisioning pools for use as Dynamic Tiering or active flash pools.
2. You can rename a pool when adding pool-VOLs to it.
3. Best practice is to specify 0% for SSD or FMD and 8% for other drives.

Display items: Setting parameters

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

* 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)	Yes	Yes
2		Capacity for each tier (Usage)	Yes	Yes
3	DP-VOL	Capacity for each tier (Usage)	Yes	Yes

Display items: Performance monitor statistics

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

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	Yes	Yes
2		Performance monitor information: Valid/ Invalid/Calculating	Yes	Yes

No.	Category	Output information	GUI	Command Control Interface
3		Relocation status: Relocating/Stopped	Yes	Yes
4		Relocation progress: 0 to 100%	Yes	Yes

Managing Dynamic Tiering for Mainframe and active flash for mainframe

To take advantage of all the benefits of tiered storage, you can convert a Dynamic Provisioning pool to a Dynamic Tiering pool with or without active flash. You can also view, monitor, and change various settings of Dynamic Tiering pools.

Changing a Dynamic Provisioning pool to a Dynamic Tiering pool

Use this procedure to change a Dynamic Provisioning pool to a pool for Dynamic Tiering or active flash.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. Check **Multi-Tier Pool**.
5. Select **Enable** from the Multi-Tier Pool field.

   If TSE-VOL is assigned to the selected pool, you cannot select **Enable**.
6. For active flash, select **Active Flash**. If there is no pool volume available using the required drive types for active flash, the check box cannot be selected.
7. Select **Tier Management**.
8. In **Tier Management**, select **Auto** or **Manual**.

   Normally **Auto** should be selected.

Option	Description
Auto	Monitoring and tier relocation can be automatically executed.
Manual	Monitoring and tier relocation can be executed by using the Command Control Interface commands or the **Pools** window.

   If you change **Auto** to **Manual** while monitoring and tier relocation is in process, the in-process operation is cancelled.
9. From **Cycle Time**, select the cycle of performance monitoring and tier relocation.

Option	Description
24 Hours (default)	Monitoring and tier relocation is performed once a day. In **Monitoring Period**, 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 you specified as the ending time on the next day. Any time that is not in the specified range of the monitor period is not monitored.
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.

Note:

- If you change the **Cycle Time** while performance monitoring and tier relocation are already in process, the setting becomes effective for the next cycle after the current cycle is complete.
- If you change the time range for the performance monitoring, the setting becomes effective from the next cycle after the in-process cycle completes.
- You can view the information gathered by monitoring by using Hitachi Device Manager - Storage Navigator and Command Control Interface.

10. Select **Monitoring Mode**.
11. From the **Monitoring Mode** options, select one of these options:

Option	Description
Period Mode	Performs tier relocation using the monitor results from the prior cycle.
Continuous Mode	Performs tier relocation weighted to the past period monitoring result.

12. Select the speed to use for page relocation in **Relocation speed**. You can set the speed to: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). The default is 3(Standard). If the speed specified is slower than 3(Standard), the data drive load is low when tier relocation is performed.
13. Select **Buffer Space for New page assignment**.
14. In **Buffer Space for New page assignment**, enter an integer value from 0 to 50 as the percentage (%) to set for each tier.
15. Select **Buffer Space for Tier relocation**.
16. In **Buffer Space for Tier relocation**, enter an integer value from 2 to 40 as the percentage (%) to set for each tier.
17. Click **Finish**.
18. In the confirmation window:

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

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

Viewing DP-VOL tier information

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** window, click the pool with the DP-VOL whose properties you want to view.
   The **DP-VOL** tab is displayed.
4. Select a DP-VOL to view the tier properties.
5. Click **More Actions**, and then select **View Tier Properties**.

Changing settings for multi-tier pools

You can change these monitoring and tier relocation settings of Dynamic Tiering for Mainframe pools:

- Automatic or manual execution of monitoring and tier relocation
- Cycle time of monitoring and tier relocation
- Time period of monitoring

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Finish**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. Click **Options** for **Multi-Tier Pool**.
5. Select **Tier Management**.
6. In **Tier Management**, select **Auto** or **Manual**.
   Normally **Auto** should be selected.

Option	Description
Auto	Monitoring and tier relocation can be automatically executed.
Manual	Monitoring and tier relocation can be executed by using the Command Control Interface commands or the **Pools** window.

If you change **Auto** to **Manual** while monitoring and tier relocation is in process, the in-process operation is cancelled.

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

Changing monitoring mode settings

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. Click **Options for Multi-Tier Pool**.
5. Click **Monitoring Mode**.
6. Select one of these options.

Option	Description
Period Mode	Enable this attribute if you want to perform tier relocation using the monitor results from the prior cycle.
Continuous Mode	Enable this attribute if you want to perform tier relocation weighted to the past period monitoring results.

7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.

b. Accept the default task name or enter a unique name.

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

\ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Changing relocation speed

Caution:

- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.
- If you need to perform two or more operations to edit several items in the same pool, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system, so the result might be different from what you expect.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. In the **Edit Pools** window, expand **Options for Multi-Tier Pool**.
5. Use the **Relocation Speed** option to set the speed for page relocation to 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest).

   The default is 3(Standard). If you want to perform tier relocation at high speed, set 5(Fastest). If the speed specified is slower than 3(Standard), the data drive load is low when tier relocation is performed.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

   \ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Changing buffer space for new page assignment setting

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. Select **Options for Multi-Tier Pool**.
5. Select **Buffer Space for New page assignment**.
6. In **Buffer Space for New page assignment**, enter an integer value from 0 to 50 as the percentage (%) to set for each tier.
7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Changing buffer space for tier relocation setting

Caution:

- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.
- If you need to perform two or more operations to edit several items in the same pool, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system, so the result might be different from what you expect.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. In the **Edit Pools** window, expand **Options for Multi-Tier Pool**.
5. Select **Buffer Space for Tier relocation**.
6. In **Buffer Space for Tier relocation**, enter an integer value from 2 to 40 as the percentage (%) to set for each tier.
7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Enabling active flash for mainframe on an existing Dynamic Tiering for Mainframe pool

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- Pool volumes whose drive type is SSD or FMD must be created.
- If tier relocation is set to Manual mode, you must change tier relocation to Auto before beginning this procedure.
- If pool-VOLs are being deleted, you must wait until the delete pool-VOL operations are complete before beginning this procedure.
- If zero pages are being reclaimed, you must wait until the reclaim zero page operations are complete before beginning this procedure.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.

4. Check **Active Flash** to ON.

   If there is no pool volume using the required drive type, the option cannot be selected.
5. Click **Finish**.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Changing a Dynamic Tiering for Mainframe pool to a pool for Dynamic Provisioning for Mainframe

You can use this procedure to change a Dynamic Tiering for Mainframe pool to a Dynamic Provisioning for Mainframe pool.

Note: You cannot change a Dynamic Tiering for Mainframe pool to a Dynamic Provisioning for Mainframe pool in these cases:

- Tier relocation is being executed manually.
- Pool-VOLs are being deleted.
- Zero pages are being reclaimed.

Caution:

- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.
- If you need to perform two or more operations to edit several items in the same pool, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system, so the result might be different from what you expect.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** tab, select the pool to change from a pool for Dynamic Tiering for Mainframe to a pool for Dynamic Provisioning for Mainframe.
4. Click **More Actions** > **Edit Pools**.
5. In the **Edit Pools** window, check **Multi-Tier Pool**.
6. Select **Disable** and click **OK** in the warning message.
7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Pool creation

Pools are required for Dynamic Provisioning for Mainframe Each pool must contain at least one DP-VOL.

About pools

Dynamic Provisioning for Mainframe 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 for Mainframe cannot be used in conjunction with other pools.

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 for Mainframe pool-VOLs assigned to the pool. Pool capacity is calculated using these formulas:

- *capacity of the pool* (MB) = *total number of pages* * 38 - 3800

  3800 (MB) 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* ÷ 116) ÷ 672)) for each pool-VOL
- 1 cylinder means 1740 blocks
- 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.

Dynamic Provisioning for Mainframe 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.

Creating pools

When you create a pool, you select the pool volumes (pool-VOLs) for the pool (manually or automatically) and set options such as the subscription limit and the warning and depletion thresholds for the pool.

Prerequisites for creating pools

- Before you can create pools, the proper amount of shared memory must be installed, 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 service representative.
- One pool-VOL with system area is defined for a pool. The priority of the pool-VOL with system area is assigned according to the drive type. The available capacity of the pool-VOL with system area is deducted from the management area capacity. The management area capacity stores the management information of software that uses the pool. If Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe is used on a mainframe system, 3.8 GB is used as the management area in the pool-VOL with system area.
- When a pool is created, a pool-VOL with system area is assigned the priority shown in the following table. If multiple pool-VOLs of the same drive type exist, the priority of each is determined by the internal index of the storage system.

Priority	Drive type
1	HDD/7.2 krpm
2	HDD/10 krpm
3	HDD/15 krpm
4	SSD or FMD
5	External volume

Creating Dynamic Provisioning for Mainframe pools by selecting pool-VOLs manually

You can use Device Manager - Storage Navigator to create a Dynamic Provisioning pool with manually selected pool-VOLs.

Note: Up to 1,024 volumes can be added including the volumes already in the pool.

For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:

- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (3D+1P)
- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (7D+1P)

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, expand the **Storage Systems** tree, and select **Pools**.
2. In the **Pools** window, click **Create Pools**.
3. From the **Pool Type** list, select **Dynamic Provisioning**.
4. For **System Type**, select **Mainframe**.
5. For **Multi-Tier Pool**, select **Disable**.
6. For **Pool Volume Selection**, select **Manual**.
7. Select pool-VOLs:
   a. Select a drive.
      - Select from **Drive Type/RPM**.
   b. From the **RAID Level** list, select the desired RAID level.
      If you selected **External Storage** in step a, a - (hyphen) is displayed and you cannot select the RAID level.
   c. Click **Select Pool VOLs**.
   d. In the **Available Pool Volumes** table, select the pool-VOLs to be associated with the pool, and then click **Add**.
      You can select a value other than **Middle** from **External LDEV Tier Rank** and click **Add** to set another tier rank for an external volume.

Note: Up to 1,024 volumes can be added including the volumes already in the pool.

For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:

- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (3D+1P)
- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (7D+1P)

To set another tier rank for an external volume, select the desired tier rank from **External LDEV Tier Rank** and click **Add**.

Note:

- It is best practice that LDEVs that belong to parity groups with accelerated compression enabled and LDEVs that belong to parity groups with accelerated compression disabled do not coexist in the same pool.

Tip:

- To apply filter conditions to the table, click **Filter**, specify the desired conditions, and then click **Apply**.
- To select all pool-VOLs in the table, click **Select All Pages**. To cancel the selection, click **Select All Pages** again.
- To change the capacity unit or the number of rows to view, click **Options**.

e. In the **Select Pool VOLs** window, if the selected pool-VOLs have no issues, click **OK**.

The information in the **Selected Pool Volumes** table is applied to **Total Selected Pool Volumes** and **Total Selected Capacity** in the **Create Pools** window.

8. In **Pool Name**, enter the desired name for the pool.
9. Click **Options**.
10. In **Initial Pool ID**, type the number of the initial pool ID (from 0 to 127).

    If you specify a pool ID that is already used, the smallest available ID is displayed by default instead of the ID you specified. If a pool ID is unavailable, no number is displayed.
11. In **Subscription Limit**, enter the desired subscription rate (%) of the pool (integer value from 0 to 65534). To set the subscription limit to Unlimited, leave this field blank (do not enter a number).
12. In **Warning Threshold**, enter the desired warning threshold (%) for the pool (integer value from 1 to 100, default = 70%).

    If the pool used-capacity is equal to or greater than the warning threshold, a service information message (SIM) is issued by the storage system.

13. In **Depletion Threshold**, enter the desired depletion threshold (%) for the pool (integer value from 1 to 100, default = 80%). Enter a value that is equal to or greater than the warning threshold.

    If the pool used-capacity is equal to or greater than the depletion threshold, a SIM is issued by the storage system.

14. Click **Add**.

    The specified pool is added to the **Selected Pools** table. If invalid values are set, an error message is displayed.

    The **Pool Type**, **Pool Volume Selection**, and **Pool Name** must be set. If these required items are not entered or selected, you cannot click **Add**.

    To view the detailed properties of a pool in the **Selected Pools** table, select the pool and click **Detail**.

    To remove a pool from the **Selected Pools** table, select the pool, click **Remove**, and then click **OK**.

15. If you want to create DP-VOLs in the new pool at this time, click **Next** to go to the **Create LDEVs** window. If **Subscription Limit** of the specified pool is set to 0%, an error message is displayed and the **Create LDEVs** window is not displayed.

    If you do not want to create DP-VOLs in the new pool at this time, click **Finish** and proceed to the next step.

16. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.

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

       \ / : , ; * ? " < > |

    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

    To view the detailed properties of a pool, select the pool and then click **Details**.

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

Creating Dynamic Provisioning for Mainframe pools by selecting pool-VOLs automatically

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Pools**.
2. Click **Create Pools**.
3. In the **Create Pools** window, select **Dynamic Provisioning** for the **Pool Type**.
4. For **System Type**, select **Mainframe**.
5. For **Multi-Tier Pool**, select **Disable**.
6. For **Pool Volume Selection**, select **Auto**.

7. Select pool-VOLs as follows:
   a. For **Resource Group**, select the resource group name of the pool-VOL.
   b. For **Performance**, select the performance of the pool.
   c. In **Total Capacity**, specify the capacity of the pool.

      Values are displayed in **Total Pool Volumes** and **Total Capacity**. These values are greater than the specified value of the pool capacity.
   d. If you want to change the pool configuration that is automatically selected, click **Change Pool Configuration**.

      In the **Pool Configuration Patterns** table in the **Change Pool Configuration Pattern** window, select the desired pool configuration, click **Select**, and then click **OK**.

      - You can select the pool configuration on a parity group basis.
      - The priority of the pool configuration is determined by these conditions:
        - Priority 1: There is no free space in the parity group and one LDEV exists in the group.
        - Priority 2: There is no free space in the parity group and multiple LDEVs exist in the group.
        - Priority 3: There is free space in the parity group and multiple LDEVs exist in the group.
      - These items are not displayed in the **Pool Configuration Patterns** table:
        - Parity groups with LDEVs that cannot be used as pool-VOLs
        - Pool configuration patterns that contain more than 1,024 LDEVs

      The information in the **Pool Configuration Patterns** table is applied to **Total Pool Volumes** and **Total Capacity** in the **Create Pools** window.
8. In **Pool Name**, enter the desired name for the pool.
9. Click **Options**.
10. In **Initial Pool ID**, type the number of the initial pool ID (from 0 to 127).

    If you specify a pool ID that is already used, the smallest available ID is displayed by default instead of the ID you specified. If a pool ID is unavailable, no number is displayed.
11. If **Subscription Limit** of the specified pool is set to 0%, an error message is displayed and the **Create LDEVs** window is not displayed.
12. In **Warning Threshold**, enter the desired warning threshold (%) for the pool (integer value from 1 to 100, default = 70%).

    If the pool used-capacity is equal to or greater than the warning threshold, a service information message (SIM) is issued by the storage system.
13. In **Depletion Threshold**, enter the desired depletion threshold (%) for the pool (integer value from 1 to 100, default = 80%). Enter a value that is equal to or greater than the warning threshold.

    If the pool used-capacity is equal to or greater than the depletion threshold, a SIM is issued by the storage system.

14. Click **Add**.

    The specified pool is added to the **Selected Pools** table. If invalid values are set, an error message is displayed.

    If an item that must be set is not entered or selected, you cannot click **Add**.

    The **Pool Type**, **Pool Volume Selection**, and **Pool Name** must be set. If these required items are not entered or selected, you cannot click **Add**.

    To view the detailed properties of a pool in the **Selected Pools** table, select the pool and click **Detail**.

    To remove a pool from the **Selected Pools** table, select the pool, click **Remove**, and then click **OK**.

15. If you want to create DP-VOLs in the new pool at this time, click **Next** to go to the **Create LDEVs** window.

    If you do not want to create DP-VOLs in the new pool at this time, click **Finish** and proceed to the next step.

16. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.

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

       \ / : , ; * ? " < > |

    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

    To view the detailed properties of a pool, select the pool and then click **Details**.

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

Creating Dynamic Tiering for Mainframe or active flash for mainframe pools by selecting pool-VOLs manually

Use this procedure to create pool-VOLs manually. These pools can be used by Dynamic Tiering and by active flash.

Note: Up to 1,024 volumes can be added including the volumes already in the pool.

For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:

- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (3D+1P)
- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (7D+1P)

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- If you are creating a pool for active flash, LDEVs for which the drive type is SSD or FMD must be created in advance.

Procedure

1. Click **Storage Systems**, expand the **Storage Systems** tree, and select **Pools**.
2. In the **Pools** window, click **Create Pools**.
3. In the **Create Pools** window, select **Dynamic Provisioning** from the **Pool Type** list.
4. From the **System Type** list, select **Mainframe**.
5. From **Multi-Tier Pool**, select **Enable**.

   If the storage system has only external volumes with the **Cache Mode** set to **Disable**, you cannot select **Enable**.
6. If the pool is to be used by active flash, select **Active Flash**.

   If there are no pool volumes available with the required drive type, this check box cannot be selected.
7. From **Pool Volume Selection**, select **Manual**.
8. Select pool-VOLs as follows:
   a. Select **Mixable**.
      - Select from **Drive Type/RPM**.

   b. In **RAID Level**, select **Mixable**.
   c. Click **Select Pool VOLs**.
   d. In the **Available Pool Volumes** table, select the pool-VOLs to be associated with the pool, and then click **Add**.

      Note: Up to 1,024 volumes can be added including the volumes already in the pool.

      For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:

      - Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (3D+1P)
      - Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (7D+1P)

      To set another tier rank for an external volume, select the desired tier rank from **External LDEV Tier Rank** and click **Add**.

      Tip:

      - To apply filter conditions to the table, click **Filter**, specify the desired conditions, and then click **Apply**.
      - To select all pool-VOLs in the table, click **Select All Pages**. To cancel the selection, click **Select All Pages** again.
      - To change the capacity unit or the number of rows to view, click **Options**.

e. In the **Select Pool VOLs** window, if the selected pool-VOLs have no issues, click **OK**.

The information in the **Selected Pool Volumes** table is applied to **Total Selected Pool Volumes** and **Total Selected Capacity** in the **Create Pools** window.

9. In **Pool Name**, enter the desired name for the pool.
10. Click **Options**.
11. In **Initial Pool ID**, type the number of the initial pool ID (from 0 to 127).

    If you specify a pool ID that is already used, the smallest available ID is displayed by default instead of the ID you specified. If a pool ID is unavailable, no number is displayed.
12. If **Subscription Limit** of the specified pool is set to 0%, an error message is displayed and the **Create LDEVs** window is not displayed.
13. In **Warning Threshold**, enter the desired warning threshold (%) for the pool (integer value from 1 to 100, default = 70%).

    If the pool used-capacity is equal to or greater than the warning threshold, a service information message (SIM) is issued by the storage system.
14. In **Depletion Threshold**, enter the desired depletion threshold (%) for the pool (integer value from 1 to 100, default = 80%). Enter a value that is equal to or greater than the warning threshold.

    If the pool used-capacity is equal to or greater than the depletion threshold, a SIM is issued by the storage system.
15. Configure Dynamic Tiering as follows:
    a. For **Tier Management**, select **Auto** or **Manual**. The selection is usually **Auto**, which allows performance monitoring and tier relocation to be performed automatically.

    If you select **Manual**, use the Command Control Interface or Hitachi Device Manager - Storage Navigator to manually perform performance monitoring and tier relocation.

    b. For **Cycle Time**, select the cycle for performance monitoring and tier relocation.

    When you select **24 Hours** (default), performance monitoring and tier relocation is performed once a day. In **Monitoring Period**, set the times to start and end performance monitoring (default is 00:00 to 23:59). Set one or more hours between the starting and ending times. If you specify a starting time that is later than the ending time, the performance monitoring continues until the ending time on the next day.

    When you select **0.5 Hours**, **1 Hour**, **2 Hours**, **4 Hours**, or **8 Hours**, performance monitoring is performed every hour that is selected, starting at 00:00. You cannot set a specific time to start performance monitoring.

Caution: When **Auto** is set, all of the V-VOL pages might not be completely migrated in one cycle. In the next cycle, migration starts by updating information for the last processed V-VOL. At that point, the collection of performance monitoring information is switched to the current cycle.

16. For **Monitoring Mode**, select **Period Mode** or **Continuous Mode**.

    If you perform tier relocation in a specified cycle, **Continuous Mode** is selected by default. If you perform tier relocation weighted to the monitoring result of the past period, select **Continuous Mode**.

17. For **Relocation Speed**, select the desired page relocation speed for the pool: **1(Slowest)**, **2(Slower)**, **3(Standard)** (default), **4(Faster)**, or **5(Fastest)**.

    - If you want tier relocation to be performed at high speed, select **5(Fastest)**.
    - If you want to minimize the data drive load when tier relocation is performed, select **1(Slowest)** or **2(Slower)**.

18. In **Buffer Space for New page assignment**, enter the percentage (%) for each tier (integer value from 0 to 50).

    The default value depends on the data drive type of the pool-VOLs in each tier: default for SSD or FMD = 0%, the other types of drives = 8%.

19. In **Buffer Space for Tier relocation**, enter the percentage (%) to set for each tier (integer value from 2 to 40, default = 2%).

20. Click **Add**.

    The specified pool is added to the **Selected Pools** table. If invalid values are set, an error message is displayed.

    The **Pool Type**, **Multi-Tier Pool**, **Pool Volume Selection**, and **Pool Name** must be set. If the required items are not registered, you cannot click **Add**.

    To view the detailed properties of a pool in the **Selected Pools** table, select the pool and click **Detail**.

    To remove a pool from the **Selected Pools** table, select the pool, click **Remove**, and then click **OK**.

21. If you want to create DP-VOLs in the new pool at this time, click **Next** to go to the **Create LDEVs** window.

    If you do not want to create DP-VOLs in the new pool at this time, click **Finish** and proceed to the next step.

22. In the confirmation window:

    a. Confirm the settings.

    b. Accept the default task name or enter a unique name.

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

       \ / : , ; * ? " < > |

    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

    To view the detailed properties of a pool, select the pool and then click **Details**.

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

Creating Dynamic Tiering for Mainframe or active flash for mainframe pools by selecting pool-VOLs automatically

Use this procedure to create pool-VOLs automatically. These pools can be used by Dynamic Tiering and by active flash.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- If you are creating a pool for active flash, LDEVs whose drive type is SSD or FMD must be created in advance.

Procedure

1. Click **Storage Systems**, expand the **Storage Systems** tree, and click **Pools**.
2. Click **Create Pools**.
3. From **Pool Type**, select **Dynamic Provisioning**.
4. From the **System Type** list, select **Mainframe**.
5. For **Multi-Tier Pool**, select **Enable**.
6. If the pool will be used by active flash for mainframe, select **Active Flash**.

   If there are no pool volumes using the required drive types, **Active Flash** cannot be selected.
7. For **Pool Volume Selection**, select **Auto**.
8. Select pool-VOLs as follows:
   a. For **Resource Group**, select the resource group name of the pool.
   b. For **Performance**, select the performance of the pool.
   c. In **Total Capacity**, specify the capacity of the pool.

      Values are displayed in **Total Pool Volumes** and **Total Capacity**. These values are greater than the specified value of the pool capacity.
   d. If you want to change the pool configuration that is automatically selected, click **Change Pool Configuration** to open the **Change Pool Configuration Pattern** window.

      In the **Pool Configuration Patterns** table, select the desired pool configuration, click **Select**, and then click **OK**.

      - You can select the pool configuration on a parity group basis.
      - The priority of the pool configuration is determined by these conditions:
        - Priority 1: There is no free space in the parity group and one LDEV exists in the group.
        - Priority 2: There is no free space in the parity group and multiple LDEVs exist in the group.
        - Priority 3: There is free space in the parity group and multiple LDEVs exist in the group.
      - These items are not displayed in the **Pool Configuration Patterns** table:
        - Parity groups with LDEVs that cannot be used as pool-VOLs
        - Pool configuration patterns that contain more than 1,024 LDEVs

      The information in the **Pool Configuration Patterns** table is applied to **Total Pool Volumes** and **Total Capacity** in the **Create Pools** window.
9. In **Pool Name**, enter the desired name for the pool.
10. Click **Options**.

11. In **Initial Pool ID**, type the number of the initial pool ID (from 0 to 127).

    If you specify a pool ID that is already used, the smallest available ID is displayed by default instead of the ID you specified. If a pool ID is unavailable, no number is displayed.

12. If **Subscription Limit** of the specified pool is set to 0%, an error message is displayed and the **Create LDEVs** window is not displayed.

13. In **Warning Threshold**, enter the desired warning threshold (%) for the pool (integer value from 1 to 100, default = 70%).

    If the pool used-capacity is equal to or greater than the warning threshold, a service information message (SIM) is issued by the storage system.

14. In **Depletion Threshold**, enter the desired depletion threshold (%) for the pool (integer value from 1 to 100, default = 80%). Enter a value that is equal to or greater than the warning threshold.

    If the pool used-capacity is equal to or greater than the depletion threshold, a SIM is issued by the storage system.

15. Configure Dynamic Tiering as follows:

    a. For **Tier Management**, select **Auto** or **Manual**. The selection is usually **Auto** which allows performance monitoring and tier relocation to be performed automatically.

       If you select **Manual**, use the Command Control Interface or Device Manager - Storage Navigator to manually perform performance monitoring and tier relocation.

    b. For **Cycle Time**, select the cycle for performance monitoring and tier relocation.

       When you select **24 Hours** (default), performance monitoring and tier relocation is performed once a day. In **Monitoring Period**, set the times to start and end performance monitoring (default is 00:00 to 23:59). Set one or more hours between the starting and ending times. If you specify a starting time that is later than the ending time, the performance monitoring continues until the ending time on the next day.

       When you select **0.5 Hours**, **1 Hour**, **2 Hours**, **4 Hours**, **8 Hours**, performance monitoring is performed every hour that is selected, starting at 00:00. You cannot set a specific time to start performance monitoring.

    Caution: When **Auto** is set, all of the V-VOL pages might not be completely migrated in one cycle. In the next cycle, migration starts by updating information for the last processed V-VOL. At that point, the collection of performance monitoring information is switched to the current cycle.

16. For **Monitoring Mode**, select **Period Mode** or **Continuous Mode**.

    If you perform tier relocation in a specified cycle or you do not need to specify the **Monitoring Mode** option, select Continuous Mode. If you perform tier relocation weighted to the monitoring result of the past period, select **Continuous Mode**.

17. For **Relocation Speed**, select the desired page relocation speed for the pool: **1(Slowest)**, **2(Slower)**, **3(Standard)** (default), **4(Faster)**, or **5(Fastest)**.

    - If you want tier relocation to be performed at high speed, select **5(Fastest)**.
    - If you want to minimize the data drive load when tier relocation is performed, select **1(Slowest)** or **2(Slower)**.

18. In **Buffer Space for New page assignment**, enter an integer value from 0 to 50 as the percentage (%) for each tier.

    The default value depends on the data drive type of the pool-VOLs in each tier: default for SSD or FMD = 0%, the other types of drives = 8%.

19. In **Buffer Space for Tier relocation**, enter the percentage (%) to set for each tier (integer value from 2 to 40, default = 2%).

20. Click **Add**.

    The specified pool is added to the **Selected Pools** table. If invalid values are set, an error message is displayed.

    If an item that must be set is not entered or selected, you cannot click **Add**.

    The **Pool Type**, **Multi-Tier Pool**, **Pool Volume Selection**, and **Pool Name** must be set. If these required items are not entered or selected, you cannot click **Add**.

    To view the detailed properties of a pool in the **Selected Pools** table, select the pool and click **Detail**.

    To remove a pool from the **Selected Pools** table, select the pool, click **Remove**, and then click **OK**.

21. If you want to create DP-VOLs in the new pool at this time, click **Next** to go to the **Create LDEVs** window.

    If you do not want to create DP-VOLs in the new pool at this time, click **Finish** and proceed to the next step.

22. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.

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

       \ / : , ; * ? " < > |

    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

    To view the detailed properties of a pool, select the pool and then click **Details**.

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

Working with DP-VOLs

Dynamic Provisioning for Mainframe requires the use of DP-VOLs, which are virtual volumes with no physical memory space. In Dynamic Provisioning for Mainframe, multiple DP-VOLs can be created.

About DP-VOLs

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.

You can define multiple DP-VOLs and assign them to a Dynamic Provisioning for Mainframe pool.

On mainframe systems, the supported emulation type for DP-VOLs is 3390-A.

Relationship between a pool and DP-VOLs

Before you can use Dynamic Provisioning for Mainframe, a DP-VOL and a pool are required. Dynamic Provisioning for Mainframe uses the pool volumes in a pool through the DP-VOLs.

Creating DP-VOLs

Note:

- The page reservation function cannot be used for the following pools. Therefore, it is necessary to monitor the free space of the pools to prevent the non-writable state due to the full pool status.
  - Pools with capacity saving enabled.
- The T10 PI attribute can be set only when creating LDEVs. The attribute cannot be released from the LDEVs for which the T10 PI attribute is set.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- If you are creating DP-VOLs for active flash for mainframe, pool volumes whose drive type is SSD or FMD must be installed in advance.

Procedure

1. Click **Storage Systems**, and expand the **Storage Systems** tree.
2. Click **Logical Devices**.
3. Click **Create LDEVs**.
4. From **Provisioning Type** in the **Create LDEVs** window, confirm **Dynamic Provisioning** is selected.

   If not, select **Dynamic Provisioning**.
5. In the **System Type** option, select a system type.

   To create mainframe volumes, select **Mainframe**.
6. From **Emulation Type**, confirm that **3390-A** is selected.
7. If you want to create a V-VOL for Dynamic Tiering for Mainframe, select **Enable** from the **Multi-Tier Pool** field. If not, select **Disable**.

   If no pool is set to **Enable** in Dynamic Tiering for Mainframe, **Disable** is fixed.

   Note: You cannot specify the **TSE Attribute** option when selecting **Open** in the **System Type** option.
8. If you are creating a TSE-VOL, select **Enable** in the **TSE Attribute** option. If not, select **Disable**.

   If you do not have the license for Compatible FlashCopy® SE, you can select only **Disable** in **TSE Attribute**. In addition, if there are no LDEV IDs that can be used as TSE-VOLs, you can select only **Disable** in **TSE Attribute**.

Note:

- You can specify the **TSE Attribute** function only when **Mainframe** is selected in the **System Type** option.
- You can specify the **TSE Attribute** function only when **Disable** is selected in the **Multi-Tier Pool** field.
- For TSE-VOL, if the associated pool ID is an odd number, the odd number is automatically assigned as the CU number for the LDEV being created. If the associated pool ID is an even number, the even number is automatically assigned as the CU number for the LDEV being created.

9. If the pool is to be used by active flash for mainframe, select **Active Flash**.

   If there are no pool volumes available using the required drive types, this check box cannot be selected.

10. Select the pool as follows:
    a. Select a drive.
       - Select from **Drive Type/RPM** in **Pool Selection**.
    b. From **RAID level**, select the RAID level.
    c. Click **Select Pool**.
    d. In the **Select Pool** window in the **Available Pools** table, select a pool.

       Note:

       You can specify a pool when creating DP-VOLs if the pool status is one of these:

       - Normal
       - Exceeded Threshold
       - In progress of pool capacity shrinking

       You can select only one pool. When **Enable** was selected previously, the Dynamic Tiering for Mainframe pools are displayed, and when **Disable** is selected, only the non-Dynamic Tiering for Mainframe pools are displayed.

       Perform these steps 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 is no longer displayed. The selected pool name is displayed in **Selected Pool Name (ID)**, and the total capacity of the selected pool is displayed in **Selected Pool Capacity**.

11. In **LDEV Capacity**, enter the DP-VOL capacity to be created.

    You can enter the capacity within the range of figures displayed below the text box. The capacity unit is fixed to **Cyl**.

12. In **Number of LDEVs**, enter the number of LDEVs to be created.

    You can enter the number of LDEVs within a range of the figures displayed.

13. In **LDEV Name**, enter these characters:

    - In **Prefix**, enter the alphanumeric characters, which are fixed characters of the head of the DP-VOL name. The characters are case-sensitive.
    - In **Initial Number**, enter the initial number following the prefix name, which can be up to 9 digits.

    You can enter a total of 32 characters including the initial number.

14. Click **Options**.
15. In **Initial LDEV ID**, 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.

    In the table, used LDEV numbers are displayed in blue, unavailable numbers are displayed in gray, and unused numbers are displayed in white. LDEV numbers that are unavailable may already be in use or already assigned to another emulation group (group by 32 LDEV numbers).

    When a mainframe volume or multi-platform volume is created, corresponding LDEV numbers cannot be specified if these values are not identical: - model/serial numbers of the virtual storage machine and the storage system - LDEV ID and the virtual LDEV ID.

    Note: When you create TSE-VOL if you select the pool and display the **View LDEV IDs** window, the displaying when the selected pool ID is an odd number is different from the displaying when the selected pool ID is an even number. If the selected pool ID is an odd number, all the LDEV IDs belonging to the CU whose ID is an even number are displayed as disabled (the cell color is gray). If the selected pool ID is an even number, all the LDEV IDs belonging to the CU whose ID is an odd number are displayed as disabled (the cell color is gray).

16. In **Initial SSID**, type the 4-digit SSID of a hexadecimal number (0004 to FFFE).

    To confirm the created SSID, click **View SSIDs** to display the **View SSIDs** window.

    Caution: For the SSID of an LDEV used by mainframe hosts, set a value in the range specified as SSID requirements. If you set a value outside the specified range, mainframe hosts might not be able to use the LDEV.

17. From **Cache Partition**, select CLPR.
18. From **MP Unit**, select an MP unit.

    Select an MP unit to be used by the LDEVs. If you assign a specific MP unit, select the ID of the MP unit. If you can assign any MP unit, click **Auto**.

19. From **Full Allocation**, select **Enable** or **Disable**. To reserve pages in the pool that are the same size as the LDEV capacity, select **Enable**.

20. From **Tiering Policy**, 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.

    From Level6(6) to Level31(31), the names of tiering policies can be changed. If these names have changed, the new names are displayed.

21. From **New Page Assignment Tier**, select a new page assignment tier that is used for LDEVs.

    You can specify the function when the **Multi-Tier Pool** is enabled.

22. In **Relocation Priority**, select a priority.

    You can specify this function when the **Multi-Tier Pool** is enabled.

23. If necessary, change the settings of the V-VOLs.

    Click **Change LDEV Settings** to open the **Change LDEV Settings** window.

24. If necessary, delete a row from the **Selected LDEVs** table.

    Select a row to be deleted, then click **Remove**.

25. Click **Add**.

    The created V-VOLs are added to the right **Selected LDEVs** table. If invalid values are set, an error message is displayed.

    The **Pool Type**, **Pool Volume Selection**, and **Pool Name** must be set. If these required items are not entered or selected, you cannot click **Add**.

26. If you want to add LUN paths, click **Next**. If not, click **Finish**.
27. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.

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

       \ / : , ; * ? " < > |

    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
28. Click **Apply** to submit the task.

Editing the SSID of a DP-VOL

Before registering a DP-VOL, you might need to use this procedure to edit the SSID of the DP-VOL. The SSID is a hexadecimal value.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, click **Create LDEVs**.

4. In the **Selected LDEVs** table of the **Create LDEVs** window, click **Edit SSIDs**.

   In the **Edit SSIDs** window, the **SSIDs** table shows the existing SSIDs and those to be added.
5. If you want to change the SSID, select the appropriate LDEV, and then click **Change SSIDs**.
6. In the **Change SSIDs** window, type the new SSID in hexadecimal format, and then click **OK**.
7. In the **Edit SSIDs** window, click **OK**.
8. Click **Finish**.
9. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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

Workflow for migrating V-VOL data

When you migrate V-VOL data through the host, unallocated areas of the volume might 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 the 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 for each V-VOL.

   When data migration is done on a file-by-file basis, perform the operation to reclaim zero pages only if necessary. For a volume copy or the physical copy, the operation to reclaim zero pages is unnecessary.

To restore the backup data

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

Monitoring of capacity and performance

Monitoring pools and DP-VOL might pinpoint lagging throughput and slow operating rates. Subsequent tuning might increase these rates.

Monitoring of 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, the storage system issues service information messages (SIMs) and SNMP traps.

You can provision a larger virtual capacity beyond the pool capacity by using DP-VOLs of Dynamic Provisioning for Mainframe. 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.

Caution: Make sure that the capacity use rate of a pool containing virtual volumes with capacity saving functions enabled does not reach 100%. If the pool capacity use rate reaches 100%, these maintenance operations cannot be performed:

- Maintenance operations for controller (including addition or removal of cache memory)
- Adding or removing shared memory
- Microcode replacement with the power turned off or offline

SNMP traps are reported if the pool capacity use rate exceeds the threshold. If the pool use rate reaches 100%, SIM code 62Axxx (Moderate) is reported.

Note: The pool usage rate values displayed on the GUI are truncated after the decimal point. For example, when the actual pool usage rate is 50.4%, the GUI displays 50%. If the threshold is set to 50%, a SIM and an SNMP trap are reported, even though the pool usage rate displayed on the GUI does not indicate that the threshold is exceeded.

Monitoring of pools and DP-VOLs

The following activities help you to monitor and control performance of DP-VOLs. Collecting monitor information and subsequent tuning might increase throughput and operating rates.

- Collecting monitor information:

  Collecting the following monitor information helps you determine the pool load (including the access frequency and the access load upon data drives) and DP-VOL load (including the access frequency). You can then use this monitor information to tune the appropriate allocation.

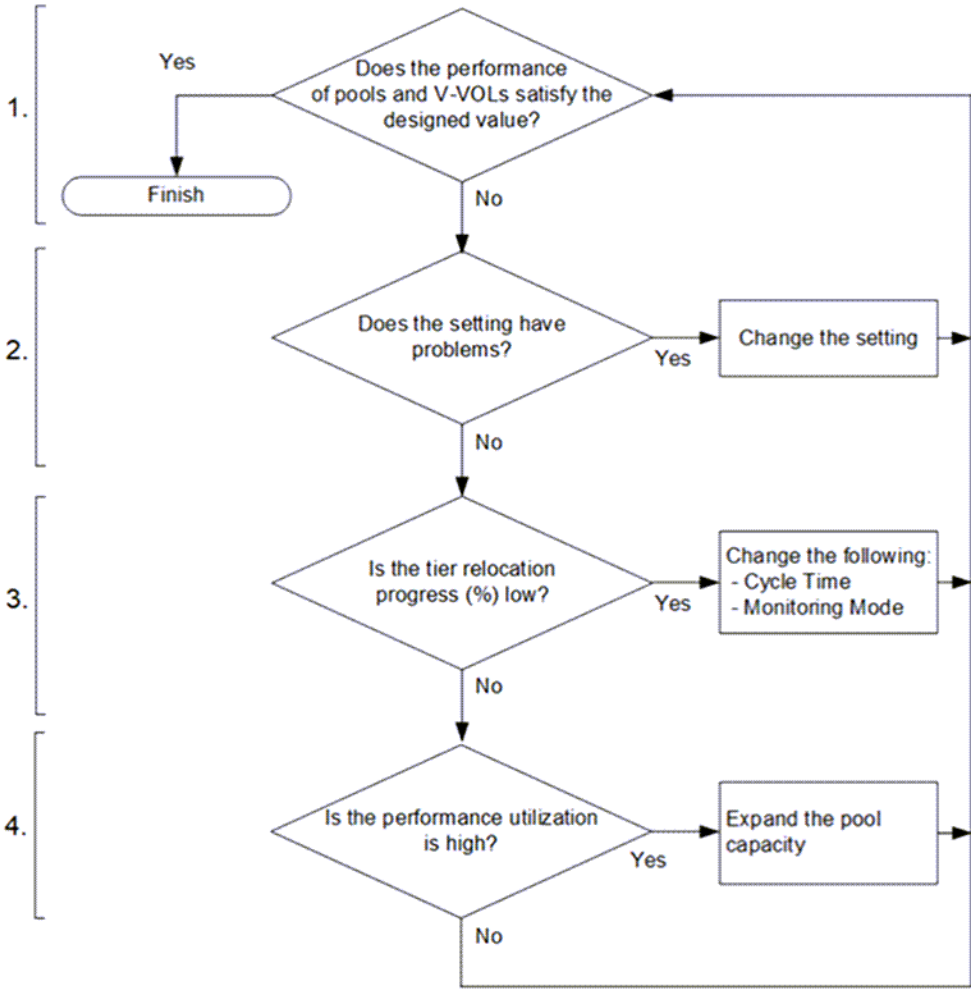
  - Access frequency of DP-VOL, read hit rates, and write hit rates (using Performance Monitor)
  - Usage rates of parity groups of pools (using Performance Monitor)
  - Pool usage (using Hitachi Device Manager - Storage Navigator)
  - DP-VOL usage (using Hitachi Device Manager - Storage Navigator)
  - Dynamic Tiering for Mainframe performance monitoring of pool storage
- Possible tuning actions (without Dynamic Tiering for Mainframe):

  These techniques using ShadowImage for Mainframe or Hitachi Tiered Storage Manager for Mainframe will move a DP-VOL:

  - The DP-VOL is copied using ShadowImage for Mainframe from a pool with an I/O bottleneck.
  - 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 the *Hitachi Command Suite User Guide*.
  - ShadowImage for Mainframe copies a DP-VOL with a high I/O load to a pool with a lower access level to adjust the pool load.

Performance improvement by monitoring pools

When the multi-tier pool is enabled, and the performance of the pools and DP-VOLs is not as expected, use this workflow to detect problems and improve the performance.



1. Confirm the performance of pools and DP-VOLs.

Using Performance Monitor, confirm the performance of pools and DP-VOLs. If the performance of pools and DP-VOLs is poor, go to Step 2.

2. Confirm the Dynamic Tiering setting.

Using Hitachi Device Manager - Storage Navigator or Command Control Interface, confirm the Dynamic Tiering setting. If the values are set but do not conform to the design of pools or LDEVs, change the settings. If the values are set and conform to the design of pools or LDEVs, go to Step 3.

3. Confirm and improve the progress of tier relocation processing.

Confirm the progress of tier relocation processing in Completed Rate (%) in the tier relocation log file. If the progress of the tier relocation process is low, there might be many pages where the page allocation is not optimized. In this case, change the Monitoring Mode or Cycle Time. Best practice is to use these values:

- Monitoring Mode: If Period Mode is set, change to Continuous Mode.
- Cycle Time: Set a longer period than the current setting.

If these values are already set or if the progress of tier relocation processing is still low even after the settings are changed, go to Step 4.

4. Confirm performance utilization of each tier.

You can confirm the performance utilization of each tier in the **Tier Properties** window or with the **`raidcom get dp_pool`** command. The performance utilization is the ratio (%) of the number of I/Os against the performance potential of the tier. For example, if the performance utilization is 90% or more, a workload greater than the processing capacity of the tier is being applied to the tier.

If performance utilization is 90% or more on one or more of the tiers, or if Performance Utilization is 60% on all tiers, add drives and expand the pool capacity.

1. If performance utilization is 90% or more on a tier:

Add drives to the tier where performance utilization is 90% or more and confirm the usage ratio of the capacity. Best practice is to add these drives:

Drives to be added to the tier where performance utilization is 90% or more	Pool volumes to be added
SSD or FMD	Add pool volumes with the same drive type.
HDD/10 krpm or HDD/15 krpm	If the performance is given greater priority than the bit-cost: Add SSD or FMD pool volumes. If the bit-cost is given greater priority than the performance: Add HDD/10 krpm or HDD/15 krpm pool volumes. However, add SSD or FMD pool volumes if the capacity utilization of the HDD tier (HDD/10 krpm or HDD/15 krpm) is low.
HDD/7.2 krpm	If the performance is given greater priority than the bit-cost: Add HDD (HDD/10 krpm or HDD/15 krpm) pool volumes. If the bit-cost is given greater priority than the performance: Add HDD/7.2 krpm pool volumes. However, add HDD (HDD/10 krpm or HDD/15 krpm) pool volumes if the capacity utilization of the HDD/7.2 krpm tier is low.

2. If performance utilization is 90% or more on two or more tiers:

a. Collect the frequency distribution on the **Tier Properties** window.

b. From the frequency distribution and the performance limit of each tier, seek the ratio of the most suitable tier capacity.

The performance limit of tier 2 is the maximum average IOPH on one page that the drive related to tier 2 can process. The performance limit of tier 3 is the maximum average IOPH on one page that the tier 3 drive can process. Based on these values, calculate the most suitable tier capacity for the tier 1, tier 2, and tier 3.

- The most suitable tier capacity for tier 1: The capacity from 0 GB to the capacity related to the performance limit of tier 2
- The most suitable tier capacity for tier 2: The capacity from the performance limit of tier 2 to tier 3 of that capacity
- The most suitable tier capacity for tier 3: The capacity from the performance limit of tier 3 to the maximum capacity of tier 3.

Then, based on the most suitable tier capacity for each tier, calculate the most suitable capacity ratio of tier 1, tier 2, and tier 3 as follows:

The most suitable tier capacity for tier 1 : The most suitable tier capacity for tier 2 : The most suitable tier capacity for tier 3

c. Compare the ratio of the real tier capacity to the ratio of the most suitable tier capacity.

Comparing the ratio of tier capacity	Pool volumes suggested to be added
The ratios of the most suitable tier capacity and real tier capacity are different.	Add pool volumes to the tier that is lacking capacity.
The ratios of the most suitable tier capacity and real tier capacity are the same.	If the performance is given greater priority than the bit-cost: Add SSD, FMD, or HDD (HDD/10 krpm or HDD/15 krpm) pool volumes. If the bit-cost is given greater priority than the performance: Add HDD (HDD/10 krpm or HDD/15 krpm) pool volumes. However, add SSD or FMD pool volumes if the capacity utilization of the HDD tier (HDD/10 krpm or HDD/15 krpm) is low.

d. Add drives and expand the pool capacity.

3. In the case that performance utilization is 60% on all tiers:

Add drives in the upper tier and expand the pool capacity.

Monitoring pools using thresholds

Dynamic Provisioning for Mainframe monitors pool capacity using thresholds. A threshold is the proportion (%) of the used capacity of the pool to the total capacity of the pool.

Pool utilization thresholds

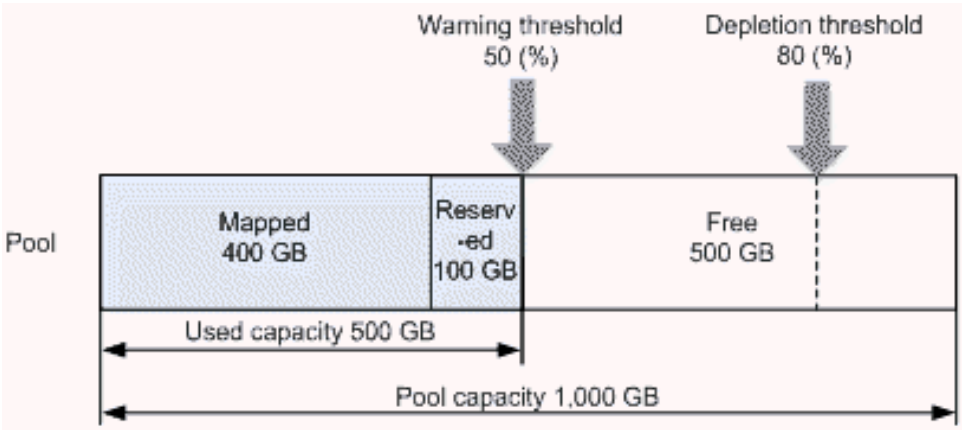
When the used capacity of a pool reaches or exceeds the utilization thresholds set for the pool, you will be alerted so that you can take the appropriate action.

You can set these threshold values for each pool:

- Warning threshold: Range = 1% to 100%, in 1% increments. Default = 70%.
- Depletion threshold: Range = 1% and 100%, in 1% increments. Default = 80%. The depletion threshold must be higher than the warning threshold.

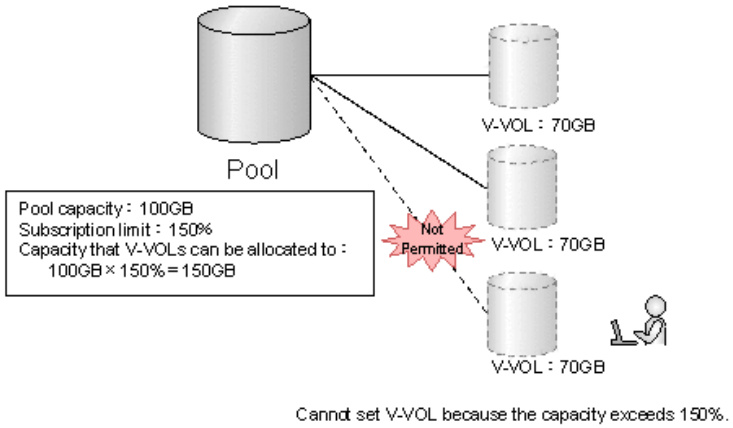
If the pool used-capacity is equal to or greater than the warning or depletion threshold, a service information message (SIM) is issued by the storage system. SIMs are displayed by Device Manager - Storage Navigator and other management software and reported to the open-system hosts as SNMP traps.

The following figure shows a pool with a total pool capacity of 1,000 GB that has a warning threshold of 50% and a depletion threshold of 80%. If the used capacity of this pool is equal to or greater than 50% (500 GB) of the total pool capacity (the warning threshold), a SIM and an SNMP trap are reported. If the used capacity of this pool increases further and is equal to or greater than the depletion threshold (80%), another SIM and SNMP trap are reported.



Pool Subscription limit

This figure depicts setting the subscription limit of pool capacity.



The value of using a 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.

If the subscription limit is set to a value that exceeds 100%, or if the subscription limit is not set, you need to monitor the free capacity of the pool because a DP-VOL larger than the pool capacity might be created.

In a pool window, the value displayed for Current Subscription (%) is obtained after the calculated subscription limit is rounded down to integer. Therefore, the rate of the capacity of DP-VOLs associated to the pool might be larger than the subscription (%) displayed in the window. If you create a DP-VOL whose capacity is the same as the capacity of the existing DP-VOL, a larger value than the current subscription (%) displayed in the window is required.

Note:

If you are using a pool comprised of pool-VOLs assigned to accelerated compression-enabled parity groups, the pool subscription limit is defined with respect to the pool capacity not reserved for writing. In this case, the free area of the pool must be monitored even if the subscription limit is defined to 100%.

If you do not want to monitor the free area of the pool, specify the subscription limit conforming to this formula:

pool-capacity / pool-capacity-reserved-for-data-writing * subscription-limit = 100%

For example, if 100 TB of the pool capacity and 80 TB of the pool capacity reserved for writing exist, specify 80% as the subscription limit.

Monitoring of 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 with 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.

The used value displayed in Current in 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 in the window. If you create a new DP-VOL of the same size as the existing DP-VOL, the larger capacity which is displayed in Current is necessary.

In this case, 25% is displayed in Current in Subscription (%). If you create a new V-VOL of the same size as the existing V-VOL, 26% or more remaining capacity is necessary.

For example, if a 262,668-Cyl V-VOL is assigned to a 41,574-cylinder pool, the capacity (%) is calculated as follows:

(262668 / 41574) * 100 = 631.80....(%)

In this case, 631% is displayed in Current in Subscription (%). If you create a new V-VOL of the same size as the existing V-VOL, 632% or more remaining capacity is necessary.

Changing pool thresholds

Caution:

- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.
- If you need to perform two or more operations to edit several items in the same pool, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system, so the result might be different from what you expect.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. In the **Edit Pools** window, check **Warning Threshold** and **Depletion Threshold**.
5. Enter the threshold values.

   The threshold value can be within the range of values indicated below the text box (default 70%). The **Depletion Threshold** value must be equal to or greater than the **Warning Threshold** (default 80%).
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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

Changing the pool subscription limit

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, select the pool with the threshold you want to change.
4. Click **More Actions** > **Edit Pools**.
5. In the **Edit Pools** window, check **Subscription Limit**, and then type the subscription limit percentage (an integer value (%) between 0 and 65534).

   If the subscription limit is blank, then it is disabled, and any number of DP-VOLs can be created regardless of the pool free capacity.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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

Working with SIMs

Service information messages (SIMs) report the status of Dynamic Provisioning for Mainframe DP-VOLs and pools when specific events occur.

About SIMs

Dynamic Provisioning for Mainframe provide service information messages (SIMs) to report the status of the DP-VOLs and pools. If an event associated with a pool occurs, a SIM and an SNMP trap are reported.

An example of a SIM condition is when the used capacity of a pool reaches or exceeds the warning threshold set for the pool. For example, if the warning threshold is set to 50% and the used capacity of the pool reaches or exceeds 50%, a SIM and an SNMP trap are reported.

SIMs for Dynamic Provisioning for Mainframe/Dynamic Tiering

This table lists and describes the SIM reference codes associated with Dynamic Provisioning for Mainframe and Dynamic Tiering operations and provides solutions for the conditions.

SIM code (SIM level)	Event	Thresholds or values	Types of reports		Solutions
			Sent to host?	Sent to maintenance personnel?	
629xxx (Moderate) xxx = hexadecimal pool number	Dynamic Provisioning pool usage level (Used (1%)) exceeded the Warning Threshold	1% to 100% (in 1% increments) Default: 70%	Yes	No	Solutions ▪ Reclaim zero data pages to release pages in which zero data are stored.
62Axxx (Moderate) xxx = hexadecimal pool number	Dynamic Provisioning pool is full	100%	Yes	No	Solutions ▪ Reclaim zero data pages to release pages in which zero data are stored.
623xxx (Moderate) xxx = hexadecimal pool number	Error occurred in the Dynamic Provisioning pool	Not applicable	Yes	Yes	Contact customer support.
624000 (Moderate)	No space in the shared memory	Not applicable	Yes	Yes	Solutions ▪ Remove pools that are not used. ▪ Remove DP-VOLs that are not used. ▪ Shrink the pool capacities.

SIM code (SIM level)	Event	Threshold s or values	Types of reports		Solutions
			Sent to host?	Sent to maintenance personnel?	
62B000 (Moderate)	Dynamic Provisioning pool usage level (Used (1%)) continues to exceed the highest pool threshold. SOM 734 must be enabled.	Highest pool threshold of Dynamic Provisioning	Yes	No	Solutions ▪ Reclaim zero data pages to release pages in which zero data are stored.
62Cxxx (Moderate) xxx = hexadecimal pool number	Dynamic Provisioning Pool usage level (Used (1%)) exceeded the Depletion Threshold	1% to 100% (in 1% increments) Default: 80%	Yes	No	Solutions ▪ Reclaim zero data pages to release pages in which zero data are stored.
62Dxxx (Moderate) xxx = hexadecimal pool number	In the Dynamic Provisioning pool, the used capacity reserved for writing exceeded the Prefixed Depletion Threshold.	90%	Yes	No	Solutions ▪ Reclaim zero data pages to release pages in which zero data are stored.
627xxx (Moderate) xxx = hexadecimal pool number	Pool-VOL is blocked	Not applicable	Yes	Yes	Contact customer support.

SIM code (SIM level)	Event	Thresholds or values	Types of reports		Solutions
			Sent to host?	Sent to maintenance personnel?	
641xxx (Service) xxx = hexadecimal pool number	In the Dynamic Tiering pool, the tier relocation operation is suspended by the system. This SIM can be displayed if "Notify an alert when tier relocation is suspended by system" is enabled on the **Edit Advanced System Settings** window.	Not applicable	Yes	No	Determine why the tier relocation was suspended.

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. The procedure described below is not required for the automatically completed SIM.

The 629xxx, 62B000, and 62Cxxx SIMs are automatically completed if you increase pool capacity by adding pool-VOLs because increasing pool capacity removes the condition that caused the SIM.

These SIMs are automatically completed in the following cases:

- SIM 629xxx

  If the physical capacity (Used (%)) of DP pool number xxx falls below the warning threshold, SIM is automatically completed.

- SIM 62B000

  If the physical capacity (Used (%)) of each DP pool in all pools of the storage system falls below the depletion threshold, SIM is automatically completed.

- SIM 62Cxxx

  If the usage level (Used (%)) of DP pool number xxx falls below the warning threshold, SIM is automatically completed.

Manually completing a SIM

Some SIMs associated with pools must be manually completed to clear them from the system. After the condition that caused the SIM is resolved, 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 cause is resolved, the SIM might reoccur.

Use the procedure described below to manually complete the following SIMs. If a problem that causes the SIM is not resolved, the SIM cannot be complete.

- A SIM associated with a pool in the normal status
- A SIM associated with a removed pool

Before you begin

- Perform the troubleshooting associated with the issued SIM to resolve the condition that caused the SIM.
- The Storage Administrator (Provisioning) role is required to perform this task.
- The Storage Administrator (System Resource Management) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, click **More Actions** > **Complete SIMs**.
4. In the **Complete SIMs** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

5. Click **Apply** to submit the task.
6. To check whether a SIM completed successfully, click **Alert** in the Device Manager - Storage Navigator main window.

Managing pools and DP-VOLs

Observe these cautions when working with pools.

Caution:

- In one pool, if you need to perform two or more operations to edit several items, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system.
- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.

Viewing pool information

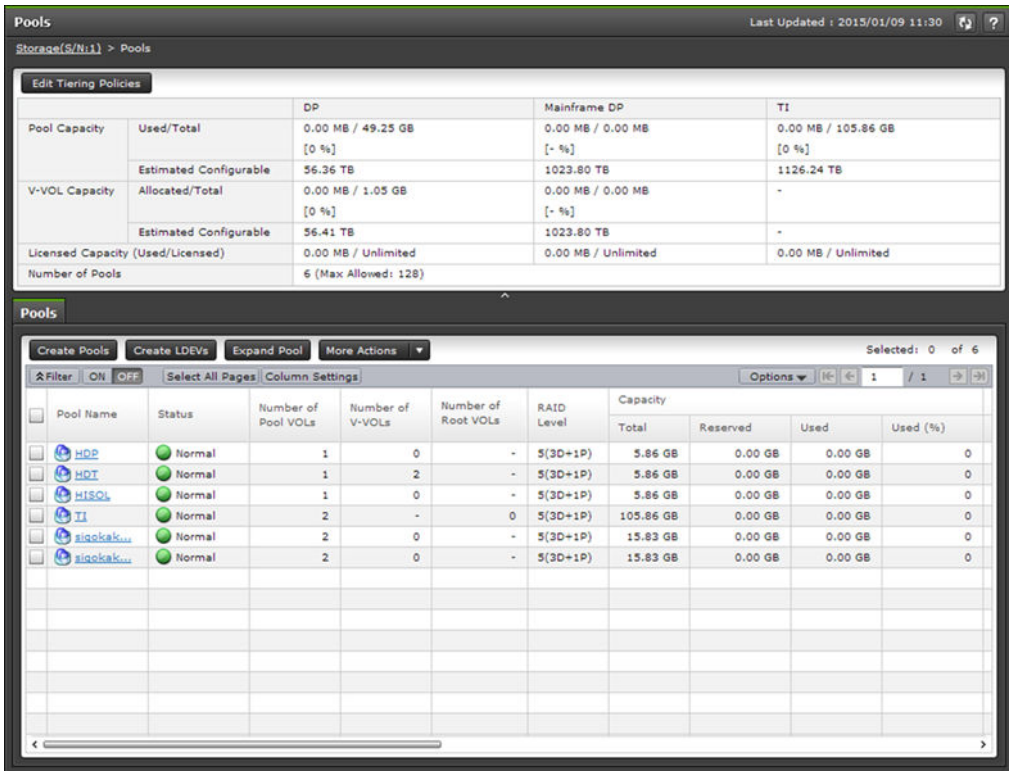
Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

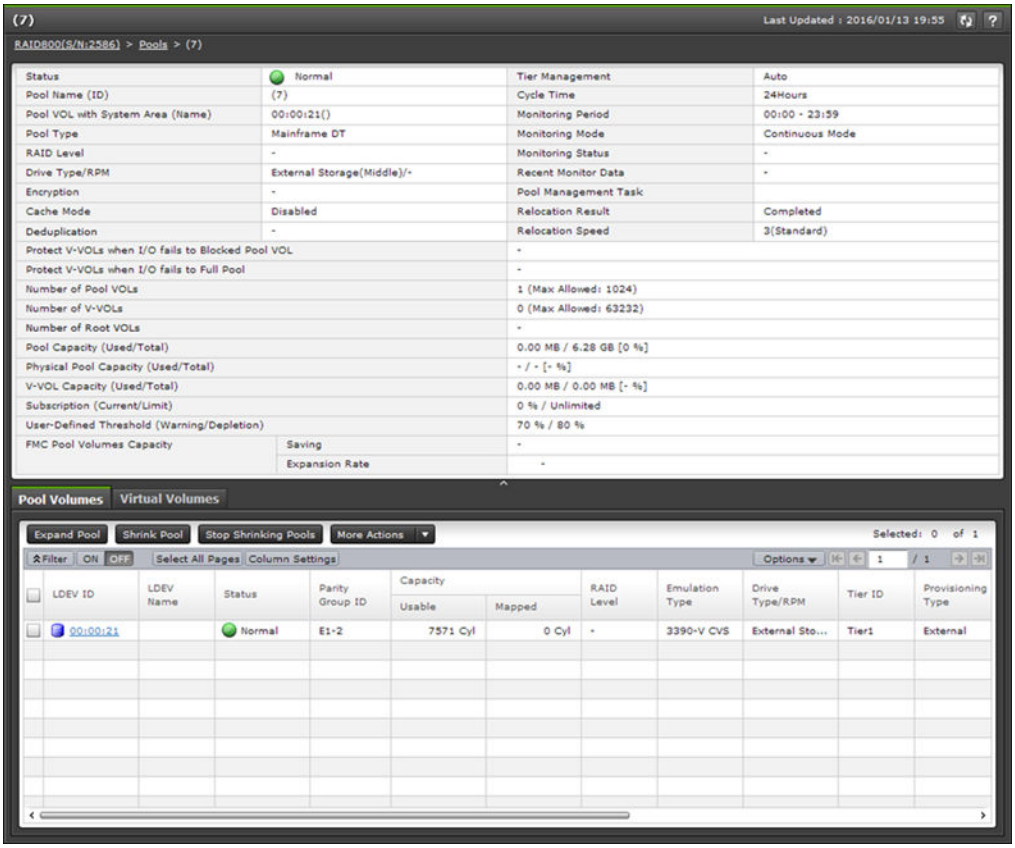
Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.

   The **Pools** window displays information about all of the pools in the storage system.



3. To view details about a specific pool, expand **Pools**, and then select the desired pool.



Viewing the capacity information for a pool

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.

   The **Pools** window contains information about the pool capacity, the V-VOL capacity, and the licensed capacity. The **Pools** tab contains detailed information about each pool.

   Caution: In **Licensed Capacity(Used/Licensed)**, 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.

Viewing formatted percentages for pool capacity

Use this procedure to view the formatted pool capacity.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, click the row of a pool with the free pool capacity you want to check.
4. Click **More Actions** > **View Pool Management Status**.

   The **View Pool Management Status** window is displayed.

Reasons to check pool capacity

These are cases in which the free space of the pool is not formatted. In these cases, the free space of the pool might not increase:

- Pools other than the selected pool are being formatted.
- The pool usage level reaches 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 that are external volumes in the selected pool are blocked.
- Correction access executes to the pool-VOL in the selected pool.

These are cases in which the formatted percentages for pool capacity might 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 parity groups

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, click the pool for which you want to check the progress of rebalancing the usage level among parity groups.
4. Click **More Actions** > **View Pool Management Status**.

   The **View Pool Management Status** window is displayed.

Note: The progress ratio might not increase in these instances:

- The usage level is being rebalanced among the parity groups in pools other than the selected pool.
- Tier relocation is performed.

Expanding a pool

To expand a pool (that is, increase the capacity of the pool), add pool-VOLs to the pool.

- You cannot expand a pool while the pool is being shrunk.
- When you add pool volumes to a Dynamic Tiering pool, tier relocation activities that are in process are stopped.
- When you add pool volumes with available monitoring information to a Dynamic Tiering pool, tier relocation is performed. When you add pool volumes without available monitoring information to a pool, the page usage rate is averaged in the tier.

Note: Up to 1,024 volumes can be added including the volumes already in the pool.

For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:

- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (3D+1P)
- Volume whose drive type is HDD/10 krpm and whose RAID level is 5 (7D+1P)

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table or the **Pool Volumes** tab on which you select the target pool name, select the pool you want to expand.

   You can expand only one pool at a time.
4. Click **Expand Pool**.
5. 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-VOLs you want to add to the pool, and then click **Add**.

      Pool considerations:

      - The pool can contain up to 1,024 pool-VOLs.
      - For a pool, you can add volumes whose drive type is the same and whose RAID levels are different. For example, you can add these volumes to the same pool:
        - Volumes whose drive type is HDD/15 krpm and whose **RAID Level** is 5 (3D +1P)
        - Volumes whose drive type is HDD/15 krpm and whose **RAID Level** is 5 (7D +1P)

      The selected pool-VOLs are registered in the **Selected Pool Volumes** table.

      Note: If necessary, perform these steps:

      i. From **Filter option**, select **ON** to filter the rows.
      ii. Click **Select All Pages** to select pool-VOLs in the table. To cancel the selection, click **Select All Pages** again.
      iii. Click **Options** to specify the unit of volumes or the number of rows to be viewed.
      iv. To set the tier rank of an external volume to a value other than **Middle**, select a tier rank from **External LDEV Tier Rank**, then click **Add**.

   c. Click **OK**.

      The **Select Pool VOLs** window is no longer displayed. The number of the selected pool volumes is displayed in **Total Selected Pool Volumes**, and the total capacity of the selected pool-VOL is displayed in **Total Selected Capacity**.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.

b. Accept the default task name or enter a unique name.

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

\ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Changing a pool name

Caution:

- If you modified pool parameters by using Command Control Interface and then use Device Manager - Storage Navigator, click File > Refresh All to display the latest pool information before performing the next operation by using Device Manager - Storage Navigator. If you use Device Manager - Storage Navigator without refreshing the windows, the information updated by Command Control Interface might not yet be displayed on the Device Manager - Storage Navigator windows, so if you perform an operation the result might be different from what you expect.
- If you need to perform two or more operations to edit several items in the same pool, wait until the first task has been applied before performing the next task. If the next task is performed while the first task is being applied, the first task is canceled and the next task is applied to the storage system, so the result might be different from what you expect.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** table, select the pool you want to edit, and then click **More Actions** > **Edit Pools**.
4. In the **Edit Pools** window, in **Pool Name**, specify a name for this pool.
5. Click **Finish**.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
7. Click **Apply** to submit the task.

Recovering a blocked pool

You can perform 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.

Tip: 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 might vary depending on the workload of the storage system at the time of recovery.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, select the pool to be recovered.
4. Click **More Actions** > **Restore Pools**.
5. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
6. Click **Apply** to submit the task.

Decreasing pool capacity

You can decrease the capacity of (shrink) Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe pools.

About decreasing pool capacity

When you want to decrease the capacity of, or shrink, a pool, you delete one or more pool volumes (pool-VOLs) from the pool. When a pool-VOL is removed from a pool, all of the used pages in the pool-VOL are moved to other pool-VOLs in the pool. If you delete the pool-VOL with the pool's system area, the used capacity and the management area are moved to other pool-VOLs in the pool. A pool must include one or more pool-VOLs.

When you decrease the pool capacity or delete a pool, the released pool-VOLs (LDEVs) are blocked. You must format the blocked pool-VOLs (LDEVs) before you can use them. If the blocked pool-VOL is an external volume, use Normal Format when formatting the volume.

Note: You cannot perform the following operations on a pool while the shrink pool operation is in process. Wait until shrinking completes, or stop the shrinking process.

- Expand Pool
- Shrink Pools
- Edit Pools
- Restore Pools

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. If multiple pool-VOLs of the same drive type exist, the priority of each is determined by internal index of the storage system.

Priority	Data drive type
1	HDD/7.2 krpm
2	HDD/10 krpm
3	SSD or FMD
4	External volume

Notes on shrinking a Dynamic Provisioning for Mainframe pool

You cannot delete a pool-VOL from a Dynamic Provisioning for Mainframe pool under these conditions:

- If the pool-VOL is deleted, the total of the used pool capacity will exceed the pool depletion threshold.
- If the pool-VOL is deleted, the subscription (the ratio (%) of the total capacity of DP-VOLs including the control information to the total capacity of the pool) will exceed the subscription limit. For more information about how to calculate the DP-VOL capacity including the control information, see Pool Subscription limit (on page 172).
- If the pool-VOL with system area is deleted, the free space in the pool will be less than 3.8 GB.
- For an active flash pool, when there will be no remaining pool-VOLs from a parity group of SSDs or FMDs.

Notes on shrinking a Dynamic Tiering for Mainframe pool

- You cannot delete a pool-VOL from a Dynamic Tiering for Mainframe pool under these conditions:
  - If the pool-VOL is deleted, the total of the used pool capacity will exceed the pool depletion threshold.
  - If the pool-VOL is deleted, the subscription (the ratio (%) of the total capacity of DP-VOLs including the control information to the total capacity of the pool) will exceed the subscription limit. For more information about how to calculate the DP-VOL capacity including the control information, see Pool Subscription limit (on page 172).
  - If the pool-VOL with system area is deleted, the free space in the pool will be less than 3.8 GB.
  - For active flash pools, when there will be no pool volume remaining with SSD or FMD drive types if you delete the pool volume.
- 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 tier are empty, the appropriate tier is deleted.
- Deleting the pool-VOL stops the tier relocation. The process resumes after the pool-VOL is deleted.

Shrinking a pool

To shrink a pool, that is, decrease the capacity of a pool, you remove the specified pool volumes from the pool. You can shrink up to eight pools at the same time.

Note these restrictions:

- You cannot shrink a pool when any of these operations is in process in the target pool:
  - The pool is being created or deleted.
  - The pool capacity is being increased or decreased.
  - The pool is being recovered.
  - The Shrink Pool operation is being stopped.
  - The threshold is being changed.
  - Zero pages are being reclaimed.
  - DP-VOLs are being created.
  - DP-VOL capacity is being increased.
- If you shrink a pool soon after creating or expanding the pool, the shrink pool operation might take a while to complete.
- If the drive type of pool-VOL being deleted is an LDEV belonging to a parity group of FMDs, the pool shrinking operations take some time due to formatting unallocated area and releasing pages.

- If the shrink pool operation is already in progress on a pool, do not issue a CCI command to the same pool to decrease the capacity of the pool.
- If the pool volumes being removed belong to a parity group that supports accelerated compression, the shrink pool operation takes more time because the unallocated area is formatted and the pages are reclaimed.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**, and then select the pool that you want to shrink.
3. On the **Pool volumes** tab, select the pool-VOL to be removed.

   You can delete the pool-VOL when **Yes** is displayed in the **Shrinkable** column.
4. Click **Shrink Pool**.
5. In **Task Name**:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
6. In **Estimated Result of Shrinking**, review the details of **Before Shrinking** and **After Shrinking**, including the total pool capacity, the used pool capacity, and the free pool capacity.
7. If the estimated result of shrinking is acceptable, click **Apply** to submit the task.

Stopping the decrease of pool capacity

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, select the pool with the capacity you want to stop decreasing.
4. Click **Stop Shrinking Pools**.
5. Click **Finish**.
6. In the confirmation window:
   a. Confirm the settings.

b. Accept the default task name or enter a unique name.

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

   \ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Deleting a tier in a pool

You must delete all the pool-VOLs in the tier to be deleted. When pool-VOLs in the tier are empty, the appropriate tier is deleted.

Note: 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:

- 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 would exceed the pool threshold.
- The subscription rate of the total V-VOL capacity would exceed the subscription limit if the pool-VOL were deleted. For more information about how to calculate the DP-VOLs capacity including the control information, see Pool Subscription limit (on page 172).
- The pool-VOL with system area has less than 3.8 GB of free space. There must be 3.8 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.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.

3. From the **Pools** table, select the pool that contains the pool-VOLs to be deleted.
4. Select the **Pool Volumes** tab and select all the pool-VOLs contained in the tier to be deleted.

   You cannot delete a pool-VOL unless **Shrinkable** has been applied.
5. Click **Shrink Pool**.
6. 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, are displayed in **Prediction of Shrinking**.
7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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

Deleting a pool

You can delete a pool only after all of the DP-VOLs have been deleted.

Caution: When you delete a pool, its pool-VOLs (LDEVs) are blocked. Blocked volumes must be formatted before use. If a blocked pool-VOL is an external volume, select Normal Format when formatting the volume.

If you use Device Manager - Storage Navigator to decrease the pool capacity of a pool that is comprised of pool volumes that are assigned by parity groups with accelerated compression enabled, then you must delete any pool volumes that do not comprise the pool.

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.
- No DP-VOLs must be associated with the target pool.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, select the pool to be deleted.
4. Click **More Actions** > **Delete Pools**.
5. To continue with the shredding operation and deleting volume data, in the **Delete Pools** window, click **Next**.

   If the pool is blocked, you might not be able to perform shredding operations.
6. Click **Finish**.

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

Changing the tier rank of an external pool-VOL

Note: When the pool-VOLs of a pool are empty, the appropriate tier is deleted.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Expand **Pools**, and then select the pool that contains the external pool-VOL whose tier rank you want to change.
3. In the **Pool Volumes** table, select the external pool-VOL whose tier rank you want to change.
   - External pool-VOLs are indicated by **External Volume** in the **Drive Type/RPM** column.
4. Click **More Actions** > **Edit External LDEV Tier Rank**.
5. In the **Edit External LDEV Tier Rank** window, select the external pool-VOL.
6. Click **Change**, and then select the desired tier rank (High, Middle, or Low).
7. Click **Finish**.
8. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
9. Click **Apply** to submit the task.

Requirements for increasing DP-VOL capacity

You can increase the capacity of a DP-VOL up to 1,182,006 cylinders (for 3390-A).

These requirements are important when increasing the DP-VOL capacity:

- The emulation type is 3390-A.
- The DP-VOL to be increased is not shared with a software product that does not allow increasing the volume capacity (see Increasing DP-VOL capacity (on page 194)).
- 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.
- The pool related to the DP-VOLs to be increased is in any one of these statuses:
  - Normal
  - Exceeding the subscription limit threshold
  - In progress of pool capacity shrinking
- You cannot expand both the TSE-VOL and the DP-VOL in one operation. You can only expand volumes whose types are same in a single operation.

Caution:

For more information about the procedure for increasing the capacity of a DP-VOL used in the TrueCopy for Mainframe pair, global-active device pair, Universal Replicator for Mainframe pair, or ShadowImage for Mainframe pair, see the User Guide for each software product.

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 LVI
- Creating DP-VOLs
- Restoring pools
- Deleting DP-VOLs
- Maintenance of your storage system

Note: After increasing DP-VOL capacity, refresh the display and confirm that the DP-VOL is increased. If the DP-VOL capacity is not increased, wait a while, refresh the display again, and confirm that the DP-VOL is increased. If you perform an operation without making sure that the DP-VOL is increased, operations from Device Manager - Storage Navigator might fail.

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

- Volume Migration
- Configuration change of journal used by Universal Replicator
- Quick Restore by ShadowImage for Mainframe

If you place the DP-VOL online with an operating system that does not support DVE (Dynamic Volume Expansion), for instance operating systems whose versions are z/OS 1.9 and z/VM 5.4, the DP-VOL capacity cannot be increased. If you add capacity to the DP-VOL, take the DP-VOL offline when the operating system that does not support DVE, and then increase the capacity of the DP-VOL. DVE is a function for increasing volume capacity while the volume is online to a host system.

After the DP-VOL capacity is increased, the host issues reserved I/Os to the DP-VOL to update the VTOC area. In this case, I/Os issued from other hosts to the DP-VOL are waiting for the reservation to be released. The reply from the DP-VOL might be delayed, or the I/Os from other hosts might time out. If the system operation could be inhibited by an interruption of a delayed reply or a timeout, do not increase the capacity of the DP-VOL.

Increasing DP-VOL capacity

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. Select the pool associated with the DP-VOL that has the capacity that you want to increase.
4. Select the **Virtual Volumes** tab.
5. From the table, select the DP-VOL with the capacity you want to increase.
6. Click **Expand V-VOLs**.
7. In the **Expand V-VOLs** window, if the DP-VOL is selected from the **LDEV** table in the **Logical Devices** window, click **More Actions** > **Expand V-VOLs**.
8. Select **Specify total capacity** or **Specify additional capacity**.
9. In **Capacity**, enter the expanded capacity amount.

   Enter the LDEV capacity to two decimal places within the range of values indicated.
10. Click **Finish**.
11. In the confirmation window:
    a. Confirm the settings.
    b. Accept the default task name or enter a unique name.

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

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    c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
12. Click **Apply** to submit the task.

Changing the name of a DP-VOL

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. In the **Pools** window, click the pool name associated with the DP-VOL you want to rename.
4. Select the **Virtual Volumes** tab, and then click **More Actions** > **Edit LDEVs**.
5. Check **LDEV Name** and change the LDEV name, if necessary.
   a. In **Prefix**, enter the characters that will become the fixed characters for the beginning of the LDEV name. The characters are case-sensitive.
   b. In **Initial Number**, enter the initial number that will follow the prefix name.
6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Reclaiming pages in a DP-VOL

You can reclaim zero pages and release the appropriate pages if the status of all data in the pages in the V-VOL reads `no logical records` (referred to as zero page). The free capacity of a pool increases after the pages are released.

About releasing pages in a DP-VOL

You can reclaim zero pages and release the appropriate pages if the status of all data in the pages in the V-VOL reads `no logical records` (referred to as zero page). The free capacity of a pool increases after the pages are released. You can reclaim zero pages on each V-VOL and then monitor the progress on the **View Pool Management Status** window. If you stop the reclaim zero pages operation, the zero pages that have already been reclaimed cannot be restored.

Logically, there is no difference between a page with zero data and the area of a DP-VOL without a page allotted. Both are effectively identical. However, a page with zero data uses pool capacity, whereas a DP-VOL without a page allotted does not use pool capacity.

Zero pages can be reclaimed when all these conditions are satisfied:

- The DP-VOL is not used in conjunction with another storage system software product that does not support reclaiming zero pages.

  See Use of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe with other software products (on page 70).
- 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.
- The DP-VOL is not TSE-VOL.
- The LUN path is not defined between DP-VOL and the host group enabled with host mode option 97.

Pages that include control cylinders are not processed when releasing pages in a DP-VOL.

While releasing pages from a DP-VOL, performance of the host I/O to the DP-VOL might 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 parity groups in the pool. This rebalancing is performed on parity groups related to the pool. If you do not want automatic balancing of the usage levels of parity groups, call customer support to change your configuration.

Note: If an operation to reclaim zero pages is performed on pools comprised of pool volumes assigned by parity groups with accelerated compression enabled, the used capacity of the pools might not be reduced in comparison with the reduced DP-VOLs capacity.

Dynamic Provisioning does not automatically balance the usage levels among parity groups if the cache memory is not redundant or if the pool usage reaches 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.

Caution:

In these cases, an operation of the reclaim zero pages stops and DP-VOL pages might not be released:

- 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 while the operation to reclaim zero pages is in progress.
- While the operation to reclaim zero pages is in progress, the initial copy operation of the TrueCopy for Mainframe pair or the Universal Replicator for Mainframe pair is performed on the DP-VOL.
- The LUN path is defined between DP-VOL and the host group enabled with host mode option 97 while the operation to reclaim zero pages is in progress.

Note: A page in a DP-VOL with the capacity saving function enabled is not released, however reclaiming the page reduces the used capacity of the pool.

If the capacity saving function is enabled on a DP-VOL, the following table lists the operations performed depending on the microcode versions and whether to enable or disable the capacity saving function. A page in a DP-VOL might not be released depending on the microcode version, however reclaiming the page reduces the used capacity of the pool in both the conditions.

Storage system	Microcode version	Operation to be performed when a zero data page is reclaimed and the Write Same/UNMAP command is received					
		Page before capacity saving function *			Page after capacity saving function		
		Reclaiming page	DP-VOL used capacity	Pool used capacity	Reclaiming page	DP-VOL used capacity	Pool used capacity
VSP 5000 series	Earlier than 90-04-07-*xx/xx* Earlier than 90-05-02-*xx/xx*	Enabled	Reduced	Reduced	Disabled	Not reduced	Reduced

Storage system	Microcode version	Operation to be performed when a zero data page is reclaimed and the Write Same/UNMAP command is received					
		Page before capacity saving function *			Page after capacity saving function		
		Reclaiming page	DP-VOL used capacity	Pool used capacity	Reclaiming page	DP-VOL used capacity	Pool used capacity
	90-04-07-*xx/xx* or later 90-05-02-*xx/xx* or later	Disabled	Not reduced	Reduced	Disabled	Not reduced	Reduced
* A page for which the capacity saving function is disabled on a DP-VOL with the post-process mode applied.							

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 by releasing zero pages. Reclaiming the page decreases the used capacity of the pool. If the operation to release zero pages is performed on V-VOLs enabled for full allocation, the used capacity of the pool is not changed before the operation to release zero pages is performed.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the table, select the LDEV ID of the volume with the pages you want to release.
4. Click **More Actions** > **Reclaim Zero Pages**.

   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.
5. In the **Reclaim Zero Pages** window, click **Finish**.
6. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

7. Click **Apply** to submit the task.
8. After the operation to reclaim zero pages is complete, refresh the display to update the **Page Status**. If the **Page Status** is not immediately updated, wait a while, then refresh the display again.

   Note: Completed is displayed as the **Page Status** even 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 these 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 for Mainframe pair or the Universal Replicator for Mainframe pair was performed on the DP-VOL in which zero pages were being reclaimed.

Stopping the release of pages in a DP-VOL

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. Select the pool associated with the DP-VOL with pages you want to stop from being released.
4. Select the **Virtual Volumes** tab.
5. From the table, select the DP-VOL with pages you want to stop from being released.
6. Click **More Actions** > **Stop Reclaiming Zero Pages**.

   The **Stop Reclaiming Zero Pages** window is displayed.

   You cannot stop releasing the pages in a DP-VOL in which zero pages are not being reclaimed.

7. Click **Finish**.
8. In the confirmation window:

a. Confirm the settings.
b. Accept the default task name or enter a unique name.

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

   \ / : , ; * ? " < > |

c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Changing full allocation settings in DP-VOLs

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, click the pool name associated with the volume that has settings that you want to change.
4. Select the **Virtual Volumes** tab, and then click **More Actions** > **Edit LDEVs**.
5. In the **Edit LDEVs** window, check **Full Allocation** and select one of these options.

Option	Description
Enable	All pages of a DP-VOL are allocated to the current pool.
Disable	All pages of a DP-VOL might not be allocated to the current pool.

Tip: If the pool of DP-VOLs contains an LDEV enabled with accelerated compression in the parity group, **Enable** is inactive.

6. Click **Finish**.
7. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

      \ / : , ; * ? " < > |

   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
8. Click **Apply** to submit the task.

Enabling or 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 **Tier Properties** window.

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, click the pool name associated with the DP-VOL you want to rename.
4. Select the **Virtual Volumes** tab, select an LDEV ID, and then click **More Actions** > **Edit LDEVs**.
5. In the **Edit LDEVs** window, check **Tier Relocation** and select one of these options.

Option	Description
Enable	Enable this attribute if you want to allow tier relocation to be performed to the DP-VOL.
Disable	Enable this attribute if you want to disallow tier relocation to be performed on the DP-VOL in the case of both automatic and manual tier relocation.

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

About deleting a DP-VOL

- You cannot delete a DP-VOL if the status is online.
- The LDEV deletion process is suspended when the size of the used capacity of a pool reaches the depletion threshold. If this occurs, you must resolve the causes of the SIM message. When enough pool capacity is ensured, the deletion process will start again.

Deleting a DP-VOL

Before you begin

- The Storage Administrator (Provisioning) role is required to perform this task.

Caution: If you try to delete a volume soon after you perform any of the following operations on that volume, deletion of the volume might fail. If deletion of the volume fails, use Performance Monitor to confirm that the write-pending rate (%) for the MP unit to which the volume to be deleted is assigned is lower than 70%, and then try the operation again after waiting for about 10 minutes.

- Changing MP unit assignment for a volume
- Deleting a ShadowImage for Mainframe pair
- Migrating a volume by using Volume Migration
- Deleting a journal volume of Universal Replicator for Mainframe

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. Select the DP-VOL to be deleted.
4. If you selected a DP-VOL with data direct mapping, do the following:
   a. Block the DP-VOL.
   b. Disconnect the external volume that has the Data Direct Mapping attribute that is associated with the DP-VOL blocked. Either disconnect the external storage system or disconnect the external volume.

      Disconnecting the external volume might output SIM RC=627xxx (xxx is the pool ID), which indicates blocked pool-VOLs.
5. Select the **Virtual Volumes** tab.
6. From the table, select the DP-VOL to be deleted.

   Do the following, if necessary:

   a. In the **Filter** option, select **ON** to filter the rows.
   b. Click **Select All Pages** to select all DP-VOLs in the list.
   c. Click **Options** to specify the unit of volumes or the number of rows to view.
7. Click **More Actions** > **Delete LDEVs**.
8. In the **Delete LDEVs** window, click **Finish**.
9. In the confirmation window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.

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

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

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

Starting pool monitoring manually

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, select the pool you want to start monitoring.
4. Click **More Actions** > **Monitor Pools**.
5. In the **Monitor Pools** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
6. Click **Apply** to submit the task.

Stopping pool monitoring manually

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools** table, click the row of a pool you want to stop monitoring.
4. Click **More Actions** > **Stop Monitoring Pools**.
5. In the **Stop Monitoring Pools** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Starting tier relocation manually

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. On the **Pools** tab, click the row of a pool you want to start monitoring.
4. Click **More Actions** > **Start Tier Relocation**.
5. In the **Start Tier Relocation** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.
6. Click **Apply** to submit the task.

Stopping tier relocation manually

Before you begin

The Storage Administrator (Provisioning) role is required to perform this task.

Procedure

1. Click **Storage Systems**, and then expand the **Storage Systems** tree.
2. Click **Pools**.
3. From the **Pools**, click the row of a pool you want to start monitoring.
4. Click **More Actions** > **Stop Tier Relocation**.
5. In the **Stop Tier Relocation** window:
   a. Confirm the settings.
   b. Accept the default task name or enter a unique name.
      You can enter up to 32 letters, numbers, and symbols, except these:
      \ / : , ; * ? " < > |
   c. If you want to view the list of tasks for the storage system after clicking **Apply**, select **Go to tasks window for status**.

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

Chapter 4: Configuring access attributes

After provisioning your system, you can assign access attributes to volumes to protect them against read and write operations and prevent unauthorized access. Hitachi Volume Retention Manager allows you to assign access attributes to volumes.

Access attribute strategies

By default, all the volumes are subject to read and write operations by hosts. With Volume Retention Manager, you can assign access attributes to volumes that restrict read and/or write operations as needed. By properly setting these attributes, you can prevent unauthorized access to data and avoid the possibility of data being damaged, lost, or leaked.

One of these access attributes can be assigned to each logical volume:

- *Read/write*: If a logical volume has the read/write attribute, hosts can perform both read and write operations on the logical volume.

  All volumes have the Read/Write attribute by default.
- *Read-only*: If a logical volume has the read-only attribute, hosts can perform read operations but cannot perform write operations on the logical volume.
- *Protect*: If a logical volume has the protect attribute, hosts cannot access the logical volume. Hosts cannot perform read or write operations on the logical volume.

Volume Retention Manager requirements

The Volume Retention Manager license key must be installed. The Volume Retention Manager software contains license keys for Volume Retention Manager and Data Retention Utility software.

Hitachi Volume Retention Manager operations are performed in a Device Manager - Storage Navigator secondary window. For more information about enabling and using secondary windows, see the *System Administrator Guide*.

Access attribute restrictions

Notes on using Volume Retention Manager with other software follow.

Performance Monitor and Volume Migration

Some software products might be set to start automatically at a certain time. For example, if an automatic start time is set in Performance Monitor or Volume Migration, monitoring begins at the specified time. If another product has been set to start automatically, you must take one of these actions:

- Perform Volume Retention Manager operations when the other program is not running.
- Reset the specified start time of the other product.

TrueCopy for Mainframe and Universal Replicator for Mainframe

- Do not assign an access attribute to a volume that is in use by TrueCopy for Mainframe or Universal Replicator for Mainframe. If you assign an access attribute to such a volume, the job might end abnormally. If you still want to assign an access attribute to such a volume, you must assign the same access attribute to both the primary volume (P-VOL) and the secondary volume (S-VOL).
- When creating a TrueCopy for Mainframe or Universal Replicator for Mainframe pair and using a read-only volume as the P-VOL, use an S-VOL on a storage system on which Volume Retention Manager is enabled.

  If the S-VOL must be on a storage system on which Volume Retention Manager is not installed, you must do either of the following:

  - Change the access attribute of the P-VOL to read/write.
  - Uninstall Volume Retention Manager on the main site.
- If you use TrueCopy for Mainframe or Universal Replicator for Mainframe to create a pair, the P-VOL and the S-VOL will have the same access attribute. Even if you suspend or delete the pair, access attribute for these volumes will not change.
- If a remote copy pair is suspended during a TrueCopy for Mainframe or Universal Replicator for Mainframe copy operation and you want to enable the S-VOL read option on the RCU (mode 20), you must ensure that the access attribute of the S-VOL is read/write before you enable the S-VOL read option. If the access attribute of the S-VOL is read-only, mode 20 will be disabled. Also, operations such as REFORMAT and REFVTOC cannot be performed for overwriting volume serial numbers.
- If a volume has the protect attribute, the volume can neither be used as a P-VOL nor an S-VOL.
  - If the protect attribute is set to the volume which is being used by TrueCopy for Mainframe, the pair might be suspended.
  - If the protect attribute is set to the volume which is being used by Universal Replicator for Mainframe, the remote copy processing might not be continued.

ShadowImage for Mainframe, Compatible FlashCopy® V2, and Hitachi Compatible Software for IBM® FlashCopy® SE

If a volume has the protect attribute, the volume cannot be used as a primary volume (P-VOL) or as a secondary volume (S-VOL) for the ShadowImage for Mainframe pair. If a volume has the protect attribute, the volume cannot be used as a source volume (S-VOL) or as a target volume (T-VOL) for the Compatible FlashCopy® V2 or for Hitachi Compatible Software for IBM® FlashCopy® SE relationship.

Assigning access attributes

You can assign access attributes to volumes by using Volume Retention Manager.

Caution: Do not perform Volume Retention Manager operations if any other software is running.

Supported volume emulation types

Volume Retention Manager supports these volume emulation types.

Supported volume emulation types	Description
3390-1, 3390-2, 3390-3 3390-9, 3390-A, 3390-L, 3390-M	These volumes can be used only by mainframe hosts.
3390-3A, 3390-3B, 3390-3C 3390-9A, 3390-9B, 3390-9C 3390-LA, 3390-LB, 3390-LC 3390-MA, 3390-MB, 3390-MC	These volumes can be used by mainframe hosts and open-systems hosts. **Notes:** ▪ You must ensure that the access attribute of these volumes is read/write. ▪ The protect attribute of Volume Retention Manager takes effect when open-system hosts or mainframe hosts access volumes. However, the read-only attribute takes effect only when mainframe hosts access volumes. The read-only attribute does not take effect when open-system hosts access volumes that have the read-only attribute.

Setting access attributes

You can prevent volumes from unauthorized read and/or write operations.

Caution:

- When jobs that manipulate data on a volume are in progress, do not assign an access attribute to the volume. The jobs in progress might be abnormally terminated.
- When I/O processing from hosts is being performed, do not change the access attribute of volumes. The I/O processing being performed might be abnormally terminated.
- Do not assign the read-only attributes to the volumes whose VTOC location has been changed with the VTOC parameters by using the ICKDSF INIT command.

Before you begin

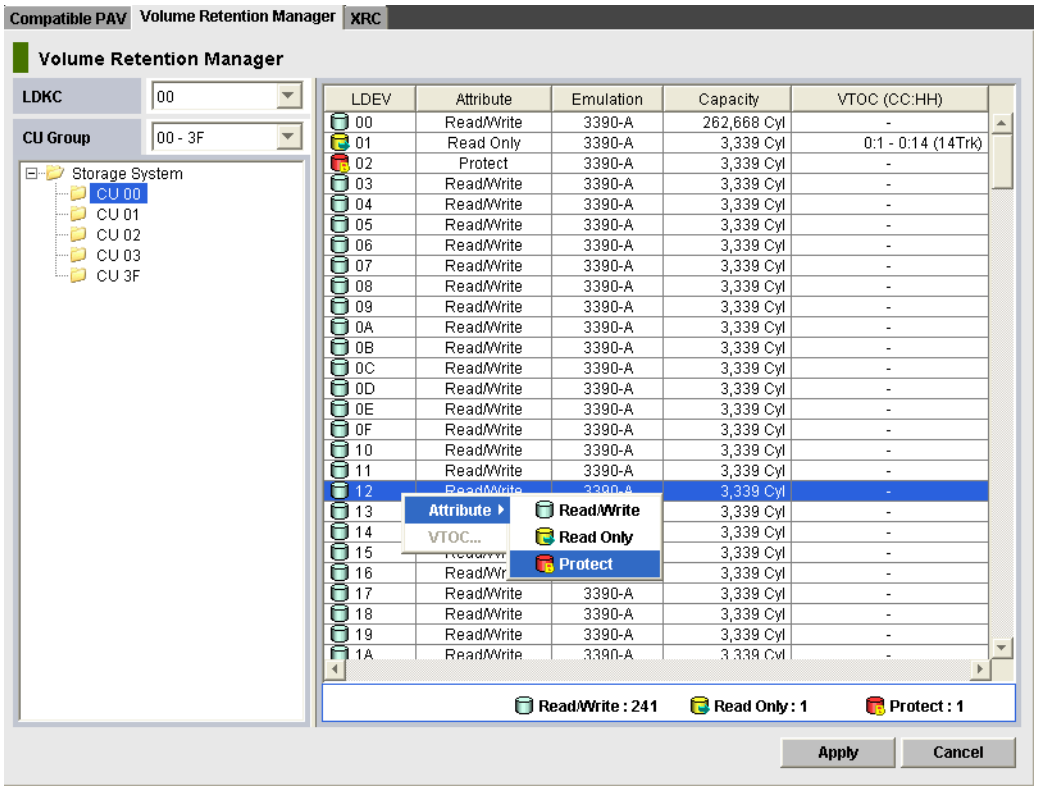
Device Manager - Storage Navigator secondary windows must be defined for use in advance. When you select Modify from the Volume Retention Manager secondary window to set access attributes, other users and programs are prevented from changing storage system settings. When you close the secondary window, Modify mode is released. For more information on Device Manager - Storage Navigator secondary windows and modify mode, see the *System Administrator Guide* or the *Hitachi Command Suite User Guide*.

Procedure

1. Click **Actions** > **Mainframe Connection** > **Volume Retention Manager**.
2. In the Volume Retention Manager window, click to change to **Modify** mode.
3. Select an LDKC number from the **LDKC** list and a group that a CU belongs to from the **CU Group** list.
4. From the tree, from the list of CUs in the specified CU group, select a CU.
5. From the table, select and right-click a volume whose access attribute you want to change.
6. From the pop-up menu, select **Attribute** to display a submenu. Then, select the desired access attribute from the submenu.

   Caution: At this point, the settings in the window have not yet been applied to the storage system.

   If you want to change access attribute of other volumes, repeat this step.



7. If you want to change access attributes of volumes in other CU images, repeat steps 2 to 5. If not, go to the next step.
8. In the Volume Retention Manager window , click **Apply**.

   The settings are applied to the storage system.

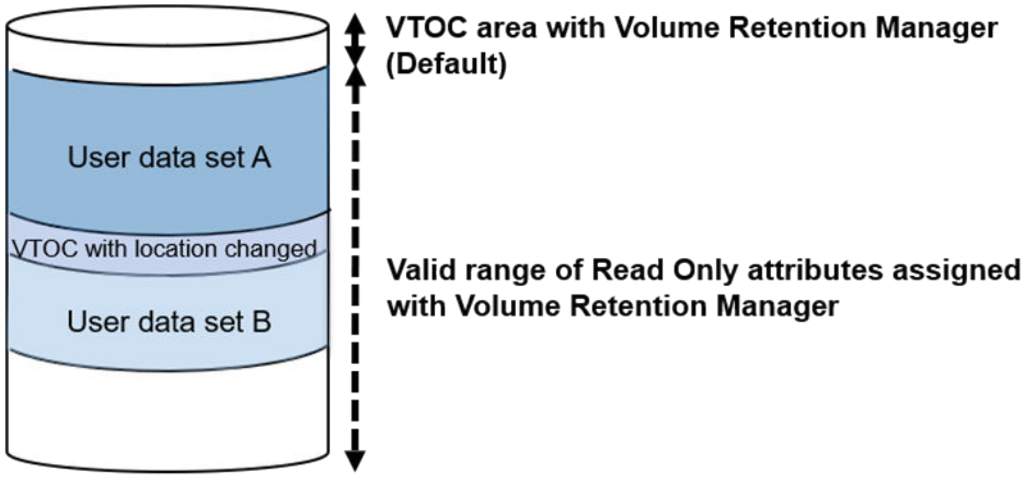
VTOC size settings with Volume Retention Manager

Do not assign the read-only attributes to the volumes whose VTOC location has been changed with the VTOC parameters by using the ICKDSF INIT command.

If you assign the read-only attributes to the volumes whose VTOC location has been changed with the VTOC parameters, a host might not write the access logs in the VTOC as shown in Example 1.

If you configure the VTOC area settings for the volumes to which the read-only attributes have been assigned in accordance with the VTOC location by using Volume Retention Manager, the data set can be updated and the read-only attributes might have no effects as shown in Example 2. For more information about the VTOC area settings by using Volume Retention Manager, see Specifying the VTOC size (on page 211).

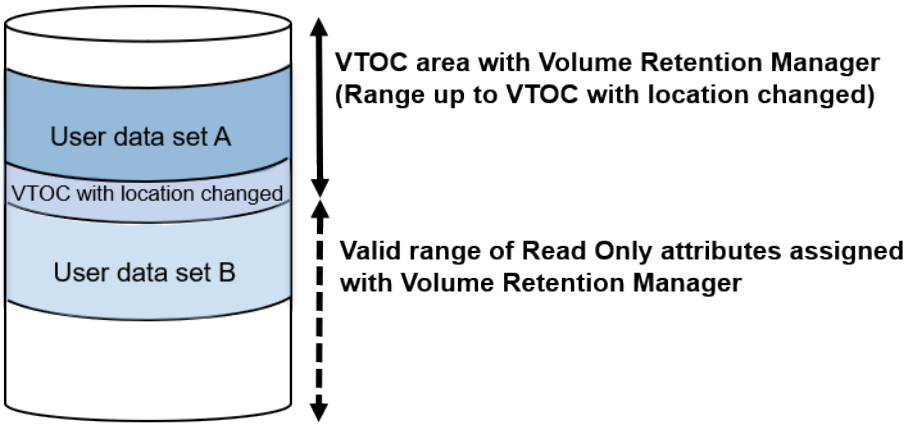
Example 1: The read-only attributes are assigned to the volumes whose VTOC location has been changed by using Volume Retention Manager.



A host tries to write updated access logs in the VTOC whose location has been changed, however it cannot write due to the read-only attributes.

Example 2: Both the following settings are configured:

- The read-only attributes are assigned to the volumes whose VTOC location has been changed by using Volume Retention Manager.
- The range up to the VTOC whose location has been changed is set for the VTOC area for Volume Retention Manager.



The user data set A is located in the VTOC area that was set by using Volume Retention Manager. The expected effects of the read-only attributes cannot be obtained because the updates can be written.

Specifying the VTOC size

When a host accesses a volume, the volume table of contents (VTOC) in the volume changes to include updated access logs.

Before you begin

- Volume has read-only attributes.
- Volume is not for a VM minidisk.
- Hitachi Device Manager - Storage Navigator secondary windows must be defined for use in advance. When you select Modify from the **Volume Retention** secondary window to set access attributes, other users and programs are prevented from changing storage system settings. When you close the secondary window, Modify mode is released. For more information on Hitachi Device Manager - Storage Navigator secondary windows and Modify mode, see the *System Administrator Guide*.
- The VTOC location in the volume has not been changed with the VTOC parameters by using the ICKDSF INIT command.

Procedure

1. Click **Actions** > **Mainframe Connection** > **Volume Retention Manager**.
2. In the Volume Retention Manager window, click to change to **Modify** mode.
3. Select an LDKC number from the **LDKC** list and a group that a CU belongs to from the **CU Group** list.
4. From the tree, from the list of CUs in the specified CU group, select a CU.
5. From the table, in the list of volumes in the specified CU, select one or more volumes that have read-only attributes and right-click the selection.
6. From the pop-up menu, select VTOC.
7. In **VTOC Area**, use **End (CC:HH)** to specify the ending position of the VTOC. Enter the cylinder number on the left and the head number on the right. The starting position of the VTOC is always 0:1 to indicate the cylinder number 0 and the head number 1. This number cannot be changed.
8. Click **OK**.

   Caution: At this point, the change to the VTOC size has not been applied to the storage system.

9. In the Volume Retention Manager window , click **Apply**.

   The settings are applied to the storage system.

Chapter 5: Troubleshooting for provisioning

Troubleshooting for provisioning operations involves identifying the cause of the error and resolving the problem. If you are unable to solve a problem, contact customer support.

Troubleshooting Dynamic Provisioning for Mainframe

The following table provides troubleshooting information for Dynamic Provisioning.

If you are unable to solve a problem, or if you encounter a problem not listed, contact customer support.

Problem	Causes and solutions
Cannot create a DP-VOL.	Causes: ▪ Usage of the pool has reached 100%. ▪ Something in the storage system is blocked. ▪ The available capacity of DP-VOL is restricted due to the value of the subscription-limit set for the pool. ▪ The available total DP-VOL capacity exceeds Estimated Configurable in V-VOL Capacity. Solutions: ▪ Add pool-VOLs to the pool. See Expanding a pool (on page 183). ▪ Perform the task to reclaim zero pages to release pages in which zero data are stored. ▪ Verify the subscription limit of the pool. ▪ Contact customer support to solve the problem.

Problem	Causes and solutions

Cannot delete a DP-VOL.	Causes:
	▪ After you perform any of the following operations, the write-pending rate (%) for the MP unit to which the volume to be deleted is assigned is 70% or larger in Performance Monitor.
	  • Changing MP unit assignment for a volume
	  • Deleting a ShadowImage for Mainframe pair
	  • Migrating a volume by using Volume Migration
	  • Deleting a journal volume of Universal Replicator for Mainframe
	Solutions:
	▪ Confirm that the write-pending rate (%) for the MP unit to which the volume to be deleted is assigned is lower than 70% in Performance Monitor, and then try the operation again after waiting for about 10 minutes.
	▪ Contact 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 fulfill 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 66).

A pool-VOL is blocked. SIM code 627xxx is reported.	Causes:
	▪ A failure occurred in data drives greater than the parity group redundancy. The redundancy of the parity group depends on the number of the blocked PDEVs (data drives). For example:
	  • When the parity group configuration is 3D +1P and failures occur in two or more drives, the failures are considered to have occurred in data drives beyond the parity group redundancy.
	  • When the parity group configuration is 6D+2P and failures occur in three or more drives, the failures are considered to have occurred in data drives beyond the parity group redundancy.
	Solution:
	▪ Ask customer support to solve the problem.

Problem	Causes and solutions
A pool is blocked.	Solution: ▪ Ask customer support to solve the problem.
A pool cannot be restored.	Causes: ▪ Processing takes time, because something in the storage system is blocked. ▪ Usage of the pool has reached to 100%. Solutions: ▪ After waiting for a while, refresh the display, and then check the pool status. ▪ Add some pool-VOLs to the pool to increase the capacity of the pool. See Expanding a pool (on page 183). ▪ Perform the operation to reclaim zero pages to release pages in which zero data are stored. ▪ Ask 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 that you can delete the pool. ▪ Ask 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. ▪ Some areas in the storage system are blocked. Solutions: ▪ Check the free space of the pool and increase the capacity of the pool. See Expanding a pool (on page 183). ▪ Perform the operation to reclaim zero pages to release pages in which zero data are stored. ▪ Ask customer support to solve the problem.

Problem	Causes and solutions
When the host computer tries to access the port, an error occurs and the host cannot access the port.	Causes: ▪ Free space of the pool is insufficient. ▪ Some areas in the storage system are blocked. Solutions: ▪ Check the free space of the pool and increase the capacity of the pool. See Expanding a pool (on page 183). ▪ Reclaim zero pages in order to release pages in which zero data are stored. ▪ Ask customer support to solve the problem.
A timeout error occurs frequently in Hitachi Device Manager - Storage Navigator.	Causes: ▪ The load on the Hitachi Device Manager - Storage Navigator computer is too heavy, so that it cannot respond to the SVP. ▪ The period of time until a timeout occurs is set too short. Solutions: ▪ Wait for a while, then try the operation again. ▪ Verify the setting of the environment parameter of Hitachi Device Manager - Storage Navigator RMI time-out period. For information about how to set the RMI time-out period, see the *System Administrator Guide*.
DP-VOL capacity cannot be increased.	Solutions: ▪ After refreshing the display, confirm whether the processing for increasing DP-VOL capacity meets the conditions described in Requirements for increasing DP-VOL capacity (on page 192). ▪ Retry the operation after 10 minutes or so. ▪ Ask customer support to solve the problem.
Cannot reclaim zero pages in a DP-VOL.	Cause: ▪ Zero pages in the DP-VOL cannot be reclaimed from Device Manager - Storage Navigator because the DP-VOL does not meet conditions for releasing pages in a DP-VOL. Solution: ▪ Make sure that the DP-VOL meets the conditions described in Releasing pages in a DP-VOL (on page 198).

Problem	Causes and solutions
The DP-VOL cannot be released if the process to reclaim zero pages in the DP-VOL is interrupted.	Cause: ▪ Pages of the DP-VOL are not released because the process of reclaiming zero pages was interrupted. Solution: ▪ Make sure that the DP-VOL meets the conditions described in Releasing pages in a DP-VOL (on page 198).
SIM code 622*xxx* was issued.	Cause: ▪ Usage of the pool has reached 100%. Solutions: ▪ Add pool-VOLs to the pool to increase the free space in the pool. See Expanding a pool (on page 183). ▪ Perform the task to reclaim zero pages in order to release pages in which zero data are stored. See Releasing pages in a DP-VOL (on page 198). The protect attribute of Data Retention Utility can have been set to DP-VOLs. After performing the above solutions, release the protect attribute of the DP-VOLs.
SIM code 624000 was issued.	Cause: ▪ The pools and DP-VOLs configuration, of which the size is more than the supported capacity, is created. Solutions: ▪ Remove pools that are not used. ▪ Shrink pools 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 that 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. See Expanding a pool (on page 183).

Problem	Causes and solutions
	▪ Perform the task to reclaim zero pages to release pages in which zero data are stored. See About releasing pages in a DP-VOL (on page 195). ▪ Confirm the display again after decreasing I/O loads of the storage system. ▪ Contact customer support to restore the cache memory. ▪ Contact customer support to restore the pool-VOL. ▪ If the blocked pool-VOL is an external volume, confirm these situations: • Path blockage • Status of the storage system
The shrink pool operation ends abnormally.	Causes: ▪ Cache memory maintenance was performed while the shrink pool operation was in progress. ▪ A cache memory error occurred while the shrink pool operation was in progress. ▪ The I/O load to DP-VOLs associated with the pool is too high. ▪ DP-VOLs associated with the pool are blocked. Solutions: ▪ Restore the cache memory, and then perform the shrink pool operation again. ▪ Wait until the I/O load to DP-VOLs associated with the pool is lower, and then perform the shrink pool operation again. ▪ Delete or format DP-VOLs associated with the pool, and then perform the shrink pool operation again.

Resolving errors when using CCI to perform Dynamic Provisioning for Mainframe operations (SSB1: 0x2e31/0x2ea0/0xb96b/0xb980)

If an error occurs while using CCI to perform Dynamic Provisioning for Mainframe operations, you might identify the cause of the error by referring to the log displayed on the CCI window or the CCI operation log file.

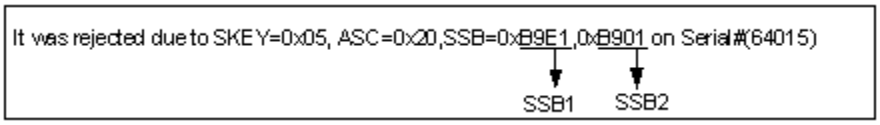
The CCI operation log file is stored in this directory.

```
/HORCM/log*/curlog/horcmlog_HOST/horcm.log
```

where

- * is the instance number.
- HOST is the host name.

This is an example log entry in the CCI window.



This table provides troubleshooting information for Dynamic Provisioning for Mainframe operations performed using CCI.

Error code (SSB2)	Error contents	Solutions
0x0207	The operation cannot be performed because a microcode version is not supported on the storage system.	Update the microcode of all storage systems to the supported microcode versions, and then retry the expansion of the DP-VOL capacity.
0x0208	The specified Request ID is not valid.	Enter the valid Request ID, and then retry the expansion of the DP-VOL capacity.
0x0209	The specified LDEV number is not valid.	Enter the valid LDEV number, and then retry the expansion of the DP-VOL capacity.
0x020A	The serial number of the virtual storage machine is not valid.	Verify the settings for the virtual storage machine, and then retry the expansion of the DP-VOL capacity.
0x020C	The command was rejected.	Wait for a while, and then retry the expansion of the DP-VOL capacity.
0x020D	The operation cannot be performed because a virtual volume is not installed.	Create a virtual volume, and then retry the expansion of the DP-VOL capacity.
0x0b27	The command cannot be executed because the virtual LDEV is not defined.	Define the virtual LDEV and then execute the command.
0x2c3f	The operation cannot be performed because the storage system is being stopped.	Turn on the power on the storage system, and then retry the operation.
0x2c61	The operation cannot be performed because the specified DP-VOL is being used in ShadowImage for Mainframe.	Specify a DP-VOL that is not used in ShadowImage for Mainframe.

Error code (SSB2)	Error contents	Solutions
0x2c63	The operation cannot be performed because the specified DP-VOL is being used in Volume Migration.	Specify a DP-VOL that is not used in Volume Migration.
0x2c64	The operation cannot be performed because the specified DP-VOL is being used in TrueCopy for Mainframe.	Specify a DP-VOL that is not used in TrueCopy for Mainframe.
0x2c65	The operation cannot be performed because the specified DP-VOL is being used in Universal Replicator for Mainframe.	Specify a DP-VOL that is not used in Universal Replicator for Mainframe.
0x2c66	The operation cannot be performed because the specified DP-VOL is being used in Compatible XRC.	Specify a DP-VOL that is not used in Compatible XRC.
0x2c67	The operation cannot be performed because the specified DP-VOL is being used in Compatible FlashCopy® V2 or Compatible FlashCopy® SE .	Specify a DP-VOL that is not used in Compatible FlashCopy® V2 or Compatible FlashCopy® SE.
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 customer support to solve the problem.
0xb902	The operation was rejected because the configuration was being changed by SVP or Hitachi Device Manager - 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 LVI operation or a maintenance operation. See Caution in Requirements for increasing DP-VOL capacity (on page 192).
0xb903	The operation cannot be performed because the specified resource is contained in NAS_Platform_System_RSG.	Move the specified resource to a resource group other than NAS_Platform_System_RSG.
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.
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.
0x020B/0xaf29	The operation was rejected because the specified volume was not a DP-VOL.	Makes sure that the volume is a DP-VOL.
0xaf2a	The operation was rejected because the specified capacities are invalid or exceeded the value immediately below LDEV Capacity in the **Expand Virtual Volumes** window.	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 192).
0xaf2b	The operation was rejected because the specified volume operation was not finished.	Re-execute the operation after a brief interval.
0xaf2c	The operation was rejected because the shared memory capacity is not enough to increase the specified capacity.	Confirm the value immediately below LDEV Capacity in the **Expand Virtual Volumes** window.
0xaf2e	The operation was rejected because the specified DP-VOL was used by other software or was being formatted.	Wait until formatting of the specified volume is finished, or see Use of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe with other software products (on page 70) and confirm whether the DP-VOL is used with software in which that the DP-VOL capacity cannot be increased. If the above-mentioned software is not used, retry the operation to increase the capacity.
0xaf2f	The specified DP-VOL capacity cannot be expanded because the configuration of journal volumes is being changed.	Re-execute the operation after the journal volume configuration is changed.
0xaf60	The operation was rejected because the pool used capacity exceeds the depletion threshold of the pool if the specified capacity is reserved in the pool.	Expand the pool capacity, and then retry the operation.

Error code (SSB2)	Error contents	Solutions
0xafa8	The operation was rejected because the DP-VOL specified for expanding the capacity is used in other software product (TrueCopy for Mainframe pair, Universal Replicator for Mainframe pair, or ShadowImage for Mainframe pair) and the asynchronous command (`-request_id auto` option) is not specified.	Delete other software product (TrueCopy for Mainframe pair, Universal Replicator for Mainframe pair, ShadowImage for Mainframe pair), or specify the asynchronous command (`-request_id auto` option), and then retry the operation.
0xafa9	The operation was rejected because the DP-VOL specified for expanding the capacity is used in other software products and the differential data management method is not valid.	Follow the procedure for expanding the DP-VOL capacity described in the User Guide for each software product, and then retry the operation.
0xafaa	The expansion of the DP-VOL capacity cannot be performed because shared memory resources cannot be reserved temporarily.	Wait for a while, and then retry the expansion of the DP-VOL capacity
0xafab	The expansion of the DP-VOL capacity cannot be performed because the specified volume is used as the secondary volume in a ShadowImage for Mainframe pair, and the capacity differs from the primary volume capacity after the expansion.	Specify the capacity to be the same as the capacity of the primary volume in a ShadowImage for Mainframe pair, and then retry the operation.
0xafac	The expansion of the DP-VOL capacity cannot be performed because shared memory resources cannot be reserved temporarily.	Wait for a while, and then retry the expansion of the DP-VOL capacity
0xafad	The command was rejected because there are not enough differential tables or pair tables of a ShadowImage for Mainframe pair required for expanding the DP-VOL capacity.	See the *Hitachi ShadowImage® for Mainframe User Guide* to verify the number of differential tables or pair tables required for expanding the DP-VOL capacity.

Troubleshooting Volume Retention Manager

If an error occurs with Volume Retention Manager, the **Error Detail** dialog box is displayed. The **Error Detail** dialog box displays error locations and error messages.

The **Error Detail** dialog box does not display Hitachi Device Manager - Storage Navigator error messages. For information about Hitachi Device Manager - Storage Navigator errors and solutions, see the *System Administrator Guide*.

Caution: Read and/or write operations might fail under these conditions:

- If a host computer attempts to write data to a read-only volume, the write operation fails, and the host receives a Write Inhibit report that the host cannot write data because of the access attribute.
- If a host computer attempts to read data from or write data to a volume that has the protect attribute, the attempted access is rejected, and an intervention request is reported to the host.
- If the DVE function of a host computer attempts to change the capacity of a volume with a read-only or protect access attribute, release the access attribute in advance. If the capacity is changed without releasing the access attribute, the modified volume will become unusable, and a Write Inhibit or an intervention request will be reported to the host.
- When jobs that manipulate data on a volume are in progress, do not assign an access attribute to the volume. The jobs in progress might be abnormally terminated.
- When I/O processing from hosts is being performed, do not change the access attribute of volumes. The I/O processing being performed might be abnormally terminated.

Appendix A: CCI command reference for provisioning

Provisioning tasks can be performed using Device Manager - Storage Navigator and Command Control Interface (CCI).

Provisioning tasks and CCI commands

This table lists the provisioning tasks that can be performed using Hitachi Device Manager - Storage Navigator (HDvM - SN) and provides the corresponding CCI command for each task.

Item	Task name in HDvM - SN	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 Unit	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/iSCSI Target (Fibre Channel)	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

Item	Task name in HDvM - SN	CCI command
	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
	View Tier Properties	raidcom get dp_pool
External Storage	Disconnect External Volumes	raidcom disconnect external_grp
	Reconnect External Volumes	raidcom check_ext_storage
Port/Host Group/iSCSI (iSCSI)	Create iSCSI Targets	raidcom add host_grp
	Delete iSCSI Targets	raidcom delete host_grp
	Edit iSCSI Targets	raidcom modify host_grp
	Add Hosts	raidcom add hba_iscsi
	Remove Hosts	raidcom delete hba_iscsi
	Edit Host	raidcom set hba_iscsi
	Add CHAP Users	raidcom add chap_user
	Remove CHAP Users	raidcom delete chap_user
	Edit CHAP User	raidcom set chap_user
	Create Alternate LUN Paths	raidcom add lun
	Edit Ports	raidcom modify port

Parameter ranges for CCI options

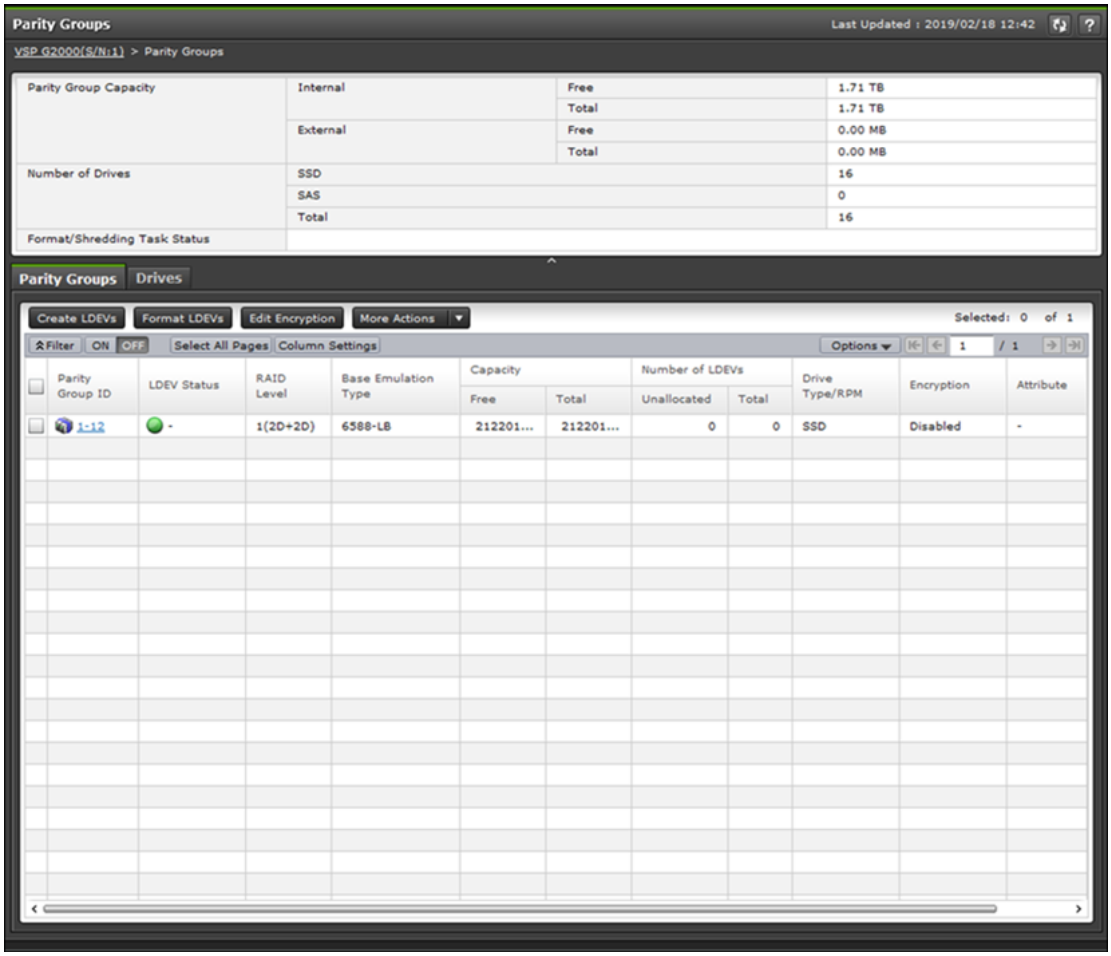
This table lists the valid parameter ranges for CCI options.

Parameter	Valid values
Serial number	500000 to 599999
LDEV ID	0 to 65279
Pool ID	0 to 127
Port number	CL*x*-*y* *x*: 1 to C *y*: A to R (except I and O) A to D, or J to M, when *x* is 9 to C.
LU number	0 to 4095
Resource group ID	1 to 1023
Parity group ID	gno: 1 to 24 sgno: 1 to 32
iSCSI virtual port ID	0 to 15
SSID	0004 to FEFF
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 values for LDEV ID in this table.
Virtual port number	See the values for Port number in this table.
Host group ID or iSCSI target ID	0 to 254
SSID for LDEV in a virtual storage machine	See the values for SSID in this table.

Appendix B: LDEV GUI reference

The Hitachi Device Manager - Storage Navigator windows display the logical device (LDEV) information for the storage system and allow you to configure and manage LDEVs.

Parity Groups window



Summary

Item	Description
Parity Group Capacity	▪ Internal: Capacity of all of the parity groups in the internal volume: • Free: Free space capacity of which the internal volumes can be created. The control information used by the storage system, such as control cylinders, is not included in the free capacity. For the free space of the accelerated compression-enabled parity group, this area is the value of which the total mapped pages capacity of LDEVs (assigned in the physical area and expanded area) is deducted from the parity group capacity. • Total: Total capacity of the internal volumes and the free space is displayed. For the total space of the accelerated compression-enabled parity group, this area is the physical area capacity. ▪ External: Capacity of all of the parity groups in the external volume: • Free: Total free space of which users can create external volumes. The control information used by the storage system, such as control cylinders, is not included in the free capacity. • Total: Total capacity of all external volumes (that are created by users) and free space.
Number of Drives	Number of drives for each drive type.
Format/Shredding Task Status	▪ Formatting *n* %: Percentage progress of the format task. ▪ Preparing Quick Format *n* %: Percentage progress of preparing the quick format. ▪ Shredding *n* %: Percentage of the progress of the shredding. ▪ Verifying *n* % (*x* / *y* parity groups): Percentage progress of the verification. *n* represents the progress of the verification. *x* represents the number of parity groups that have completed verification. *y* represents the number of all parity groups that are to be verified. ▪ Blank: Formatting, shredding, or verification is not being performed. If the configuration of the storage system is being changed, this field is also blank because the information cannot be collected.

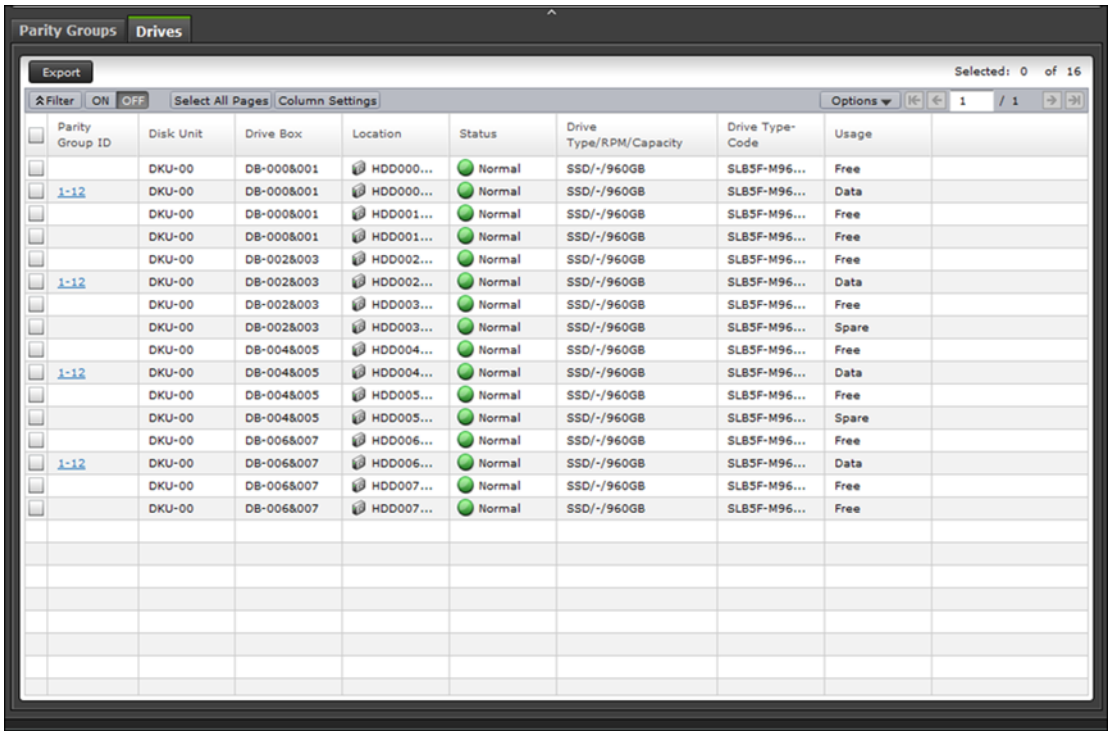
Parity Groups tab

Item	Description
Parity Group ID	Parity group identifier
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).
Base Emulation Type	Emulation type of each parity group
Capacity	Pool capacity: ▪ Free: Free space capacity of which the internal volumes can be created. The control information used by the storage system, such as control cylinders, is not included in the free capacity. ▪ Total: Total capacity of the internal volumes and the free space.
Number of LDEVs	▪ Unallocated: number of unallocated LDEVs in each parity group ▪ Total: total number of LDEVs in each parity group
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.

Item	Description
Encryption	▪ Enable: encrypted parity group ▪ Disable: non-encrypted parity group ▪ - (hyphen): parity group for which the encryption setting is not defined
Accelerated Compression Not available by default. Available when you click Column Settings.	▪ Enabled: Accelerated compression of the parity group is enabled. ▪ Disabled: Accelerated compression of the parity group is disabled. ▪ - (hyphen): Parity group with accelerated compression is not supported.
Expanded Space Used Not available by default. Available when you click Column Settings.	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Attribute	Attribute of the parity group. - (hyphen): 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
Virtual Storage Machine Not available by default. Available when you click Column Settings.	Model type and serial number of the virtual storage machine to which the parity group belongs
Pool Name (ID)	Pool name with identifier in parentheses

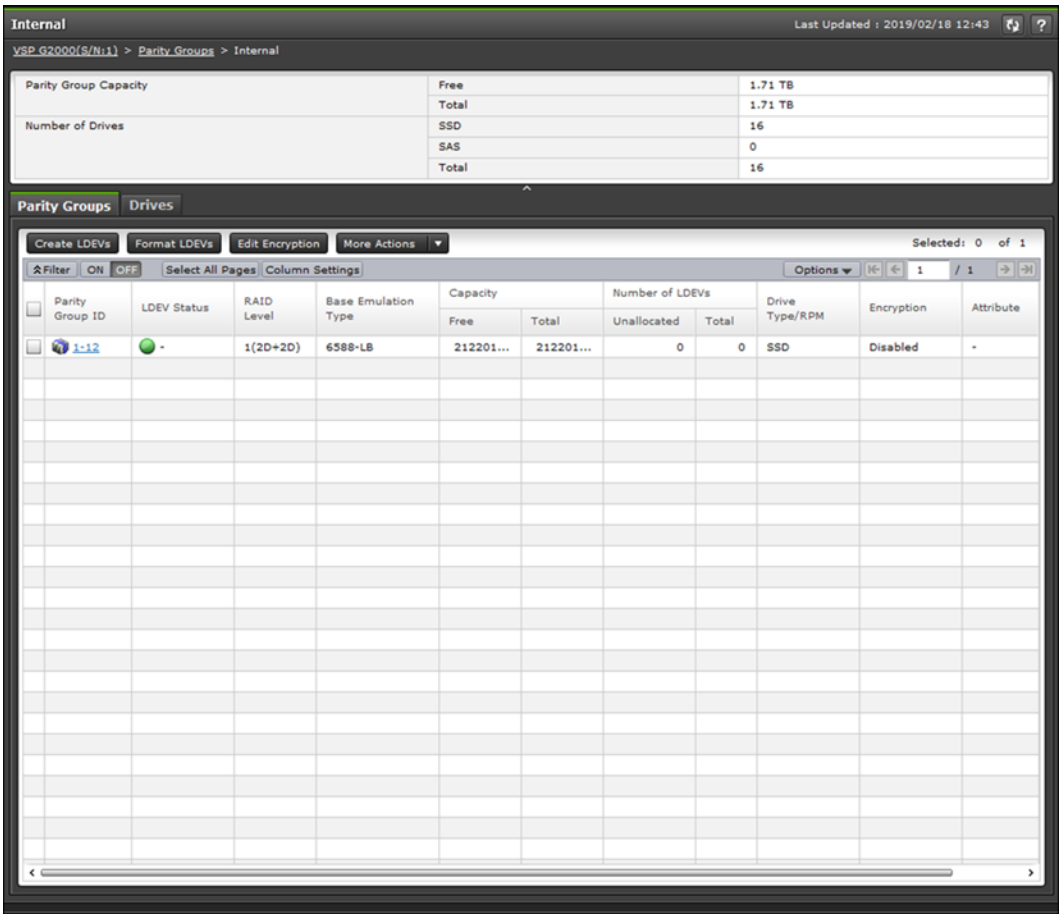
Drives tab

Only drives assigned to the logged-on user are displayed.



Item	Description
Parity Group ID	Parity group identifier
Disk Unit	Disk unit number
Drive Box	Drive box number
Location	Drive box location
Status	Drive box status
Drive Type/Interface/RPM/ Capacity	Drive type, interface, rpm, and capacity. For drive types other than HDD, a hyphen (-) is displayed for RPM.
Drive Type-Code	Drive type-code
Usage	▪ Data: data drive ▪ Spare: spare drive ▪ Free: drive that is not used

Parity Groups tab: Internal or external volume



Summary

Item	Description
Parity Group Capacity	▪ Free: Free space capacity of which the internal (or external) volumes can be created. For the free space of the accelerated compression-enabled parity group, this area is the value of which the total mapped pages capacity of LDEVs (assigned in the physical area and expanded area) is deducted from the parity group capacity. The control information used by the storage system, such as control cylinders, is not included in the free capacity. ▪ Total: Total capacity of the internal (or external) volumes and the free space is displayed. For the total space of the accelerated compression-enabled parity group, this area is the physical area capacity.
Number of Drives	Number of drives for each drive type.

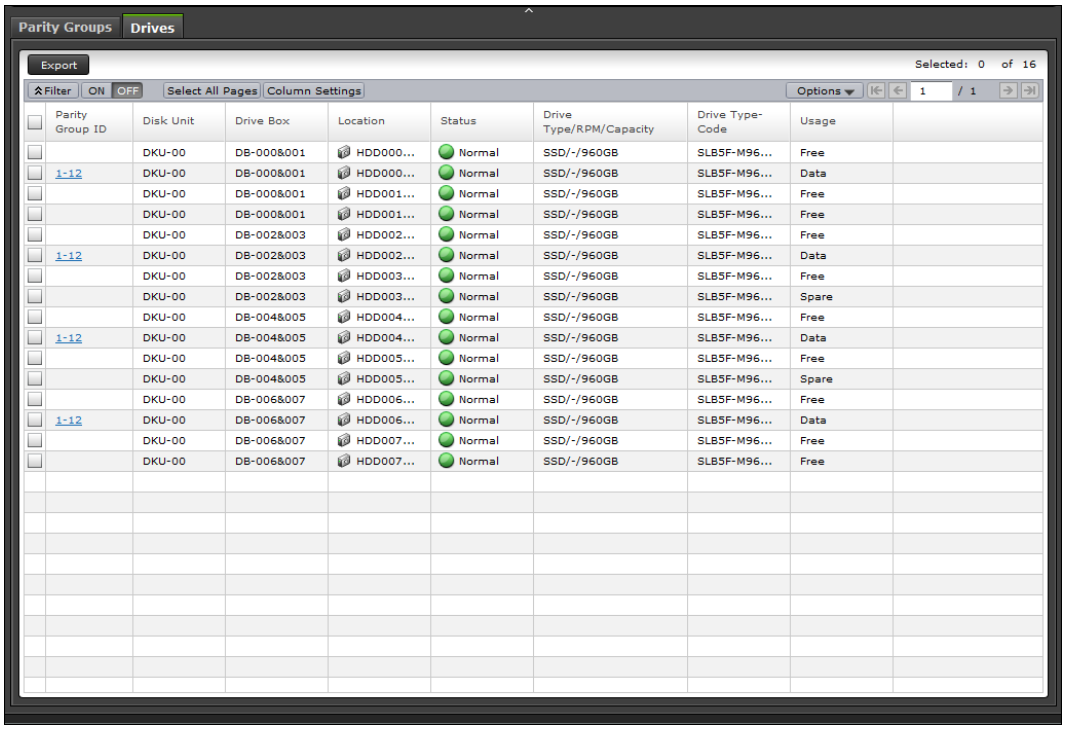
Parity Groups tab

Item	Description
Parity Group ID	Parity group identifier
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).
Base Emulation Type	Emulation type
Capacity	Pool capacity: ▪ Pool capacity. ▪ Free: Free space capacity of which the internal volumes can be created. The control information used by the storage system, such as control cylinders, is not included in the displayed capacity. ▪ Total: Total capacity of the internal volumes and the free space.
Number of LDEVs	▪ Unallocated: number of unallocated LDEVs ▪ Total: total number of LDEVs
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.

Item	Description
Encryption	▪ Enable: encrypted parity group ▪ Disable: non-encrypted parity group ▪ - (hyphen): parity group in which the encryption setting is not defined
Accelerated Compression Not available by default. Available when you click Column Settings.	▪ Enabled: Accelerated compression of the parity group is enabled. ▪ Disabled: Accelerated compression of the parity group is disabled. ▪ - (hyphen): Parity group with accelerated compression is not supported.
Expanded Space Used Not available by default. Available when you click Column Settings.	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area. ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Attribute	Attribute of the parity group. - (hyphen): 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
Virtual Storage Machine Not available by default. Available when you click Column Settings.	Model type and serial number of the virtual storage machine to which the parity group belongs.
Pool Name (ID)	Pool name with identifier in parentheses

Drives tab

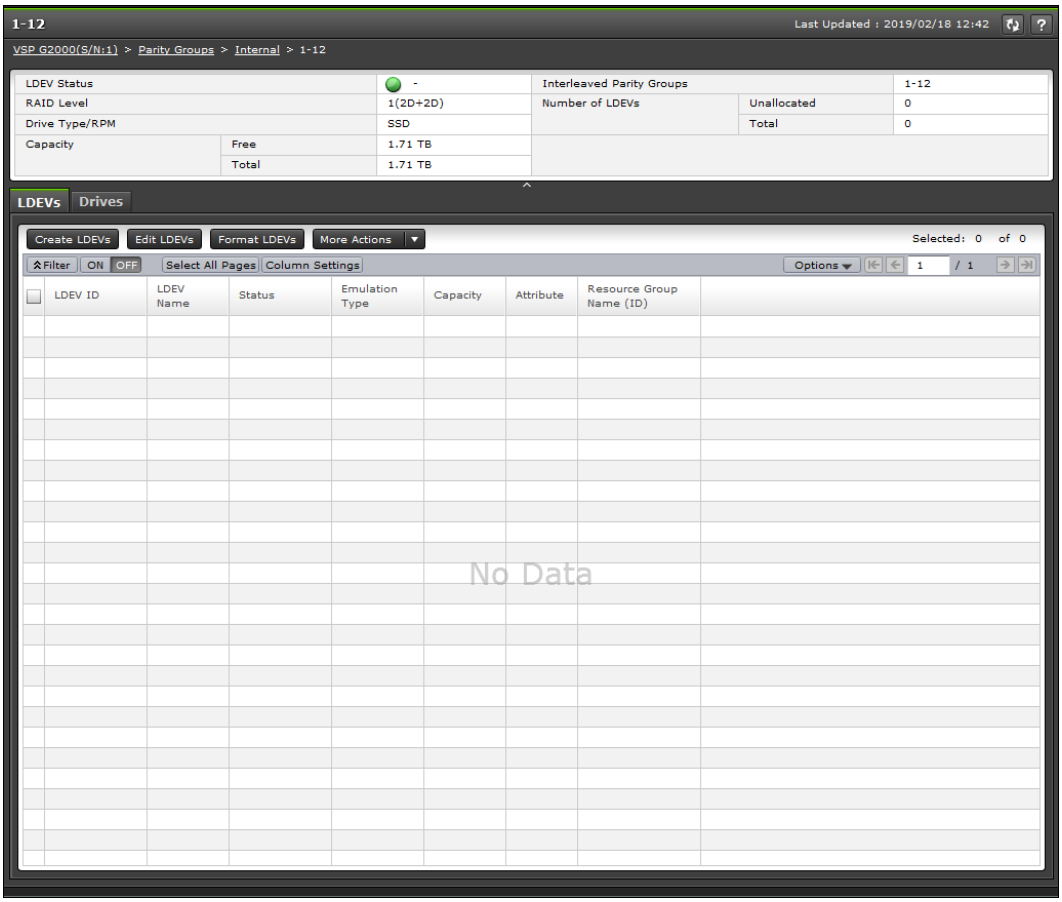
Only drives assigned to the logged-on user are displayed.



Item	Description
Parity Group ID	Parity group identifier
Disk Unit	Disk unit number
Drive Box	Drive box number
Location	Drive box location
Status	Drive box status
Drive Type/Interface/RPM/ Capacity	Drive type, interface, rpm, and capacity. For drive types other than HDD, a hyphen (-) is displayed for RPM.
Drive Type-Code	Drive type-code
Usage	▪ Data: data drive ▪ Spare: spare drive ▪ Free: drive that is not used

LDEVs tab: Internal or external volumes

Use this tab to view information about the LDEVs assigned to parity groups in an internal or external volume.



Summary

Item	Description
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.

Item	Description
	▪ 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	Pool capacity: ▪ Pool capacity. ▪ Free: Fee space capacity of which the LDEVs can be created. For the free space of the accelerated compression-enabled parity group, this area is the value of which the total mapped pages capacity of LDEVs (assigned in the physical area and expanded area) is deducted from the parity group capacity. The control information used by the storage system, such as control cylinders, is not included in the free capacity. ▪ Total: Total capacity of the LDEVs and the free space. For the total space of the accelerated compression-enabled parity group, this area is the physical area capacity. Because LDEVs that are allocated in the virtual capacity area are displayed in this table, the capacity of which free space is deducted from total space might be larger than the total capacity of LDEVs in this table.
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.
Interleaved Parity Groups	Interleaved (concatenated) parity groups.
Accelerated Compression	▪ Enabled: Accelerated compression of the parity group is enabled. ▪ Disabled: of the parity group is disabled. ▪ - (hyphen): Parity group with accelerated compression is not supported.
Number of LDEVs	▪ Unallocated: number of unallocated LDEVs ▪ Total: total number of LDEVs

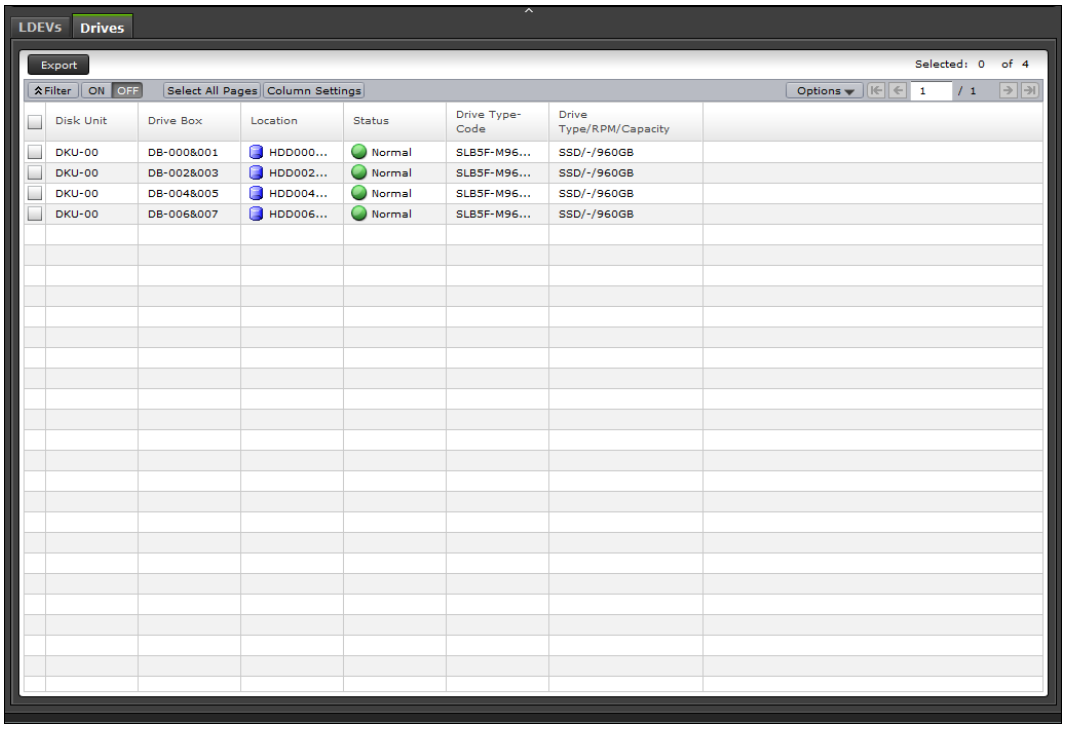
LDEVs tab

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Status	▪ Normal: Normal status. ▪ Blocked: Hosts 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.
Emulation Type	Emulation type
Capacity	Capacity of the selected LDEV
Attribute	LDEV attribute: ▪ Command Device: Volume is a command device. ▪ Remote Command Device: Volume is a remote command device. ▪ JNL VOL: Volume is a journal volume. ▪ Pool VOL: Volume is a pool volume. The number in the parentheses indicates the pool identifier. ▪ Quorum Disk: Quorum disk for global-active device. ▪ Data Direct Mapping: LDEV of the data direct mapping attribute. ▪ - (hyphen): Volume in which the attribute is not defined

Item	Description
Resource Group Name (ID)	Resource group name and identifier of LDEV
Expanded Space Used Not available by default. Available when you click Column Settings.	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Virtual Storage Machine Not available by default. Available when you click Column Settings.	▪ Model / Serial Number: Model name and serial number of the virtual storage machine that has an LDEV. Not available by default. Available when you click Column Settings. ▪ LDEV ID: Virtual LDEV ID. If a Virtual LDEV ID is not assigned to LDEV, this column is blank. Not available by default. Available when you click Column Settings. ▪ Device Name: Virtual device name, which is a combination of the virtual emulation type, virtual LUSE volume number, and the virtual CVS attribute. Values of the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are displayed only for items that have been set. This column is blank when the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are not set. If the virtual CVS attribute is set, CVS is attached as the suffix to the device name. Not available by default. Available when you click Column Settings. ▪ SSID: Virtual SSID. If Virtual SSID is not set for LDEV, this column is blank. Not available by default. Available when you click Column Settings. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for LDEV, this column is blank. Not available by default. Available when you click Column Settings.

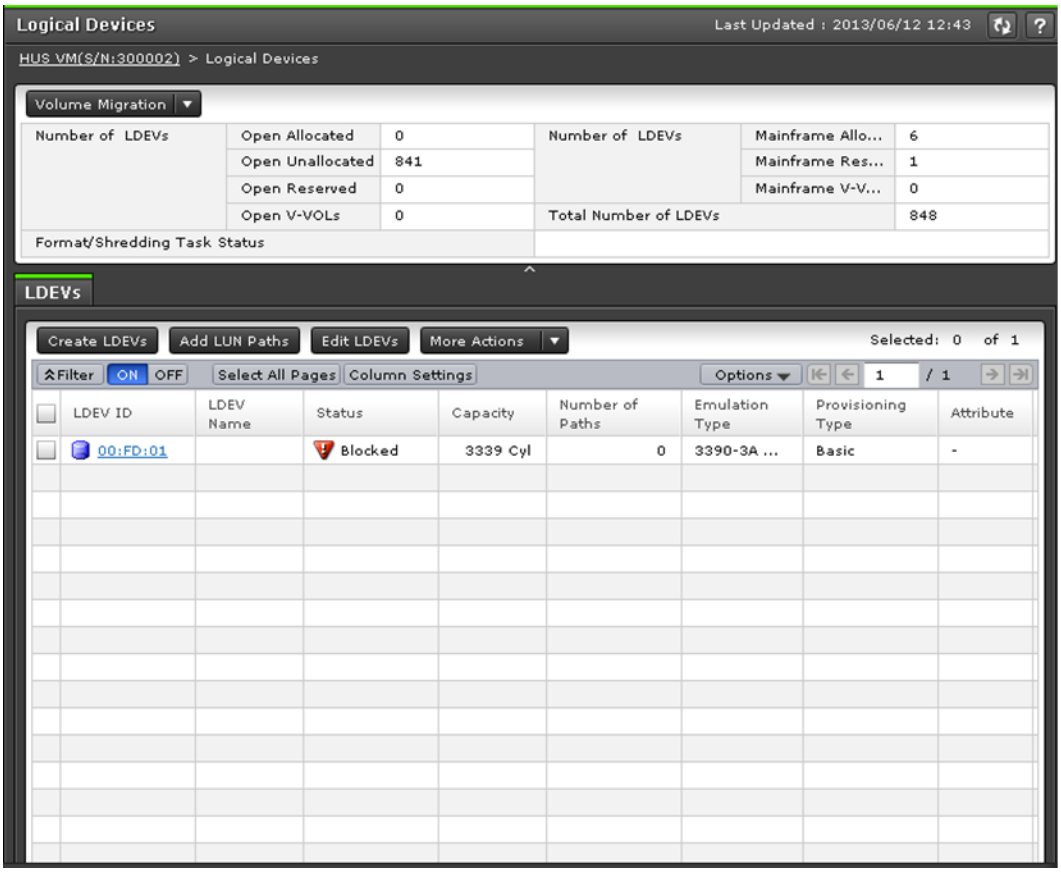
Drives tab

Only drives assigned to the logged-on user are displayed.



Item	Description
Disk Unit	Disk unit number
Drive Box	Drive box number
Location	Drive box location
Status	Drive box status
Drive Type-Code	Drive type-code
Drive Type/Interface/RPM/ Capacity	Drive type, interface, rpm, and capacity. For drive types other than HDD, a hyphen (-) is displayed for RPM.

Logical Devices window



Summary

Item	Description
Volume Migration	▪ View Migration Plans: Opens the **View Migration Plans** window. ▪ View Histories: Opens the **View Histories** window.
Number of LDEVs	▪ Open Allocated: number of allocated LDEVs for open system ▪ Open Unallocated: number of unallocated LDEVs for open system ▪ Open Reserved: number of reserved LDEVs for the open system ▪ Open V-VOLs: number of allocated V-VOLs for the open system ▪ Mainframe allocated: number of allocated LDEVs for the mainframe system

Item	Description
	▪ Mainframe Reserved: number of reserved LDEVs for the mainframe system ▪ Mainframe V-VOLs: number of allocated V-VOLs for the mainframe system
Total Number of LDEVs	Total number of LDEVs
Format/Shredding Task Status	▪ Formatting *n* %: Percentage progress of the formatting. ▪ Preparing Quick Format *n* %: Percentage progress of preparing the quick format. ▪ Shredding *n* %: Percentage progress of the shredding. ▪ Blank: Formatting, shredding, or verification is not being performed. If the configuration of the storage system is being changed, this item is also blank because the information cannot be collected.

LDEVs tab

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Status	▪ Normal: Normal status. ▪ Blocked: Hosts 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.

Item	Description
	▪ Shredding: Volume is being shredded. ▪ - (hyphen): Any status other than the above.
PIN Status Not available by default. Available when you click Column Settings.	PIN status
V-VOL Management Task Not available by default. Available when you click Column Settings.	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: Process is in progress. ▪ Waiting for Zero Page Reclaiming: Process is being waited on. ▪ Blank: V-VOL management task can be performed on the volume, but the task is not currently in process. ▪ - (hyphen): V-VOL management task cannot be performed on the volume.
Capacity	LDEV capacity
Capacity Saving Not available by default. Available when you click Column Settings.	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used.
Capacity Saving Status Not available by default. Available when you click Column Settings.	▪ Enabling: Format for enabling the capacity saving function is being performed. ▪ Rehydrating: Format for disabling the capacity saving function is being performed. ▪ Deleting Volume: DP-VOL whose capacity saving function is enabled is being deleted. ▪ Enabled: Capacity saving function is enabled. ▪ Disabled: Capacity saving function is disabled. ▪ Failed: Data cannot be secured. ▪ - (hyphen): LDEV does not support the capacity saving function.

Item	Description
Deduplication Data Not available by default. Available when you click Column Settings.	Whether the deduplication function is applied to the volume (DP-VOL): ▪ Enabled: Deduplication function is applied. ▪ Disabled: Deduplication function is not applied. ▪ - (hyphen): LDEV is not a DP-VOL, or the microcode version does not support deduplication. If the capacity saving of a DP-VOL is Deduplication and Compression, Enabled is displayed even if the used capacity is 0. If the capacity saving setting is Disabled and capacity saving is being disabled, Enabled is displayed for Deduplication Data while deduplicated data remains in the DP-VOL. When capacity saving is completely disabled and no deduplicated data remains in the DP-VOL, Disabled is displayed.
Number of paths	Number of paths set for the LDEV
Emulation Type	Emulation type
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ External MF: Migration volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Attribute	LDEV attribute: ▪ Command Device: Volume is a command device. ▪ Remote Command Device: Volume is a remote command device. ▪ JNL VOL: Volume is a journal volume. ▪ Pool VOL: Volume is a pool volume. The number in parentheses shows the pool identifier. ▪ Quorum Disk: Quorum disk for global-active device. ▪ TSE: TSE-VOL. ▪ ALU: LDEV of the ALU attribution. ▪ SLU: LDEV of the SLU attribution. ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled.

Item	Description
	▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication. ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication. ▪ - (hyphen): Volume other than the above.
Access Attribute Not available by default. Available when you click Column Settings.	Access attribute of the LDEV
Pool Name (ID)	Pool name (pool identifier)
Parity Group ID	Parity group identifier
RAID Level	RAID level. An asterisk (*) indicates that the parity group that the LDEV belong to is interleaved (concatenated).
MP Unit ID	MP unit identifier. If an MP unit is blocked due to a failure, the processing to be performed by the MP unit where the failure occurred is taken over by another normal MP unit. See MP unit priorities after takeover (2 or more nodes) Table 1 and MP unit priorities after takeover (2 or more nodes) Table 2, below.
Encryption Not available by default. Available when you click Column Settings.	▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume or migration volume. For DP-VOL, the pool-VOL in the pool to which DP-VOL belongs is an external volume, or the pool to which DP-VOL belongs is blocked.

Item	Description
Accelerated Compression Not available by default. Available when you click Column Settings.	▪ Enabled: Accelerated compression of the parity group is enabled. ▪ Disabled: Accelerated compression of the parity group is disabled. ▪ - (hyphen): Parity group with accelerated compression is not supported.
Expanded Space Used Not available by default. Available when you click Column Settings.	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
ALUA Mode	▪ Enabled: LDEV can be used in ALUA. ▪ Disabled: LDEV cannot be used in ALUA.
T10 PI Not available by default. Available when you click Column Settings.	LDEV's T10 PI attribute (Enabled or Disabled)
Resource Group Name (ID) Not available by default. Available when you click Column Settings.	Name and ID of the resource group to which this LDEV belongs
External Storage System Not available by default. Available when you click Column Settings.	If the LDEV is the DP-VOL of the data direct mapping attribute, the information about the external storage system to which the LDEV is being mapped: ▪ Vendor/Model/Serial Number A hyphen (-) is displayed if an external storage system is not mapped to the LDEV. ▪ Path Group ID: If Path Group ID is clicked, the Mapped Volumes tab is displayed. A hyphen (-) is displayed if an external storage system is not mapped to the LDEV.

Item	Description
Data Direct Mapping Not available by default. Available when you click Column Settings.	▪ LDEV ID: LDEV ID of the pool-VOL in the pool with data direct mapping enabled, or LDEV ID of the DP-VOL with data direct mapping enabled. If LDEV ID is clicked, the **LDEV Properties** window is displayed. If data direct mapping is disabled, a hyphen (-) is displayed. If a DP-VOL with data direct mapping enabled is not created in the pool with data direct mapping enabled, this field is blank. ▪ Parity Group ID: Parity Group ID of the pool-VOL in the pool with data direct mapping enabled. If data direct mapping is disabled, a hyphen (-) is displayed.
Virtual Storage Machine Not available by default. Available when you click Column Settings.	▪ Model / Serial Number: Model name and serial number of the virtual storage machine with the LDEV. Not available by default. Available when you click Column Settings. ▪ LDEV ID: Virtual LDEV ID. If a Virtual LDEV ID is not assigned to LDEV, this column is blank. Not available by default. Available when you click Column Settings. ▪ Device Name: Virtual device name, which is a combination of the virtual emulation type, virtual LUSE volume number, and the virtual CVS attribute. Values of the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are displayed only for items that have been set. This column is blank when the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are not set. If the virtual CVS attribute is set, CVS is attached as the suffix to the device name. Not available by default. Available when you click Column Settings. ▪ SSID: Virtual SSID. If Virtual SSID is not set for the LDEV, this column is blank. Not available by default. Available when you click Column Settings. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for the LDEV, this column is blank. Not available by default. Available when you click Column Settings.

MP unit priorities after takeover (2 or more nodes) Table 1

	Priority assumed by MP units after takeover					
MP unit blocked by failure	1st	2nd	3rd	4th	5th	6th
MPU-010	MPU-110	MPU-120	MPU-020	MPU-310	MPU-320	MPU-510
MPU-020	MPU-120	MPU-110	MPU-010	MPU-320	MPU-310	MPU-520
MPU-110	MPU-010	MPU-020	MPU-120	MPU-210	MPU-220	MPU-410
MPU-120	MPU-020	MPU-010	MPU-110	MPU-220	MPU-210	MPU-420
MPU-210	MPU-310	MPU-320	MPU-220	MPU-510	MPU-520	MPU-110
MPU-220	MPU-320	MPU-310	MPU-210	MPU-520	MPU-510	MPU-120
MPU-310	MPU-210	MPU-220	MPU-320	MPU-410	MPU-420	MPU-010
MPU-320	MPU-220	MPU-210	MPU-310	MPU-420	MPU-410	MPU-020
MPU-410	MPU-510	MPU-520	MPU-420	MPU-110	MPU-120	MPU-310
MPU-420	MPU-520	MPU-510	MPU-410	MPU-120	MPU-110	MPU-320
MPU-510	MPU-410	MPU-420	MPU-520	MPU-010	MPU-020	MPU-210
MPU-520	MPU-420	MPU-410	MPU-510	MPU-020	MPU-010	MPU-220

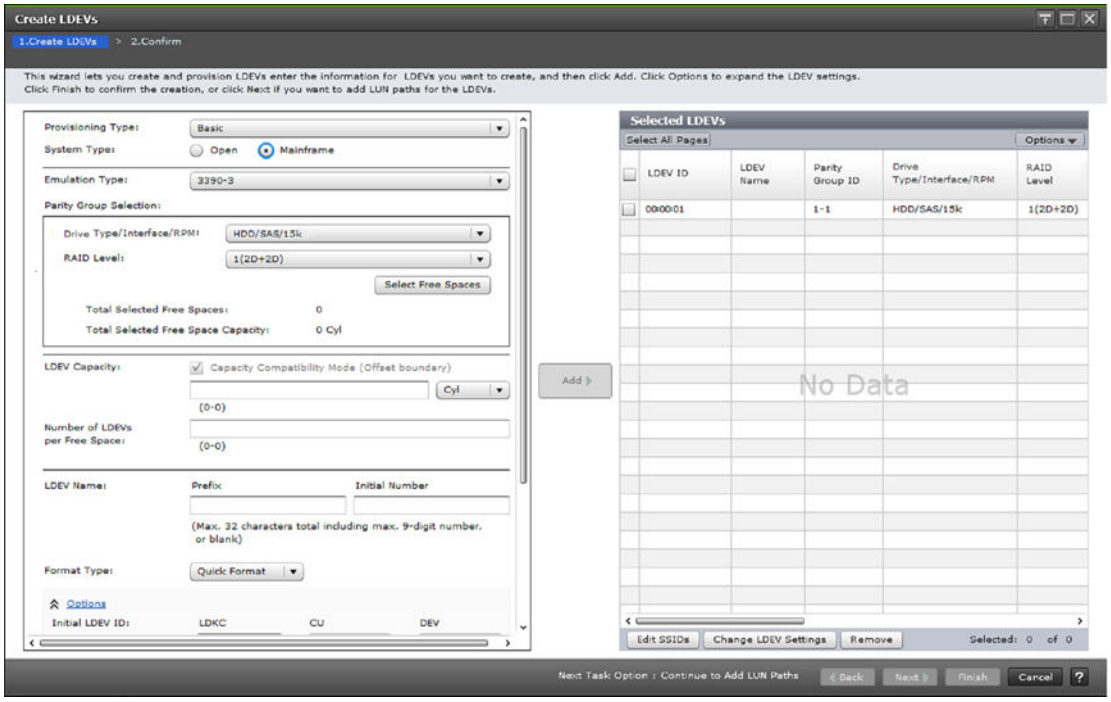
MP unit priorities after takeover (2 or more nodes) Table 2

	Priority assumed by MP units after takeover				
MP unit blocked by failure	7th	8th	9th	10th	11th
MPU-010	MPU-520	MPU-210	MPU-220	MPU-410	MPU-420
MPU-020	MPU-510	MPU-220	MPU-210	MPU-420	MPU-410
MPU-110	MPU-420	MPU-310	MPU-320	MPU-510	MPU-520
MPU-120	MPU-410	MPU-320	MPU-310	MPU-520	MPU-510
MPU-210	MPU-120	MPU-410	MPU-420	MPU-010	MPU-020
MPU-220	MPU-110	MPU-420	MPU-410	MPU-020	MPU-010
MPU-310	MPU-020	MPU-510	MPU-520	MPU-110	MPU-120
MPU-320	MPU-010	MPU-520	MPU-510	MPU-120	MPU-110
MPU-410	MPU-320	MPU-010	MPU-020	MPU-210	MPU-220

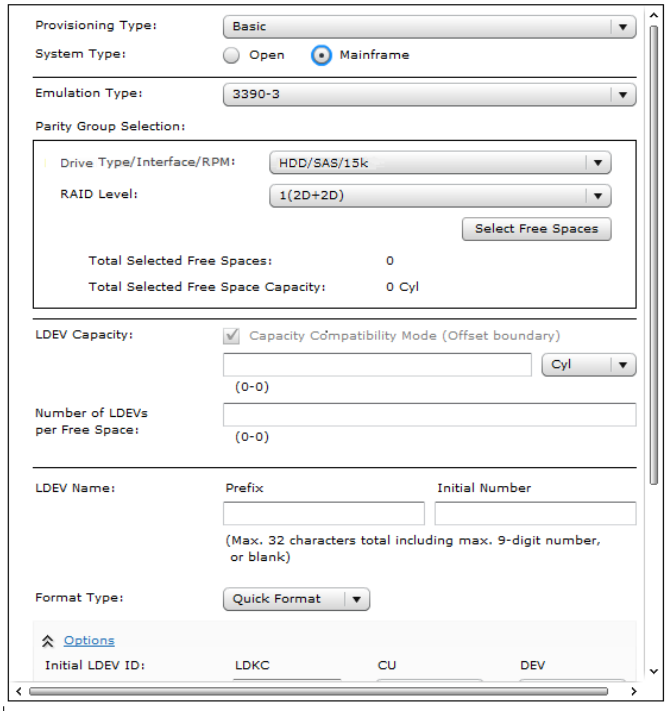
MPU-420	MPU-310	MPU-020	MPU-010	MPU-220	MPU-210
MPU-510	MPU-220	MPU-110	MPU-120	MPU-310	MPU-320
MPU-520	MPU-210	MPU-120	MPU-110	MPU-320	MPU-310

Create LDEVs wizard

Create LDEVs window



Setting fields



Item	Description
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
System Type	▪ Open: volume for open systems ▪ Mainframe: volume for mainframe systems
Data Direct Mapping	Available if the provisioning type is Dynamic Provisioning or external, and if the system type is open. If the provisioning type is external and an external volume with the data direct mapping attribute enabled does not exist, you cannot enable this attribute. ▪ Enable: Data direct mapping attribute is enabled. ▪ Disable: Data direct mapping attribute is disabled.
Emulation Type	▪ For open systems, OPEN-V is default. ▪ For mainframe systems, 3390 is default.

Item	Description
	Note: The emulation type might differ depending on the configuration.
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. This option is not available if the LDEV status of the deduplication system data volume in the target pool is other than normal. ▪ Disabled: Capacity saving function is not used. Disabled is automatically displayed if any of these conditions is satisfied: • Data direct mapping is enabled. • License for the capacity saving functions is not installed. • Multi-Tier Pool is enabled. • System type is mainframe. • Device emulation type is other than OPEN-V.
Multi-Tier Pool	Applies to Dynamic Tiering or Dynamic Tiering for Mainframe: ▪ Enable: Pool for Dynamic Tiering or Dynamic Tiering for Mainframe is displayed in the **Select Pool** window. ▪ Disable: Pool for Dynamic Tiering or Dynamic Tiering for Mainframe is not displayed in the **Select Pool** window.
Active Flash	All of these conditions must be met: ▪ Multi-Tier Pool option is enabled. ▪ Pool volumes whose drive type is SSD or FMD are installed.
TSE Attribute	▪ Enable: TSE-VOL is created. ▪ Disable: TSE-VOL is not created. All these conditions must be met: ▪ System type is mainframe. ▪ Multi-Tier Pool is disabled.
Parity Group Selection, Pool Selection, or External Volume Selection	Parity group to which the LDEV is assigned: ▪ Parity Group Selection: Internal volumes are created. ▪ Pool Selection: DP-VOLs are created. If data direct mapping is enabled, this item is not displayed. ▪ External Volume Selection: External volumes are created.

Item	Description
Drive Type/Interface/RPM	Data drive type, interface, and rpm: ▪ Any: Any drives where system configurations are created and rpms ▪ FMD DC2: Select this item when creating LDEVs belonging to a parity group with accelerated compression enabled ▪ SSD: SSDs ▪ SSD(RI): SSDs (Read Intensive type) ▪ SAS/RPM: SAS drives and rpms ▪ External Storage: External storage systems ▪ Mixable: Mixing of drive types
RAID Level	RAID level. If External Storage is selected from Drive Type/RPM, a hyphen (-) is displayed.
Total Selected Free Spaces	Number of the selected free spaces
Total Selected Free Space Capacity	Total capacity of the free spaces
Selected Pool Name (ID)	Selected pool name and ID
Selected Pool Capacity	Selected pool capacity
LDEV Capacity	▪ Capacity Compatibility Mode (Offset boundary): • If you want to offset the specified LDEV capacity by boundary, Capacity Compatibility Mode (Offset boundary) must be turned on. • If the emulation type is OPEN-V, Capacity Compatibility Mode (Offset boundary) is off by default. ▪ Input area: 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. If data direct mapping is enabled, this item is not displayed.
Number of LDEVs per Free Space, Number of LDEVs, or Number of LDEVs per External Volume	If the provisioning type is Dynamic Provisioning and data direct mapping is enabled, this item is not available. If the provisioning type is external and data direct mapping is enabled, 1 is displayed in Number of LDEVs per External Volume.

Item	Description
Available Volumes	Available when the provisioning type is Dynamic Provisioning and data direct mapping is enabled: ▪ LDEV ID ▪ LDEV Name ▪ Parity Group ID ▪ Capacity: capacity of the LDEV ▪ Vender/Model/Serial Number ▪ Pool Name (ID) ▪ Current Subscription (%): current subscription of the pool ▪ Subscription Limit (%): subscription limit of the pool ▪ Capacity: capacity of the pool
LDEV Name	LDEV name, which can be up to 32 characters: ▪ Prefix: Fixed character string ▪ Initial Number: Initial number characters Examples: • 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	Displayed when an internal or external volume is selected. Format types: ▪ Quick Format (default): Unavailable if the provisioning type is external volume or for an LDEV in a parity group with accelerated compression enabled. ▪ Write to Control Blocks: Available when the external mainframe volume is created. Default when selecting the external volume of the mainframe system. ▪ Normal Format: Normal formatting. ▪ Parity Group Format: Available only when there are no existing LDEVs in a parity group. When Parity Group Format is performed, the LDEVs are not available for use until the format operation is complete (the same behavior as Normal Format). ▪ No Format: Volumes are not formatted.

Item	Description
Initial LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV. The ID is assigned at a certain interval starting with the specified ID. ▪ LDKC: Fixed to 00. ▪ CU: CU number. ▪ DEV: LDEV number. ▪ Interval: Interval of the assigned LDEV ID.
Initial SSID	Default is 0004. When creating multiple LDEVs, the beginning number of the LDEV must be specified.
CLPR	Cache logical partition number, in *ID*:*CLPR* format
MP Unit ID	MP unit to assign to the LDEV, any or Auto. If automatic assignment is enabled for one or more MPs, Auto is also available. If Auto is enabled, the default is Auto. If Auto is disabled, the default is the lowest number of the MP unit.
Full Allocation	Reserved pages in a pool that is associated with LDEVs: ▪ Enable: Full allocation is performed. ▪ Disable (default): Full allocation is not performed. Enable is available only when all of these conditions are met: ▪ Sum of the mapped capacity and the reserved capacity is the same or less than the depletion threshold. ▪ Specified pool is not undergoing shrink processing. ▪ Data direct mapping is disabled.
Tiering Policy	Selected by default. Level1(1) to Level5(5) or from Level6(6) can be changed to Level31(31). From Level 6 (6) to Level 31 (31), the names of tiering policies can also be changed. If these names have changed, the new names are displayed. For a DP-VOL for which the capacity saving function is enabled, All(0) or Level1(1) through Level5(5) can be specified. Available if the multi-tier pool option is enabled.
New Page Assignment Tier	New page assignment tier to assign to the LDEV: High, Middle, and Low. Middle is the default. Available if the multi-tier pool option is enabled.
Relocation Priority	LDEV to be relocated preferentially. Options are Default or Prioritize. Available if the Multi-Tier Pool is enabled.

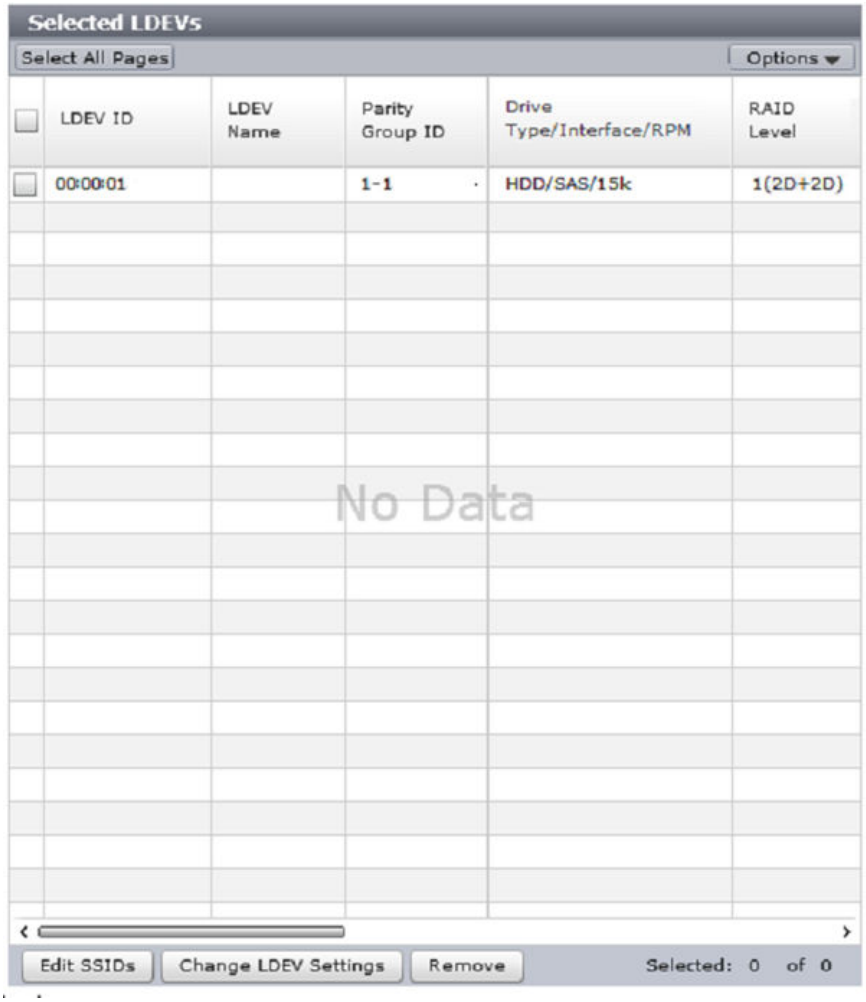
Item	Description
T10 PI	LDEV's T10 PI attribute (Enabled or Disabled). Available only when the provisioning type is Basic, Dynamic Provisioning, or Snapshot.

The items that can be set in this window depend on the type of volume you are creating. This 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	LDEV of the ALU attribution
Provisioning Type	Required	Required	Required	Required	Required	Required
System Type	Required	Required	Required	Required	Required	N/A
Data Direct Mapping	N/A	Optional	Disabled	Optional	N/A	N/A
Emulation Type	Required	Required	Required	Required	Required	N/A
Capacity Saving	N/A	Optional	N/A	N/A	N/A	N/A
Multi-Tier Pool	N/A	Required	Required	N/A	N/A	N/A
Active Flash	N/A	Optional	N/A	N/A	N/A	N/A
TSE Attribute	N/A	Disabled	Required	N/A	N/A	N/A
Drive Type/ Interface/RPM	Required	Required	Required	Disabled	N/A	N/A
RAID Level	Required	Required	Required	Disabled	N/A	N/A
Select Free Spaces	Required	N/A	N/A	Required	N/A	N/A
Select Pool	N/A	Required	Required	N/A	N/A	N/A
Capacity Compatibility Mode (Offset boundary)	Optional	Optional	N/A	Optional	Optional	N/A
LDEV Capacity	Required	Required	Required	Required	Required	N/A
Number of LDEVs per Free Space	Required	N/A	N/A	N/A	N/A	N/A
Number of LDEVs	N/A	Required	Required	N/A	Required	Required
Number of LDEVs per External Volume	N/A	N/A	N/A	Required	N/A	N/A
Available Volumes	N/A	Optional	N/A	Optional	N/A	N/A
LDEV Name	Optional	Optional	Optional	Optional	Optional	Optional

Item	Internal volume	V-VOL for open system	V-VOL for mainframe system	External volume	Snapshot volume	LDEV of the ALU attribution
Format Type	Required	N/A	N/A	Required	N/A	N/A
Initial LDEV ID	Optional	Optional	Optional	Optional	Optional	Optional
View LDEV IDs	Optional	Optional	Optional	Optional	Optional	Optional
Initial SSID	Optional	Optional	Optional	Optional	Optional	Optional
View SSIDs	Optional	Optional	Optional	Optional	Optional	Optional
CLPR	N/A	Optional	Optional	N/A	Optional	Optional
MP Unit	Optional	Optional	Optional	Optional	Optional	Optional
Full Allocation	N/A	Optional	Optional	N/A	N/A	N/A
Tiering Policy	N/A	Optional	Optional	N/A	N/A	N/A
New Page Assignment Tier	N/A	Optional	Optional	N/A	N/A	N/A
Relocation Priority	N/A	Optional	Optional	N/A	N/A	N/A
T10 PI	Optional	Optional	Disabled	N/A	Optional	N/A

Selected LDEVs table

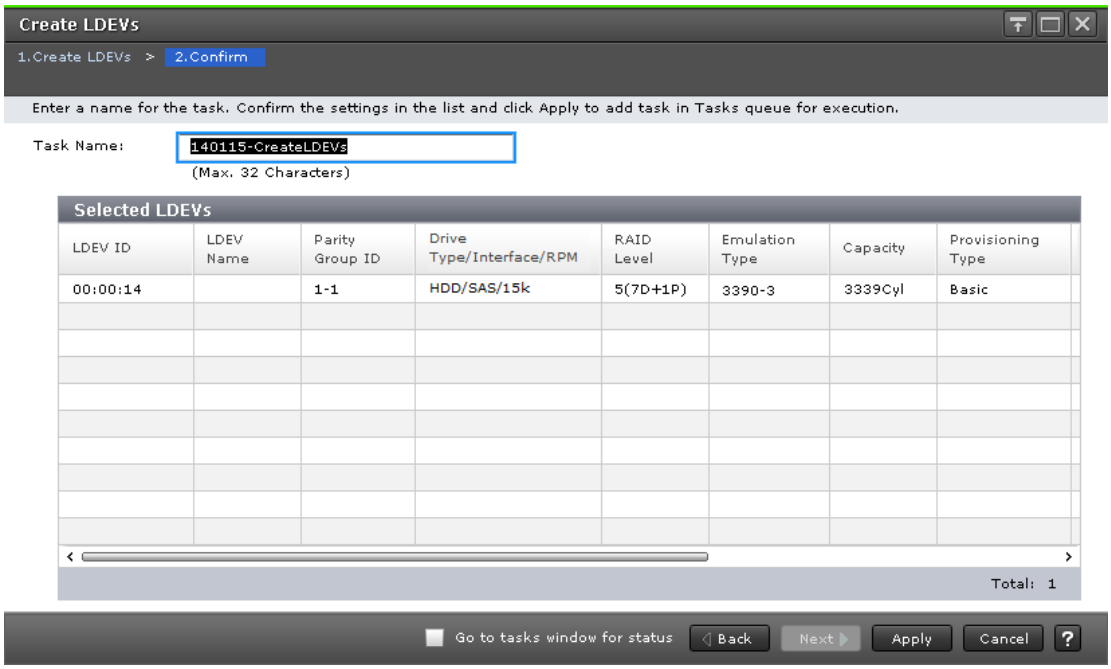


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name, including the combination of prefix characters and the initial number
Parity Group ID	Parity group identifier
Pool Name (ID)	Pool name and pool identifier
Data Direct Mapping	▪ LDEV ID: LDEV ID of the pool-VOL in the pool with data direct mapping enabled, or LDEV ID of the DP-VOL with data direct mapping enabled. ▪ Parity Group ID: Parity Group ID of the pool-VOL in the pool with data direct mapping enabled. ▪ - (hyphen): Data direct mapping is disabled.

Item	Description
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.
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, in *ID*:*CLPR* format. For detailed information about CLPRs, see the *Performance Guide*.
MP Unit ID	MP unit identifier. If Auto is selected, the ID is automatically assigned.
Multi-Tier Pool	▪ Enabled: LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ Disabled: LDEV is not for Dynamic Tiering or Dynamic Tiering for Mainframe.
Full Allocation	Status of the full allocation in a pool associated with the V-VOL: ▪ Enable: Full allocation of all DP-VOL pages is performed. ▪ Disable: Full allocation of all DP-VOL pages is not performed.
Active Flash	▪ Enabled: LDEV is for active flash or active flash for mainframe. ▪ Disable: LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ - (hyphen): LDEV is for Dynamic Provisioning or Dynamic Provisioning for Mainframe.
Tiering Policy	Tiering policy name and ID for the LDEV
New Page Assignment Tier	New page assignment tier for the LDEV
Relocation Priority	Relocation priority assigned to the LDEV
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used.

Item	Description
Attribute	LDEV attribute: ▪ TSE: TSE-VOL ▪ ALU: LDEV of the ALU attribution ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ - (hyphen): Volume for which the attribute is not defined
Encryption	▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume or migration volume. For DP-VOL, the pool-VOL in the pool to which DP-VOL belongs is an external volume, or the pool to which DP-VOL belongs is blocked.
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
T10 PI	LDEV's T10 PI attribute (Enabled or Disabled)
Resource Group Name (ID)	Resource group name and ID of which this LDEV is a member
Virtual Storage Machine	▪ Model / Serial Number: Model name and serial number of the virtual storage machine with the LDEV. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for LDEV, this column is blank.

Create LDEVs confirmation window



Selected LDEVs table

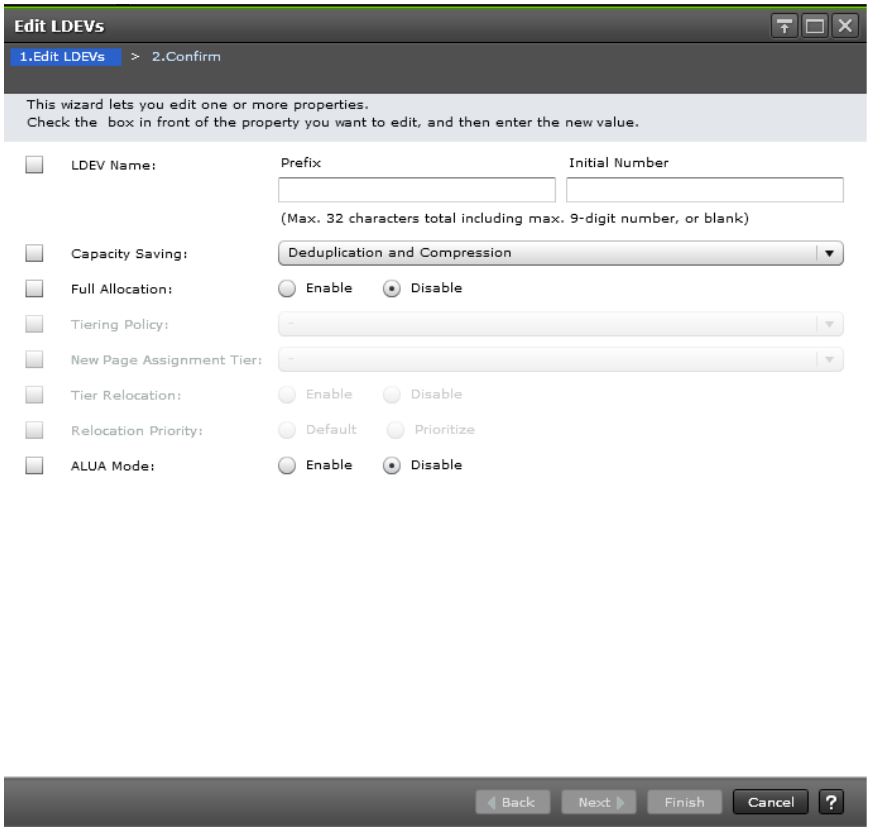
Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name, including the combination of prefix characters and the initial number
Data Direct Mapping	▪ LDEV ID: LDEV ID of the pool-VOL in the pool with data direct mapping enabled, or LDEV ID of the DP-VOL with data direct mapping enabled. If data direct mapping is disabled, a hyphen (-) is displayed. ▪ Parity Group ID: Parity Group ID of the pool-VOL in the pool with data direct mapping enabled. If data direct mapping is disabled, a hyphen (-) is displayed.
Parity Group ID	Parity group identifier
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.
Pool Name (ID)	Pool name (pool identifier)
RAID Level	RAID level. An asterisk (*) indicates that the parity group to which the LDEV belongs is interleaved (concatenated).
Emulation Type	Emulation type

Item	Description
Capacity	LDEV capacity
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Format Type	Format type
SSID	Storage system identifier in hexadecimal format
CLPR	Cache logical partition number, in *ID*:*CLPR* format. For detailed information about CLPRs, see the *Performance Guide*.
MP Unit ID	MP unit identifier. If Auto is selected, the ID is automatically assigned.
Multi-Tier Pool	▪ Enable: LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ Disable: LDEV is for Dynamic Provisioning or Dynamic Provisioning for Mainframe.
Active Flash	▪ Enabled: LDEV is for active flash or active flash for mainframe. ▪ Disable: LDEV is for Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ - (hyphen): LDEV is for Dynamic Provisioning or Dynamic Provisioning for Mainframe.
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Enable: Full allocation of all DP-VOL pages is performed. ▪ Disable: Full allocation of all DP-VOL pages is not performed.
Tiering Policy	Tiering policy name and ID for the LDEV
New Page Assignment Tier	New page assignment tier for the LDEV
Relocation Priority	Relocation priority assigned to the LDEV
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used.

Item	Description
Attribute	▪ TSE: TSE-VOL ▪ ALU: LDEV of the ALU attribution ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ - (hyphen): Volume in which attribute is not defined
Encryption	▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume or migration volume. For DP-VOL, the pool-VOL in the pool to which DP-VOL belongs is an external volume, or the pool to which DP-VOL belongs is blocked.
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
T10 PI	LDEV's T10 PI attribute (Enabled or Disabled)
Resource Group Name (ID)	Resource group name and ID of which this LDEV is a member
Virtual Storage Machine	▪ Model / Serial Number: Model name and serial number of the virtual storage machine with the LDEV. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for LDEV, this column is blank.

Edit LDEVs wizard

Edit LDEVs window

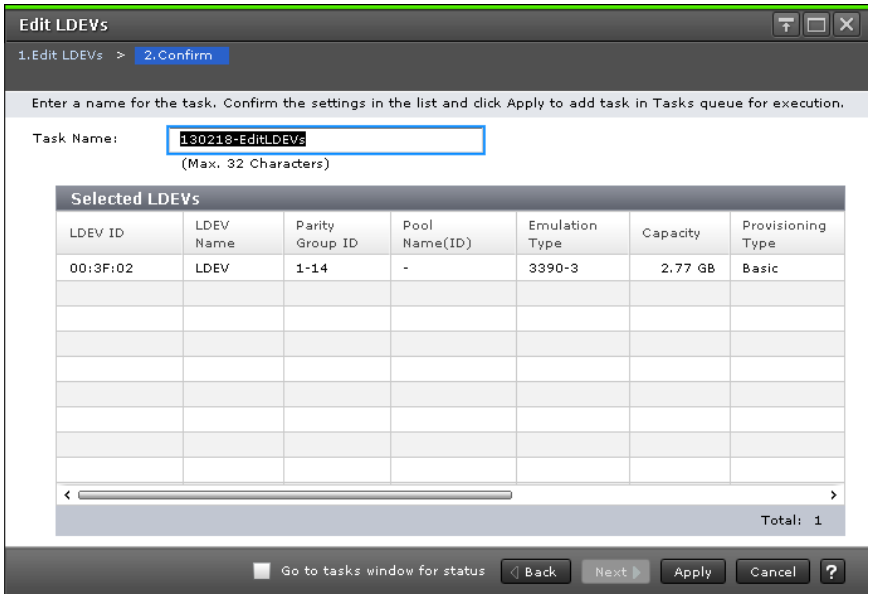


Item	Description
LDEV Name	LDEV name, which can be up to 32 characters: ▪ Prefix: Fixed character string ▪ Initial Number: Initial number characters Examples: • 1: Up to 9 numbers are added (1, 2, 3 ... 9) • 08: Up to 92 numbers are added (08, 09, 10 ... 99) • 23: Up to 77 numbers are added (23, 24, 25 ... 99) • 098: Up to 902 numbers are added (098, 099, 100 ... 999)

Item	Description
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used. If any of these conditions is satisfied, Disabled is set for capacity saving: ▪ Data direct mapping is enabled. ▪ The license for the capacity saving function is not installed. ▪ There are not enough cache management devices. ▪ A journal volume for Universal Replicator is selected. ▪ The subscription limit of the pool is not set to Unlimited.
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Disable (default): Full allocation is disabled. ▪ Enable: All pages of LDEVs on the current pool are allocated. LDEVs must satisfy all of these conditions: • All LDEVs are V-VOLs of Dynamic Provisioning or Dynamic Provisioning for Mainframe. • Sum of the mapped capacity and the reserved capacity is the same or less than the depletion threshold. • Specified pool is not in the shrink processing of the pool capacity. • LDEV emulation type is OPEN-V or 3390-A. • Status of the LDEV is Normal. • Data direct mapping is disabled.
Tiering Policy	Tiering policy for Dynamic Tiering or Dynamic Tiering for Mainframe V-VOLs.
New Page Assignment Tier	New page assignment tier: High, Middle, and Low. Middle is the default. Available only for Dynamic Tiering or Dynamic Tiering for Mainframe V-VOLs.
Tier Relocation	Tier relocation. Available only for Dynamic Tiering or Dynamic Tiering for Mainframe V-VOLs.
Relocation Priority	Relocation priority. Available only for Dynamic Tiering or Dynamic Tiering for Mainframe V-VOLs with tier relocation enabled.

Item	Description
ALUA Mode	ALUA mode for global-active device pairs: ▪ Enabled: LDEV can be used in ALUA. ▪ Disabled: LDEV cannot be used in ALUA.

Edit LDEVs confirmation window

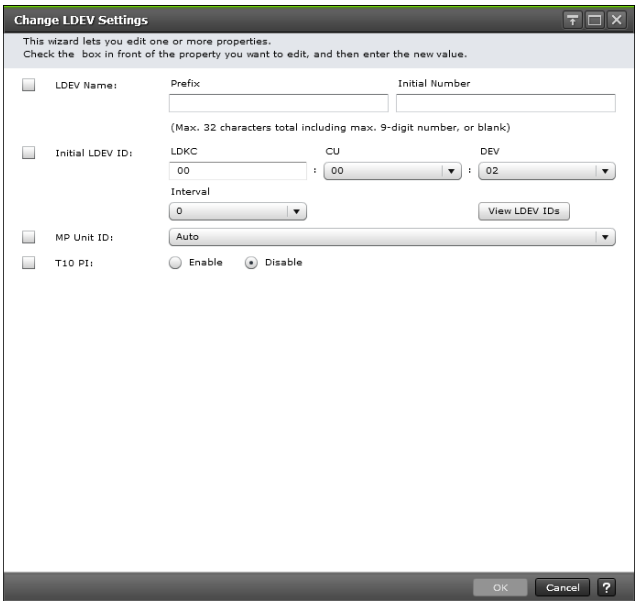


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name, including the combination of prefix characters and the initial number
Parity Group ID	Parity group identifier
Pool Name (ID)	Pool name and pool identifier
Emulation Type	Emulation type
Capacity	LDEV capacity
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume

Item	Description
	▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used. ▪ - (hyphen): LDEV does not support the capacity saving function.
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Enable: Full allocation is performed. ▪ Disable: Full allocation is not performed. ▪ - (hyphen): LDEVs other than V-VOLs for Dynamic Provisioning or Dynamic Provisioning for Mainframe.
Tiering Policy	Tiering policy. A hyphen (-) is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
New Page Assignment Tier	New page assignment tier. A hyphen (-) is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
Tier Relocation	Tier relocation. A hyphen (-) is displayed for volumes other than Dynamic Tiering or Dynamic Tiering for Mainframe volumes.
Relocation Priority	Relocation priority. A hyphen (-) is displayed if the LDEV is the one of these items: ▪ LDEV other than Dynamic Tiering. ▪ LDEV other than Dynamic Tiering for Mainframe. ▪ Tier relocation of LDEV is disabled.
ALUA Mode	▪ Enabled: LDEV can be used in ALUA. ▪ Disabled: LDEV cannot be used in ALUA.

Change LDEV Settings window

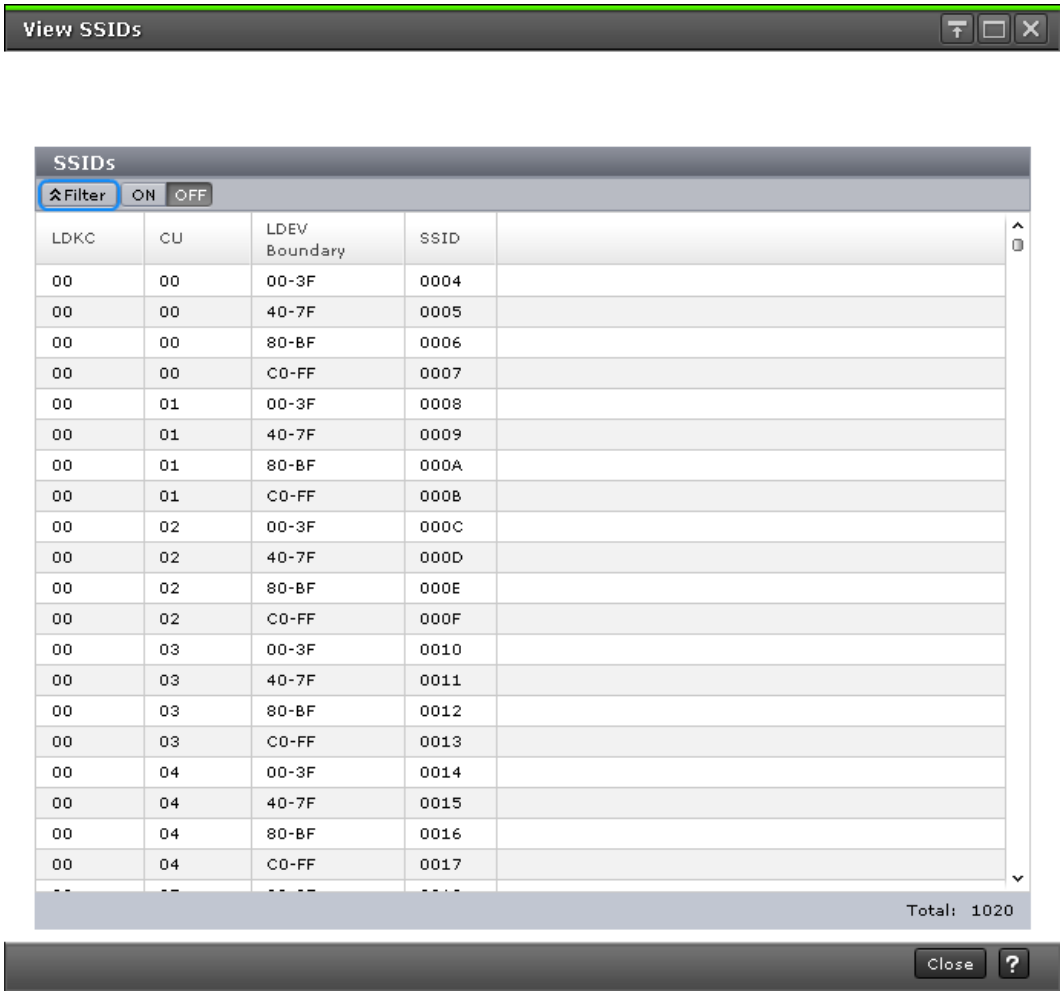
Use this window to edit LDEV properties.



Item	Description
LDEV Name	LDEV name, which can be up to 32 characters: ▪ Prefix: Fixed character string ▪ Initial Number: Initial number characters Examples: • 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	LDEV identifier, which is the combination of LDKC, CU, and LDEV. The ID is assigned at a certain interval starting with the specified ID: ▪ LDKC: Fixed to 00. ▪ CU: CU number. ▪ DEV: LDEV number. ▪ Interval: Interval of the assigned LDEV ID.
MP Unit ID	MP unit ID assigned to the LDEV, any ID or Auto. If automatic assignment is enabled for one or more MPs, the Auto option is also available.
T10 PI	LDEV's T10 PI attribute (enabled or disabled). Available only when the provisioning type is basic, Dynamic Provisioning, or Snapshot.

View SSIDs window

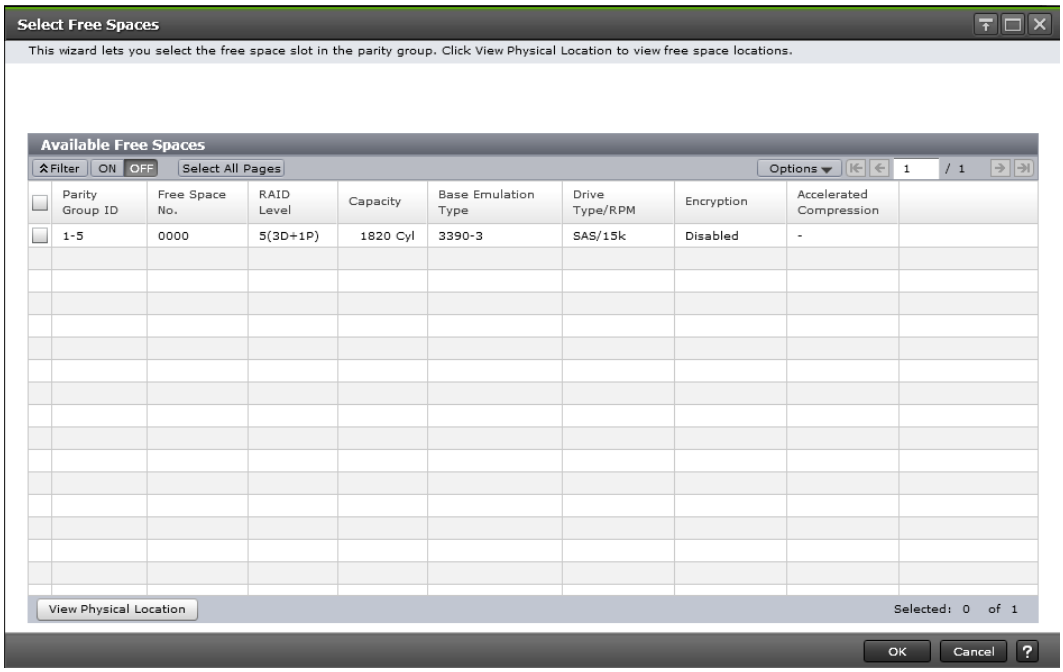
Use this window to view storage system identifier information.



Item	Description
LDKC	LDEV identifier, which is the combination of LDKC, CU, and LDEV
CU	Control unit number
LDEV Boundary	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

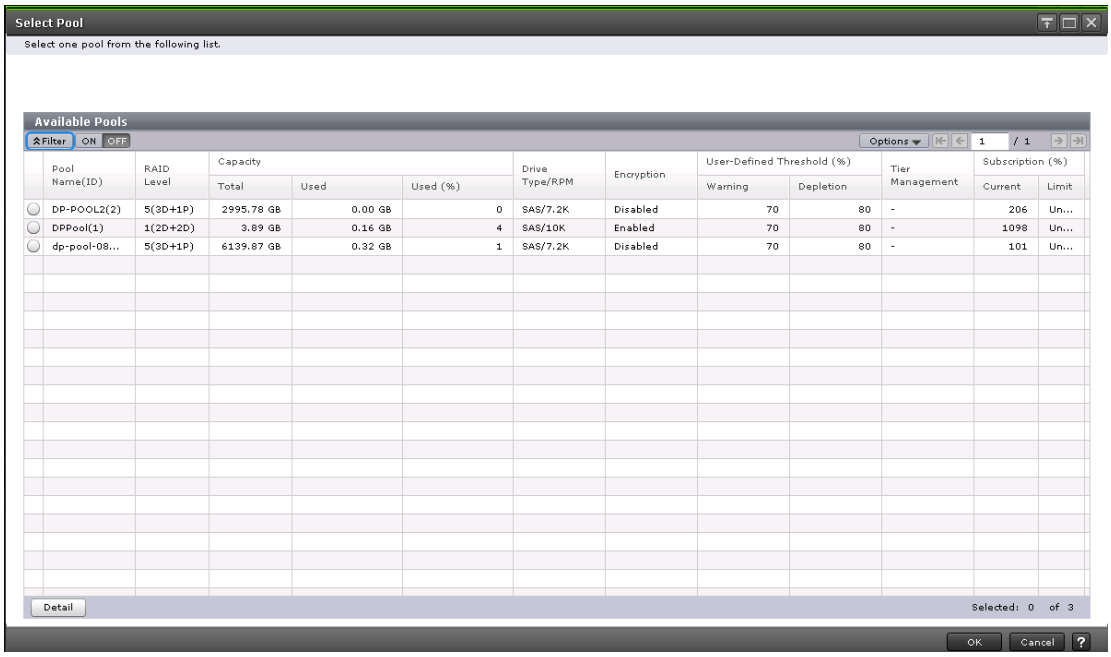
Select Free Spaces window

Use this window to view information about available free space slots in the parity group. Only the physical free space 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/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.
Encryption	▪ Enable: encrypted parity group ▪ Disable: non-encrypted parity group ▪ - (hyphen): parity group in which encryption is not defined
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.

Select Pool window



Available Pools table

Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level

Item	Description
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. ▪ Used: For a pool composed of pool volumes assigned to accelerated compression-disabled parity groups, the sum of the mapped capacity and reserved capacity. For a pool composed of pool volumes assigned to accelerated compression-enabled parity groups, the pool used capacity is displayed. For a pool composed of pool volumes assigned to accelerated compression-disabled parity groups, the displayed value of Used might be larger than the displayed value of Total due to following reason: • If the emulation type is 3390-A, the mapped 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 enabled, the mapped capacity for DP-VOL contains the management area capacity. • The mapped capacity of DP-VOL includes the capacity of the control information (uses a maximum of 168 MB per 3,145,548 MB). • DP-VOL with the data direct mapping attribute includes the control information (168 MB is used per 3,145,548 MB) and capacity for one page. ▪ Used (%): For a pool composed of pool volumes assigned to accelerated compression-disabled parity groups, the percentage of the sum of the mapped capacity and the reserved capacity of a pool. For a pool composed of pool volumes assigned to accelerated compression-enabled parity groups, the pool used capacity percentages against the pool capacity is displayed. Used (%) is the value that is truncated after the decimal point of the actual value.
Drive Type/RPM	Data drive type and rpm. For an external volume, External Storage with the value of the external LDEV tier rank is displayed in Drive Type.
Encryption	▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted.

Item	Description
	▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): Pool is created by external volumes, or pool is blocked.
User-Defined Threshold (%)	Pool threshold: ▪ Warning: warning threshold ▪ Depletion: depletion threshold
Tier Management	▪ Auto or Manual: Dynamic Tiering or Dynamic Tiering for Mainframe is enabled. ▪ Manual: Pools other than Dynamic Tiering or Dynamic Tiering for Mainframe are available for monitoring. ▪ - (hyphen): Other pools.
Subscription (%)	Pool subscription percentage: ▪ 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

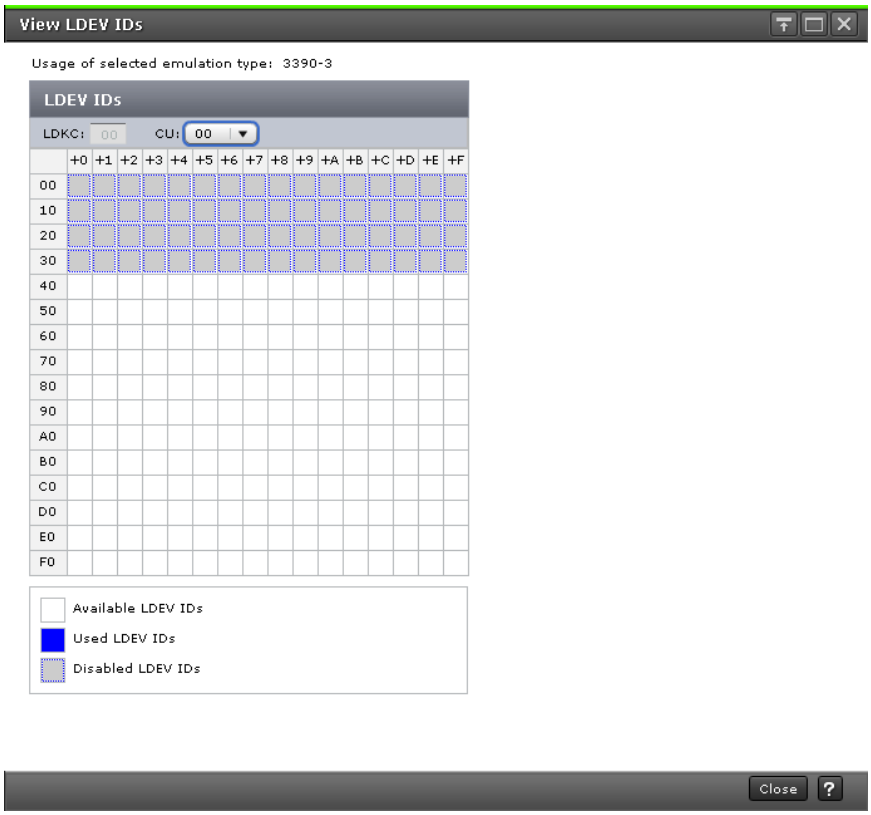
View LDEV IDs window

Use this window to view available, used, and unavailable LDEV IDs in matrix format. The vertical scale in the matrix indicates the second-to-last digit of the LDEV number, and the horizontal scale indicates the last digit of the LDEV number.

In the matrix, used LDEV numbers are displayed in blue, unselectable LDEV numbers are displayed in gray, and unused LDEV numbers are displayed in white. The LDEV numbers corresponding to any one of these conditions cannot be specified:

- The LDEV is already in use.
- The LDEV is already assigned to another emulation group (grouped every 32 LDEVs).

- The LDEV is not assigned to the user.
- If these values are not identical when a mainframe volume or multiplatform volume is created:
  - The LDEV ID and the virtual LDEV ID
  - The model and serial number of the storage system and the virtual storage machine



Summary

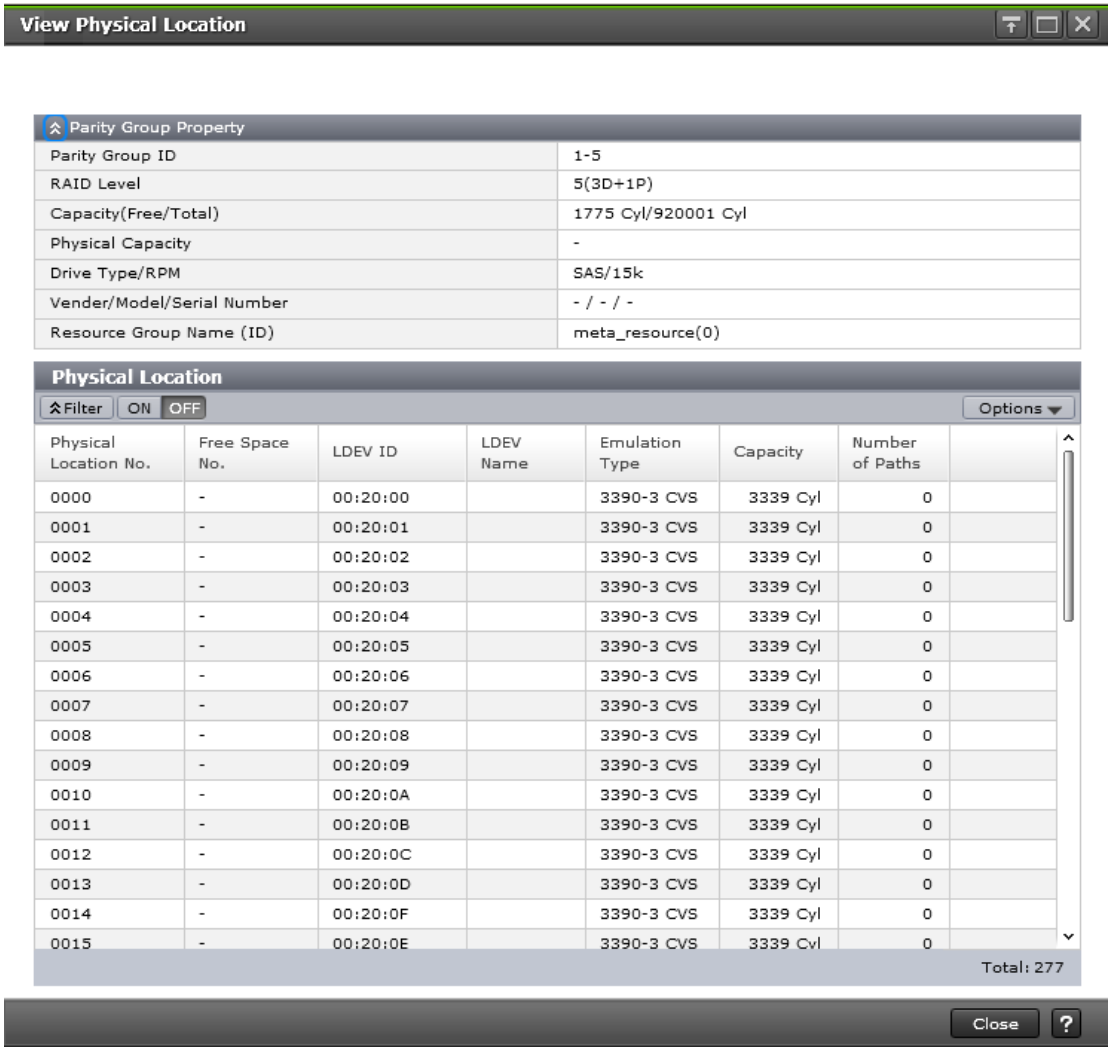
Item	Description
Usage of selected emulation type	Emulation type selected in the **Create LDEVs** window
LDEV IDs	LDEV identifier, which is the combination of LDKC, CU, and LDEV: ▪ LDKC: LDKC number ▪ CU: CU number.

Emulation groups and types for mainframe systems

Emulation group	Emulation type
Group 1	3390-3, 3390-3A, 3390-3B, 3390-3C 3390-9, 3390-9A, 3390-9B, 3390-9C 3390-A 3390-L, 3390-LA, 3390-LB, 3390-LC 3390-M, 3390-MA, 3390-MB, 3390-MC 3390-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 displayed.
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 used by the storage system, such as control cylinders, is not included in the free capacity. The total capacity of the LDEVs and free capacity is displayed in Total.
Drive Type/Interface/RPM	Drive type, interface, and rpm in use on this LDEV. A hyphen (-) is displayed if Drive Type/Interface/RPM is not set.

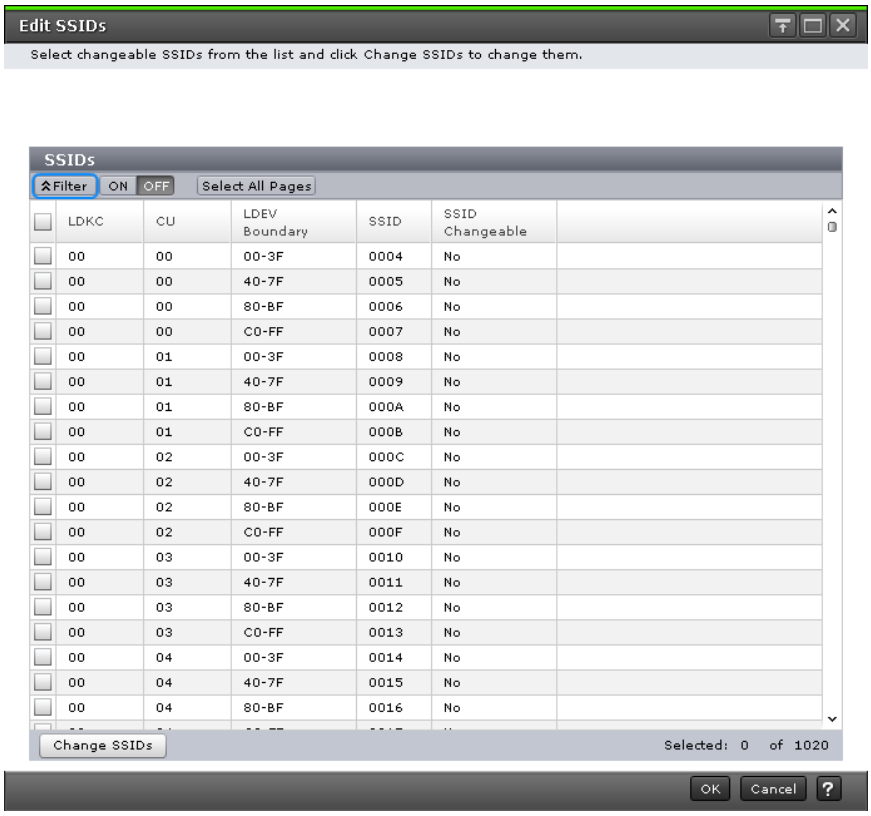
Item	Description
Vendor/Model/Serial Number	For external volumes, vendor name, model name, and serial number are displayed. For internal volumes, -/-/- is displayed.
Resource Group Name (ID)	Resource group name and ID of which this parity group is a member

Physical Location table

Item	Description
Physical Location No.	Location where the free spaces and LDEVs are assigned
Capacity	Physical capacity of the LDEV. If LDEVs are allocated across the physical area and virtual area, the capacity allocated in the physical area is displayed (the capacity allocated in the virtual area is not displayed). Therefore, the LDEV capacity might not match with the capacity for LDEVs displayed in the **Logical Devices** window.
Free Space No.	Free space number. A hyphen (-) is displayed for volumes other than free spaces.
LDEV ID	LDEV identifier. A hyphen (-) is displayed for other than LDEV IDs.
LDEV Name	LDEV name. A hyphen (-) is displayed for volumes other than LDEVs.
Emulation Type	Emulation type. A hyphen (-) is displayed for volumes other than LDEVs.
Number of Paths	Number of paths set for the LDEV. A hyphen (-) is displayed for volumes other than LDEVs.

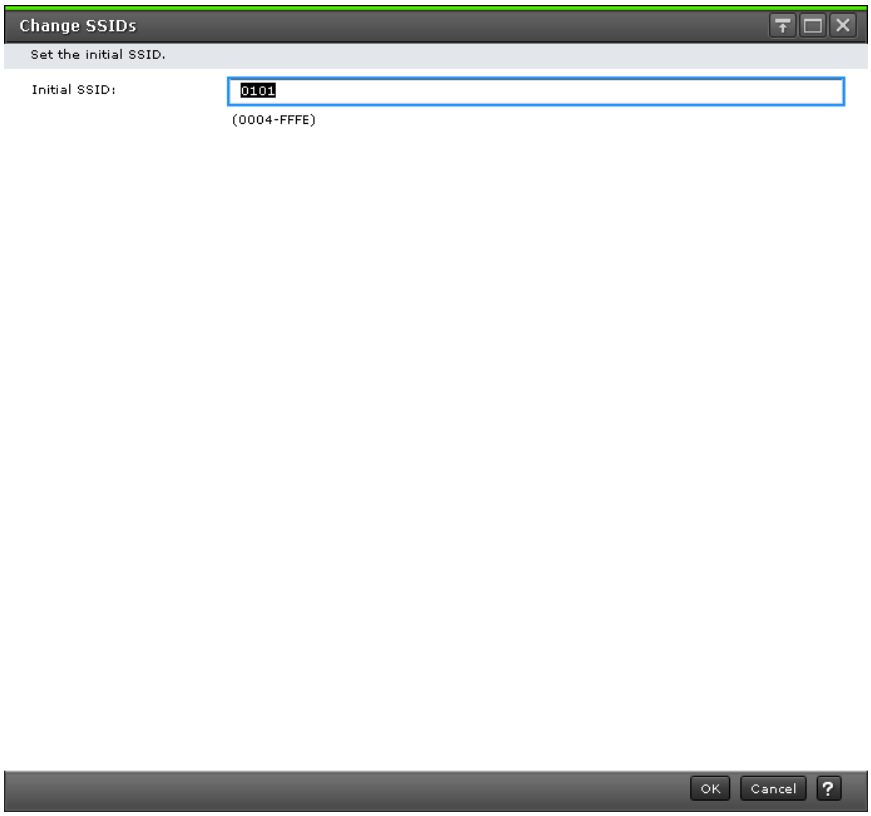
Edit SSIDs window

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	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	▪ Yes: SSID can be changed. The SSID was assigned when creating LDEVs but has not yet been registered (unused). ▪ No: SSID cannot be changed. The SSID has been registered (used) and cannot be changed. ▪ - (hyphen): SSID is not assigned.

Change SSIDs window

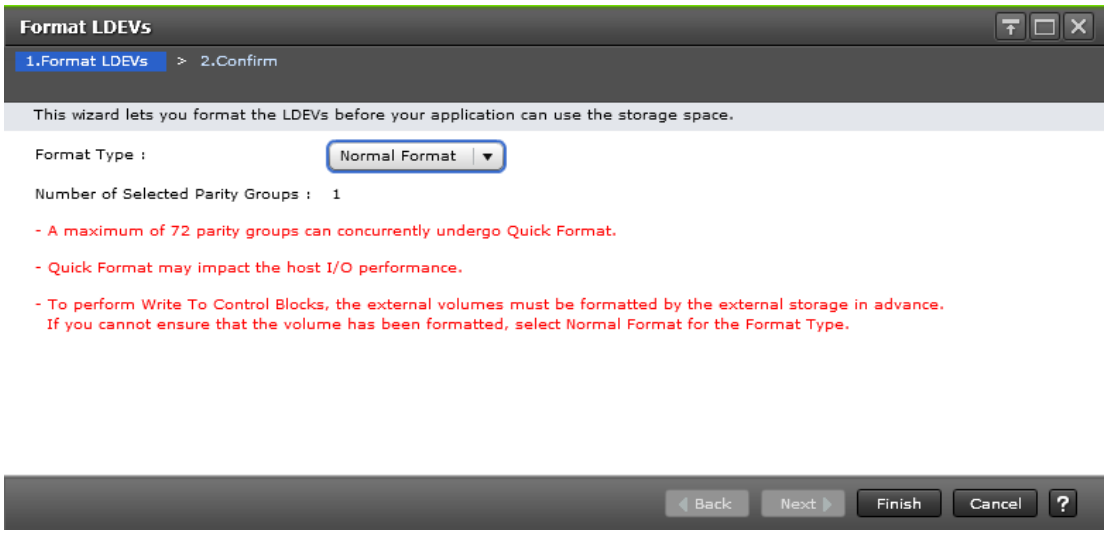


Item	Description
Initial SSID	Initial storage system identifier in hexadecimal format. The default is 0004 if none is specified.

Format LDEVs wizard

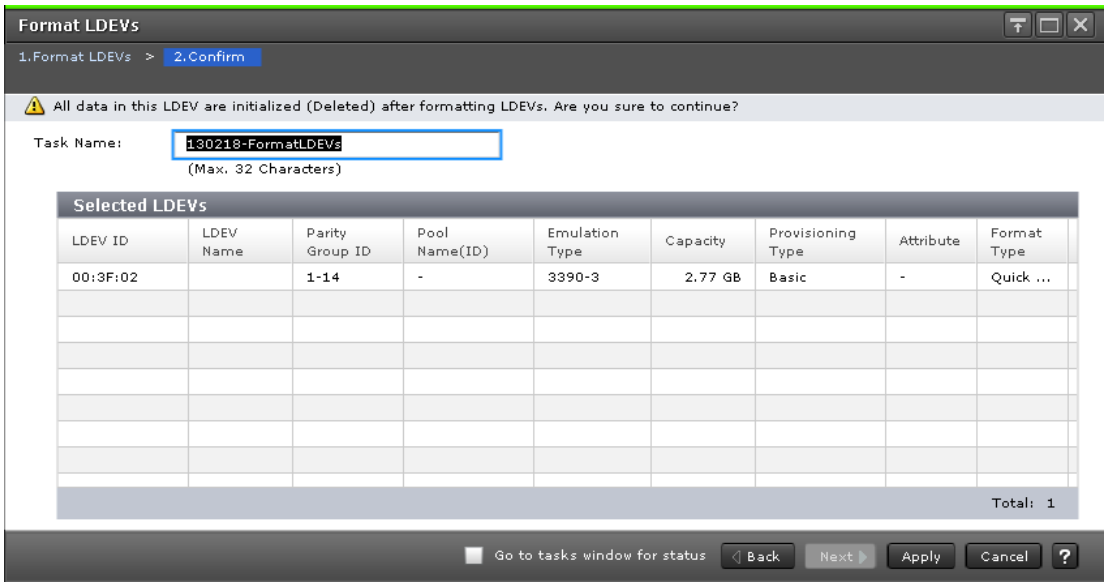
LDEVs must be formatted before you can use the storage space.

Format LDEVs window



Item	Description
Format Type	▪ Quick Format (default): Quick formatting, available only for formatting an internal volume. ▪ Normal Format: Normal formatting, available for formatting an internal volume or an external volume whose emulation type is OPEN. ▪ Write to Control Blocks: If the provisioning type is for a mainframe external volume, the management area of external volumes for mainframe systems will be overwritten. Default option for an external volume.
Number of Selected Parity Groups	Number of selected parity groups

Format LDEVs confirmation window

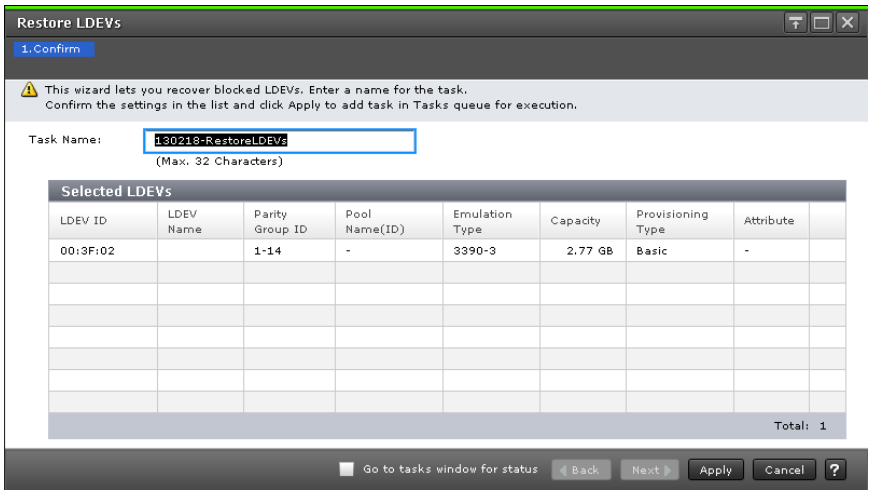


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Parity Group ID	Parity group identifier
Pool Name (ID)	Pool name and pool identifier
Emulation Type	Emulation type
Capacity	LDEV capacity
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Attribute	LDEV attribute: ▪ Command Device: CCI command device ▪ TSE: TSE-VOL for Compatible FlashCopy® SE ▪ ALU: LDEV with the ALU attribution ▪ SLU: LDEV with the SLU attribution

Item	Description
	▪ Data Direct Mapping: LDEV with the data direct mapping attribute ▪ - (hyphen): LDEV for which the attribute is not defined
Format Type	▪ Quick Format: Quick formatting. ▪ Normal Format: Normal formatting. ▪ Write to Control Blocks: Management area of external volumes for mainframe systems is overwritten.

Restore LDEVs window

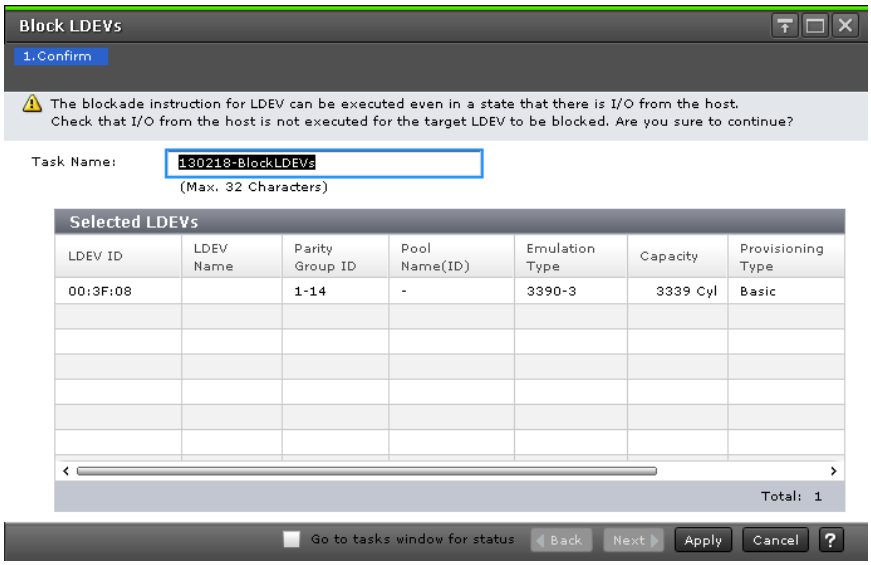
Use this window to recover blocked LDEVs.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
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

Item	Description
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Attribute	LDEV attribute: ▪ Command Device: CCI command device ▪ Remote Command Device: Remote command device for CCI ▪ JNL VOL: Journal volume for Universal Replicator ▪ Quorum Disk: Quorum disk for global-active device ▪ TSE: TSE-VOL for Compatible FlashCopy® SE. ▪ ALU: LDEV of the ALU attribution ▪ SLU: LDEV of the SLU attribution ▪ Data Direct Mapping: LDEV with the data direct mapping attribute ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): LDEV for which the attribute is not defined

Block LDEVs window

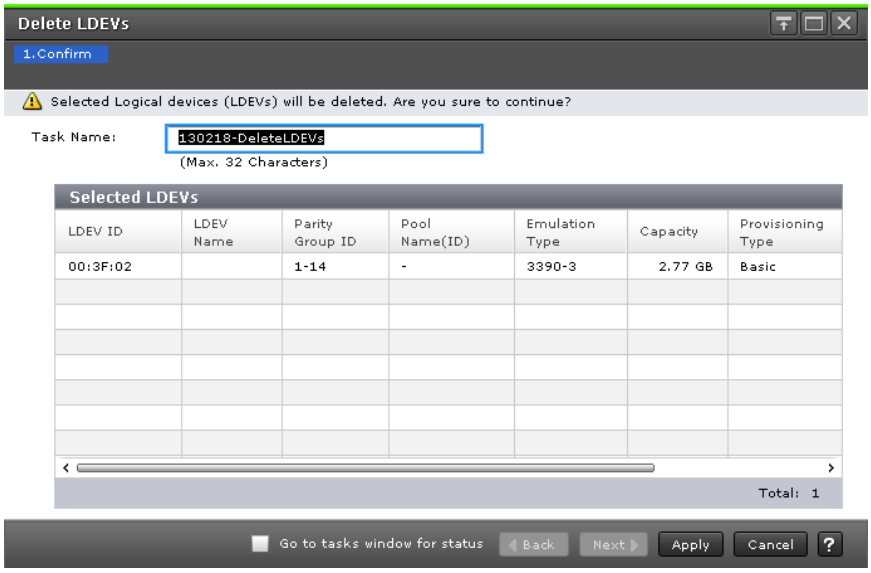


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Parity Group ID	Parity group identifier
Pool Name (ID)	Pool name and pool identifier
Emulation Type	Emulation type
Capacity	LDEV capacity
Provisioning Type	LDEV provisioning: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Attribute	LDEV attribute: ▪ Command Device: CCI command device ▪ Remote Command Device: Remote command device for CCI ▪ TSE: TSE-VOL for Compatible FlashCopy® SE. ▪ ALU: LDEV with the ALU attribution ▪ SLU: LDEV with the SLU attribution

Item	Description
	▪ Data Direct Mapping: LDEV with the data direct mapping attribute ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): LDEV for 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

Item	Description
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV with the ALU attribution
Attribute	LDEV attribute: ▪ Command Device: CCI command device ▪ TSE: TSE-VOL for Compatible FlashCopy® SE. ▪ ALU: LDEV with the ALU attribution ▪ SLU: LDEV with the SLU attribution ▪ Data Direct Mapping: LDEV with the data direct mapping attribute ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): LDEV for which the attribute is not defined
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Expanded Space Used	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used. ▪ - (hyphen): LDEV does not support the capacity saving function.

LDEV Properties window

LDEV Properties table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Emulation Type	Emulation type
Capacity	LDEV capacity

Item	Description
Virtual Storage Machine	▪ Model / Serial Number: Model name and serial number of the virtual storage machine that has an LDEV. ▪ LDEV ID: Virtual LDEV ID. If a Virtual LDEV ID is not assigned to an LDEV, this column is blank. ▪ Device Name: Virtual device name, which is a combination of the virtual emulation type, virtual LUSE volume number, and the virtual CVS attribute. Values of the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are displayed only for items that have been set. This column is blank when the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are not set. If the virtual CVS attribute is set, CVS is attached as the suffix to the device name. ▪ SSID: Virtual SSID. If the Virtual SSID is not set for LDEV, this column is blank.

Basic tab

LDEV basic information is displayed in the Basic Properties, LUNs, and Hosts tables.

Basic Properties table

Item	Description
Parity Group	▪ ID: Parity group ID. ▪ Interleaved Parity Groups: Interleaved parity groups. ▪ RAID Level: RAID level of parity group. An asterisk (*) indicates the parity group is the interleaved parity group. ▪ Drive Type/Interface/RPM: Data drive type, interface, and rpm. If Drive Type/Interface/RPM is not set, a hyphen (-) is displayed. ▪ Encryption: Encryption (enabled or disabled). If encryption is not defined in the parity group, a hyphen (-) is displayed. ▪ Accelerated compression: Accelerated compression setting (Enable or Disable). If the parity group with accelerated compression is not defined, a hyphen (-) is displayed.
Pool	▪ Name (ID): Pool name and ID. ▪ RAID Level: RAID level of the pool.

Item	Description
	▪ Type: Data drive type of the pool. ▪ Encryption: Encryption of the pool: • Enabled: Pool created by pool-VOLs with encryption enabled. • Disable: Pool created by pool-VOLs with encryption disabled. • Mixed: Two or more of these items are specified as pool-VOLs: ▪ Volume encryption setting is enabled. ▪ Volume encryption setting is disabled. ▪ External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. • - (hyphen): Pool created by external volumes. Or pool is blocked.
Provisioning Type	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ External MF: Migration volume ▪ Snapshot: Thin Image volume ▪ ALU: LDEV of the ALU attribution
Status	▪ Normal: Normal status. ▪ Blocked: Host cannot access blocked volumes. ▪ Warning: Problem occurs in the volumes. ▪ Formatting: Volumes are being formatted. ▪ 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.
PIN status	PIN status

Item	Description
Attribute	LDEV attribute: ▪ Command Device: Command device ▪ Remote Command Device: Remote command device ▪ JNL VOL: Journal volume ▪ Pool VOL: Pool volume with pool ID in parentheses ▪ Quorum Disk: Quorum disk for global-active device ▪ TSE: TSE-VOL ▪ ALU: LDEV of the ALU attribution ▪ SLU: LDEV of the SLU attribution ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): Volume in which the attribute is not defined
Command Device Attribute	▪ Security: Enable or Disable command device security ▪ User Authentication: Enable or Disable ▪ Device Group Definition: Enable or Disable
Number of Paths	Number of paths of the selected LDEV
UUID	UUID
CLPR	Cache logical partition number, in *ID*:*CLPR* format
Access Attribute	Access attribute of the LDEV
SSID	SSID
Cache Mode	Cache mode
V-VOL Management Task	V-VOL management task being performed on a Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, or a Dynamic Tiering for Mainframe V-VOL
Current MP Unit ID	Current MP unit ID
Current MP Unit Name	Current MP unit name
Assigned MP Unit ID	Assigned MP unit ID
Assigned MP Unit Name	Assigned MP unit name

Item	Description
ALUA Mode	▪ Enabled: LDEV can be used in ALUA. ▪ Disabled: LDEV cannot be used in ALUA.
T10 PI	LDEV's T10 PI attribute (Enabled or Disabled)
External Storage System	If the LDEV is the DP-VOL of the data direct mapping attribute, details of the external storage system to which LDEV is being mapped: ▪ Vendor/Model/Serial Number: Vendor/model/serial number of the external storage system is displayed. If an external storage system is not mapped to the LDEV, a hyphen (-) is displayed. ▪ Path Group ID: Path group ID of the external storage system. A hyphen (-) is displayed if an external storage system is not mapped to the LDEV. If Path Group ID is clicked, the Mapped Volumes tab is displayed.
Data Direct Mapping	▪ LDEV ID: LDEV ID of the pool-VOL in the pool with data direct mapping enabled, or LDEV ID of the DP-VOL with data direct mapping enabled. If LDEV ID is clicked, the **LDEV Properties** window is displayed. If data direct mapping is disabled, a hyphen (-) is displayed. If a DP-VOL with data direct mapping enabled is not created in the pool with data direct mapping enabled, this item is blank. ▪ Parity Group ID: Parity Group ID of the pool-VOL in the pool with data direct mapping enabled. If data direct mapping is disabled, a hyphen (-) is displayed.
Resource Group Name (ID)	Resource group name and ID of the LDEV
Full Allocation	Status for the full allocation with V-VOLs for Dynamic Provisioning or Dynamic Provisioning for Mainframe: ▪ Enabled: Full allocation is performed. ▪ Disabled: Full allocation is not performed. ▪ - (hyphen): LDEVs other than V-VOLs for Dynamic Provisioning or Dynamic Provisioning for Mainframe.
Tiering Policy	Tiering policy name and ID
New page Assignment Tier	New page assignment tier
Tier Relocation	Tier relocation setting
Relocation Priority	Relocation priority setting

Item	Description
Expanded Space Used	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Capacity Saving	▪ Compression: Compression function is used. ▪ Deduplication and Compression: Deduplication and compression functions are used. ▪ Disabled: Capacity saving function is not used. ▪ - (hyphen): LDEV does not support the capacity saving function.
Capacity Saving Status	▪ Enabling: Format for enabling the capacity saving function is being performed. ▪ Rehydrating: Format for disabling the capacity saving function is being performed. ▪ Deleting Volume: Deletion of DP-VOL whose capacity saving function is enabled is being performed. ▪ Enabled: Capacity saving function is enabled. ▪ Disabled: Capacity saving function is disabled. ▪ Failed: Data cannot be secured. ▪ - (hyphen): LDEV does not support the capacity saving function.
Deduplication Data	Whether the deduplication function is applied to the volume (DP-VOL). ▪ Enabled: Deduplication function is applied. ▪ Disabled: Deduplication function is not applied. ▪ - (hyphen): LDEV is not a DP-VOL, or the microcode version does not support deduplication. If the capacity saving of a DP-VOL is Deduplication and Compression, `Enabled` is displayed even if the used capacity is 0. If the capacity saving setting is `Disabled` and capacity saving is being disabled, `Enabled` is displayed for Deduplication Data while deduplicated data remains in the DP-VOL. When capacity saving is completely disabled and no deduplicated data remains in the DP-VOL, `Disabled` is displayed.
Virtual Attribute	Virtual LDEV attribute. If the attribute is not set for LDEV, this column is blank.

LUNs table

This table is displayed only if the path is set.

Item	Description
Port ID	Port name
Host Group Name / iSCSI Target Alias	Host group name or iSCSI target alias
iSCSI Target Name	iSCSI target name
LUN ID	Logical unit ID
Asymmetric Access States	Asymmetric access states of the port: ▪ Active/Optimized: Access from the host is preferentially performed on this port. ▪ Active/Non-Optimized: When the Active/Optimized port is disabled, access from the host is performed on this port. ▪ - (hyphen): iSCSI is used.

Hosts table

This table provides information about the host that can view LDEVs. This table is available only if the WWN is registered in the host to which the path is set.

Item	Description
Type	▪ Fibre: Fibre Channel ports ▪ iSCSI: iSCSI ports
HBA WWN / iSCSI Name	HBA WWN or iSCSI name
Host Name	Host name

Replication Tab

Information about the volume of the local replication pair is displayed in the Replication, ShadowImage for Mainframe Pairs, Thin Image Pairs, TrueCopy for Mainframe Pairs, Universal Replicator for Mainframe Pairs, and Global-active device Pairs tables.

Replication table

Item	Description
Local Replication	▪ ShadowImage L1: status of the ShadowImage L1 pair ▪ ShadowImage L2: status of the ShadowImage L2 pair ▪ Thin Image: status of the Thin Image pair ▪ ShadowImage for Mainframe: status of the ShadowImage for Mainframe pair ▪ Compatible FlashCopy® V2: status of the Compatible FlashCopy® V2 relationship ▪ Compatible FlashCopy® SE: status of the Compatible FlashCopy® SE relationship
Remote Replication	▪ TrueCopy: status of the TrueCopy pair ▪ Universal Replicator: status of the Universal Replicator pair ▪ TrueCopy for Mainframe: status of the TrueCopy for Mainframe pair ▪ Universal Replicator for Mainframe: status of the Universal Replicator for Mainframe pair ▪ global-active device: status of the global-active device pairs

ShadowImage for Mainframe Pairs table

Item	Description
Primary Volume	▪ LDEV ID: LDEV ID of the primary volume ▪ LDEV Name: LDEV name of the primary volume ▪ Emulation Type: Emulation type of the primary volume ▪ Capacity: Capacity of the primary volume ▪ CLPR: CLPR ID of the primary volume
Copy Type	Copy type of the pair
Status	Pair status
Secondary Volume	▪ LDEV ID: LDEV ID of the secondary volume ▪ LDEV Name: LDEV name of the secondary volume ▪ Emulation Type: emulation type of the secondary volume ▪ Capacity: Capacity of the secondary volume ▪ CLPR: CLPR ID of the secondary volume

Item	Description
Copy Pace	Pace of copying the pair
CTG ID	Consistency group number of the pair
Mirror Unit	Mirror unit number of the pair

Thin Image Pairs table

Item	Description
Primary Volume	▪ LDEV ID: LDEV ID of the primary volume ▪ LDEV Name: LDEV name of the primary volume ▪ Emulation Type: Emulation type of the primary volume ▪ Capacity: Capacity of the primary volume ▪ CLPR: CLPR ID of the primary volume
Snapshot Group	Snapshot group name: Displayed only if a snapshot group for the HTI pair was configured.
Status	Pair status
Snapshot Date	Date and time when you created the pair to store the snapshot
Secondary Volume	▪ LDEV ID: LDEV ID of the secondary volume ▪ LDEV Name: LDEV name of the secondary volume ▪ Capacity: Capacity of the secondary volume ▪ CLPR: CLPR ID of the secondary volume
Pool Name (ID)	Pool name and identification number
CTG ID	Consistency group identification number
Mirror Unit	Mirror unit number of the pair
Cascade	Whether a cascade pair can be created by using the pair: ▪ Enabled: Cascade pair can be created. ▪ Disabled: Cascade pair cannot be created.
Diff Compare Volume	LDEV ID of the diff compare volume

Item	Description
Type	▪ Snapshot: pair with the snapshot attribute ▪ Clone: pair with the clone attribute or diff clone attribute In the TI Pairs window, if Diff Compare Volume displays the LDEV ID, the diff clone attribute is set for the pair. If Diff Compare Volume displays a hyphen (-), the clone attribute is set for the pair. For details about the TI Pairs window, see the *Hitachi Thin Image User Guide*.
Topology ID	Topology ID of the pair: Layer of the pair location based on the mirror unit. The topology ID consists of the LDEV ID of the root volume and the mirror unit.
Root Volume	LDEV ID of the root volume of the pair

TrueCopy for Mainframe Pairs table

Item	Description
Copy Type	▪ TC: TrueCopy pair ▪ TCMF: TrueCopy for Mainframe pair
Pair Position	Primary or secondary volume
Status	Pair status
Remote Storage System	▪ Model / Serial Number: Model and serial number of the remote storage system ▪ Remote Storage System - SSID: SSID of the remote storage system ▪ Remote Storage System - LDEV ID: LDEV ID of the remote storage system ▪ Remote Storage System - Port ID, Host Group ID, LUN ID: Port ID, Host Group ID, and LUN ID of the remote storage system ▪ Host Group ID / iSCSI Target ID: Host Group ID or iSCSI Target ID of the remote storage system ▪ LUN ID: LUN ID of the remote storage system
Path Group ID	Path group ID
Update Type	Update type
CTG ID	Consistency group ID

Item	Description
CTG Utilization	Whether the consistency group is shared by multiple local and remote storage systems
Preserve Mirror Status	Preserve mirror status
Fence Level	Fence level
Host I/O Time Stamp Transfer	Whether the host I/O time stamp is transferred from P-VOL to S-VOL
Detail	Opens the **View Pair Properties** window.

Universal Replicator for Mainframe Pairs table

Item	Description
Copy Type	▪ UR: Universal Replicator pair ▪ URMF: Universal Replicator for Mainframe pair
Journal ID	Journal ID
Pair 1	▪ Pair Position: Primary or secondary volume ▪ Mirror ID: Mirror ID ▪ Status: Pair status ▪ Remote Storage System: • Model / Serial Number: Model and serial number of the remote storage system • LDEV ID: LDEV ID of the remote storage system • Port ID, Host Group ID, LUN ID: Port ID, Host Group ID, and LUN ID of the remote storage system • Host Group ID / iSCSI Target ID: Host Group ID or iSCSI Target ID of the remote storage system • LUN ID: LUN ID of the remote storage system • Journal ID: Journal ID of the remote storage system ▪ Path Group ID: Path group ID ▪ CTG ID: Consistency group ID ▪ Error Level: Error level
Pair 2	▪ Pair Position: Primary or secondary volume ▪ Mirror ID: Mirror ID ▪ Status: Pair status

Item	Description

	▪ Remote Storage System:
	  • Model / Serial Number: Model and serial number of the remote storage system
	  • LDEV ID: LDEV ID of the remote storage system
	  • Port ID, Host Group ID, LUN ID: Port ID, Host Group ID, and LUN ID of the remote storage system
	  • Host Group ID / iSCSI Target ID: Host Group ID or iSCSI Target ID of the remote storage system
	  • LUN ID: LUN ID of the remote storage system
	  • Journal ID: Journal ID of the remote storage system
	▪ Path Group ID: Path group ID
	▪ CTG ID: Consistency group ID
	▪ Error Level: Error level

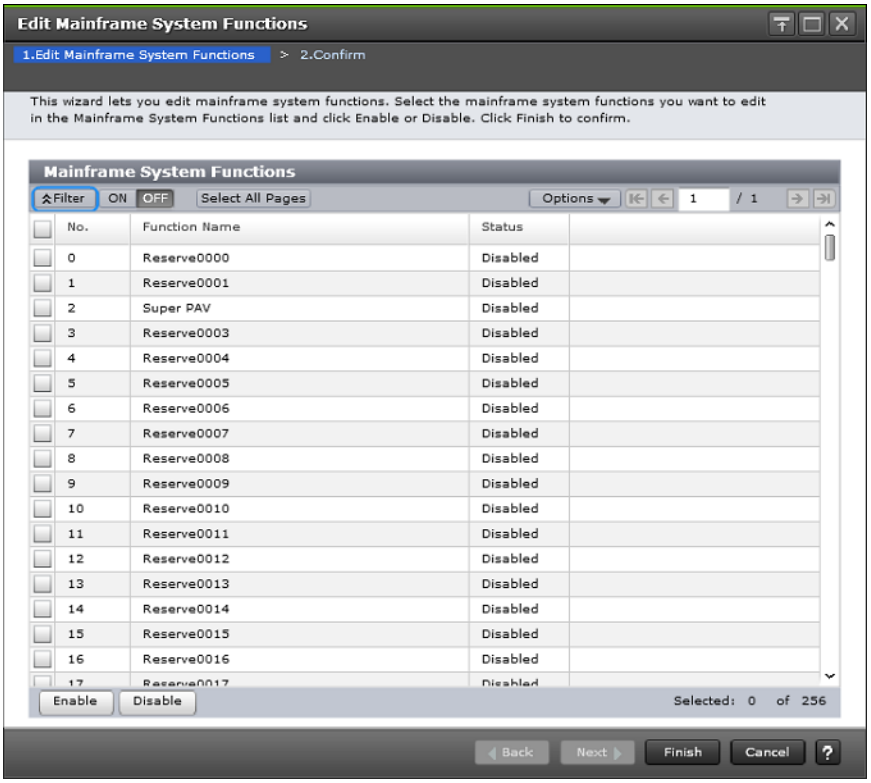
Global-active device Pairs table

Item	Description
Pair Position	Primary or secondary volume
Status	Pair status
Remote Storage System	▪ Model / Serial Number: Model and serial number of the remote storage system ▪ LDEV ID: LDEV ID of the remote storage system ▪ Port ID, Host Group ID, LUN ID: Port ID, Host Group ID, and LUN ID of the remote storage system
Path Group ID	Path group ID
Quorum Disk ID	Quorum disk ID
Mirror ID	Mirror ID
CTG ID	Consistency group ID

Edit Mainframe System Functions wizard

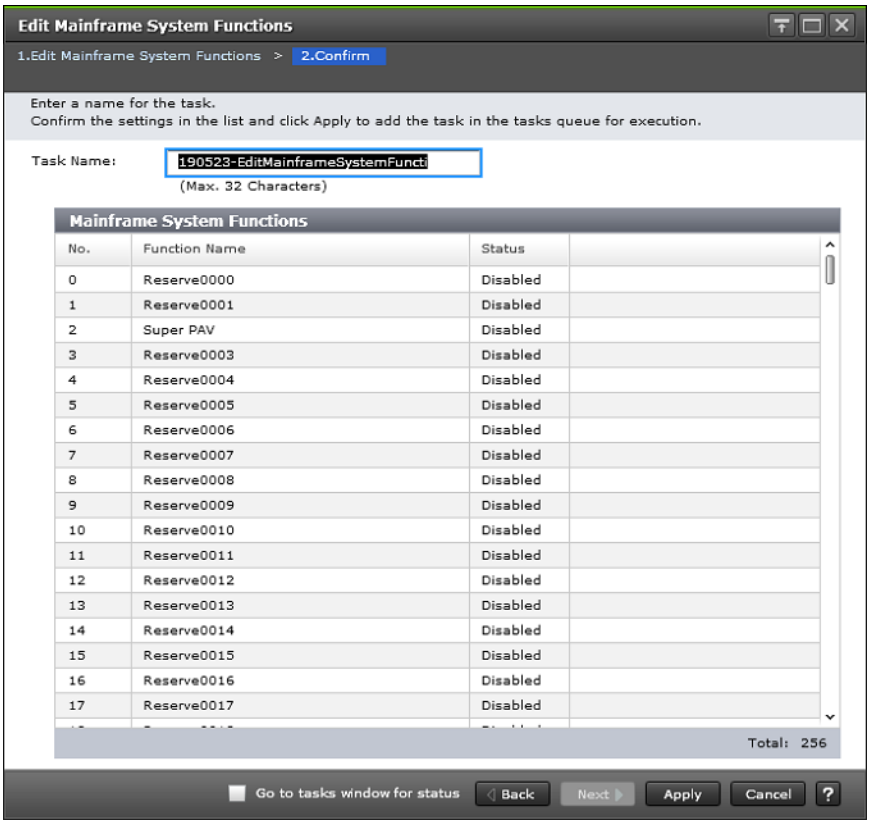
Edit Mainframe System Functions window

Use this window to enable and disable the mainframe system functions.



Item	Description
No.	Number of the mainframe system function
Function Name	Name of the mainframe system function: ▪ Super PAV: If this item is enabled, the Super PAV functions can be used on the storage system. ▪ Reserve0000 to Reserve0001, Reserve0004 to Reserve0255: These items are reserved for future use and cannot be selected.
Status	Status of the mainframe system function

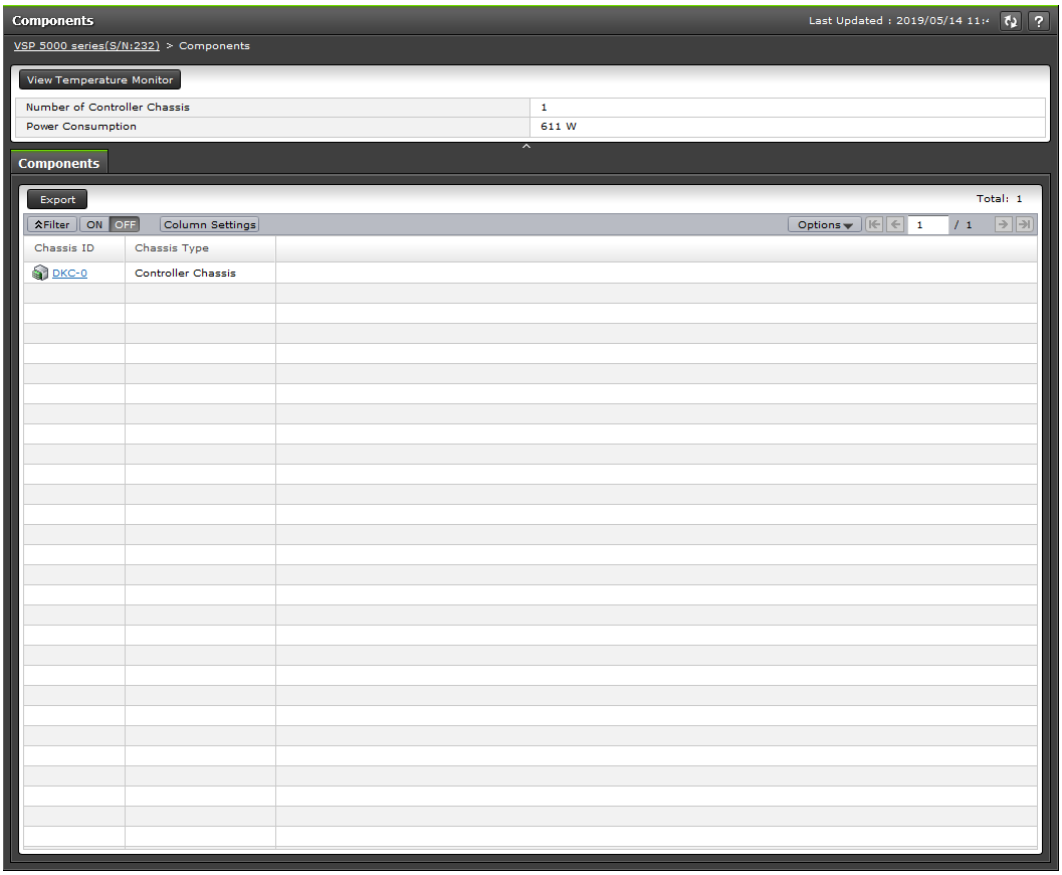
Edit Mainframe System Functions confirmation window



Item	Description
No.	Number of the mainframe system function
Function Name	Name of the mainframe system function: ▪ Super PAV: If this item is enabled, functions of Super PAV can be used in the storage system. ▪ Db2 Castout Accelerator: If this item is enabled, the DB2® Cast Out Accelerator functions can be used on the storage system. ▪ Reserve0000 to Reserve0001, Reserve0004 to Reserve0255: These items are reserved for future use and cannot be selected.
Status	Status of the mainframe system function

Components window

Use this window to view information about the controller chassis components in the storage system.



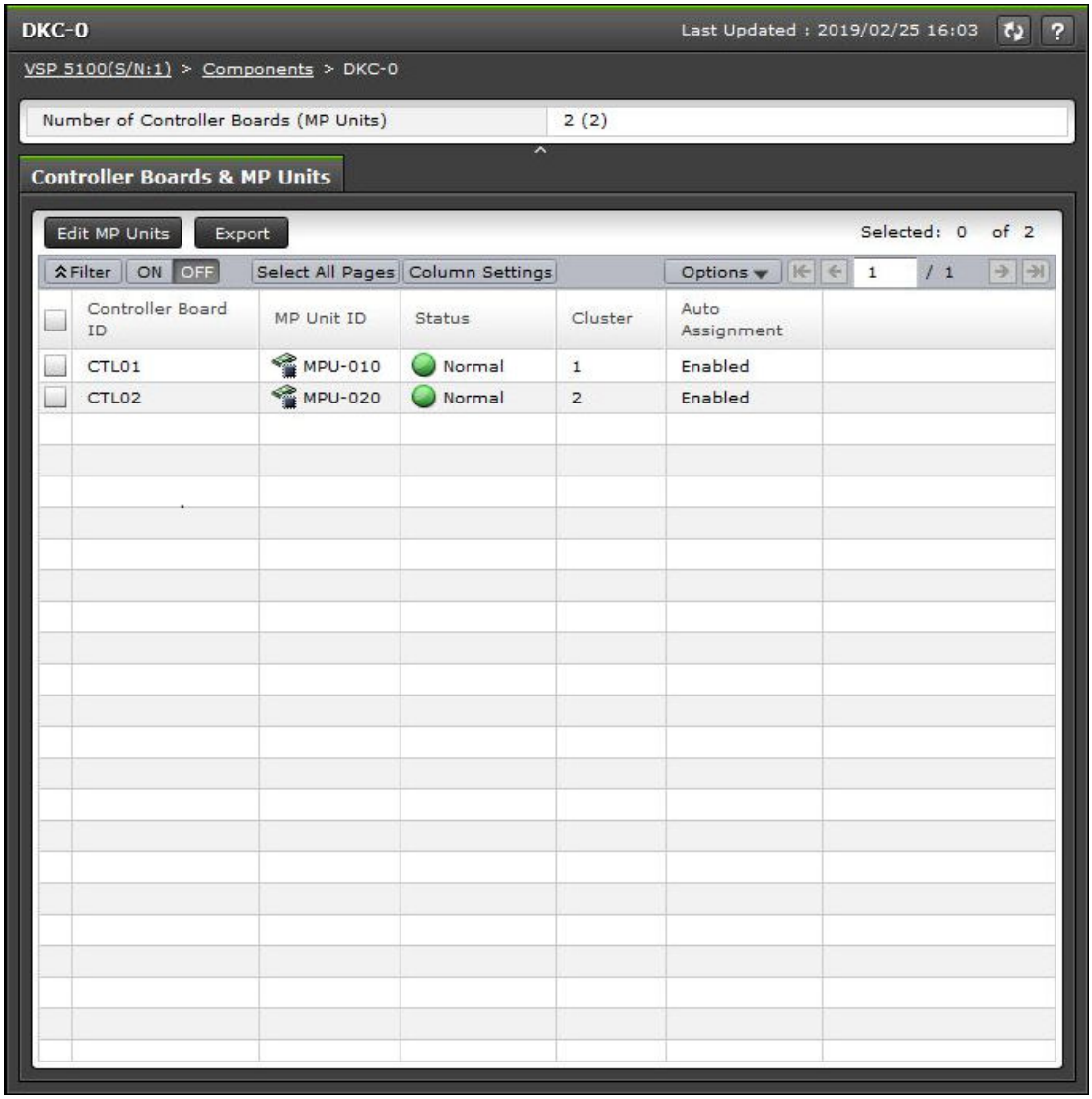
Summary

Item	Description
Number of Controller Chassis	Number of the controller chassis
Power Consumption	Total power consumption of the controller chassis and DKUs. If the power information cannot be acquired because of a failure in the component or network, the power information is not added to the power consumption information. In these cases, the power consumption value might temporarily be displayed lower: ▪ When starting the storage system ▪ After replacing a part of the storage system ▪ When updating the microcode or after updating the microcode

Components tab

Item	Description
Chassis ID	Chassis identifier of the storage system
Chassis Type	Chassis type

DKC - Controller Boards and MP Units tab



Summary

Item	Description
Number of Controller Boards (MP Units)	Number of controller boards and MP units

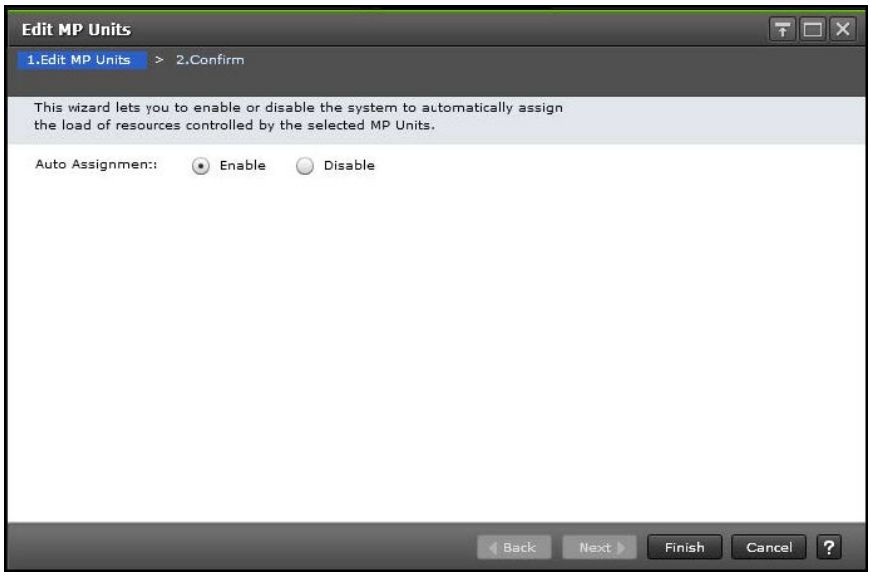
Controller Boards & MP Units tab

Item	Description
Controller Board ID	Identifier of the controller board
MP Unit ID	Identifier of the MP unit
Status	▪ Normal: Available. ▪ Warning: The MP unit is partially blocked. ▪ Blocked: The MP unit is blocked. ▪ Failed: The MP unit is in abnormal status.
Cluster	Cluster number of the MP unit
Auto Assignment	▪ Enabled: MP unit is automatically assigned to resources (logical devices, external volumes, and journal volumes). ▪ Disabled: MP unit is not automatically assigned to resources.

Edit MP Units wizard

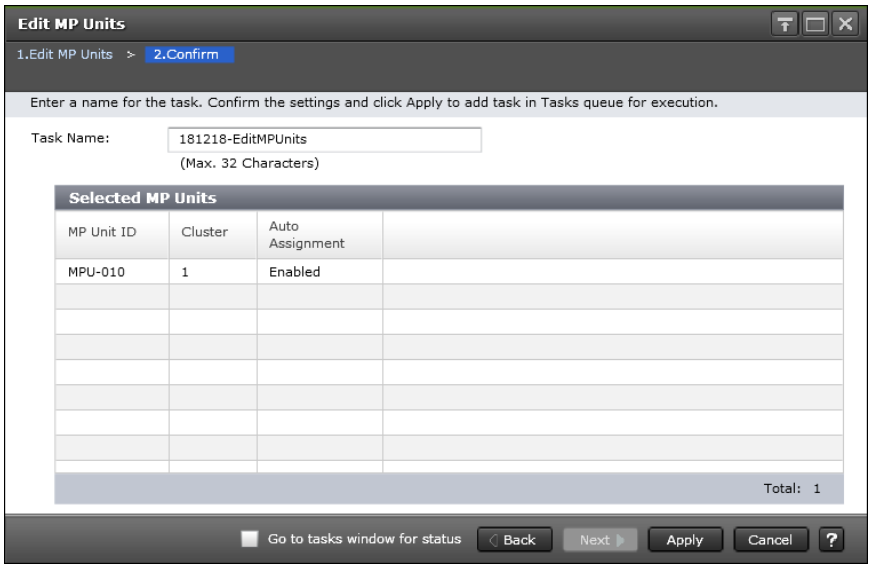
Use this wizard to enable or disable the storage system to automatically assign the load of resources controlled by the selected MP units.

Edit MP Units window



Item	Description
Auto Assignment	▪ Enabled: MP unit is automatically assigned to resources (logical devices, external volumes, and journal volumes). ▪ Disabled: MP unit is not automatically assigned to resources.

Edit MP Units confirmation window



Item	Description
MP Unit ID	MP unit identifier

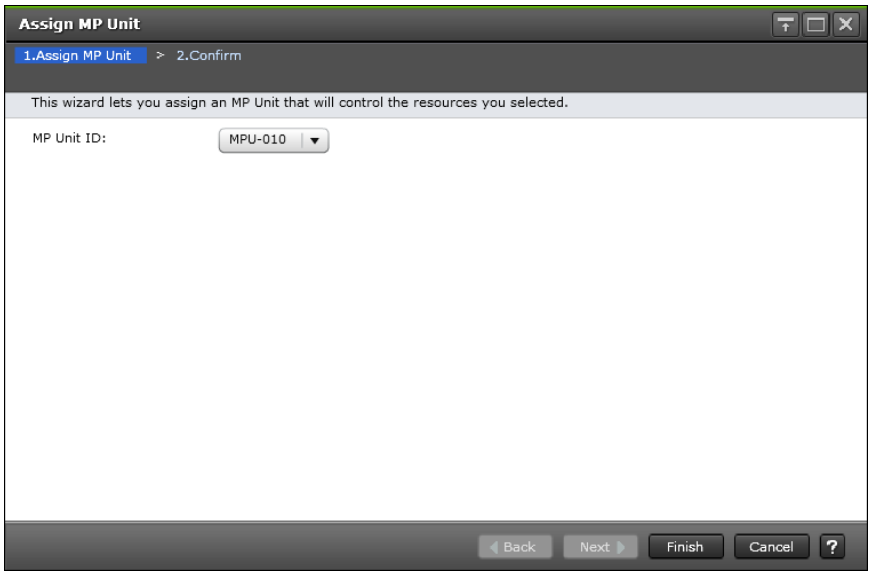
Item	Description
Cluster	Cluster number of the MP unit
Auto Assignment	▪ Enabled: MP unit is automatically assigned to resources (logical devices, external volumes, and journal volumes). ▪ Disabled: MP unit is not automatically assigned to resources.

Assign MP Unit wizard

Use this wizard to assign an MP unit that will control selected resources.

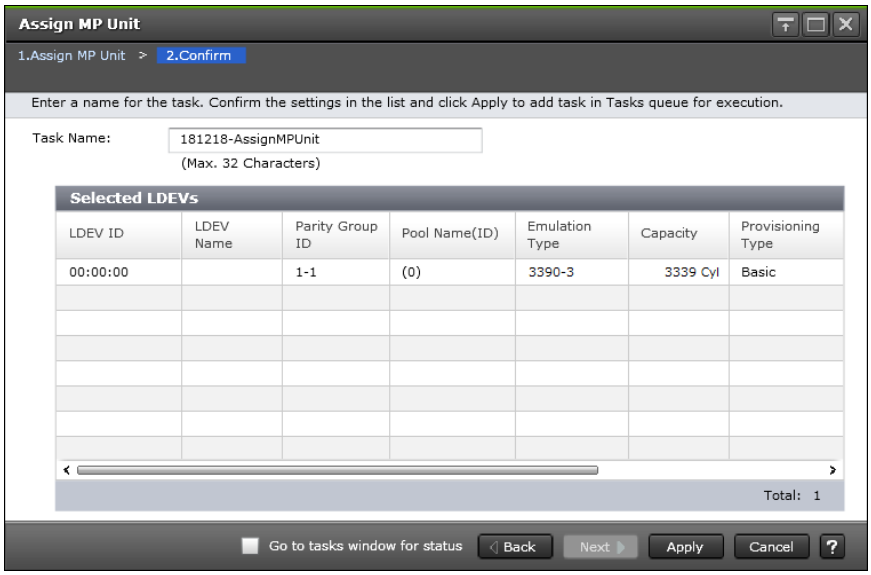
Assign MP Unit window

Use this window to select an MP unit to assign to an LDEV.



Item	Description
MP Unit ID	MP unit identifier assigned to the LDEV

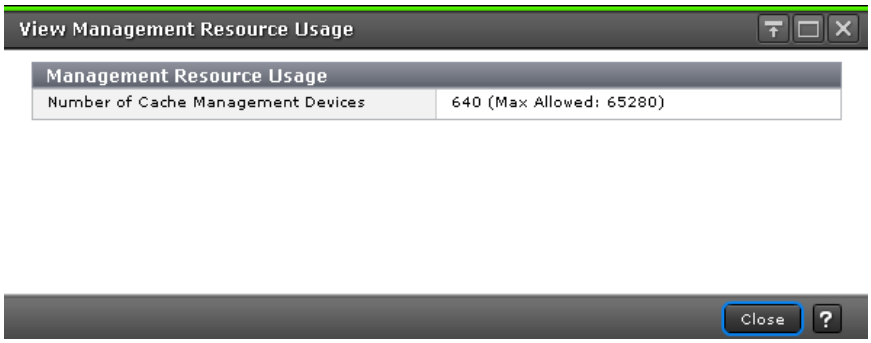
Assign MP Unit confirmation window



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	LDEV provisioning type: ▪ Basic: Internal volume ▪ DP: DP-VOL ▪ External: External volume ▪ External MF: Migration volume ▪ Snapshot: Thin Image volume
Attribute	LDEV attribute: ▪ Command Device: Command device ▪ Remote Command Device: Remote command device ▪ JNL VOL: Journal volume ▪ Pool VOL: Pool volume with the ID in parentheses ▪ Quorum Disk: Quorum disk for global-active device

Item	Description
	▪ TSE: TSE-VOL (mainframe systems) ▪ ALU: LDEV of the ALU attribution ▪ SLU: LDEV of the SLU attribution ▪ Data Direct Mapping: LDEV of the data direct mapping attribute ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): Volume in which the attribute is not defined
MP Unit ID	MP unit identifier assigned to the LDEV

View Management Resource Usage window

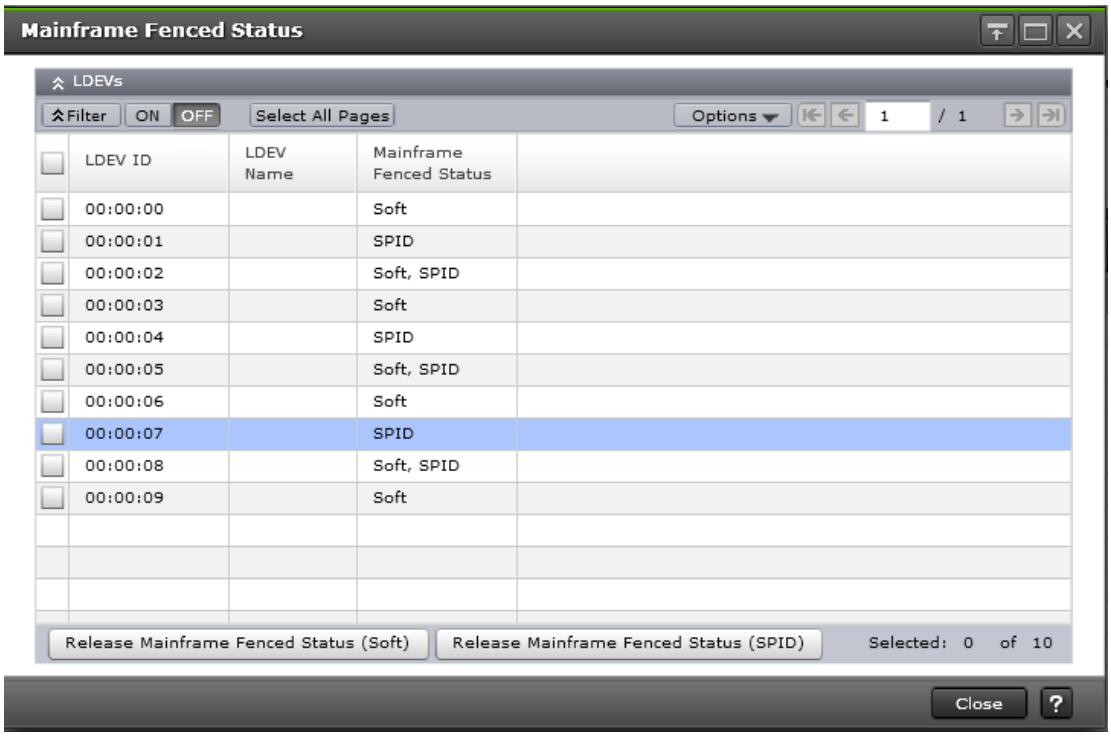


Management Resource Usage table

Item	Description
Number of Cache Management Devices	Current number and maximum allowed number of cache management devices in the storage system

Mainframe Fenced Status window

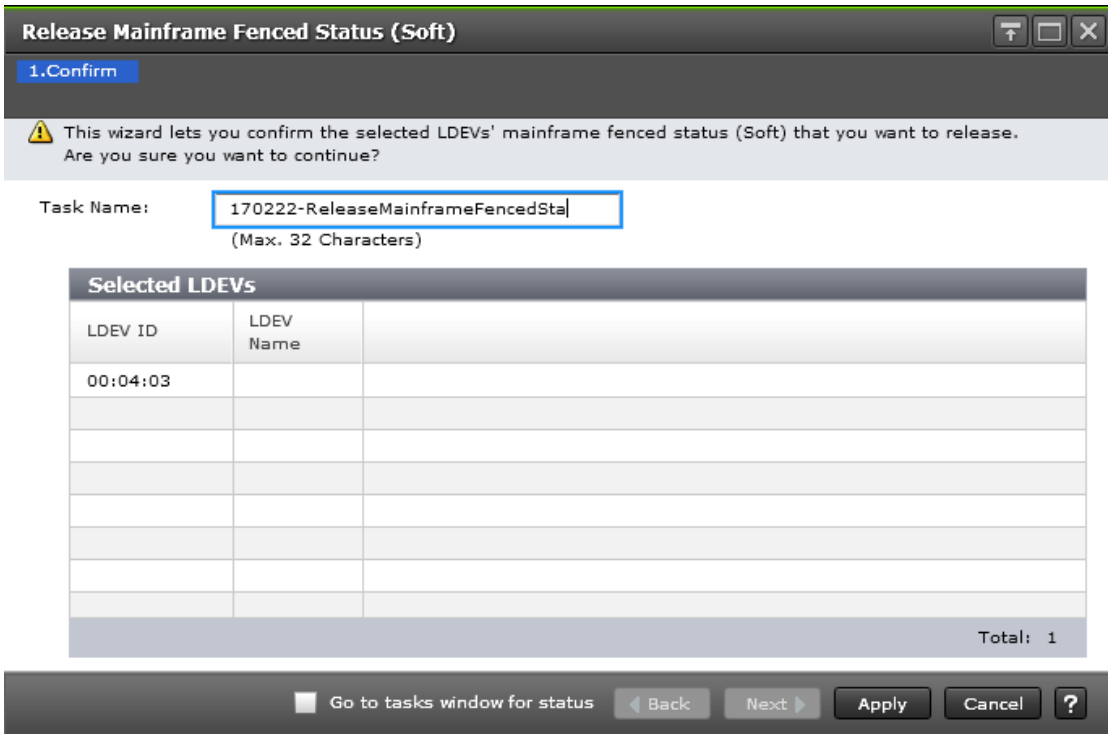
Use this window to view the Soft Fence status and SPID Fence status of mainframe volumes.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV name	LDEV name
Mainframe Fenced Status	▪ Soft: Soft Fence is applied. ▪ SPID: SPID Fence is applied. ▪ Soft, SPID: Soft Fence and SPID Fence are applied.

Release Mainframe Fenced Status (Soft) window

This window lists the selected volumes for which you want to forcibly disable the Soft Fence setting.

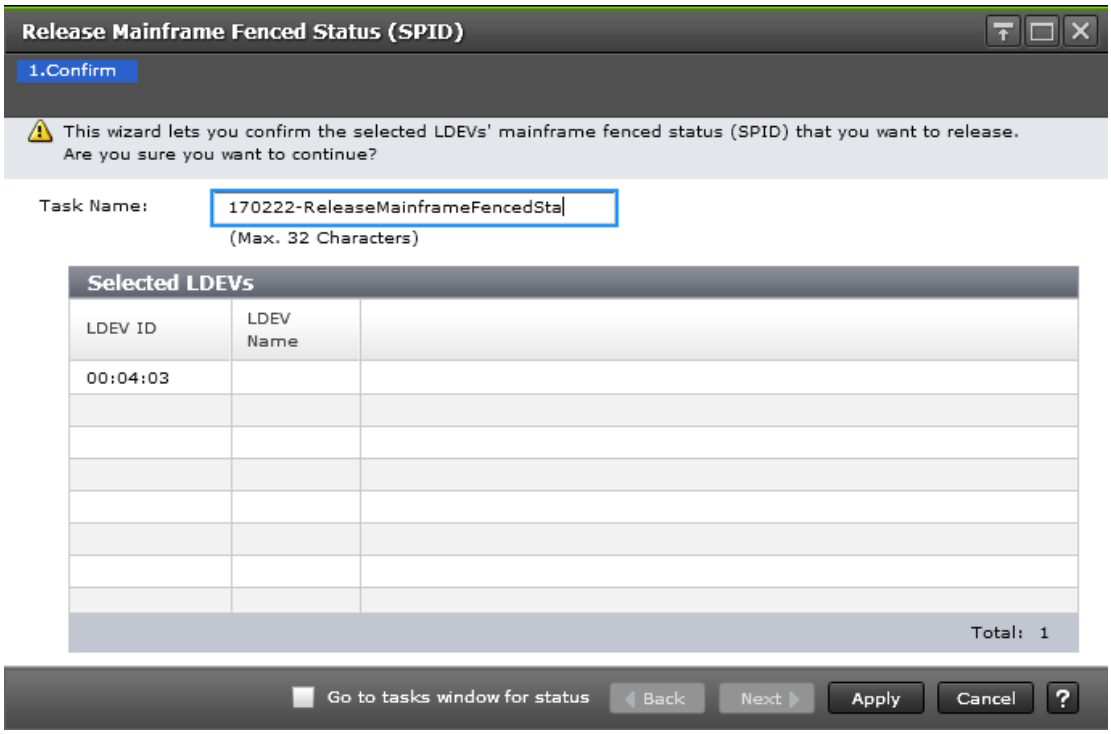


Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV name	LDEV name

Release Mainframe Fenced Status (SPID) window

This window lists the selected volumes for which you want to forcibly disable the SPID Fence setting.



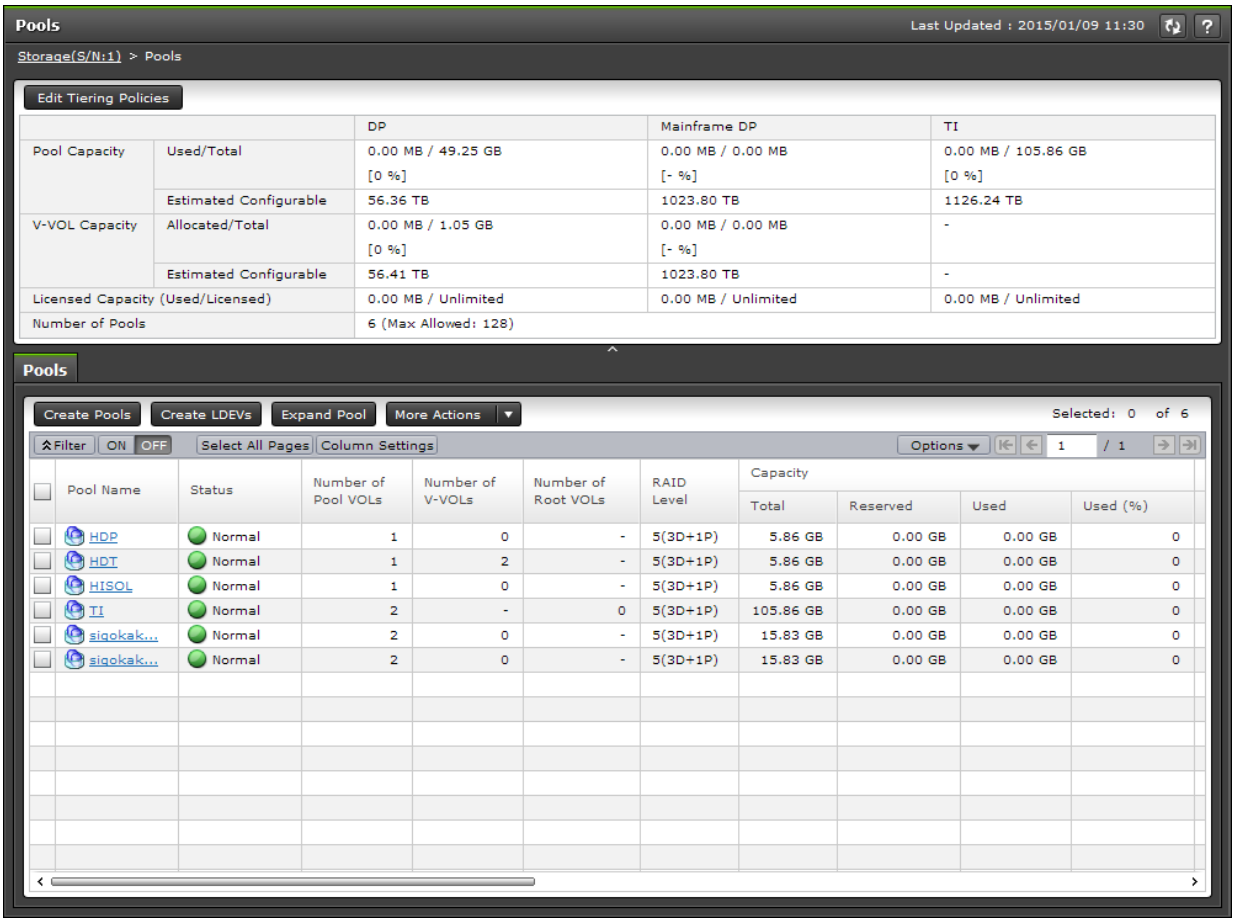
Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV name	LDEV name

Appendix C: Dynamic Provisioning for Mainframe, Dynamic Tiering for Mainframe, and active flash for mainframe GUI reference

The Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe windows in Hitachi Device Manager - Storage Navigator display the Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe information for the storage system and allow you to perform Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe operations.

Pools window



Summary

Item	Description
Pool Capacity[1]	▪ Used/Total: • DP: pool capacity (the sum of the used capacity and reserved capacity, and the total pool capacity) of Dynamic Provisioning and Dynamic Tiering • Mainframe DP: pool capacity (the used capacity and the total pool capacity) of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe • TI: pool capacity (the used capacity and the total pool capacity) of Thin Image For each value, if the Estimated Configurable capacity is zero, ⚠ is displayed in the cell. For a pool comprised of pool volumes assigned to accelerated compression-enabled parity groups, the used capacity and total capacity of drives that are used in the pool and that support the compression function are displayed. ▪ Estimated Configurable:[2] • DP: estimated pool capacity of Dynamic Provisioning and Dynamic Tiering • Mainframe DP: estimated pool capacity of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe • TI: remaining pool capacity that is configurable for Thin Image

Item	Description
V-VOL Capacity[1]	DP-VOL capacity: ▪ Allocated/Total • DP: In Allocated, total capacity of the Dynamic Provisioning and Dynamic Tiering DP-VOLs to which LU paths are allocated is displayed. In Total, total capacity of the Dynamic Provisioning and Dynamic Tiering DP-VOLs is displayed. • Mainframe DP: In Allocated and Total, 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: DP-VOL estimated configurable capacity of Dynamic Provisioning and Dynamic Tiering • Mainframe DP: DP-VOL estimated configurable capacity of Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe
Licensed Capacity (Used / Licensed)	▪ DP: Licensed capacity of Dynamic Provisioning. Total capacity of pools for Dynamic Provisioning and Dynamic Tiering is displayed in Used. ▪ Mainframe DP: Licensed capacity of Dynamic Provisioning for Mainframe. Total capacity of pools for Dynamic Provisioning for Mainframe and Dynamic Tiering for Mainframe is displayed in Used. ▪ TI: Licensed capacity of the Thin Image. **Caution:** In Licensed Capacity(Used/Licensed), 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	Total number of pools for Dynamic Tiering for Mainframe, Dynamic Tiering active flash for mainframe, and Thin Image
Notes:	

Item	Description
1. The total value of the Total cells under Capacity of each pool type in the Pools tab 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 HDPz 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 HDPz 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 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	Pool name
Pool ID Not available by default. Available when you click Column Settings.	Pool ID
Status	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.

Item	Description
Number of Pool VOLs	Number of pool-VOLs associated with the pool
Number of V-VOLs	Number of V-VOLs associated with the pool. For a Thin Image pool, a hyphen (-) is displayed.
Number of Root VOLs	Number of root volumes of the Thin Image pairs. If the pool is other than a Thin Image pool, a hyphen (-) is displayed.
RAID level	RAID level. If multiple RAID levels exist in a pool, the RAID level is displayed as Mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. For a pool that contains pool-VOLs assigned to accelerated compression-enabled parity groups, the writeable capacity might be smaller than the displayed capacity. Option: Desired capacity unit is displayed: • One block = 512 bytes • One page = 42 MB • Mainframe: One slot = 58 KB, and one page = 38 MB ▪ Reserved: Reserved page capacity of the pool. The displayed value of Reserved might be larger than the displayed value of Total due to these reasons: • The sum of the used V-VOL capacity and the reserved page capacity that is rounded up on each page is displayed in Reserved. • For a pool that contains pool-VOLs belonging to a parity group with accelerated compression disabled, reserved page capacity that is rounded up on each page is displayed in Reserved. • If the emulation type is 3390-A, the mapped capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl). • The mapped capacity of V-VOL for Dynamic Provisioning for Mainframe includes the capacity of control information (168 MB is required per 3,145,548 MB). • The mapped capacity of DP-VOL includes the capacity of the control information (requires a maximum of 168 MB per 3,145,548 MB).

Item	Description
	▪ Used: Sum of the mapped capacity and reserved capacity. For a pool that contains pool-VOLs belonging to a parity group with accelerated compression enabled, Used is displayed. The displayed value of Used might be larger than the displayed value of Total due to these reasons: • For a pool that contains pool-VOLs belonging to a parity group with accelerated compression enabled, on a total pool capacity basis, percentages of Used are displayed. The sum of the mapped capacity and reserved capacity, which are rounded up on each page is displayed in Used. • The mapped capacity of a DP-VOL includes the capacity of the control information (uses a maximum of 168 MB per 3,145,548 MB). • A DP-VOL with data direct mapping attribute includes the control information (168 MB is used per 3,145,548 MB) and capacity for one page. ▪ Used (%): On a pool capacity basis, percentages of the sum of the mapped capacity and the reserved page capacity (rounded down to the nearest integer). For Dynamic Provisioning, Dynamic Tiering, and Thin Image pools, a hyphen (-) is displayed if the capacity unit is changed to Cylinder.
Data Volumes Used Capacity Not available by default. Available when you click Column Settings.	User data capacity other than the deduplication system data volumes. The user data before the processing of the accelerated compression and the capacity saving is displayed.
Saving Effect Not available by default. Available when you click Column Settings.	Capacity saving rates and capacity that is reduced by accelerated compression and the capacity saving function (compression and deduplication): ▪ Saving Ratio: Ratio of the user data capacity before and after performing the capacity saving and the accelerated compression functions. "1.00:1" is displayed if the pool is used in a mainframe system. ▪ Saving: Saved capacity for a pool. The total value of the accelerated compression function and the capacity saving function. 0 is displayed if the pool is used in a mainframe system.

Item	Description
Software Saving	Data capacity reduced by the capacity saving function, which includes compression and deduplication: ▪ Saving Ratio: Capacity reduction ratio for data, before and after processing. If no data can be displayed, a hyphen (-) is displayed. Not available by default. Available when you click Column Settings. ▪ Compression Ratio: Capacity compression ratio for data, before and after processing. If no data can be displayed, a hyphen (-) is displayed. Not available by default. Available when you click Column Settings. ▪ Deduplication Ratio: Capacity deduplication ratio by the capacity saving function. If no data can be displayed, a hyphen (-) is displayed. Not available by default. Available when you click Column Settings. ▪ Saving: Capacity saved by the capacity saving function. This is the value that System Data is deducted from the total capacity of Compression Deduplication and Reclaim. Not available by default. Available when you click Column Settings. ▪ Compression: Capacity compressed by the capacity saving function. ▪ Deduplication: Capacity deduplicated by the capacity saving function. Not available by default. Available when you click Column Settings. ▪ Reclaim [1]: Capacity reclaimed by the capacity saving function. ▪ System Data: System data consumed by the capacity saving function. This data includes meta data, garbage data, and deduplication system data volumes. Not available by default. Available when you click Column Settings.

Item	Description
	▪ Used (Pre Processed Data): Data capacity before performing the capacity saving function. Not available by default. Available when you click Column Settings. ▪ - (hyphen): No DP-VOLs whose capacity saving is Compression or Deduplication and Compression are associated with the pool. The pool is used in the mainframe system.
FMD Saving Not available by default. Available when you click Column Settings.	Data capacity saved by the accelerated compression function: ▪ Compression Ratio: Capacity compression ratio for data, before and after processing. If no data can be displayed, a hyphen (-) is displayed. ▪ Saving: Capacity reduced by the accelerated compression function. Saving is the total of Compression and Pattern matching. ▪ Compression: Capacity compressed by the accelerated compression function. ▪ Pattern Matching: Capacity reclaimed by the accelerated compression function. ▪ - (hyphen): Pool does not support accelerated compression.
FMD Capacity Not available by default. Available when you click Column Settings.	Pool capacity of FMD drives: ▪ Total: Total pool capacity of FMD drives. ▪ Used: Used capacity of FMD drives after data compression is performed. ▪ - (hyphen): Pool does not contain pool volumes that belong to a parity group consisting of FMD drives.
Logical FMD Capacity Not available by default. Available when you click Column Settings.	Logical capacity of pool volumes whose drive type is FMD: ▪ Total: Total capacity of pool volumes whose drive type is FMD. ▪ Used: Used capacity of FMD drives before data compression is performed. ▪ - (hyphen): Pool does not contain pool volumes whose drive type is FMD.
Efficiency Not available by default. Available when you click Column Settings.	This item is blank if the calculation for these items is not finished.

Item	Description
	System data is not included in the ratio displayed for the items below, except the calculation date: ▪ Total Efficiency Ratio: Ratio of the total saving effect achieved by accelerated compression, capacity saving (compression and deduplication), snapshot, and Dynamic Provisioning. ▪ Data Reduction Ratio: Data reduction ratio before and after accelerated compression and capacity saving (compression and deduplication). ▪ Software Saving Ratio: Capacity reduction ratio before and after capacity saving. ▪ Software Compression Ratio: Capacity compression ratio before and after capacity saving. ▪ Software Deduplication Ratio: Capacity deduplication ratio before and after capacity saving. ▪ Software Pattern Matching Ratio: Capacity reduction ratio before and after the pattern matching function of capacity saving. ▪ FMD Saving Ratio: Capacity reduction ratio before and after accelerated compression. ▪ FMD Compression Ratio: Capacity compression ratio before and after accelerated compression. ▪ FMD Pattern Matching Ratio: Capacity reduction ratio before and after the pattern matching function of accelerated compression. ▪ Snapshot Efficiency Ratio: Efficiency ratio achieved by snapshot. ▪ Provisioning Efficiency (%)[1]: Efficiency ratio achieved by Dynamic Provisioning. ▪ Calculation date : Start and end times for the calculation. These times are based on the system date and time (date, time, and timezone) of the storage system. **Note:** For Last Updated in HDvM - SN, the system date and time of the SVP is displayed. If the storage system time is different from the SVP time, the time displayed for the calculation is different from the time displayed for Last Updated. For details about system date and time settings for storage systems and SVPs, see the *Service Processor Technical Reference*. ▪ - (hyphen): Information is invalid.
User-Defined Threshold (%)	Threshold of a pool: ▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold.

Item	Description
	For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Data direct mapping pool ▪ TI: Thin Image pool
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.

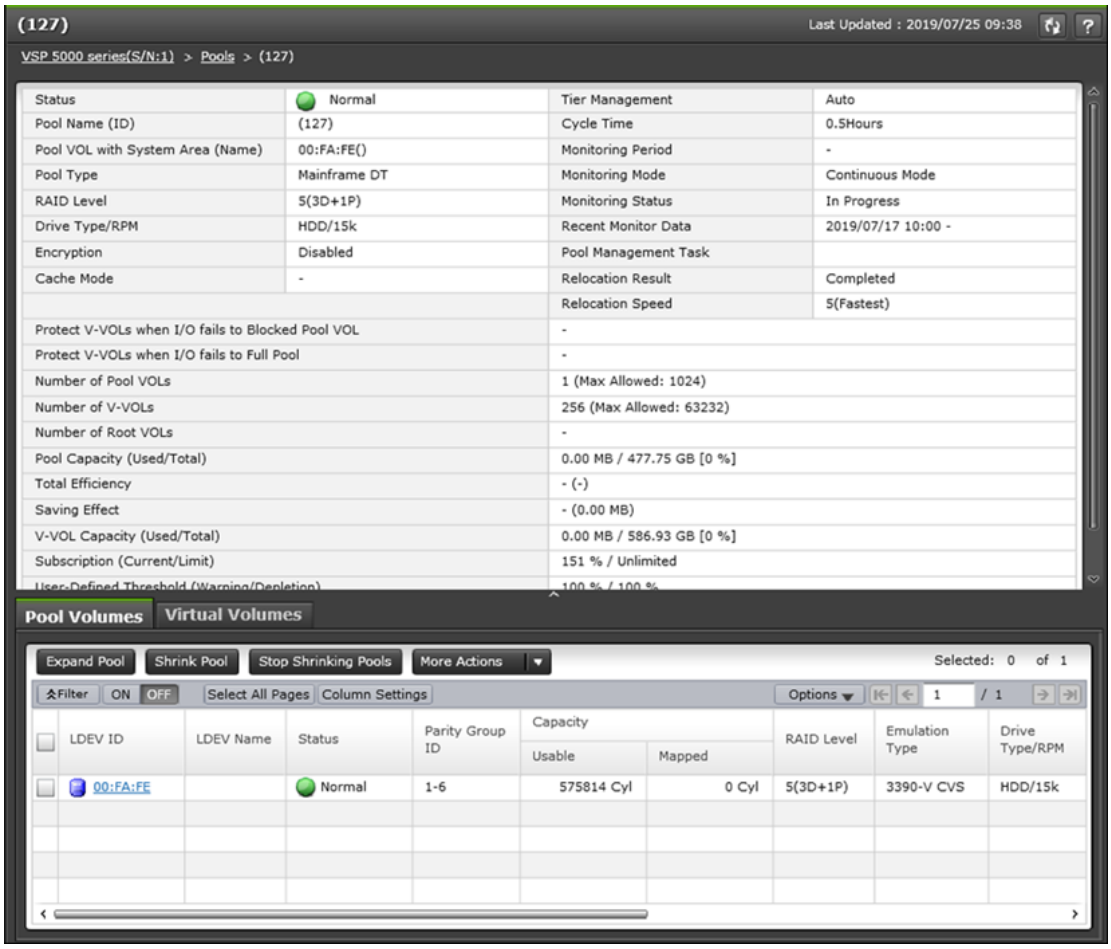
Encryption	▪ Enabled: Pool created by encrypted pool-VOLs
	▪ Disable: Pool created by non-encrypted pool-VOLs
	▪ Mixed: Two or more of these items are specified as pool-VOLs:
	  • Volume encryption setting is enabled.
	  • Volume encryption setting is disabled.
	  • External volume.
	  Caution: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption.
	▪ - (hyphen): Pool created by external volumes. Or pool is blocked.

Tier Management	▪ Auto or Manual: Dynamic Tiering or Dynamic Tiering for Mainframe is enabled. ▪ - (hyphen): Dynamic Tiering or Dynamic Tiering for Mainframe is disabled. Or it is a Thin Image pool.
Shrinkable	Whether the pool-VOL can be removed. While the pool is being shrunk, a hyphen (-) is displayed.
Monitoring Mode	Pool monitoring mode: ▪ Continuous Mode: Continuous Mode is enabled. ▪ Period Mode: Period Mode is enabled. ▪ - (hyphen): Dynamic Tiering or Dynamic Tiering for Mainframe is disabled.

Item	Description
Monitoring Status	Pool monitoring status: ▪ In Progress: Monitoring is being performed. ▪ During Computation: Calculating is being processed. ▪ - (hyphen): Something else is happening.
Recent Monitor Data	▪ If the monitoring data exists, the monitoring time period 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	Management task being performed on the pool: ▪ Waiting for Rebalance: Rebalance process is being waited on. ▪ Rebalancing: Rebalance process is being performed. ▪ Waiting for Relocation: Tier relocation process is being waited on. ▪ Relocating: Tier relocation process is being performed. ▪ Waiting for Shrink: Pool shrinking process is being waited on. ▪ Shrinking: Pool shrinking process is being performed. ▪ Blank: Pool management task is not being performed. For details about tier relocation, see the tier relocation log file.
Relocation Result	Status of the tier relocation processing: ▪ In Progress: Status of Pool Management Task is Waiting for Relocation or Relocating. ▪ Completed: Tier relocation operation is not in progress, or the tier relocation is complete. ▪ Uncompleted (n% relocated): Tier relocation is suspended at the indicated percentage progression. ▪ (-) (hyphen): Pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.
Relocation Speed	Tier relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest)

Item	Description
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Enabled: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Protect V-VOLs when I/O fails to Full Pool	▪ Enabled: When the pool usage reaches the full size, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool usage reaches the full size, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Subscription (%)	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 pool, a hyphen (-) is displayed for Current and Limit.

Pools: Volume tabs



Summary

Item	Description
Status	▪ Normal: Pool is in a normal status. ▪ Warning: Pool-VOL in the pool is blocked, or the pool is being shrunk. ▪ Exceeded Threshold: Percentages of the sum of the mapped capacity of the pool and the reserved capacity of the pool exceed 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)	Pool name and pool ID
Pool VOL with System Area (Name)	LDEV ID and LDEV name of the pool-VOL that includes the pool management area
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT(Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DT (data direct mapping): Data direct mapping pool ▪ TI: Thin Image pool
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Encryption	▪ Enabled: Pool that is created by pool-VOLs whose encryption settings are enabled. ▪ Disable: Pool that is created by pool-VOLs whose encryption settings are disabled.

Item	Description
	▪ Mixed: When two or more of these times are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool that has the Mixed encryption setting. To manage data encryption securely, use a pool with the encryption setting of Enabled or Disabled. ▪ - (hyphen): Pool is created by external volumes, or pool is blocked.
Cache Mode	For a configuration of external volumes, cache mode is displayed as Enabled or Disabled. For the configuration of external volumes, whose cache modes are enabled and disabled, Mixed is displayed. For other configurations, a hyphen (-) is displayed.
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Enabled: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Protect V-VOLs when I/O fails to Full Pool	▪ Enabled: When the pool usage reaches the full size, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool usage reaches the full size, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Number of Pool VOLs	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	Number of V-VOLs associated with the pool and the maximum number of V-VOLs that can be associated with the pool.

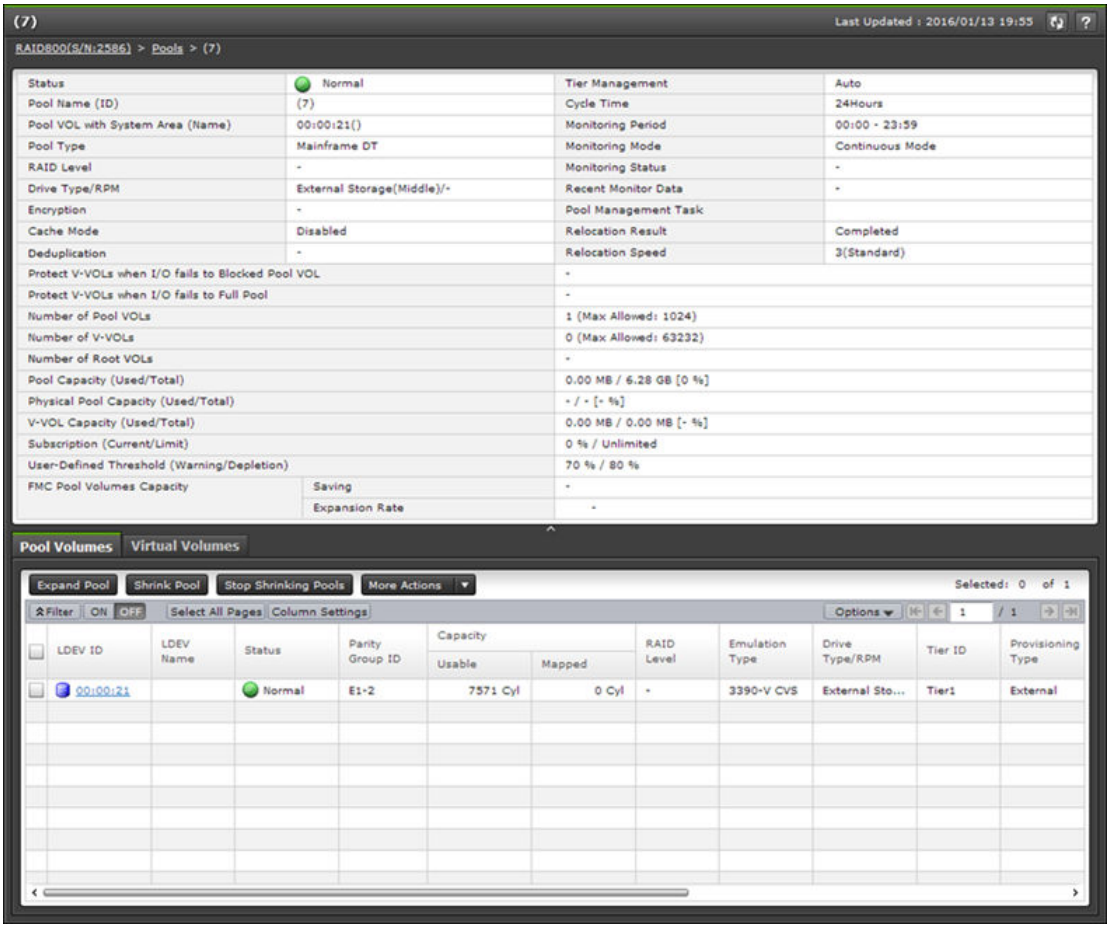
Item	Description
	For a pool with the data direct mapping attribute, a hyphen (-) is displayed for the maximum number of V-VOLs that can associate with the pool. For a Thin Image pool, a hyphen (-) is displayed.
Number of Root VOLs	Number of root volumes of the Thin Image pairs. When the applicable volume does not exist, a hyphen (-) is displayed.
Pool Capacity (Used/Total)	Sum of the mapped capacity and reserved capacity for the pool, and the total capacity of the pool. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field.
Total Efficiency	Ratio of the total saving effect achieved by accelerated compression, capacity saving (compression and deduplication), snapshot, and Dynamic Provisioning followed by the start and end times for the calculation. These times are based on the system date and time (date, time, and timezone) of the storage system. System data is not included in the Total Efficiency ratio. **Note:** The time displayed in Last Updated in HDvM - SN is based on the system date and time (date, time, and timezone) of the SVP. If the storage system time is different from the SVP time, the time displayed for the calculation is different from the time displayed for Last Updated. For details about system date and time settings for storage systems and SVPs, see the *Service Processor Technical Reference*.
Saving Effect	Data capacity saving rate and size provided by the accelerated compression function and the capacity saving function, which includes the compression and deduplication functions. A hyphen (-) is displayed for rates and 0 for size if the pool is used in the mainframe system. The saved capacity displayed in this area contains the reclaimed capacity and system data capacity. However, information for items of Compression and Deduplication in Software Saving and items of FMD Compression do not contain the reclaimed capacity and system data capacity. Therefore, the total of Compression and Deduplication in Software Saving and FMD Compression does not match with the capacity for Saving Effect.
V-VOL Capacity (Used/Total)	Sum of the mapped capacity and the reserved capacity for virtual volumes, and the total capacity of virtual volumes. For a Thin Image pool, a hyphen (-) is displayed along with the used and total V-VOL capacity.
Subscription (Current/Limit)	Ratio (%) of the total DP-VOL capacity that has been configured to the total capacity of the pool and the subscription limit setting. For a Thin Image pool, a hyphen (-) is displayed for Current and Limit.

Item	Description
User-Defined Threshold (Warning/Depletion)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For Thin Image, a hyphen (-) is displayed for Depletion.
Tier Management	▪ Auto or Manual: Dynamic Tiering is enabled. ▪ - (hyphen): Thin Image.
Cycle Time	Cycle of performance monitoring and tier relocation. If Dynamic Tiering is disabled, a hyphen (-) is displayed.
Monitoring Period	Time of starting and ending of performance monitoring. If Dynamic Tiering is disabled, a hyphen (-) is displayed.
Monitoring Mode	Monitoring mode for the pool: ▪ Continuous Mode: Continuous mode is enabled. ▪ Period Mode: Period mode is enabled. ▪ - (hyphen): Dynamic Tiering
Monitoring Status	Status of pool monitoring: ▪ In Progress: Monitoring is being performed. ▪ - (hyphen): Other situations are occurring.
Recent Monitor 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	Management task being performed on the pool: ▪ Waiting for Rebalance: Rebalance process is being waited on. ▪ Rebalancing: Rebalance process is being performed. ▪ Waiting for Relocation: Tier relocation process is being waited on. ▪ Relocating: Tier relocation process is being performed. ▪ Waiting for Shrink: Pool shrinking process is being waited on. ▪ Shrinking: Pool shrinking process is being performed. ▪ Blank: Pool management task is not being performed to the pool.

Item	Description
	For details about the tier relocation, see the tier relocation log file.
Relocation Result	Status of the tier relocation processing: ▪ In Progress: Status of Pool Management Task is Waiting for Relocation or Relocating. ▪ Completed: Tier relocation operation is not in progress, or the tier relocation is complete. ▪ Uncompleted (n% relocated): Tier relocation is suspended at the indicated percentage progression. ▪ - (hyphen): Pool is not a Dynamic Tiering pool.
Relocation Speed	Relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest)

Pool Volumes tab

Only the LDEVs assigned to the logged-on user are available.



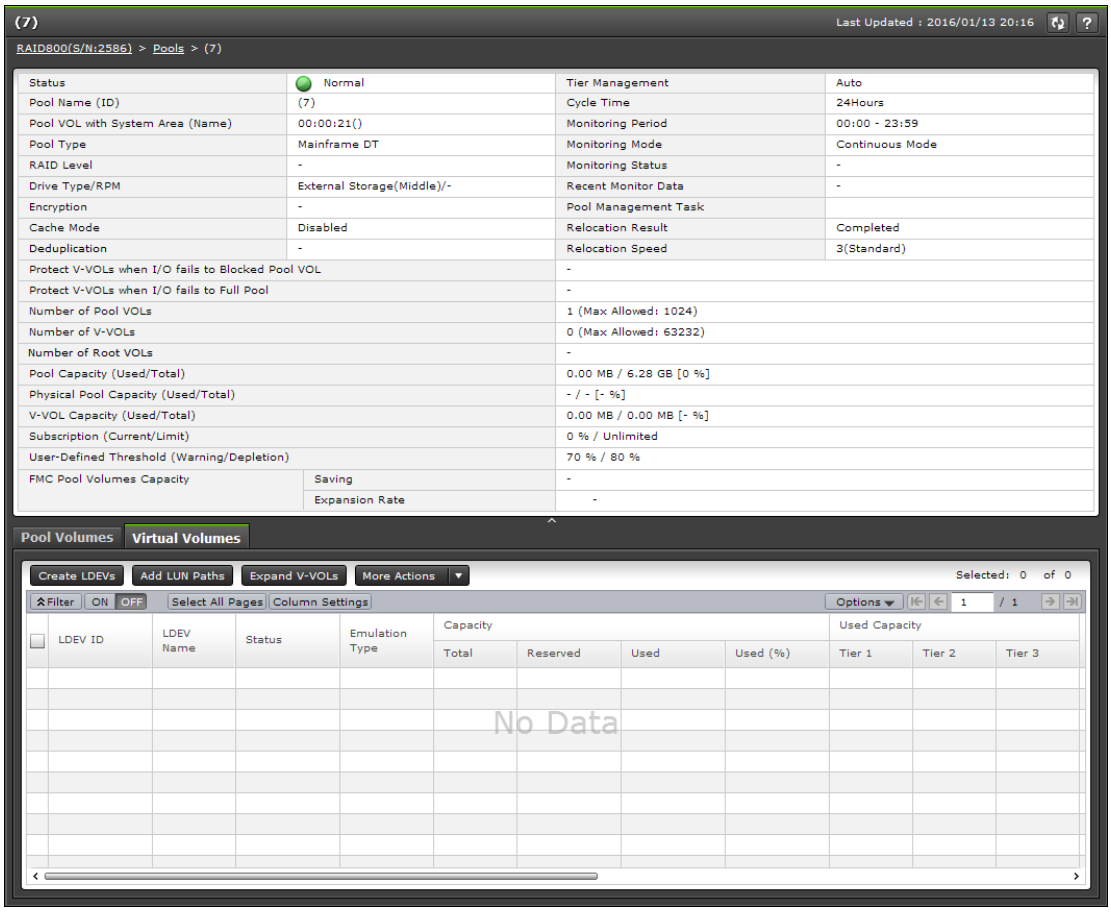
Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Status	Pool-VOL status: ▪ Normal: Pool-VOL is in the normal status. ▪ Shrinking: Pool-VOL is being reduced. ▪ Blocked: Pool-VOL is blocked.
Parity Group ID	Parity group ID
Capacity	Pool capacity: ▪ Usable: Usable capacity in the pool-VOL that is offset on the basis of the page. For the pool-VOL with system area, the displayed capacity does not include the capacity of the management area. ▪ Mapped: Mapped capacity in the pool-VOL that is offset on the basis of the page. ▪ - (hyphen): If the unit of capacity is changed to Cylinder for the pool of Dynamic Provisioning, Dynamic Tiering, active flash, and Thin Image.
RAID Level	RAID level
Emulation Type	Emulation type
Drive Type/RPM	Drive type and rpm. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Tier ID	Tier ID. For a Dynamic Provisioning, Dynamic Provisioning for Mainframe, or a Thin Image pool, a hyphen (-) is displayed.
Provisioning Type	LDEV provisioning type: ▪ Basic: internal volume ▪ External: external volume
Attribute	LDEV attribute: ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ - (hyphen): LDEV for which the attribute is not defined

Item	Description
Cache Mode	▪ Enabled: Cache mode is enabled for the external volume. ▪ Disabled: Cache mode is disabled for the external volume. ▪ - (hyphen): LDEV is not an external volume.
Shrinkable	Whether the pool-VOL can be removed while the pool is being shrunk: ▪ Yes: Pool-VOL can be removed. ▪ No: Pool-VOL cannot be removed. ▪ - (hyphen): Pool-VOL is being shrunk.
Encryption Not available by default. Available when you click Column Settings.	Parity group encryption: ▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume.
Accelerated Compression Not available by default. Available when you click Column Settings.	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Expanded Space Used Not available by default. Available when you click Column Settings.	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.
Data Direct Mapped LDEV	LDEV ID of a pool-VOL in the pool with data direct mapping enabled.

Item	Description
	A hyphen (-) is displayed if data direct mapping is disabled. If a DP-VOL with data direct mapping enabled is not created in the pool with data direct mapping enabled, this item is blank.
Resource Group Name (ID)	Resource group names and IDs of the LDEV
Physical Parity Group Capacity Expansion Ratio	For accelerated compression-enabled parity groups of which pool volumes are created, the capacity expansion ratio before and after the processing. If either the used pool capacity or the used physical pool capacity exceeds 50% of the depletion threshold (the warning threshold for the Thin Image pool), an icon of one of these statuses is displayed: ▪ : In all accelerated compression-enabled parity groups, this status is displayed when the expansion rate and the saving ratio are balanced. ▪ : In one or more accelerated compression-enabled parity groups, this status is displayed if an excess of the unanticipated usage might occur. In this case, consider revising the total capacity of LDEVs (pool volumes) carved from these parity groups. . ▪ : In one or more accelerated compression-enabled parity groups, this status is displayed when the accelerated compression function is not performed in the effective utilization. However, if there is a parity group with a status (see above) in the pool, then this icon is not displayed. In this case, consider revising the total capacity of LDEVs (pool volumes) carved from these parity groups. .

Virtual Volumes tab

When you select a Thin Image pool, this tab is not displayed.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	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.

Item	Description
	▪ 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	Emulation type
Capacity	V-VOL capacity: ▪ Total: V-VOL capacity. ▪ Reserved: Reserved capacity of the V-VOL. The value of Reserved might be larger than the value of Total for these reasons: • The reserved capacity that is rounded up on each page is in Reserved. • If the emulation type is 3390-A, the mapped capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl). • The mapped capacity of V-VOL for Dynamic Provisioning includes the capacity of control information (168 MB is required per 3,145,548 MB).

Item	Description
	▪ Used: Sum of the mapped capacity and the reserved capacity. The value of Used might be larger than the value of Total for these reasons: • The sum of the mapped capacity and the reserved capacity that is rounded up on each page is in Used. • If the emulation type is 3390-A, the mapped 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 enabled, the mapped capacity for DP-VOL contains the management area capacity. • The mapped capacity of DP-VOL includes the capacity of the control information (uses a maximum of 168 MB per 3,145,548 MB). • DP-VOL with data direct mapping enabled includes the control information (168 MB is used per 3,145,548 MB) and the capacity for one page. If used capacity is referenced during I/O or copy processing by software such as ShadowImage or Universal Replicator, the used capacity displayed might be different from the actual capacity even if the full allocation is enabled on the V-VOL. This is caused by a gap between the times that information is gathered about the mapped capacity and the reserved capacity. ▪ Used(%): For the entire capacity of V-VOL, percentages of the sum of the mapped capacity and the reserved capacity. Used(%) is obtained by dividing the total of the user data and control information by the user area capacity. For an LDEV such as a TSE-VOL, where the ratio of the control information is high relative to the user area, Used(%) might exceed 100%.

Item	Description
Used Capacity	Mapped capacity of a V-VOL: ▪ Tier1: Used capacity of tier 1. A hyphen (-) is displayed if the logical volume is a not a V-VOL of Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ Tier2: Used capacity of tier 2. A hyphen (-) is displayed if tier 2 does not exist or if the logical volume is a not a V-VOL of Dynamic Tiering or Dynamic Tiering for Mainframe. ▪ Tier3: Used capacity of tier 3. A hyphen (-) is displayed if tier 3 does not exist or if the logical volume is a not a V-VOL of Dynamic Tiering or Dynamic Tiering for Mainframe. The reserved page capacity is not included in the used capacity for each tier of the V-VOL. Therefore, the Used value in the Capacity column might not correspond with the Used Capacity value.
Number of Paths	Number of alternate paths. A hyphen(-) is displayed for the Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe V-VOL.
CLPR	Cache logical partition number, in *ID*:*CLPR* format
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Enable: Pages are reserved. ▪ Disable: Pages are not reserved.
Tiering Policy	Tiering policy name and ID: ▪ All(0): The policy of which all tiers in the pool are used. ▪ Level1(1) - Level5(5): One of the policies from Level1 to Level5 is set to V-VOL. ▪ Level6(6) - Level31(31): Tiering policy of the user definition is set to V-VOL. From Level 6 (6) to Level 31 (31), the names of tiering policies can be changed. If these names have changed, the new names are displayed. ▪ - (hyphen): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
New Page Assignment Tier	▪ High: High is set to V-VOL. ▪ Middle: Middle is set to V-VOL.

Item	Description
	▪ Low: Low is set to V-VOL. ▪ - (hyphen): V-VOL is not the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.
Tier Relocation	Whether tier relocation is enabled or disabled. If the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL is not used, a hyphen (-) is displayed.
Relocation Priority	▪ Prioritized: Priority is set to V-VOL. ▪ Blank: 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	Management task being performed on the pool: ▪ Waiting for Rebalance: Rebalance process is being waited on. ▪ Rebalancing: Rebalance process is being performed. ▪ Waiting for Relocation: Tier relocation process is being waited on. ▪ Relocating: Tier relocation process is being performed. ▪ Waiting for Shrink: Pool shrinking process is being waited on. ▪ Shrinking: Pool shrinking process is being performed. ▪ Blank: Pool management task is not being performed.
V-VOL Management Task	Management task being performed on the V-VOL: ▪ Reclaiming Zero Pages: Processing is being performed. ▪ Waiting for Zero Page Reclaiming: Processing is being waited on. ▪ Blank: V-VOL management task is not being performed on the V-VOL.
Attribute	LDEV attribute: ▪ TSE: TSE-VOL ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication ▪ - (hyphen): Volume in which the attribute is not defined
Access Attribute	Access attribute of the LDEV.

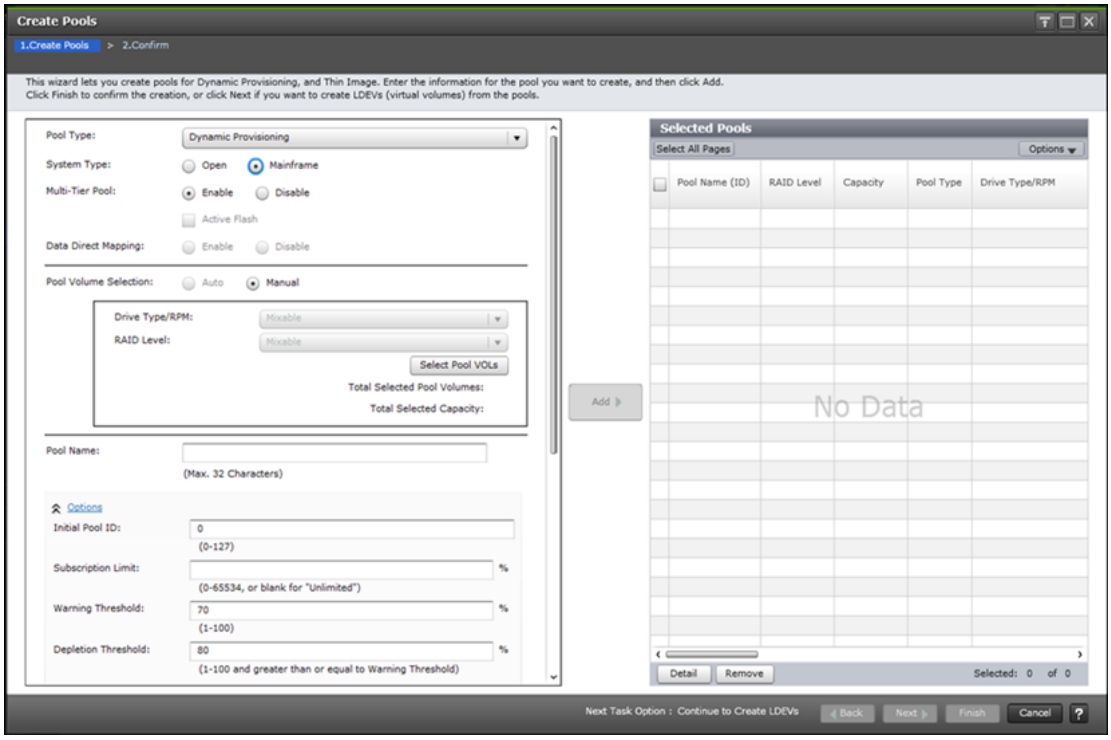
Item	Description
Not available by default. Available when you click Column Settings.	
T10 PI Not available by default. Available when you click Column Settings.	LDEV's T10 PI attribute (Enabled or Disabled).
Data Direct Mapped LDEVs Not available by default. Available when you click Column Settings.	LDEV ID of the pool-VOL in the pool with data direct mapping enabled. A hyphen (-) is displayed if the data direct mapping attribute is disabled.
Resource Group Name (ID)	Resource group names and IDs of the LDEV
Virtual Storage Machines Not available by default. Available when you click Column Settings.	▪ Model / Serial Number: Model name and serial number of the virtual storage machine that has an LDEV. ▪ LDEV ID: Virtual LDEV ID. If a Virtual LDEV ID is not assigned to LDEV, this column is blank. ▪ Device Name: Virtual device name, which is a combination of the virtual emulation type, virtual LUSE volume number, and the virtual CVS attribute. Values of the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are displayed only for items that have been set. This column is blank when the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are not set. If the virtual CVS attribute is set, CVS is attached as the suffix to the device name. ▪ SSID: Virtual SSID. If Virtual SSID is not set for LDEV, this column is blank. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for LDEV, this column is blank.

Create Pools wizard

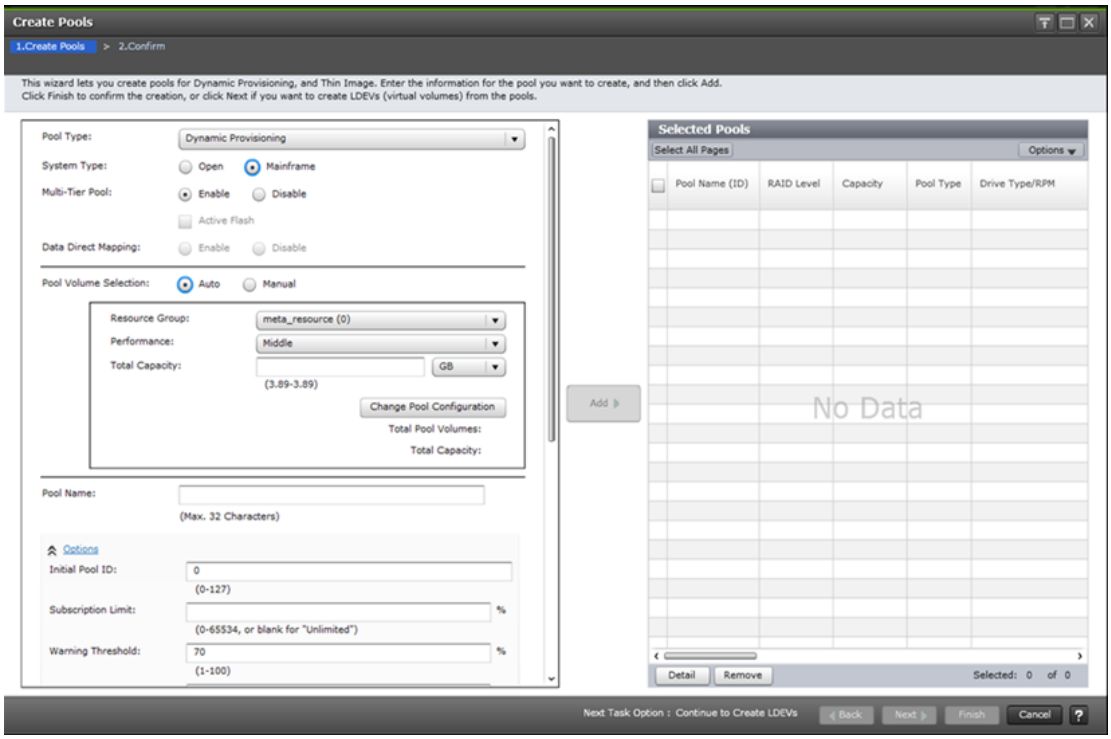
Create Pools window

Use this window to create new pools for , Dynamic Provisioning for Mainframe, and Thin Image.

When selecting pool-VOLs manually



When selecting pool-VOLs automatically



Item	Description
Pool Type Requires configuration.	▪ Thin Image: Thin Image pool ▪ Dynamic Provisioning: These pool types: • Dynamic Provisioning pool • Dynamic Tiering pool • Dynamic Provisioning for Mainframe pool • Dynamic Tiering for Mainframe pool • Active flash pool • Active flash for mainframe pool
System Type Requires configuration.	System type. For Thin Image, only Open is displayed.
Multi-Tier Pool Requires configuration.	If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual for performance monitoring and tier relocation is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Active Flash	Available if these conditions are met: ▪ Multi-Tier Pool is enabled. ▪ Pool volumes whose drive type is SSD or FMD are installed. ▪ Multi-Tier Pool is enabled. ▪ Pool volumes whose drive type is SSD or FMD are installed.
Data Direct Mapping	Available if these items are specified: ▪ Pool Type: Dynamic Provisioning ▪ System Type: Open ▪ Multi-Tier Pool: Disable
Pool Volume Selection Requires configuration.	Mode of the pool-VOL (Auto or Manual). If Enable is selected in Data Direct Mapping, Manual is selected automatically.
Drive Type/RPM Requires configuration.	Drive type and rpm of the pool-VOL: ▪ Mixable: Volume created by Dynamic Provisioning, Dynamic Tiering, or active flash. ▪ External Storage: External volume. Available if Manual was selected for Pool Volume Selection.

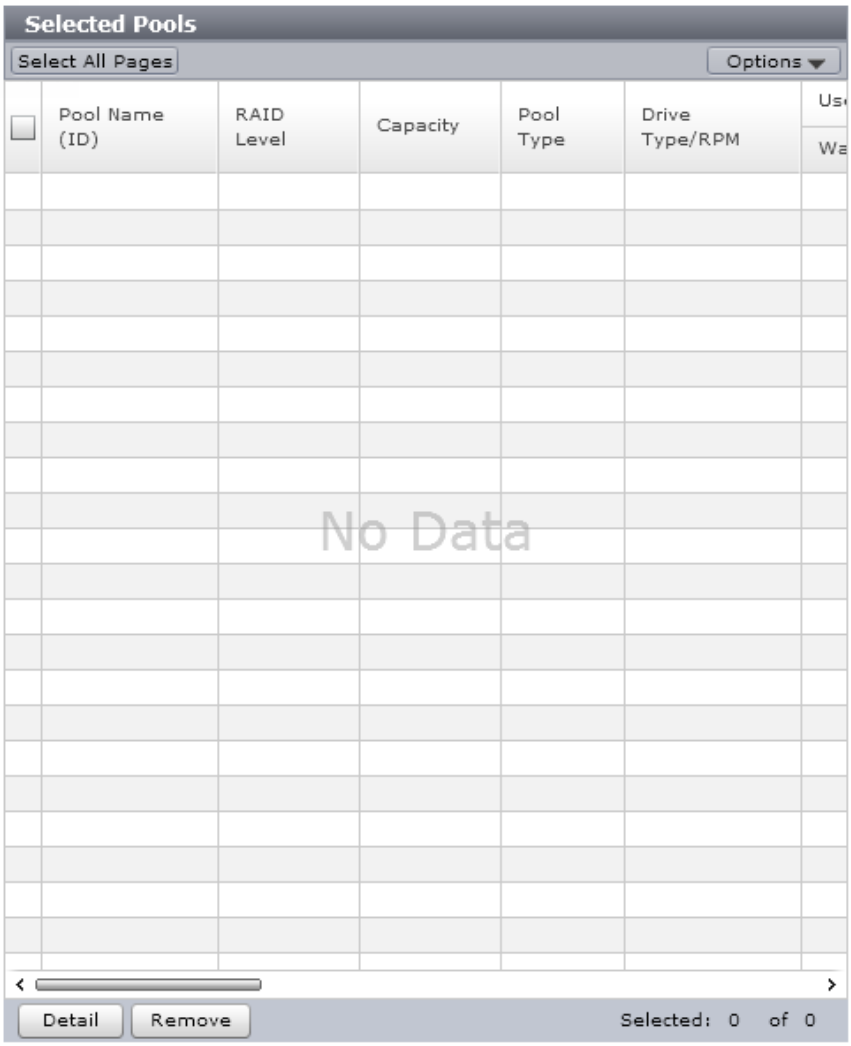
Item	Description
RAID Level Requires configuration.	RAID level of the pool-VOL: ▪ Mixable: Dynamic Provisioning, Dynamic Tiering, or active flash. ▪ - (hyphen): If External Storage is selected in Drive Type/RPM. Available if Manual was selected for Pool Volume Selection.
Total Selected Pool Volumes	Total number of the selected pool-VOLs. Available if Manual was selected for Pool Volume Selection.
Total Selected Capacity	Total capacity of the selected pool-VOLs. Available if Manual was selected for Pool Volume Selection.
Enable Accelerated Compression for FMD parity group	Available when all of these conditions are met: ▪ All selected pool volumes are created using parity groups of drives that support accelerated compression. ▪ If the selected pool volume is created using an accelerated compression-disabled parity group, the accelerated compression the parity group can be enabled. ▪ At least one pool volume created using accelerated compression-disabled parity group is selected. When this item is selected, FMD compression effect can be achieved. This item cannot be selected if Mainframe is selected for System Type.
Resource Group	Resource group name of the pool. Available if Auto was selected for Pool Volume Selection.
Performance	Performance of the pool. Available if Auto was selected for Pool Volume Selection.
Total Capacity	Total capacity of the pool. Available if Auto was selected for Pool Volume Selection.
Total Pool Volumes	Total number of pool-VOLs. Available if Auto was selected for Pool Volume Selection.
Total Capacity	Capacity of the pool created by the selected pool configuration. Available if Auto was selected for Pool Volume Selection.
Pool Name Requires configuration.	Pool name up to 32 case-sensitive and alphanumeric characters.
Initial Pool ID	Smallest available number is displayed as a default. No number is displayed if no available pool ID exists.

Item	Description
	If a pool ID already in use is specified, the minimum pool ID after that the specified pool ID is automatically set.
Subscription Limit	Subscription limit of the pool, an integer from 0 to 65534 (%). If this item is blank, the subscription is set to Unlimited. If the pool contains Thin Image pairs, this item cannot be changed.
Warning Threshold	Warning threshold between 1 and 100%. The default value is 70%. For a Thin Image pool, the threshold should be between 20% and 95%. The default value is 80%. If data direct mapping is enabled, 100% is specified automatically.
Depletion Threshold	Depletion threshold between 1% and 100%. The default value is 80%. For a Thin Image pool, this setting is not necessary. If data direct mapping is enabled, 100% is specified automatically.
Suspend TI pairs when depletion threshold is exceeded	For a Dynamic Provisioning pool that contains Thin Image pairs and snapshot data, whether SIM code 62Exxx is output when the pool used capacity exceeds the depletion threshold (default = yes). If a Thin Image pair in the pool is split after SIM code 62Exxx is output, the operation fails and the pair is suspended by error. ▪ Yes (default): When the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is output, and Thin Image pairs in the pool cannot be split. If Multi-Tier Pool or data direct mapping is enabled for the pool, Yes cannot be selected. ▪ No: When the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is not output, and Thin Image pairs in the pool can be split.
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Yes: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. At the same time, the access attribute of the DP-VOL is changed to the protect attribute. ▪ No: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. Available if these conditions are met: ▪ Pool type is Dynamic Provisioning. ▪ System type is open. ▪ Data Retention Utility is installed.

Item	Description
Protect V-VOLs when I/O fails to Full Pool	▪ Yes: When the pool-VOL usage reaches the full size, DP-VOL is protected from reading and writing requests. At the same time, the access attribute of the DP-VOL is changed to the protect attribute. ▪ No: When the pool-VOL usage reaches the full size, DP-VOL is not protected from reading and writing requests. Available if these conditions are met: ▪ Pool type is Dynamic Provisioning. ▪ System type is open. ▪ Data Retention Utility is installed.
Tier Management	Performance monitoring and tier relocation (Auto or Manual): ▪ Cycle Time: Cycle of performance monitoring and tier relocation. ▪ Monitoring Period: If 24 Hours is selected in the Cycle Time list, the time zone in which performance monitoring is to be performed must be specified from 00:00 to 23:59 (default value),. Take one or more hours between the starting time and the ending time. If the starting time is specified for later than the ending time, the performance monitoring continues until the time that is specified as the ending time on the next day. Available if Multi-Tier Pool is enabled.
Monitoring Mode	▪ Continuous Mode: Tier relocation weighted to the past period monitoring result is performed. ▪ Period Mode: Tier relocation on the specified cycle is performed. Available if Multi-Tier Pool is enabled.
Relocation speed	Page relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). The default is 3(Standard). If the speed is specified slower than 3(Standard), the data drive load is low when tier relocation is performed.
Buffer Space for New page assignment	▪ Tier 1: Percentage from 0 to 50. A default value depends on the data drive type of pool-VOL in tier 1. The default value of SSD or FMD is 0%. The default value of drive types other than SSD or FMD is 8%. ▪ Tier 2: Percentage from 0 to 50. A default value depends on the data drive type of pool-VOL in tier 2. ▪ Tier 3: Percentage from 0 to 50. A default value depends on the data drive type of pool-VOL in tier 3. Available if Multi-Tier Pool is enabled.

Item	Description
Buffer Space for Tier relocation	▪ Tier 1: Percentage from 2 to 40 A default value is 2%. A default value is 2%. ▪ Tier 2: Percentage from 2 to 40 A default value is 2%. A default value is 2%. ▪ Tier 3: Percentage from 2 to 40 A default value is 2%. A default value is 2%. Available if Multi-Tier Pool is enabled.

Selected Pools table



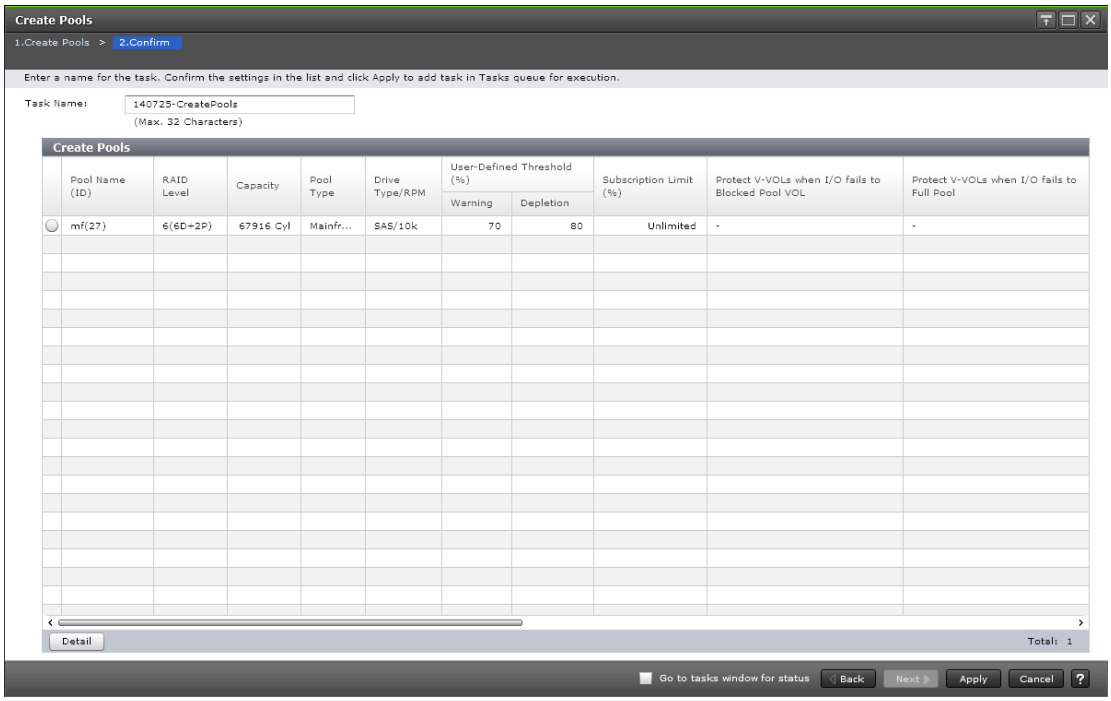
Item	Description
Pool Name (ID)	Pool name and pool ID

Item	Description
RAID Level	RAID level of the pool. If multiple RAID levels exist in a pool, the RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Total capacity of the created pool. 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 volumes. 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 volumes. As for a pool comprised of pool volumes assigned to accelerated compression-enabled parity groups, the writable capacity might be smaller than the displayed capacity.
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT(Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Data direct mapping pool ▪ TI: Thin Image pool
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Encryption	▪ Enabled: Encrypted pool. ▪ Disable: Non-encrypted pool. ▪ Mixed: Two or more of these items must be specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): Pool created by external volumes.

Item	Description
User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Subscription Limit (%)	Subscription limit of the pool. For Thin Image pool, a hyphen (-) is displayed.
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Enabled: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Protect V-VOLs when I/O fails to Full Pool	▪ Enabled: When the pool usage reaches the full size, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool usage reaches the full size, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Number of Pool VOLs	Number of pool-VOLs
Tier Management	▪ If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual for performance monitoring and tier relocation is displayed. ▪ If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Cycle Time	Cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Period	Time zone of performance monitoring when 24 Hours is selected as the cycle time. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.

Item	Description
Monitoring Mode	▪ Continuous Mode: Tier relocation weighted to the past period monitoring result is performed. ▪ Period Mode: Tier relocation on the specified cycle is performed.
Relocation speed	Page relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Buffer Space for New page assignment (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for new page assignment to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Buffer Space for Tier relocation (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for tier relocation to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.

Create Pools confirmation window



Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity. For a pool containing pool volumes assigned by accelerated compression-enabled parity groups, the writable capacity might be smaller than the displayed capacity.
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT(Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool

Item	Description
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.

Encryption	▪ Enabled: Encrypted pool.
	▪ Disable: Non-encrypted pool.
	▪ Mixed: Two or more of these items must be specified as pool-VOLs:
	  • Volume encryption setting is enabled.
	  • Volume encryption setting is disabled.
	  • External volume.
	  Caution: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption.
	▪ - (hyphen): Pool created by external volumes.

User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Subscription Limit (%)	Subscription limit of the pool. For a Thin Image pool, a hyphen (-) is displayed.

Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Enabled: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute.
	▪ Disabled: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests.
	▪ - (hyphen): The pool corresponds with one of these situations:
	  • Data Retention Utility is not installed.
	  • Pool type is other than DP or DT.

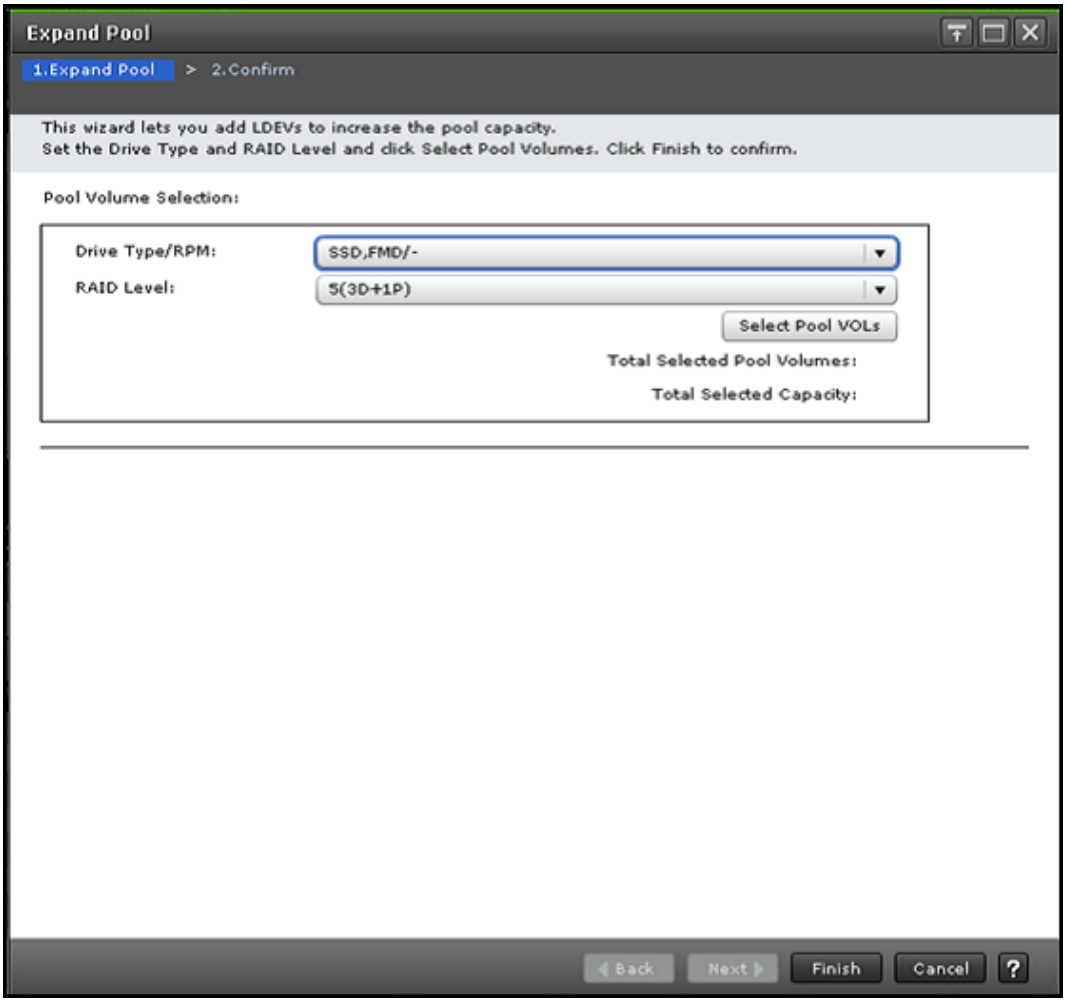
Item	Description
Protect V-VOLs when I/O fails to Full Pool	▪ Enabled: When the pool usage reaches the full size, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool usage reaches the full size, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Number of Pool VOLs	Number of pool-VOLs
Tier Management	▪ If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual for performance monitoring and tier relocation is displayed. ▪ If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Cycle Time	Cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Period	Time zone of performance monitoring when 24 Hours is selected as the Cycle Time. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Mode	▪ Continuous Mode: Tier relocation weighted to the past period monitoring result is performed. ▪ Period Mode: Tier relocation on the specified cycle is performed.
Relocation speed	Page relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.

Item	Description
Buffer Space for New page assignment (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for new page assignment to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Buffer Space for Tier relocation (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for tier relocation to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.
Deduplication (Open systems)	▪ Available or Not Available: Pool type is DP. ▪ - (hyphen): Pool type is other than DP.
Enable Accelerated Compression for FMD parity group	▪ Yes: Accelerated compression is enabled on the FMD parity group. ▪ No: Accelerated compression is not enabled on the FMD parity group. ▪ - (hyphen): Accelerated compression cannot be enabled on the parity group.

Expand Pool wizard

Expand Pool window

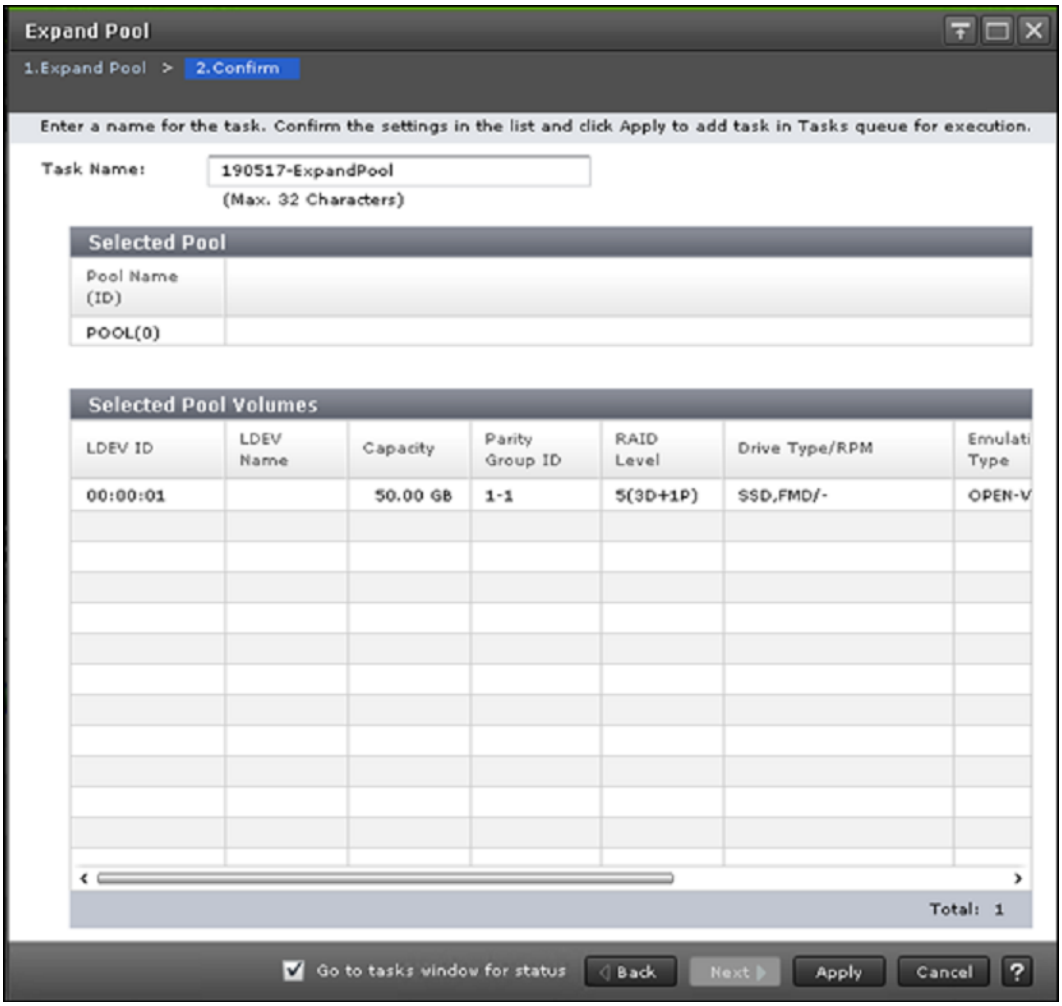
Use this window to add LDEVs to a pool to expand the pool to increase pool capacity.



Item	Description
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
RAID Level	RAID level of the pool. If the level is not set, Mixable is displayed. If External Storage is selected in Drive Type/RPM, a hyphen (-) is displayed.
Total Selected Pool Volumes	Total number of the pool-VOLs selected for this pool

Item	Description
Total Selected Capacity	Total capacity of the pool-VOLs selected for this pool
Enable Accelerated Compression for FMD parity group	Available if all of these conditions are met: ▪ All pool volumes in the pool to be expanded and all pool volumes to be added are created using parity groups of SSD or FMD drives. ▪ If the pool volumes in the pool to be expanded and the pool volumes to be added are created using an accelerated compression-disabled parity group, the accelerated compression setting of the parity group can be enabled. ▪ At least one pool volume is selected, and at least one pool volume created using accelerated compression-disabled parity group is contained in the pool volumes of the target pool or in the selected pool volumes.

Expand Pool confirmation window



Selected Pool table

Item	Description
Pool Name (ID)	Pool name and pool ID

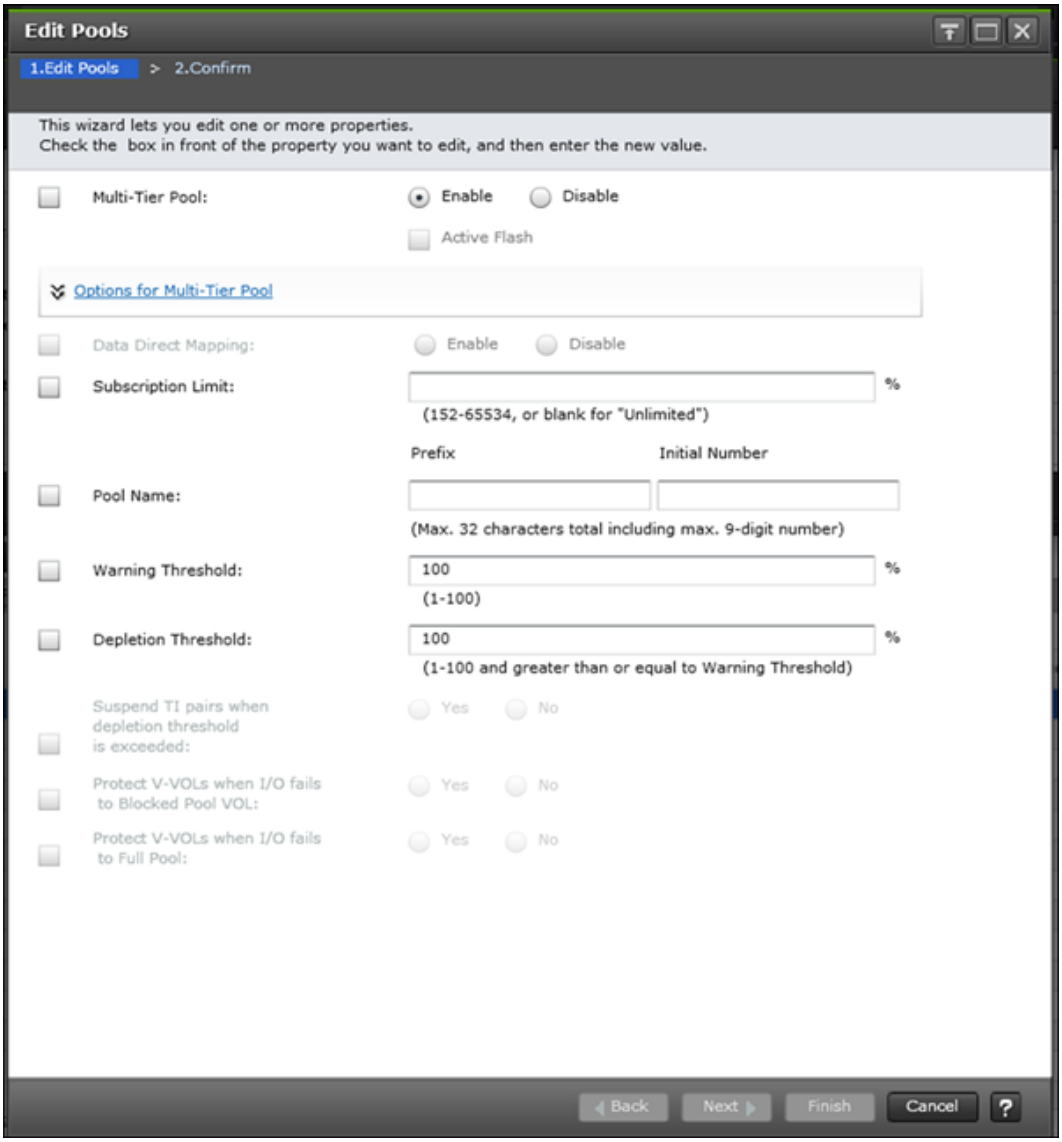
Selected Pool Volumes table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Capacity	Pool-VOL capacity

Item	Description
Parity Group ID	Parity group ID
RAID Level	RAID level. If a pool-VOL is an external volume, a hyphen (-) is displayed.
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Emulation Type	Device emulation type
Cache Mode	▪ Enabled or Disabled: external volume ▪ - (hyphen): not an external volume
Attribute	▪ Data Direct Mapping: LDEV with the data direct mapping attribute ▪ Deduplication System Data Volume: LDEV used to manage data deduplication ▪ - (hyphen): Volume for which the attribute is not defined
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Enable Accelerated Compression for FMD parity group	▪ Yes: Accelerated compression is enabled on the FMD parity group. ▪ No: Accelerated compression is not enabled on the FMD parity group. ▪ - (hyphen): Accelerated compression cannot be enabled on the parity group.

Edit Pools wizard

Edit Pools window



Item	Description
Multi-Tier Pool	▪ Enable: Dynamic Tiering or Dynamic Tiering for Mainframe is enabled. ▪ Disable: Dynamic Tiering or Dynamic Tiering for Mainframe is disabled. In Thin Image, the setting cannot be changed.

Item	Description
	For a Dynamic Provisioning pool that contains Thin Image pairs and snapshot data, the setting cannot be changed from Disable to Enable. If TSE-VOL is assigned to the selected pool, the pool cannot be changed from Disable to Enable.
Active Flash	If pool volumes whose drive type is SSD or FMD are installed, this item can be selected. In Thin Image, the setting cannot be changed.
Tier Management	Performance monitoring and tier relocation (Auto or Manual): ▪ Cycle Time: Cycle of performance monitoring and tier relocation. ▪ Monitoring Period: If 24 Hours is selected in the Cycle Time list, the time zone in which performance monitoring is to be performed must be specified from 00:00 to 23:59 (default value),. Take one or more hours between the starting time and the ending time. If the starting time is specified for later than the ending time, the performance monitoring continues until the time that is specified as the ending time on the next day. In Thin Image, the setting cannot be changed. If the pool setting is changed from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe) or active flash (or active flash for mainframe), this item must be set. Available if Multi-Tier Pool is enabled.
Monitoring Mode	▪ Continuous Mode: Tier relocation weighted to the past period monitoring result is performed. ▪ Period Mode: Tier relocation on the specified cycle is performed. If the pool setting is changed from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe) or active flash (or active flash for mainframe), this item must be set. Available if Multi-Tier Pool is enabled.
Relocation speed	Page relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). If the pool setting is changed from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe) or active flash (or active flash for mainframe), this item must be set.

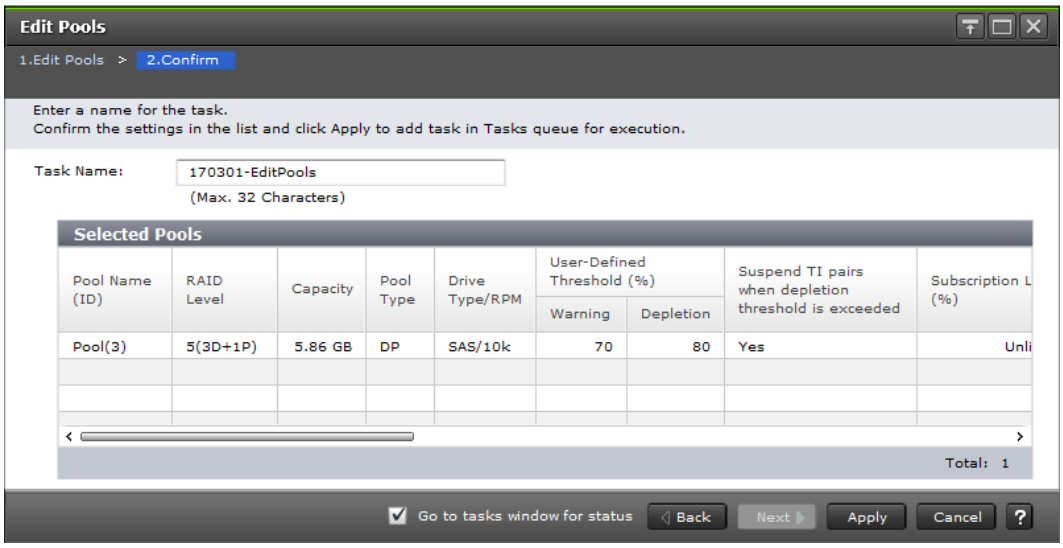
Item	Description
Buffer Space for New page assignment	Integer value from 0 to 50 as the percentage (%) for tier 1, tier 2, and tier 3. If there is no tier, this item cannot be set. If the pool setting is changed from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe) or active flash (or active flash for mainframe), this item must be set. Available if Multi-Tier Pool is enabled.
Buffer Space for Tier relocation	Integer value from 2 to 40 as the percentage (%) for tier 1, tier 2, and tier 3. If the pool setting is changed from Dynamic Provisioning (or Dynamic Provisioning for Mainframe) to Dynamic Tiering (or Dynamic Tiering for Mainframe) or active flash (or active flash for mainframe), this item must be set. Available if Multi-Tier Pool is enabled.
Data Direct Mapping	▪ Enable: Data direct mapping is enabled. ▪ Disable: Data direct mapping is disabled. Enable and Disable are unavailable in these cases: ▪ Multi-Tier Pool is enabled. ▪ A Thin Image pool is selected. ▪ A Dynamic Provisioning for Mainframe pool is selected. ▪ A Dynamic Tiering for Mainframe pool is selected. Enable is unavailable in these cases: ▪ If the selected pool contains a DP-VOL associated with an LDEV that does not have the data direct mapping attribute. ▪ If the selected Dynamic Provisioning pool contains Thin Image pairs and snapshot data. Disable is unavailable if the selected pool contains an LDEV with the data direct mapping attribute. Available if the pool type is Dynamic Provisioning and multi-tier pool is disabled.

Item	Description
Subscription Limit	Select the Subscription Limit check box, and then enter the subscription limit (%). In Thin Image, you cannot change the setting of this function. ▪ If this field is blank, the subscription is set to unlimited. If the V-VOLs in the selected pools contain volumes with capacity saving, you can specify only blank in this field. ▪ For open systems, use blank or a value in this range: (Total V-VOL capacity including the control information / pool capacity) × 100(%) +1 to 65534(%) ▪ For mainframe systems, use blank or a value in this range: (Total V-VOL capacity / pool capacity) × 100(%) +1 to 65534(%) ▪ For open systems, when the current subscription setting is unlimited and the value calculated by the following formula exceeds 65534, you cannot configure the subscription limit: ((Total V-VOL capacity including the control information / pool capacity) × 100) ▪ For mainframe systems, when the current subscription setting is unlimited and the value calculated by the following formula exceeds 65534, you cannot configure the subscription limit: ((Total V-VOL capacity / pool capacity) × 100) ▪ If the check box is not selected, this item is disabled.
Pool Name	Pool name up to 32 characters: ▪ Prefix: Fixed character string. ▪ Initial Number: Initial number up to 9 digits. When a pool is selected, the pool name is displayed in Prefix by default. When multiple pools are selected, the initial number from the set number to the maximum number of digits is automatically set. Examples: ▪ 1: Up to 9 numbers are added (1, 2, 3... 9). ▪ 08: Up to 92 numbers are added (08, 09, 10... 99). ▪ 098: Up to 902 numbers are added (098, 099, 100... 999).
Warning Threshold	Warning threshold between 1 and 100%. The default value is 70%. Minimum threshold is the sum of the mapped capacity rates, reserved capacity rates, and one percent (1%).

Item	Description
	For a Thin Image pool, the threshold should be between 20% and 95%. The default value is 80%. If data direct mapping is enabled, 100% is specified automatically. For Thin Image, this item cannot be changed. This item cannot be set if the result of this calculation exceeds 95: (*used-pool-capacity*/*pool-capacity*) × 100 (%)
Depletion Threshold	Depletion threshold between 1% and 100%. The minimum threshold is the sum of the mapped capacity rates, reserved capacity rates, and one percent (1%). If the Thin Image pool is changed, this item cannot be set.
Suspend TI pairs when depletion threshold is exceeded	For a Dynamic Provisioning pool that contains Thin Image pairs and snapshot data, whether SIM code 62Exxx is output when the pool used capacity exceeds the depletion threshold. If a Thin Image pair in the pool is split after SIM code 62Exxx is output, the operation fails and the pair is suspended by error. ▪ Yes: When the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is output, and Thin Image pairs in the pool cannot be split. If Multi-Tier Pool or Data Direct Mapping is enabled for the pool, Yes cannot be selected. ▪ No: When the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is not output, and Thin Image pairs in the pool can be split.
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Yes: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. At the same time, the access attribute of the DP-VOL is changed to the protect attribute. ▪ No: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. Unavailable if any of these conditions is met: ▪ Data Retention Utility is not installed. ▪ Mainframe pools are selected.
Protect V-VOLs when I/O fails to Full Pool	▪ Yes: When the pool-VOL usage reaches the full size, DP-VOL is protected from reading and writing requests. At the same time, the access attribute of the DP-VOL is changed to the protect attribute. ▪ No: When the pool-VOL usage reaches the full size, DP-VOL is not protected from reading and writing requests.

Item	Description
	Unavailable if any of these conditions is met: ▪ Data Retention Utility is not installed. ▪ Mainframe pools are selected.

Edit Pools confirmation window



Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level. If multiple RAID levels exist in a pool, this field indicates that RAID levels are mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Data direct mapping pool ▪ TI: Thin Image pool

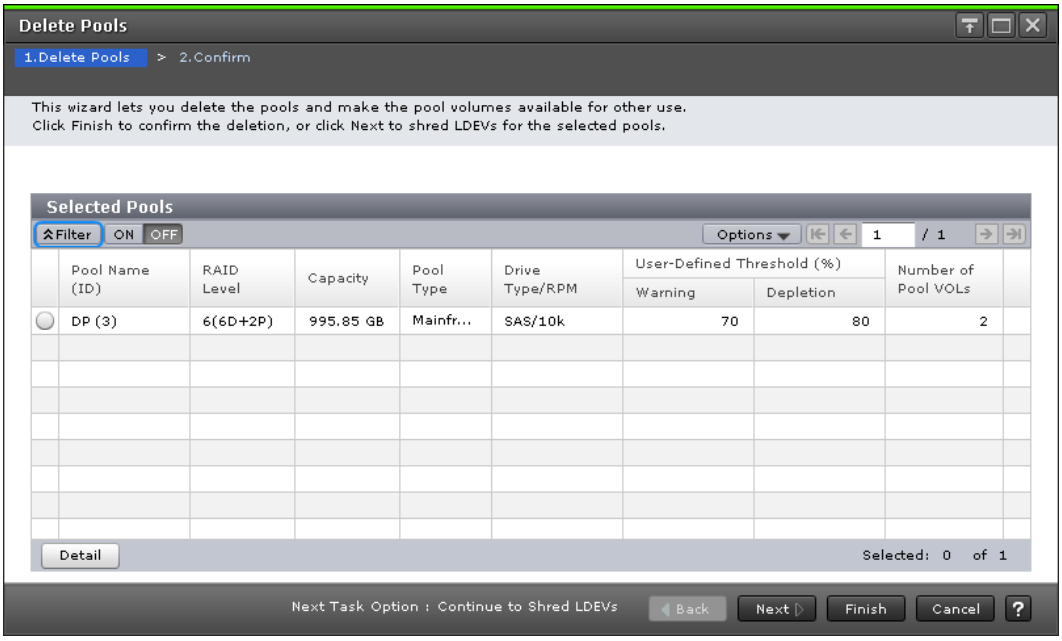
Item	Description
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
User-Defined Threshold (%)	▪ Warning: warning threshold. ▪ Depletion: depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Suspend TI pairs when depletion threshold is exceeded	▪ Yes: If the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is output. ▪ No: If the pool used capacity exceeds the depletion threshold, SIM code 62Exxx is not output.
Subscription Limit (%)	Subscription limit of the pool. For Thin Image pool, a hyphen (-) is displayed.
Protect V-VOLs when I/O fails to Blocked Pool VOL	▪ Enabled: When the pool-VOL is blocked, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool-VOL is blocked, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Protect V-VOLs when I/O fails to Full Pool	▪ Enabled: When the pool usage reaches the full size, DP-VOL is protected from reading and writing requests. And at the same instant, the access attribute of the DP-VOL is changed to the protect attribute. ▪ Disabled: When the pool usage reaches the full size, DP-VOL is not protected from reading and writing requests. ▪ - (hyphen): The pool corresponds with one of these situations: • Data Retention Utility is not installed. • Pool type is other than DP or DT.
Number of Pool VOLs	Number of pool-VOLs

Item	Description
Tier Management	▪ If Dynamic Tiering or Dynamic Tiering for Mainframe is enabled, Auto or Manual for 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	Cycle of performance monitoring and tier relocation. If Dynamic Tiering or Dynamic Tiering for Mainframe is disabled, a hyphen (-) is displayed.
Monitoring Mode	▪ Continuous Mode: Continuous mode is enabled. ▪ Period Mode: Period mode is enabled.
Relocation speed	Page relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). If Dynamic Tiering or Dynamic Tiering for Mainframe i is disabled, a hyphen (-) is displayed.
Buffer Space for New page assignment (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for new page assignment to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for new page assignment to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for new page assignment to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.

Item	Description
Buffer Space for Tier relocation (%)	▪ Tier 1: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, the buffer space for tier relocation to tier 1 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, a hyphen (-) is displayed. ▪ Tier 2: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 2 exists, the buffer space for tier relocation to tier 2 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 2 does not exist, a hyphen (-) is displayed. ▪ Tier 3: If Dynamic Tiering or Dynamic Tiering for Mainframe is available, and tier 3 exists, the buffer space for tier relocation to tier 3 is displayed. If Dynamic Tiering or Dynamic Tiering for Mainframe is unavailable, or tier 3 does not exist, a hyphen (-) is displayed.

Delete Pools wizard

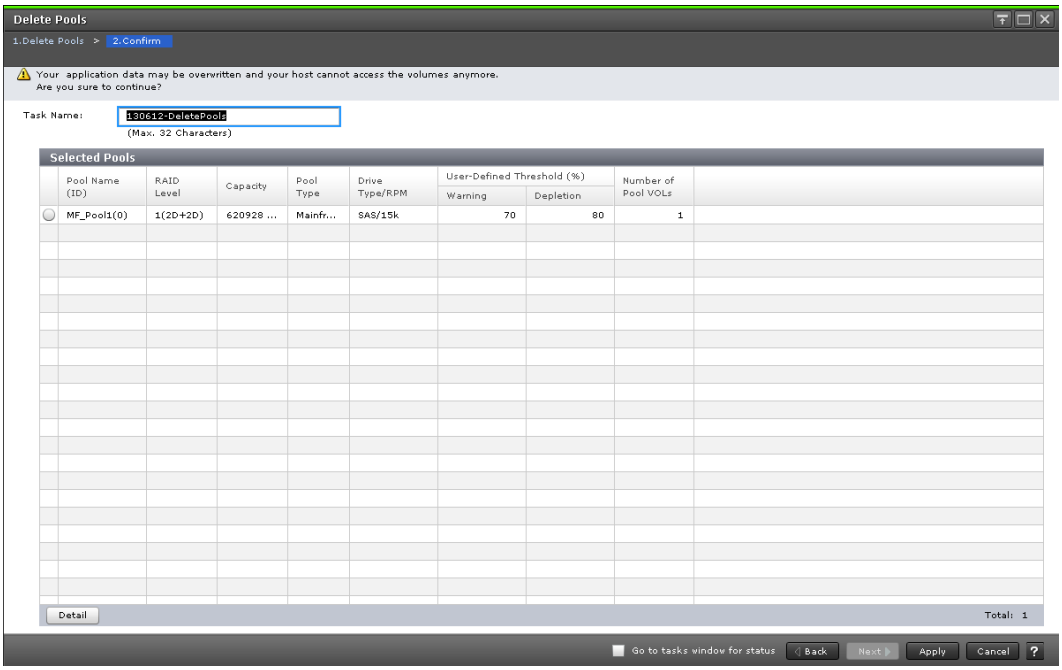
Delete Pools window



Item	Description
Pool Name (ID)	Pool name and pool ID

Item	Description
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Number of pool-VOLs

Delete Pools confirmation window



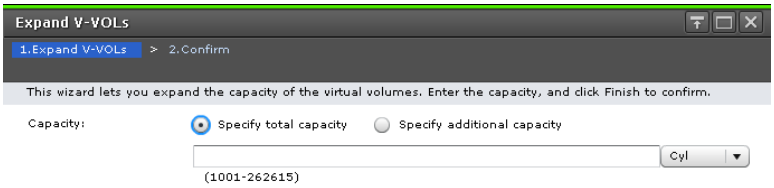
Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.

Item	Description
User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Number of pool-VOLs

Expand V-VOLs wizard

Expand V-VOLs window

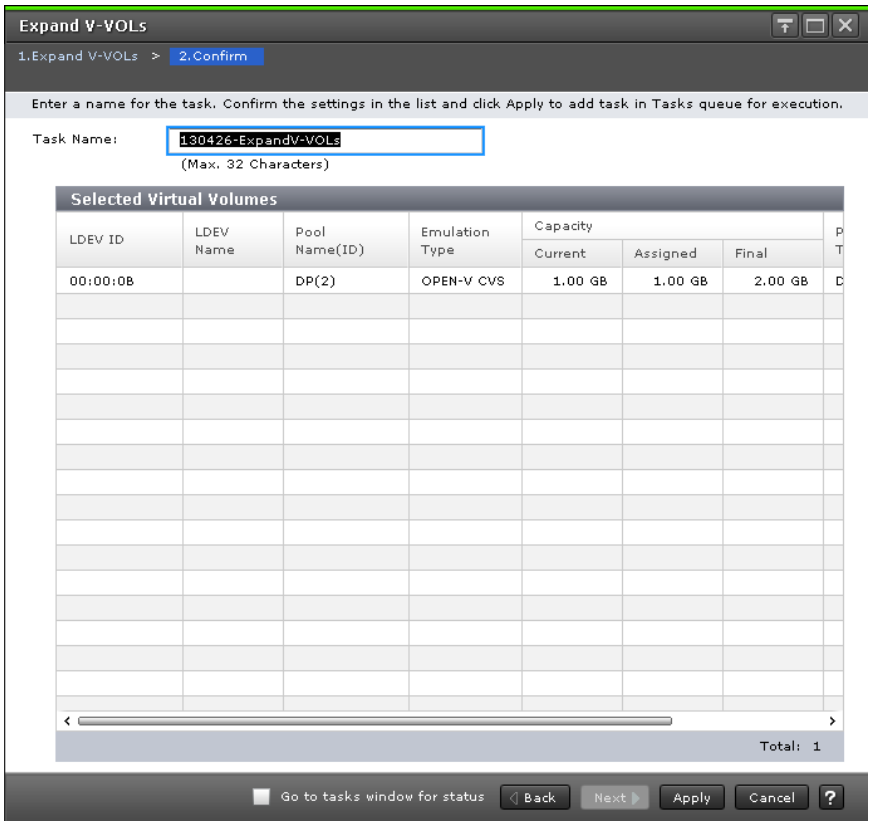
Use this window to expand the V-VOLs to the defined final capacity of the virtual volumes.



Item	Description
Specify total capacity	Total capacity of V-VOL
Specify additional capacity	Additional capacity of V-VOL
Capacity Compatibility Mode (Offset boundary)	Offset the specified LDEV capacity by boundary

Item	Description
Text Box	V-VOL (LDEV) capacity within the range of values displayed

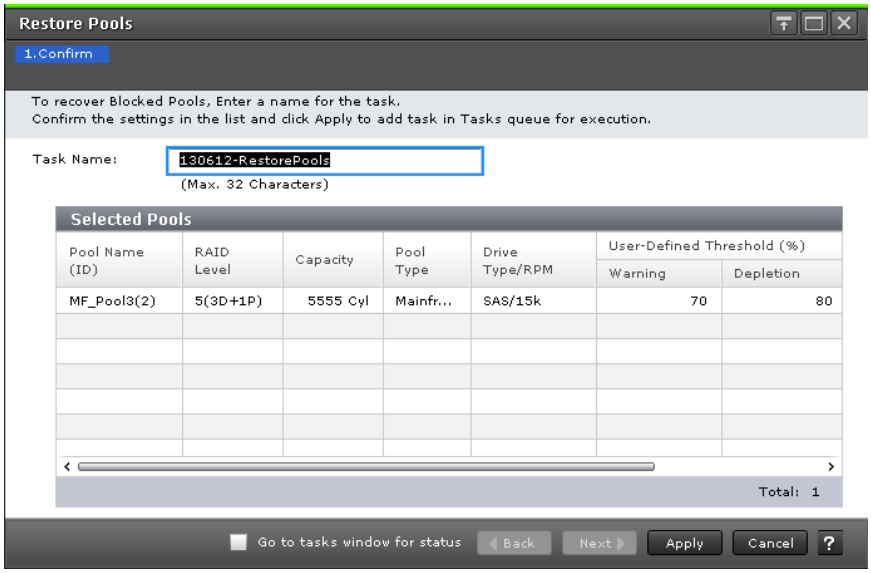
Expand V-VOLs confirmation window



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Pool Name (ID)	Pool name and pool ID
Emulation Type	Emulation type
Capacity	LDEV capacity: ▪ Current: Capacity before expanding the volume. ▪ Assigned: Capacity that is derived by the current value subtracted from the final value. The value might not be exact because the size is displayed with two decimal places. ▪ Final: Capacity after expanding the volume.

Item	Description
Provisioning Type	LDEV type. In this case, DP is displayed.
Attribute	LDEV attribute: ▪ Command Device: Command device of CCI ▪ TSE: TSE-VOL ▪ - (hyphen): Volume in which the attribute is not defined
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Enable: Full allocation of all DP-VOL pages is performed. ▪ Disable: Full allocation of all DP-VOL pages is not performed.

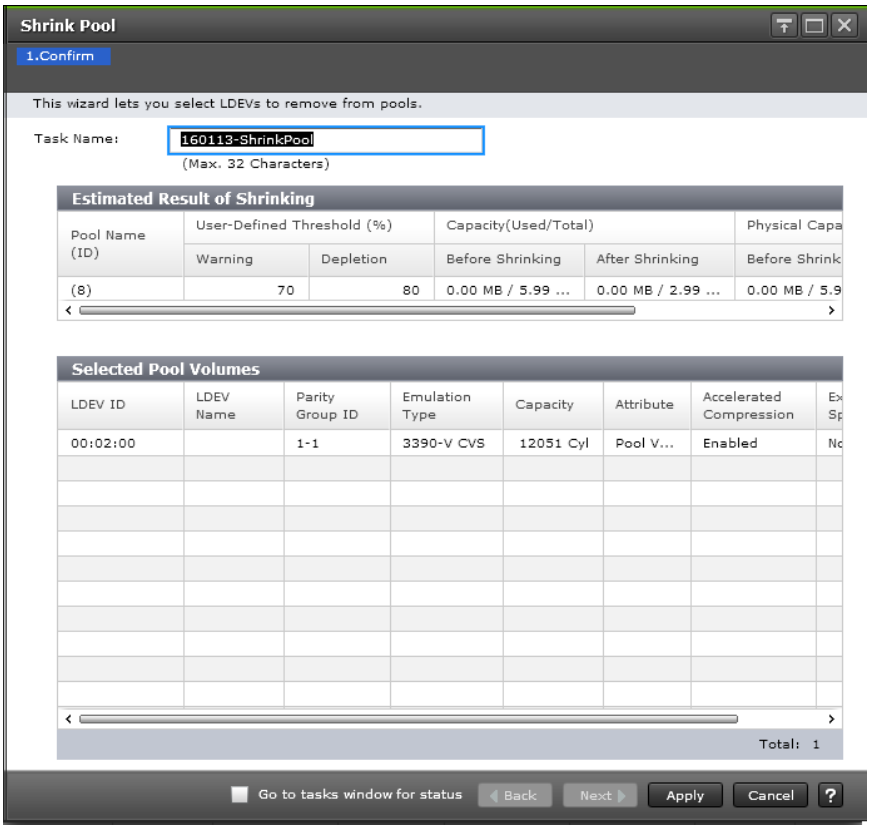
Restore Pools window



Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity. If the pool is blocked and pool-VOLs that belong to the pool cannot be identified, 0 is displayed.

Item	Description
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed in Depletion.
Number of Pool VOLs	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



Estimated Result of Shrinking table

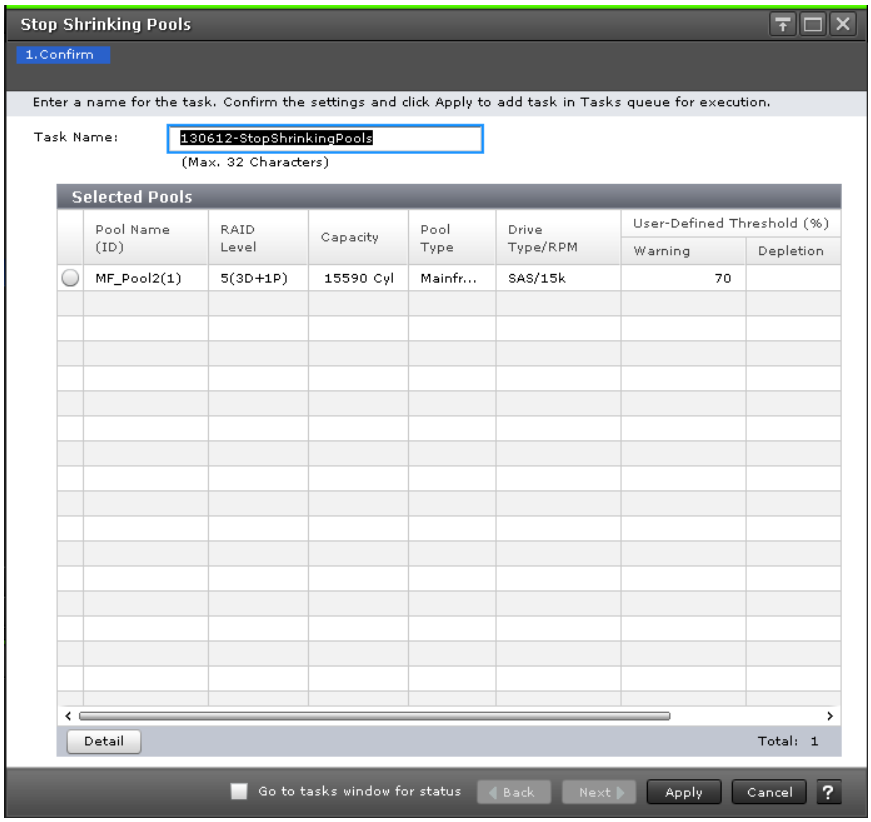
Item	Description
Pool Name (ID)	Pool name and pool ID
User-Defined Threshold (%)	Pool threshold: ▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Capacity(Used/Total)	Capacity before and after shrinking:

Item	Description
	For a pool comprised of pool volumes assigned by the accelerated compression-enabled parity groups, the writable capacity might be smaller than the displayed capacity. ▪ Before Shrinking: Sum of the mapped capacity and the reserved page capacity, the total capacity before shrinking the pool, and the pool usage rates ▪ After Shrinking: Sum of the mapped capacity and the reserved page capacity, the total capacity after shrinking the pool, and the pool usage rates

Selected Pool Volumes table

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Parity Group ID	Parity group ID
Emulation Type	Emulation type
Capacity	Pool-VOL capacity
Attribute	LDEV attribute: ▪ Pool VOL: LDEV with pool-VOL ▪ Data Direct Mapping: LDEV with data direct mapping ▪ - (hyphen): Volume in which the attribute is not defined
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Expanded Space Used	Whether the LDEV is allocated in the expanded area or the physical area. If accelerated compression is enabled, LDEVs are initially allocated in the physical area, and then LDEVs are allocated in the expanded area: ▪ Yes: LDEV is allocated in the expanded area. ▪ No: LDEV is allocated in the physical area.

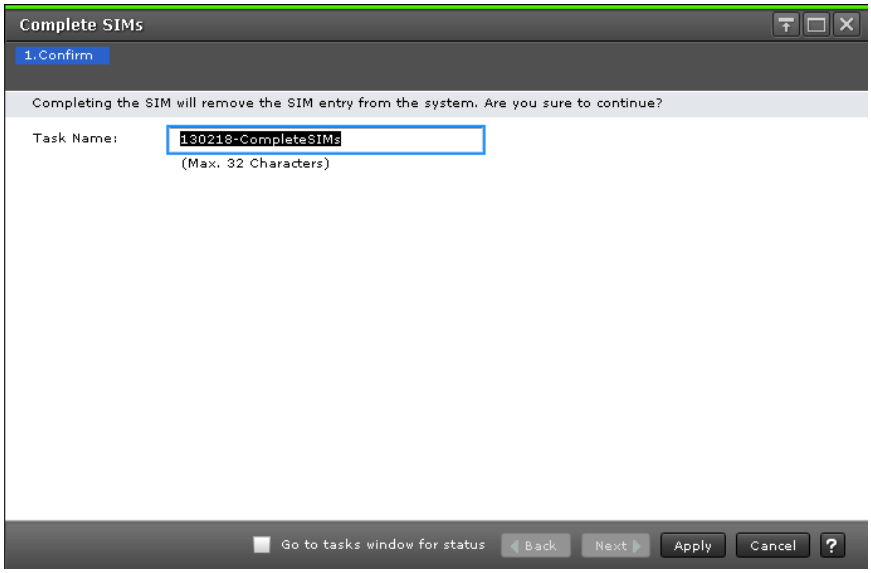
Stop Shrinking Pools window



Item	Description
Pool Name (ID)	Pool name and pool ID
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Capacity	Pool capacity
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool

Item	Description
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
User-Defined Threshold (%)	▪ Warning: Warning threshold. ▪ Depletion: Depletion threshold. For a Thin Image pool, a hyphen (-) is displayed for Depletion.
Number of Pool VOLs	Number of pool-VOLs

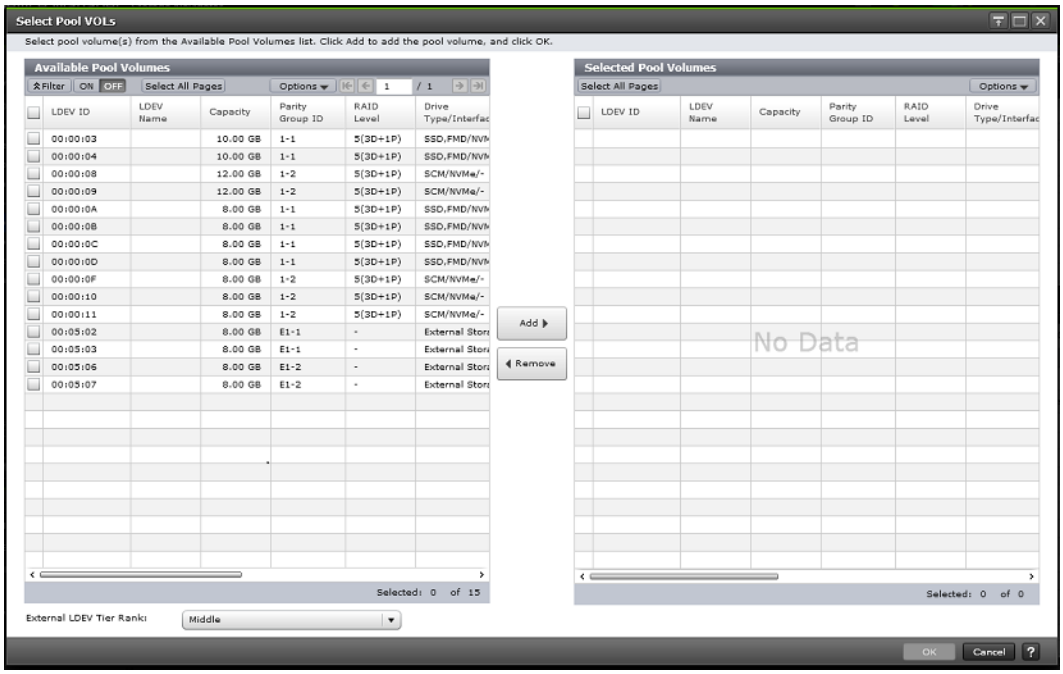
Complete SIMs window



Item	Description
Task Name	Task name. Case-sensitive and can be up to 32 ASCII letters, numbers, and symbols. Default is *date-window-name*.

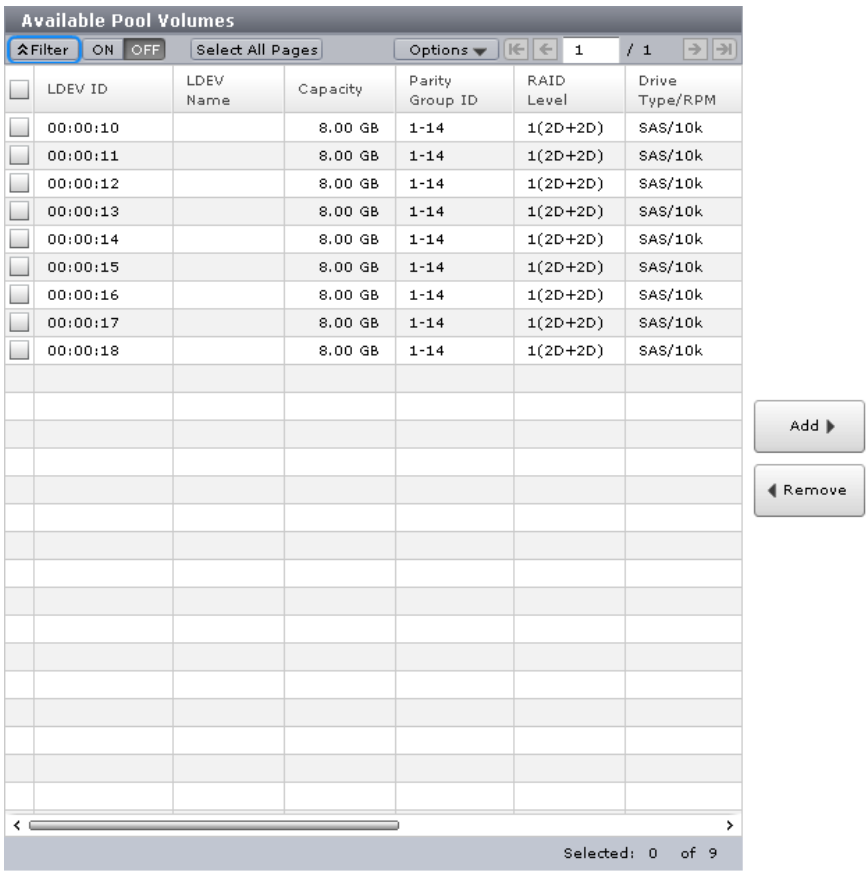
Select Pool VOLs window

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.



Available Pool Volumes table

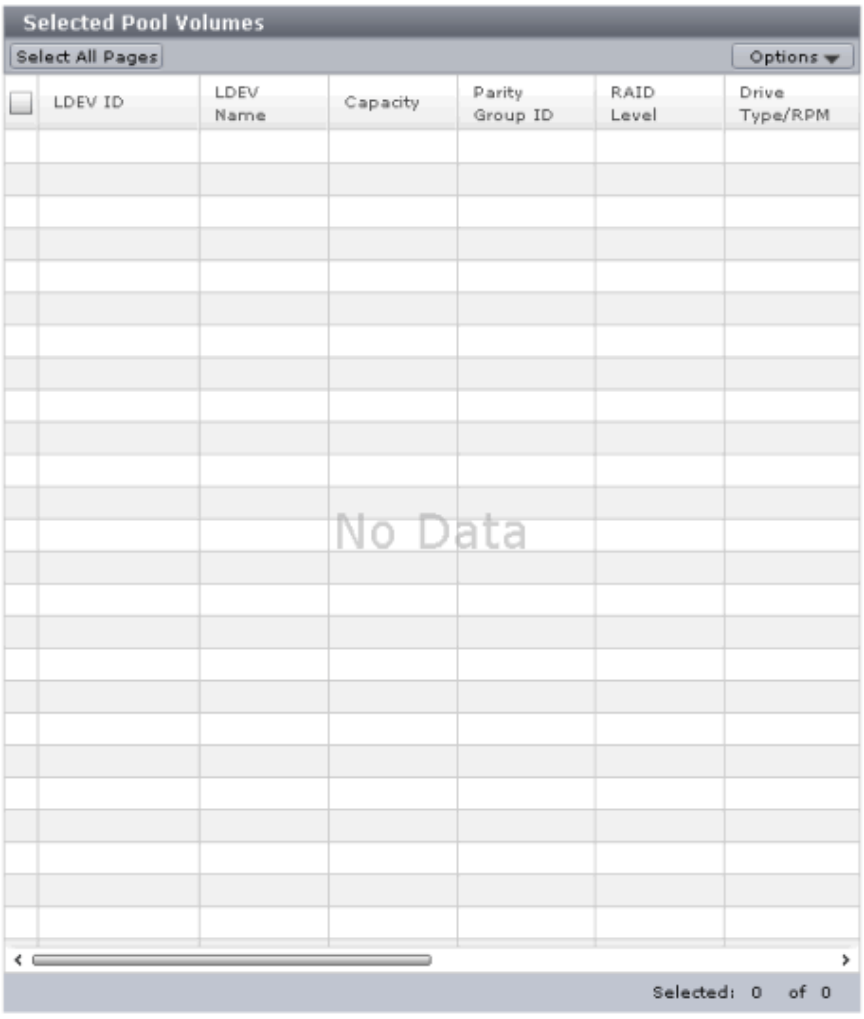
Only the LDEVs assigned to the user are displayed.



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Capacity	Pool-VOL capacity
Parity Group ID	Parity group ID
RAID Level	RAID level. If an LDEV is an external volume, a hyphen (-) is displayed.
Drive Type/RPM	Drive type and rpm. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Emulation Type	Emulation type
Provisioning Type	LDEV provisioning type: ▪ Basic: internal volume ▪ External: external volume
Attribute	LDEV attribute: ▪ Data Direct Mapping: LDEV with data direct mapping ▪ - (hyphen): Volume in which the attribute is not defined
Cache Mode	▪ Enabled or Disabled: external volume ▪ - (hyphen): not an external volume
Encryption	▪ Enabled: Encrypted pool. ▪ Disable: Non-encrypted pool. ▪ Mixed: Two or more of these items must be specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): Pool created by external volumes.

Item	Description
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Resource Group Name (ID)	Resource group names and IDs of the LDEV

Selected Pool Volumes table

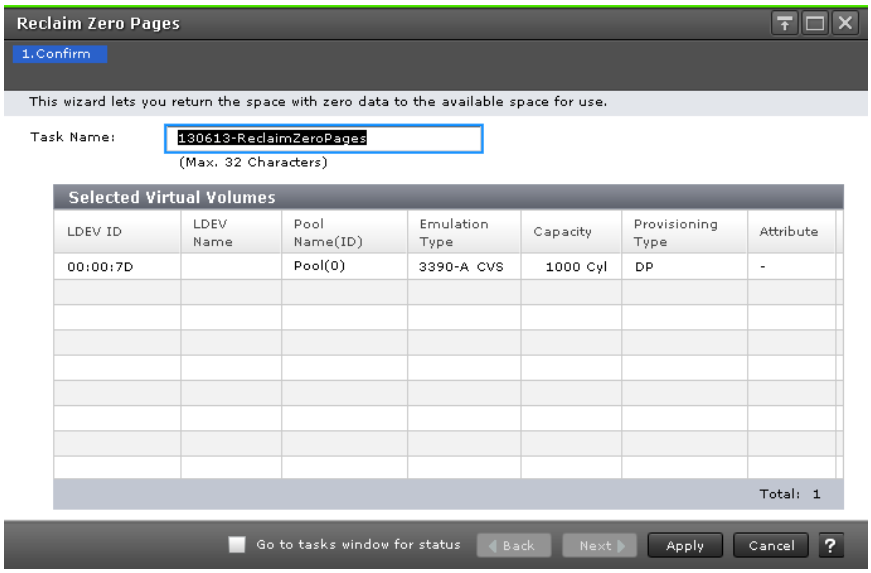


Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV

Item	Description
LDEV Name	LDEV name
Capacity	Pool-VOL capacity
Parity Group ID	Parity group ID
RAID Level	RAID level. If an LDEV is an external volume, a hyphen (-) is displayed.
Drive Type/RPM	Drive type and rpm. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
External LDEV Tier Rank	Tier rank of the external volume. If the volume is not an external volume, a hyphen (-) is displayed.
Emulation Type	Emulation type
Provisioning Type	LDEV provisioning type: ▪ Basic: internal volume ▪ External: external volume
Attribute	Volume attribute: ▪ Data Direct Mapping: LDEV with data direct mapping ▪ - (hyphen): Volume in which the attribute is not defined
Cache Mode	For an external volume: ▪ Enabled: Cache mode is enabled. ▪ Disabled: Cache mode is disabled. ▪ - (hyphen): LDEV is not an external volume.
Encryption	▪ Enable: LDEV belongs to an encrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are encrypted. ▪ Disable: LDEV belongs to an unencrypted parity group, or the V-VOL is associated with a pool whose pool-VOLs are not encrypted.

Item	Description
	▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume.
Accelerated Compression	▪ Enabled: Accelerated compression of the parity group is enabled. ▪ Disabled: Accelerated compression of the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Resource Group Name (ID)	Resource group names and IDs of the LDEV

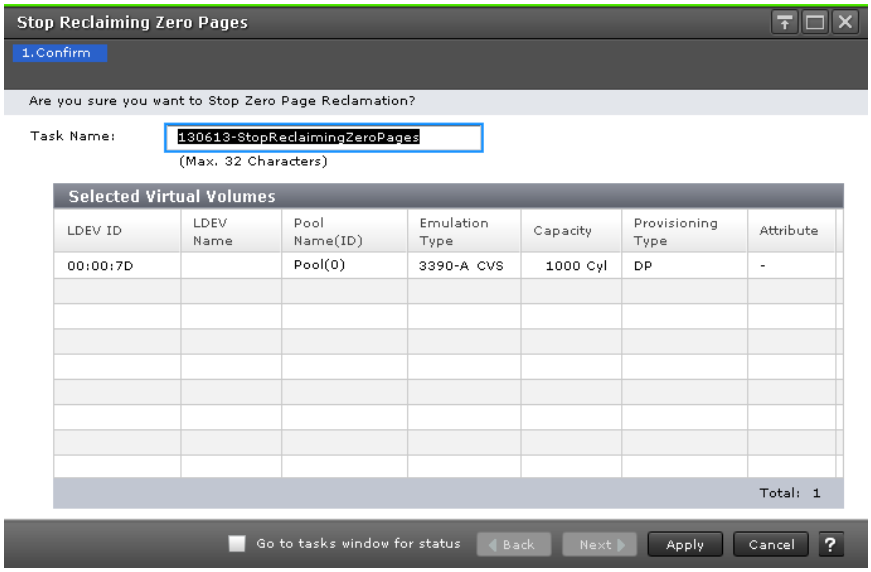
Reclaim Zero Pages window



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV

Item	Description
LDEV Name	LDEV name
Pool Name (ID)	Pool name and pool ID
Emulation Type	Emulation type
Capacity	Capacity
Provisioning Type	LDEV type. In this case, DP is displayed.
Attribute	▪ Command Device: Command device of CCI. ▪ - (hyphen): Volume in which the attribute is not defined

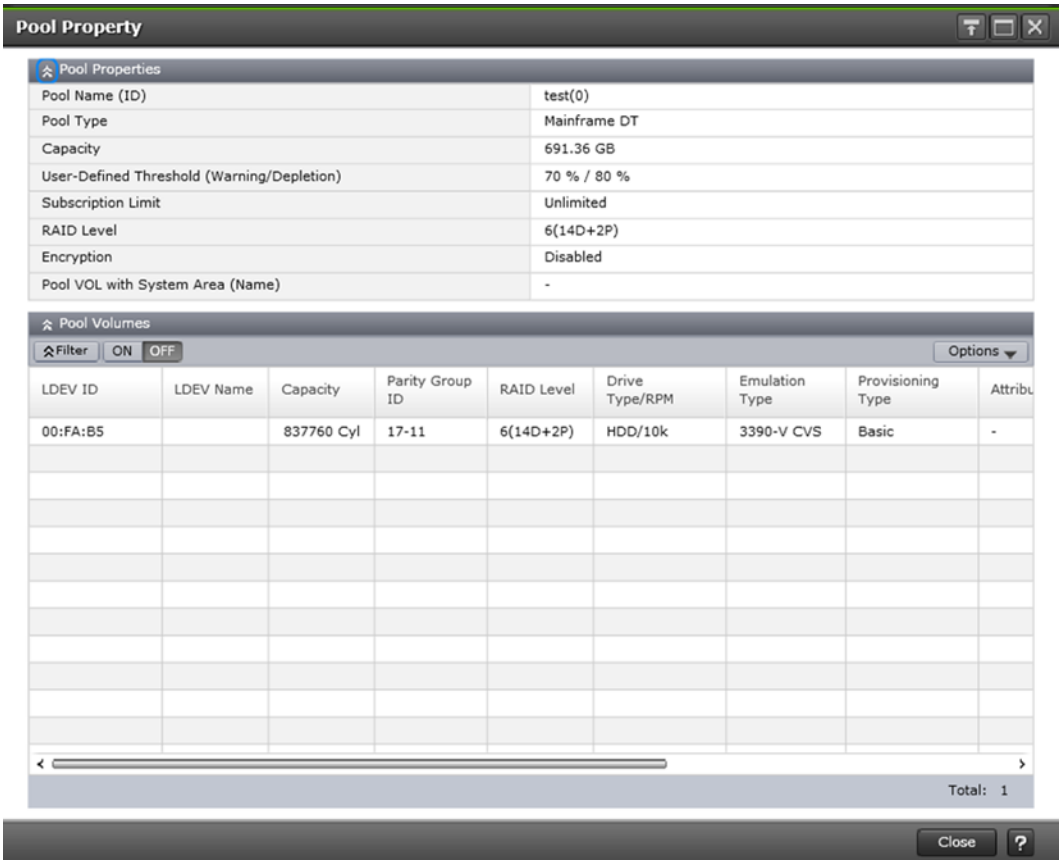
Stop Reclaiming Zero Pages window



Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Pool Name (ID)	Pool name and pool ID
Emulation Type	Emulation type
Capacity	Capacity
Provisioning Type	LDEV type. In this case, DP is displayed.

Item	Description
Attribute	▪ Command Device: Command device of CCI ▪ - (hyphen): Volume in which the attribute is not defined

Pool Property window



Pool Properties table

Item	Description
Pool Name (ID)	Pool name and pool ID
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool

Item	Description
	▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool
Capacity	Pool capacity. For a pool comprised of pool volumes assigned by the accelerated compression-enabled parity groups, the writable capacity might be smaller than the displayed capacity.
User-Defined Threshold (Warning/Depletion)	Threshold of a pool: ▪ Warning: warning threshold ▪ Depletion: depletion threshold
Subscription Limit (%)	Subscription limit. For a Thin Image pool, a hyphen (-) is displayed.
RAID Level	RAID level. If multiple RAID levels exist in a pool, RAID levels are displayed as mixed. If all pool-VOLs are external volumes, a hyphen (-) is displayed.
Encryption	▪ Enabled: Pool created by encrypted pool-VOLs. ▪ Disable: Pool created by non-encrypted pool-VOLs. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): Pool created by external volumes. Or pool is blocked.
Pool VOL with System Area (Name)	LDEV ID and LDEV name of the pool-VOL that includes the system area. If this window was opened from the Selected Pools table in the **Create Pools** window, a hyphen (-) is displayed.

Pool Volumes table

Only the LDEVs assigned to the user are displayed.

Item	Description
LDEV ID	LDEV identifier, which is the combination of LDKC, CU, and LDEV

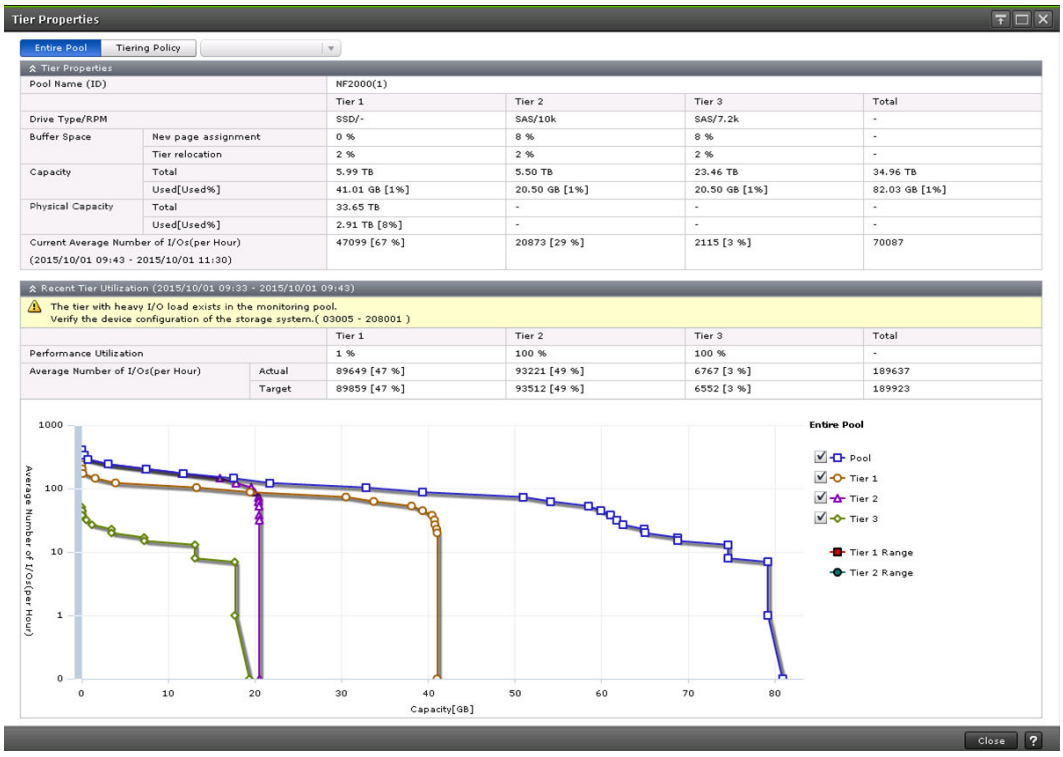
Item	Description
LDEV Name	LDEV name
Capacity	Pool volume capacity. If this window was opened from the Selected Pools table in the **Create Pools** window, the LDEV capacity selected in the **Select Pool VOLs** window is displayed.
Parity Group ID	Parity group ID
RAID Level	RAID level. If a pool-VOL is an external volume, a hyphen (-) is displayed.
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Tier ID	Tier ID. A hyphen (-) is displayed when you select a Dynamic Provisioning, Dynamic Provisioning for Mainframe or Thin Image pool.
Emulation Type	Emulation type
Provisioning Type	LDEV provisioning type: ▪ Basic: internal volume ▪ External: external volume
Attribute	Volume attribute: ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled ▪ - (hyphen): Volume in which the attribute is not defined
Cache Mode	▪ Enabled or Disabled: external volume ▪ - (hyphen): not an external volume
Encryption	▪ Enabled: Pool created by encrypted pool-VOLs. ▪ Disable: Pool created by non-encrypted pool-VOLs. ▪ Mixed: Two or more of these items are specified as pool-VOLs: • Volume encryption setting is enabled. • Volume encryption setting is disabled. • External volume. **Caution**: Data encryption is not ensured in a pool with mixed encryption. To manage the data encryption securely, use a pool with enabled or disabled encryption. ▪ - (hyphen): External volume.

Item	Description
Accelerated Compression	▪ Enabled: Accelerated compression for the parity group is enabled. ▪ Disabled: Accelerated compression for the parity group is disabled. ▪ - (hyphen): Parity group does not support accelerated compression.
Resource Group Name (ID)	Resource group names and IDs

Tier Properties window

This window displays tier properties and a performance graph.

If the pool name (pool ID) is displayed in the graph banner, pool information is displayed. If the LDEV name (LDEV ID) is displayed in the graph banner, V-VOL information is displayed.



For pools

These tables list the Tier Properties information.

When selecting Entire Pool or Tiering Policy

Item	Description
Entire Pool or Tiering Policy	▪ Entire Pool: performance graph of the entire pool ▪ Tiering Policy: performance graph of the tiering policy
All(0), and from Level1(1) to Level31(31)	Tiering policy. The performance graph that corresponds to the selected tiering policy is displayed. From Level 6 (6) to Level 31 (31), the names of tiering policies can be changed. If these names have changed, the new names are displayed.

Tier Properties table

Item	Description
Pool Name (ID)	Pool name and ID
Tier name	Tier names: Tier1, Tier2, Tier3, and Total
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Buffer Space	▪ New page assignment: buffer spaces for new page assignment ▪ Tier relocation: buffer spaces for tier relocation
Capacity	Capacity of the pool and each tier. ▪ Total: Total capacity of each tier and a pool. ▪ Used [Used%]: Percentage of the used capacity for the pool and each tier. The value is updated asynchronously with the Recent Tier Utilization table and when the Tier Properties window is opened. The used capacity of each tier can differ from the sum of the used capacities of all tiers. Tiering Policy: Used capacity size and percentage related to the tiering-policy of the pool and each tier. This item is displayed if a tiering policy is selected.
Total Capacity	Total capacity of each tier and total capacity of the pool
Used Capacity (Used %)	Percentage of the used capacity for the pool and each tier. The value is updated asynchronously with the Recent Tier Utilization table and when the **Tier Properties** window is opened. The used capacity of each tier can differ from the sum of the used capacities of all tiers.

Item	Description
Tiering Policy: tiering policy name	Used capacity size and percentage related to the tiering-policy of the pool and each tier. This item is available when a tiering policy is selected.
Current Average Number of I/O(per Hour)	Actual monitored average I/Os and percentages of each tier and entire pool for the period from the creation of the pool to the current state. In addition, in these cases, the number of I/Os is initialized, and then I/Os are counted again: ▪ When monitoring information collection is completed. ▪ When the number of tiers in a pool changes. ▪ When a tier location of the pool VOL changes by adding a pool VOL. ▪ When multi-tier pools are enabled after being invalid. ▪ When the fixed monitoring information is calculated again. For details about cases that the fixed monitoring information is calculated again, see Tier relocation rules, restrictions, and guidelines (on page 87). This item is displayed when Entire Pool is selected.

Recent Tier Utilization (monitoring period) table

Item	Description
Header area	If an error occurs, a message is displayed.
Tier name	Tier names: Tier1, Tier2, Tier3, and Total
Performance Utilization	Percentage progress in performance utilization processing
Average Number of I/Os (per Hour)	Average number of I/Os in a pool and each tier: ▪ Actual: Actual monitored average I/Os and percentages for each tier and a pool on an hourly basis. This item is displayed if Entire Pool is selected. ▪ Target: Target average I/Os and percentages for each tier and a pool after the tier determination calculation. This item is displayed if Entire Pool is selected. ▪ Tiering Policy: Tiering policy name: Average number of I/Os for the pool and each tier that are related to the tiering-policy. This item is displayed if a tiering policy is selected.

Item	Description
	These values are updated when performance monitoring information is collected, asynchronously with Used Capacity (Used %). If a question mark (?) is displayed, take the actions displayed in the header area of the Recent Tier Utilization table. If an error message and countermeasure are not shown in the header area of the Recent Tier Utilization table, refresh the window. If a question mark (?) continues to be displayed, call customer support.

Performance Graph

Item	Description
Pool	If Entire Pool is selected and the monitoring mode is Period mode, this item is displayed. In the performance graph, the vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Pool(Weighted average)	If Entire Pool is selected and the monitoring mode is Continuous mode, this item is displayed. In the performance graph, the vertical scale indicates the average number of I/Os on an hourly basis. The number of I/Os is a weighted, averaged with the monitoring data from the past cycle weighted against the monitoring data from the current cycle. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Policy	If Tiering Policy is selected and the monitoring mode is Period mode, this item is displayed. In the performance graph, the vertical scale of the performance graph indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Policy(Weighted average)	If Tiering Policy is selected and the monitoring mode is Continuous mode, this item is displayed. In the performance graph, the vertical scale of the performance graph indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Tier1	Performance graph of tier 1. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data in tier 1, this item is not displayed.

Item	Description
Tier2	Performance graph of tier 2. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data in tier 2, this item is not displayed.
Tier3	Performance graph of tier 3. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data in tier 3, this item is not displayed.
Tier1 range	Range in tier1. If there is no monitor data in tier 1, this item is not displayed.
Tier2 range	Range in tier2. If there is no monitor data in tier 2, this item is not displayed.
Performance graph	Performance graph of the entire pool or tiering policy. This information 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. 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 graph can display a maximum of 127 data points: ▪ If t the cursor is placed on the data point of the Tier1, Tier2, Tier3, Pool, or Pool(Weighted average), capacities, average I/Os, and total I/Os are displayed. ▪ If the cursor is placed on the data point of Tier1 Range or Tier2 Range, the lower value of the average I/Os is displayed.

Item	Description
	This information is displayed for each data point in a pop-up: ▪ Capacities: Capacity (GB) of the area from the data point of the maximum value on the vertical scale to a specified data point. The capacity of the data point on the vertical scale is 0.00 GB. ▪ Average Number of I/Os: All I/Os are sorted into 127 sections. The average I/O is the representative I/O number assigned to each section, based on the definition of the storage system. If the total number of I/Os is less than 127, the number of data points might be 127 or less. ▪ Total Number of I/Os: Total number of I/Os in the section from the data point of the maximum value on the vertical scale to a specified data point. The total I/Os is calculated using the average I/Os and capacities in the specified section. If the specified data point is on the vertical scale, the total I/Os is zero. If 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 data point is placed far from the lower limit of the tier range, the lower limit levels of the Tier1 Range and Tier2 Range are adjusted to improve the visibility of the performance graph. In this case, the value that is obtained by Command Control Interface might not correspond with the value of the data point displayed in a performance graph.

For V-VOLs

This table provides the View Properties table information when LDEV information is present.

Properties table when selecting a DP-VOL

Item	Description
LDEV ID	LDEV ID, which is the combination of the LDKC, CU, and LDEV
LDEV name	LDEV name
Tiering Policy	Tiering policy name and ID
New Page Assignment	New page assigned
Tier Relocation	Tier relocation (Enabled or Disabled)
Relocation Priority	Relocation priority
Tier name	Tier names: Tier1, Tier2, Tier3, and Total

Item	Description
Drive Type/RPM	Drive type and rpm of the pool. If multiple drive types or rpms exist in a pool, the drive types or rpms are displayed as mixed. When the volume is the external volume, External Storage and the value of the external LDEV tier rank are displayed in Drive Type.
Pool Capacity	Total capacity of each tier and total capacity of the pool
Used Capacity (Used %)	Percentage of the used capacity for the pool and each tier. The value is updated asynchronously with the Recent Tier Utilization table and when the **Tier Properties** window is opened. The used capacity of each tier might differ from the sum of the used capacities of all tiers.
Current Average Number of I/O(per Hour)	Actual monitored average I/Os and percentages of each tier and entire pool for the period from the creation of the DP-VOL to the current state. In addition, in these cases, the number of I/Os is initialized, and then I/Os are counted again: ▪ When monitoring information collection is completed. ▪ When the number of tiers in a pool changes. ▪ When a tier location of the pool VOL changes by adding a pool VOL. ▪ When multi-tier pools are enabled after being invalid. ▪ When the fixed monitoring information is calculated again. For details about cases that the fixed monitoring information is calculated again, see Tier relocation rules, restrictions, and guidelines (on page 87).

Recent Tier Utilization (monitoring period) table

Item	Description
Header area	If an error occurs, a message is displayed.
Tier name	Tier names: Tier1, Tier2, Tier3, and Total

Item	Description
Average Number of I/O (per Hour)	▪ Actual monitored average I/Os and percentages of each tier and a DP-VOL on an hourly basis. This value is updated when performance monitoring information is collected, asynchronously with Used Capacity (Used %). If a question mark (?) is displayed, take the actions displayed in the header area of the Recent Tier Utilization table. If an error message and countermeasure are not displayed in the header area of the Recent Tier Utilization table, refresh the window. If a question mark (?) continues to be displayed, call customer support. ▪ Target: Target average I/Os and percentages of each tier and a DP-VOL after the tier determination calculation..

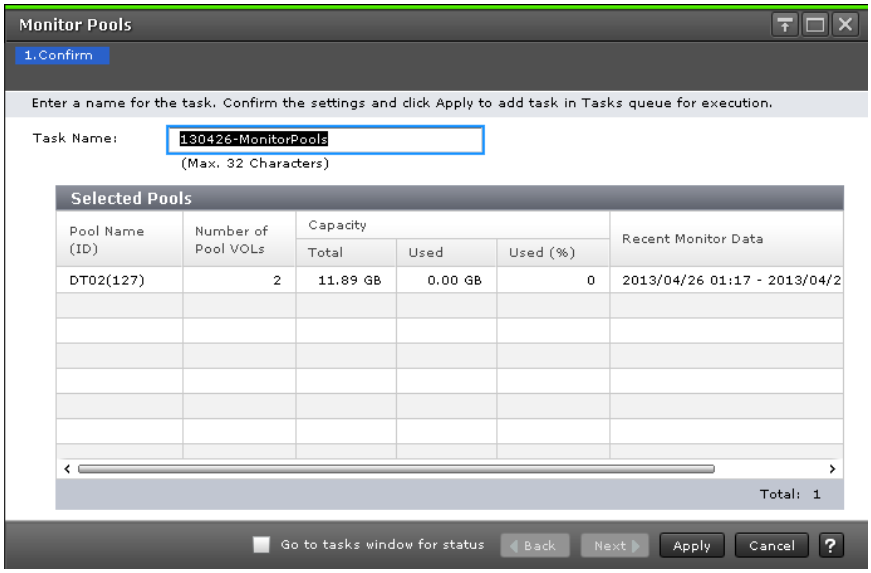
Performance Graph

Item	Description
Volume	If the monitoring mode is Period mode, this item is displayed. In the performance graph, the vertical scale of the performance graph indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Volume(Weighted average)	If the monitoring mode is Continuous mode, this item is displayed. In the performance graph, the vertical scale indicates the average number of I/Os on an hourly basis. The number of I/Os is a weighted, averaged with the monitoring data from the past cycle weighted against the monitoring data from the current cycle. The horizontal scale indicates the capacity. If there is no monitor data, this item is not displayed.
Tier1	Performance graph of tier 1. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data in tier 1, this item is not displayed.
Tier2	Performance graph of tier 2. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity. If there is no monitor data in tier 2, this item is not displayed.
Tier3	Performance graph of tier 3. The vertical scale indicates the average number of I/Os on an hourly basis. The horizontal scale indicates the capacity.

Item	Description
	If there is no monitor data in tier 3, this item is not displayed.
Tier1 range	Range in tier 1. If there is no monitor data in tier 1, this item is not displayed.
Tier2 range	Range in tier 2. If there is no monitor data in tier 2, this item is not displayed
Performance graph	Performance graph of the entire pool or tiering policy. This information 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. 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 graph can display a maximum of 127 data points: ▪ If t the cursor is placed on the data point of the Tier1, Tier2, Tier3, Pool, or Pool(Weighted average), capacities, average I/Os, and total I/Os are displayed. ▪ If the cursor is placed on the data point of Tier1 Range or Tier2 Range, the lower value of the average I/Os is displayed. This information is displayed for each data point in a pop-up: ▪ Capacities: Capacity (GB) of the area from the data point of the maximum value on the vertical scale to a specified data point. The capacity of the data point on the vertical scale is 0.00 GB. ▪ Average Number of I/Os: All I/Os are sorted into 127 sections. The average I/O is the representative I/O number assigned to each section, based on the definition of the storage system. If the total number of I/Os is less than 127, the number of data points might be 127 or less. ▪ Total Number of I/Os: Total number of I/Os in the section from the data point of the maximum value on the vertical scale to a specified data point. The total I/Os is calculated using the average I/Os and capacities in the specified section. If the specified data point is on the vertical scale, the total I/Os is zero.

Item	Description
	If no I/Os are displayed in the lower tier with multiple tiers, the tier range line is placed at 0 on the vertical scale. For example, if the data point 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 might not correspond with the value of the data point displayed in a performance graph.

Monitor Pools window

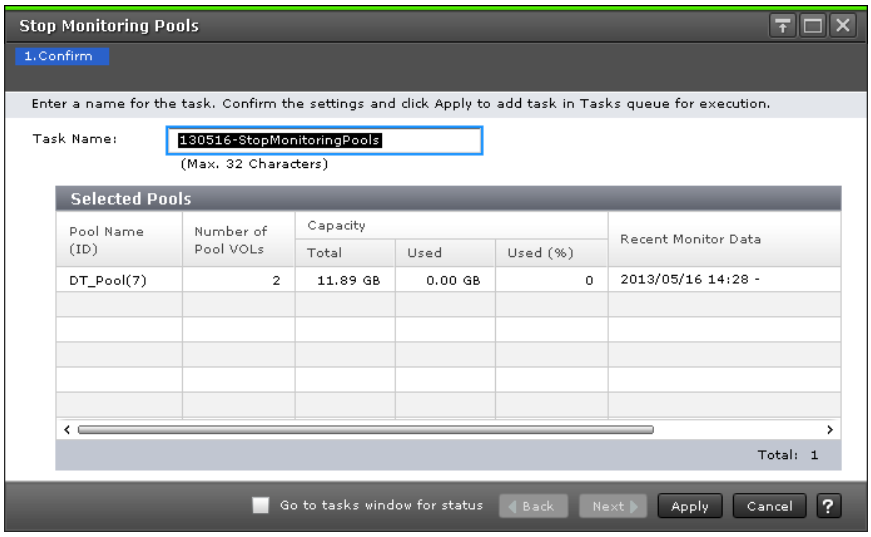


Selected Pools table

Item	Description
Pool Name (ID)	Pool name and pool ID
Number of Pool VOLs	Number of pool-VOLs in the selected pool

Item	Description
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. Option is used to select the 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 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. ▪ Used: For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used displays the page capacity of the pool in which user data and control information is stored. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the used pool capacity is displayed. ▪ Used (%): For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used (%) displays the ratio of the page capacity of the pool that contains user data and control information. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the ratio of the used pool capacity to the total pool capacity is displayed. Used (%) is the value that is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, or Thin Image, a hyphen (-) is displayed if the unit of capacity is changed to `Cylinder`.
Recent Monitor Data	Monitoring period: *start-time-end-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

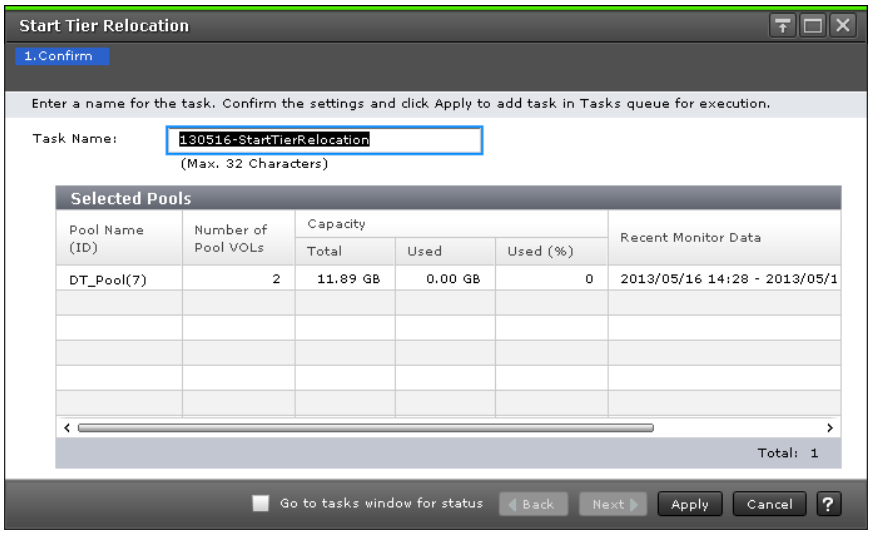


Selected Pools table

Item	Description
Pool Name (ID)	Pool name and pool ID
Number of Pool VOLs	Number of pool-VOLs in the selected pool

Item	Description
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. Option is used to select the 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 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. ▪ Used: For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used displays the page capacity of the pool in which user data and control information is stored. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the used pool capacity is displayed. ▪ Used (%): For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used (%) displays the ratio of the page capacity of the pool that contains user data and control information. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the ratio of the used pool capacity to the total pool capacity is displayed. Used (%) is the value that is truncated after the decimal point of the actual value. For the pool of Dynamic Provisioning, Dynamic Tiering, or Thin Image, a hyphen (-) is displayed if the unit of capacity is changed into `Cylinder`.
Recent Monitor Data	Monitoring period: *start-time-end-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

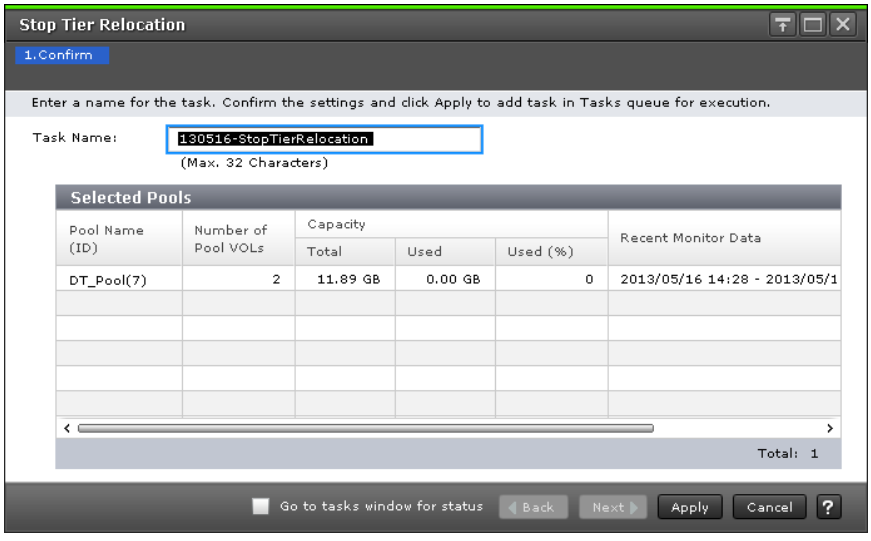


Selected Pools table

Item	Description
Pool Name (ID)	Pool name and pool ID
Number of Pool VOLs	Number of pool-VOLs in the selected pool
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. Option is used to select the 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 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. ▪ Used: For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used displays the page capacity of the pool in which user data and control information is stored. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the used pool capacity is displayed.

Item	Description
	▪ Used (%): For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used (%) displays the ratio of the page capacity of the pool that contains user data and control information. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the ratio of the used pool capacity to the total pool capacity is displayed. Used (%) is the value that is truncated after the decimal point of the actual value. ▪ - (hyphen): For the pool of Dynamic Provisioning, Dynamic Tiering, or Thin Image, if the unit of capacity is changed into Cylinder.
Recent Monitor Data	Monitoring period: *start-time-end-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 Speed	Relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest)

Stop Tier Relocation window

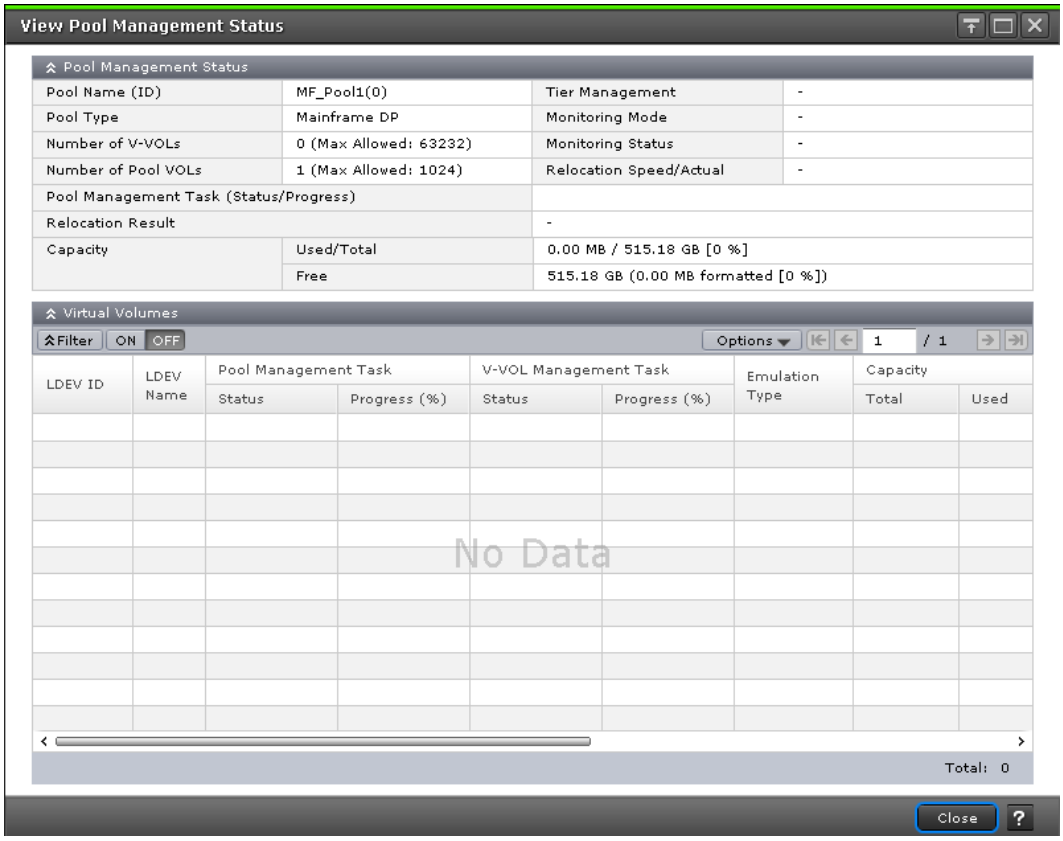


Selected Pools table

Item	Description
Pool Name (ID)	Pool name and pool ID
Number of Pool VOLs	Number of pool-VOLs in the selected pool
Capacity	Pool capacity: ▪ Total: Total capacity of the pool. Option is used to select the 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 38 megabytes in a pool capacity of Dynamic Provisioning for Mainframe or Dynamic Tiering for Mainframe. ▪ Used: For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used displays the page capacity of the pool in which user data and control information is stored. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the used pool capacity is displayed. ▪ Used (%): For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Used (%) displays the ratio of the page capacity of the pool that contains user data and control information. For a pool that contains pool volumes belonging to a parity group with accelerated compression enabled, the ratio of the used pool capacity to the total pool capacity is displayed. Used (%) is the value that is truncated after the decimal point of the actual value. ▪ For the pool of Dynamic Provisioning, Dynamic Tiering, or Thin Image, a hyphen (-) is displayed if the unit of capacity is changed into `Cylinder`.
Recent Monitor Data	Monitoring period: *start-time-end-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.

Item	Description
Relocation Progress(%)	Progress percentage of the tier relocation: ▪ 0 to 99: Relocation is performed at the indicated percentage progression. ▪ 100: Relocation operation is not in performed, or the relocation is complete. For details about the tier relocation, see the tier relocation log file.
Relocation Speed	Relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest)

View Pool Management Status window



Pool Management Status table

Item	Description
Pool Name (ID)	Pool name and pool ID

Item	Description
Pool Type	▪ DP: Dynamic Provisioning pool ▪ DT: Dynamic Tiering pool ▪ Mainframe DP: Dynamic Provisioning for Mainframe pool ▪ Mainframe DT: Dynamic Tiering for Mainframe pool ▪ DT (Active Flash): Active Flash pool ▪ Mainframe DT (Active Flash): Active flash for mainframe pool ▪ DP (data direct mapping): Pool with data direct mapping enabled ▪ TI: Thin Image pool
Number of V-VOLs	Number of V-VOLs associated with the pool, and the maximum number of V-VOLs that can be associated with the pool. If you select a Dynamic Provisioning, Dynamic Tiering, Dynamic Provisioning for Mainframe, or a Dynamic Tiering for Mainframe pool, this item is displayed. If the pool with the data direct mapping attribute is selected, the number of the V-VOLs is displayed, then a hyphen (-) is displayed for the maximum number of V-VOLs which can associate with the pool.
Number of Root VOLs	Number of root volumes of Thin Image pairs that are associated with the pool
Number of Pool VOLs	Number of pool-VOLs set for the pool, and the maximum number of pool-VOLs that can be set for the pool
Pool Management Task (Status/ Progress)	Status and progress ratio of the pool management task being performed to the pool, and average progress ratio of each V-VOL in the pool: ▪ Waiting for Rebalance: Rebalance process is being waited on. ▪ Rebalancing: Rebalance process is being performed. ▪ Waiting for Relocation: Tier relocation process is being waited on. ▪ Relocating: Tier relocation process is being performed. ▪ Waiting for Shrink: Pool shrinking process is being waited on. ▪ Shrinking: Pool shrinking process is being performed. ▪ Blank: Pool management task is not being performed.

Item	Description
	The values that are displayed in the Virtual Volume table might not correspond with the value displayed for this item. This is because the progress of the pool management task is calculated after the progress of each V-VOL displayed in the Virtual Volume table is calculated. ▪ Pool Management Task - Status ▪ Pool Management Task - Progress(%) For details about the tier relocation, see the tier relocation log file.
Relocation Result	Status of the tier relocation processing: ▪ In Progress: Status of Pool Management Task is Waiting for Relocation or Relocating. ▪ Completed: Tier relocation operation is not in progress, or the tier relocation is complete. ▪ Uncompleted (n% relocated): Tier relocation is suspended at the indicated percentage progression. ▪ - (hyphen): Pool is not a Dynamic Tiering or Dynamic Tiering for Mainframe pool.
Capacity	▪ Used/Total: Used and total pool capacity. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field. As for the pool comprised of pool volumes assigned by accelerated compression-enabled parity groups, the writable capacity might be smaller than the displayed capacity. ▪ Free + Reserved: Sum of the free capacity and reserved capacity, and displays the formatted pool capacity. If the pool consists of multiple pool-VOLs, the sum of its capacities is displayed in the Total field. ▪ If the emulation type is 3390-A, the mapped capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl).
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	Pool 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.
Monitoring Status	Pool monitoring status.

Item	Description
	If monitoring is being performed, In Progress is displayed. A hyphen (-) is displayed other than this case.
Relocation Speed/Actual	Tier relocation speed: 1(Slowest), 2(Slower), 3(Standard), 4(Faster), or 5(Fastest). Actual displays the measured value of the tier relocation capacity per second.

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	LDEV identifier, which is the combination of LDKC, CU, and LDEV
LDEV Name	LDEV name
Pool Management Task	▪ Status: Pool management task being performed on the pool: • Waiting for Rebalance: Rebalance process is being waited on. • Rebalancing: Rebalance process is being performed. • Waiting for Relocation: The tier relocation process is being waited on. • Relocating: Tier relocation process is being performed. • Waiting for Shrink: Pool shrinking process is being waited on. • Shrinking: Pool shrinking process is being performed. • Blank: Pool management task is not being performed on the pool. ▪ Progress(%): V-VOL progress percentage (%) of the pool management task being performed. ▪ - (hyphen): Pool management task is not performed.

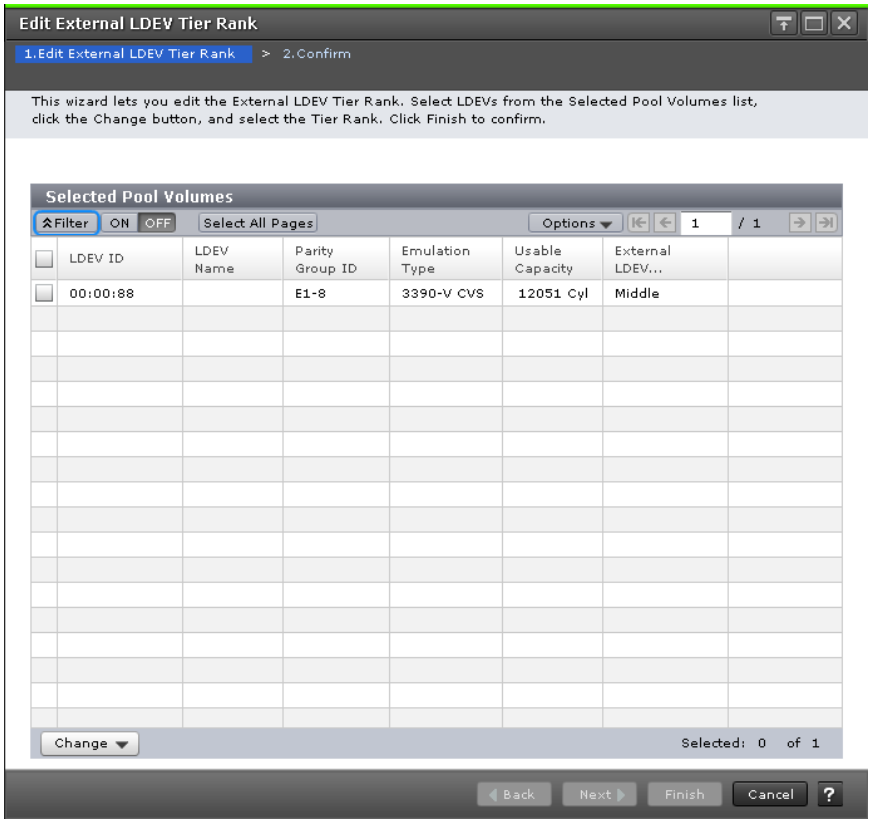
Item	Description
V-VOL Management Task	▪ Status: Status of the V-VOL management task being performed on V-VOL: • Reclaiming Zero Pages: Processing is being performed. • Waiting for Zero Page Reclaiming: Processing is being waited on. • Blank: V-VOL management task is not being performed on the V-VOL. ▪ Progress(%): Progress percentages (%) of the V-VOL management task being performed. ▪ - (hyphen): V-VOL management task is not performed
Emulation Type	Emulation type
Capacity	V-VOL used capacity: ▪ Total: V-VOL capacity. ▪ Reserved: Reserved page capacity of the V-VOL. The displayed value of Reserved might be larger than the displayed value of Total due to following reasons: • For a pool that contains pool volumes belonging to a parity group with accelerated compression disabled, Reserved displays the sum of the used V-VOL capacity and the reserved page capacity that is rounded up on each page. • If the emulation type is 3390-A, the mapped capacity of V-VOL includes the capacity of control cylinders (7 Cyl is required per 1,113 Cyl). • The mapped capacity of V-VOL for Dynamic Provisioning includes the capacity of control information (168 MB is required per 3,145,548 MB).

Item	Description
	▪ Used: Sum of the mapped capacity and the reserved page capacity. The displayed value of Used might be larger than the displayed value of Total due to these reasons: • If the emulation type is 3390-A, the mapped 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 enabled, the mapped capacity for DP-VOL contains the management area capacity. • The mapped capacity of DP-VOL includes the capacity of the control information (uses a maximum of 168 MB per 3,145,548 MB). • DP-VOL with data direct mapping enabled includes the control information (168 MB is used per 3,145,548 MB) and the capacity for one page. If used capacity is referenced during I/O or copy processing by software such as ShadowImage or Universal Replicator, the used capacity displayed might be different from the actual capacity even if the full allocation is enabled on the V-VOL. This is caused by a gap between the times that information is gathered about the mapped capacity and the reserved capacity. ▪ Used (%): For the entire capacity of V-VOL, this item displays percentages of the sum of the mapped capacity and the reserved capacity.
Full Allocation	Full allocation status in a pool associated with the V-VOL: ▪ Enable: Pages are reserved. ▪ Disable: Pages are not reserved.
Tiering Policy	Tiering policy name and ID: ▪ All(0): Policy in which all tiers of the pool are used. ▪ Level1(1) - Level5(5):Policy selected from levels 1 to 5 is set to the V-VOL. ▪ Level6(6) - Level31(31): Policy defined by the user and set to the V-VOL. From Level 6 (6) to Level 31 (31), the names of tiering policies can be changed. If these names have changed, the new names are displayed. ▪ - (hyphen): V-VOL is not the V-VOL of Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL.

Item	Description
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 or Dynamic Tiering for Mainframe V-VOL.
Tier Relocation	Whether tier relocation is enabled or disabled. If the Dynamic Tiering or Dynamic Tiering for Mainframe V-VOL is not used, a hyphen (-) is displayed.
Relocation Priority	▪ Prioritized: The priority is set to the V-VOL. ▪ Blank: The priority is not set to the 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	LDEV attribute: ▪ TSE: TSE-VOL for Compatible FlashCopy® SE. ▪ Data Direct Mapping: LDEV with the data direct mapping attribute enabled. ▪ Deduplication System Data Volume (Fingerprint): LDEV used to manage data deduplication. ▪ Deduplication System Data Volume (Data Store): LDEV used to manage data deduplication. ▪ - (hyphen): Volume in which the attribute is not defined.
Virtual Storage Machine	▪ Model / Serial Number: Model name and serial number of the virtual storage machine to which the LDEV belongs. ▪ LDEV ID: Virtual LDEV ID. If a Virtual LDEV ID is not assigned to the LDEV, this column is blank. ▪ Device Name: Virtual device name, which is a combination of the virtual emulation type, virtual LUSE volume number, and the virtual CVS attribute. Values of the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are displayed only for items that have been set. This column is blank when the virtual emulation type, virtual LUSE volume number, and virtual CVS attribute are not set. If the virtual CVS attribute is set, CVS is attached as the suffix to the device name. ▪ SSID: Virtual SSID. If a Virtual SSID is not set for the LDEV, this column is blank. ▪ Attribute: Virtual LDEV attribute. If the attribute is not set for the LDEV, this column is blank.

Edit External LDEV Tier Rank wizard

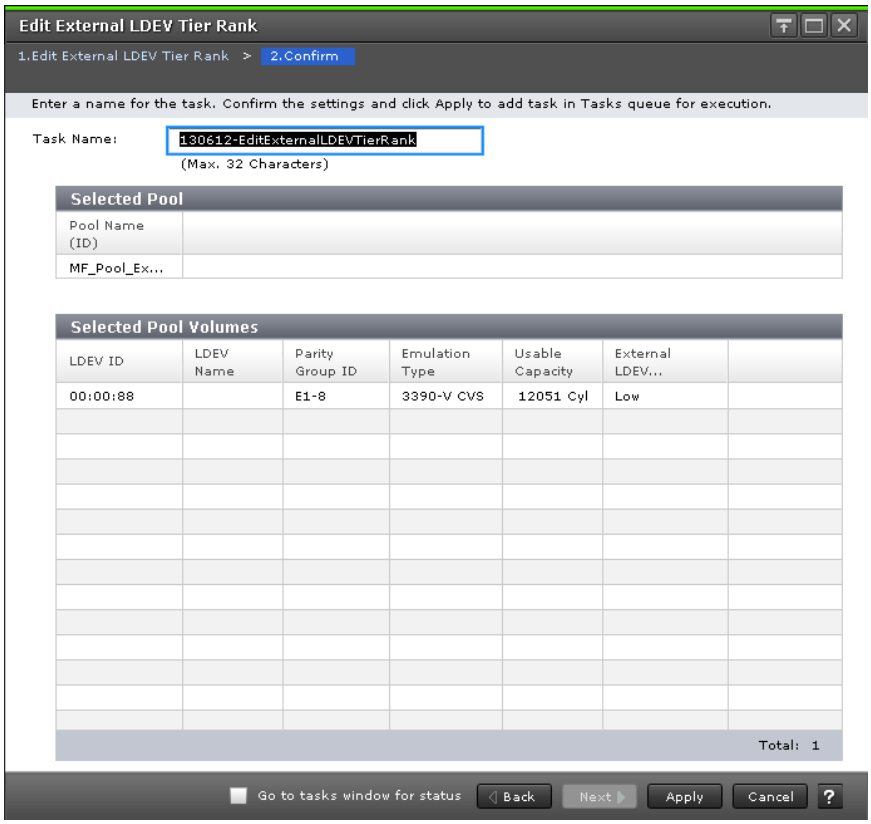
Edit External LDEV Tier Rank window



Selected Pool Volumes table

Item	Description
LDEV ID	LDEV ID, which is the combination of the LDKC, CU, and LDEV
LDEV Name	LDEV name
Parity Group ID	Parity group ID
Emulation Type	Emulation type
Usable Capacity	Usable capacity in the pool-VOL that is offset on the basis of the page. For a pool-VOL with system area, the displayed capacity does not include the capacity of the management area.
External LDEV Tier Rank	Tier rank of the external volume
Change	Tier rank of the selected pool-VOL: High, Middle, or Low

Edit External LDEV Tier Rank confirmation window



Selected Pool table

Item	Description
Pool Name (ID)	Pool name and pool ID

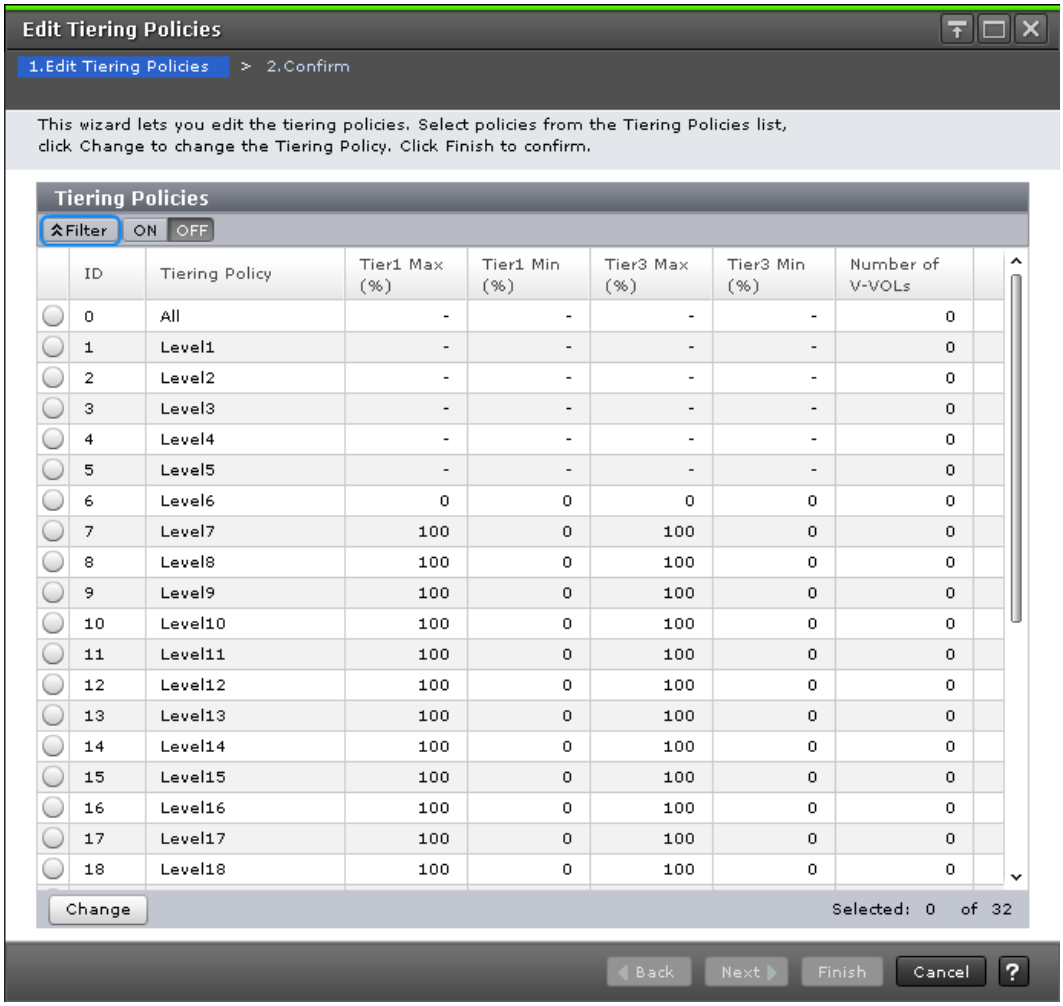
Selected Pool Volumes table

Item	Description
LDEV ID	LDEV ID, which is the combination of the LDKC, CU, and LDEV
LDEV Name	LDEV name
Parity Group ID	Parity group ID
Emulation Type	Emulation type
Usable Capacity	Usable capacity in the pool-VOL that is offset on the basis of the page. For a pool-VOL with system area, the displayed capacity does not include the capacity of the management area.

Item	Description
External LDEV Tier Rank	Tier rank of the external volume

Edit Tiering Policies wizard

Edit Tiering Policies window

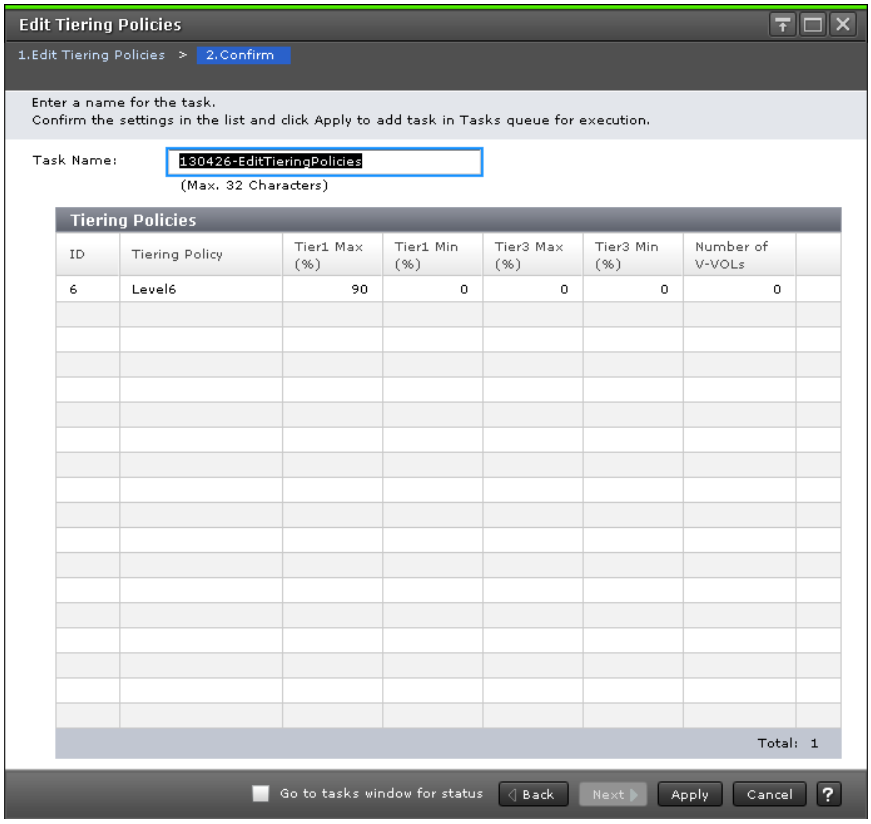


Tiering Policies table

Item	Description
ID	ID of the tiering policy
Tiering Policy	Name of the tiering policy

Item	Description
Tier1 Max(%)	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(%)	Minimum 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.
Tier3 Max(%)	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(%)	Minimum 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.
Number of V-VOLs	Number of V-VOLs to which the tiering policy is set

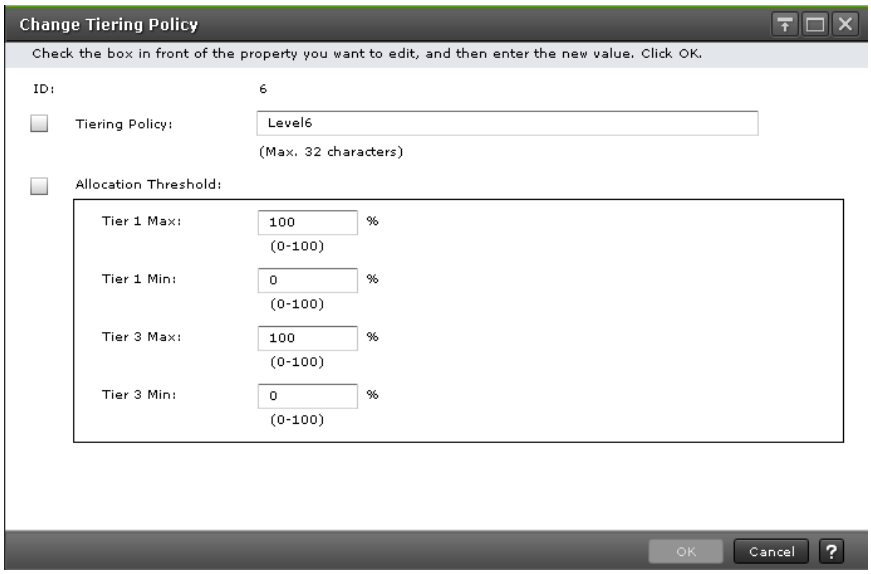
Edit Tiering Policies confirmation window



Tiering Policies table

Item	Description
ID	ID of the tiering policy
Tiering Policy	Name of the tiering policy
Tier1 Max(%)	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(%)	Minimum 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.
Tier3 Max(%)	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(%)	Minimum 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.
Number of V-VOLs	Number of V-VOLs to which the tiering policy is set

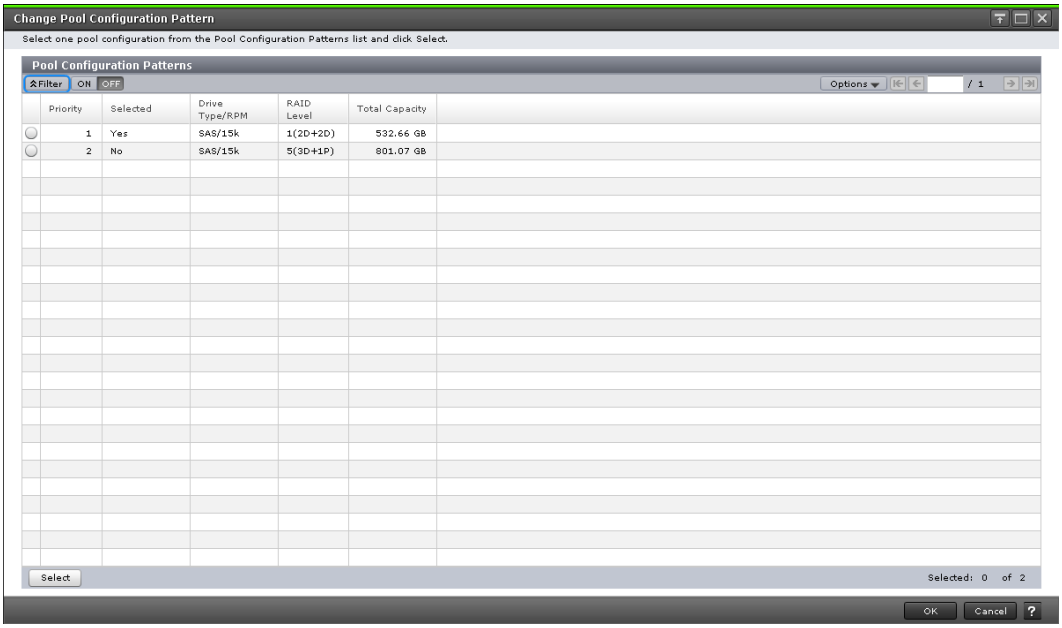
Change Tiering Policy window



Item	Description
ID	ID of the tiering policy
Tiering Policy	Tiering policy name. Up to 32 alphanumeric, case-sensitive characters are allowed. These symbols are not allowed: \ / : , ; * ? " < > |
Allocation Threshold	Allocation thresholds for tier 1 and tier 3
Tier1 Max(%)	Maximum percentage that is allocated to tier 1 in the total capacity for the tier relocation from 0 (%) to 100 (%). The value must either be equal to or larger than Tier1 Min.
Tier1 Min(%)	Minimum percentage that is allocated to tier 1 in the total capacity for the tier relocation from 0 (%) to 100 (%). The value must either be equal to or smaller than Tier1 Min. The total of Tier1 Min and Tier3 Min must be 100(%) or less.
Tier3 Max(%)	Maximum percentage that is allocated to tier 3 in the total capacity for the tier relocation from 0 (%) to 100 (%). The value must either be equal to or larger than Tier1 Min.
Tier3 Min(%)	Minimum percentage that is allocated to tier 3 in the total capacity for the tier relocation from 0 (%) to 100 (%). The value must either be equal to or smaller than Tier1 Min. The total of Tier1 Min and Tier3 Min must be 100(%) or less.

Change Pool Configuration Pattern window

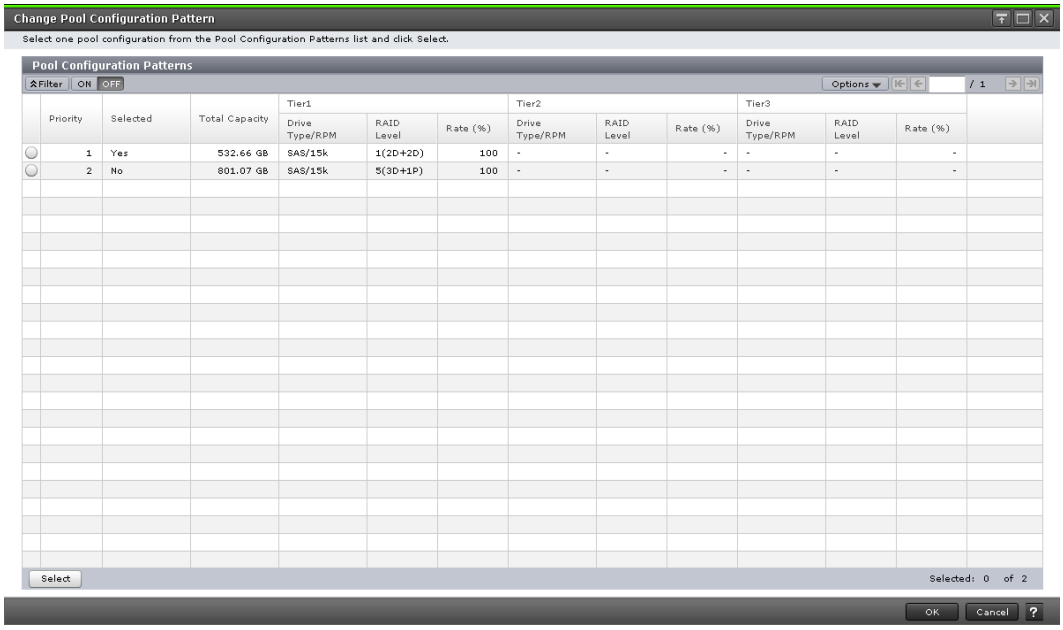
For or Dynamic Provisioning for Mainframe pools



Pool Configuration Patterns table

Item	Description
Priority	Priority of the pool configuration
Selected	Whether the pool configuration is selected or not
Total Capacity	Total capacity of the pool
Drive Type/RPM	Drive type and rpm of the pool
RAID Level	RAID level of the pool

For Dynamic Tiering or Dynamic Tiering for Mainframe pools



Pool Configuration Patterns table

When you create a Dynamic Tiering or Dynamic Tiering for Mainframe pool, this table is displayed.

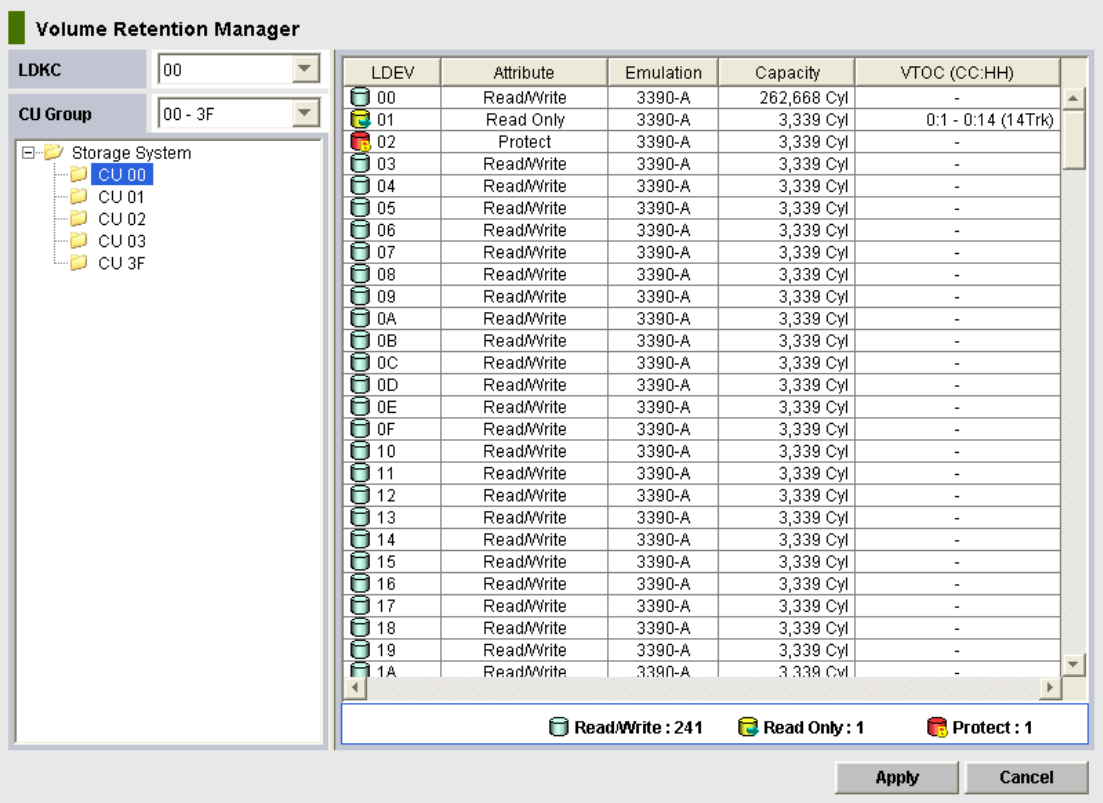
Item	Description
Priority	Priority of the pool configuration
Selected	Whether the pool configuration is selected or not
Total Capacity	Total capacity of the pool
Tier 1	Tier 1 information: ▪ Drive Type/RPM: Drive type and rpm of pool-VOLs ▪ RAID Level: RAID level of pool-VOLs ▪ Rate (%): Percentage of tier 1 against the total capacity of the pool
Tier 2	Tier 2 information: ▪ Drive Type/RPM: Drive type and rpm of pool-VOLs ▪ RAID Level: RAID level of pool-VOLs ▪ Rate (%): Percentage of tier 2 against the total capacity of the pool

Item	Description
Tier 3	Tier 3 information: ▪ Drive Type/RPM: Drive type and rpm of pool-VOLs ▪ RAID Level: RAID level of pool-VOLs ▪ Rate (%): Percentage of tier 3 against the total capacity of the pool

Appendix D: Volume Retention Manager GUI reference

The Volume Retention Manager windows in Hitachi Device Manager - Storage Navigator display the Volume Retention Manager information for the storage system and allow you to perform Volume Retention Manager operations.

Volume Retention Manager window



Use Volume Retention Manager to change attributes of volumes.

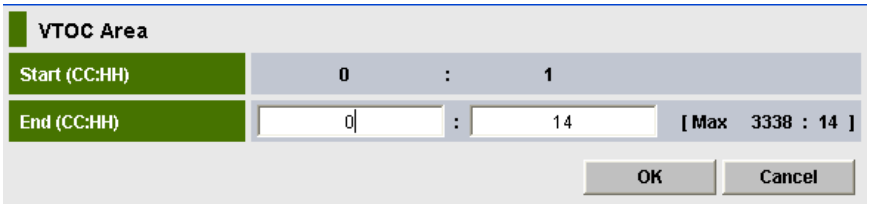
Item	Description
LDKC	LDKC to be displayed in the tree
CU Group	CU group to be displayed in the tree

Item	Description
Tree	List of CUs. If a CU is selected. its details are displayed to the right of the tree. Only the CUs that include volumes to which access attributes can be set are displayed.
Table	Volumes and their details, such as access attributes. For details, see the table below. At the bottom of the table, the number of volumes on each access attribute in the table is displayed: ▪ Read/Write: number of read/write volumes in the selected CU ▪ Read Only: number of read-only volumes in the selected CU ▪ Protect: number of protected volumes in the selected CU

The table of Volume Retention Manager displays these items.

Item	Description
LDEV	LDEV ID. If an LDEV ID is displayed with a number sign (#), the volume is an external volume. Volume types: ▪ Read/write volume ▪ Read-only volume ▪ Protected volume
Attribute	Access attribute of the volume
Emulation	Device emulation type of the volume
Capacity	Capacity (in cylinders) of the volume
VTOC (CC:HH)	Range of the VTOC area (*CC*:*HH* – *CC*:*HH*) and the number of tracks in the VTOC area. *CC* indicates a cylinder number. *HH* indicates a head number. For example, 0:1-0:14(14Trk) indicates these items: ▪ The range of the VTOC area is from cylinder 0 head 1 to cylinder 0 head 14. ▪ The number of tracks in the VTOC area is 14.

VTOC Area dialog box

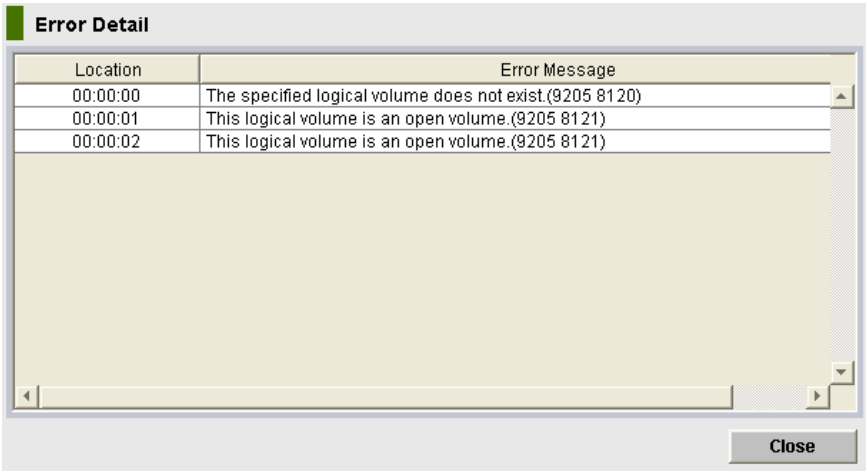


When a host accesses a volume, the volume table of contents (VTOC) in the volume is updated to include updated access logs. Use the **VTOC Area** dialog box to specify the size of VTOC area.

Item	Description
Start (CC:HH)	Starting location of the VTOC: ▪ *CC*: cylinder number ▪ *HH*: head number You cannot change the starting location.
End (CC:HH)	Ending location of the VTOC: ▪ *CC*: cylinder number ▪ *HH*: head number

Error Detail dialog box

If an error occurs with Volume Retention Manager, the **Error Detail** dialog box is displayed. The **Error Detail** dialog box displays error locations and error messages. For troubleshooting information related to the Volume Retention Manager, see Troubleshooting Volume Retention Manager (on page 222).



The items and descriptions of the **Error Detail** dialog box follow.

Item	Description
Location	Location where the error occurred. If an error occurred with a volume, the LDEV ID (LDKC number, CU number, and LDEV number) is displayed, for example 00:00:01.
Error Message	Error message

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