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Hitachi TrueCopy®
User Guide

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

Hitachi Data Systems

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Contents

Preface

This document describes and provides instructions for performing Hitachi TrueCopy® operations on the Hitachi Virtual Storage Platform G200, G400, G600, G800 (VSP G200, G400, G600, G800) and Hitachi Virtual Storage Platform F400, F600, F800 (VSP F400, F600, F800) storage systems.

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

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and authorized service providers who install, configure, and operate the VSP G200, G400, G600, G800 storage systems (VSP Gx00 models) and VSP F400, F600, F800 storage systems (VSP Fx00 models).

Readers of this document should be familiar with the following:

- Data processing and RAID systems and their basic functions.
- The VSP Gx00 models or VSP Fx00 models and the *Hardware Reference Guide* for your storage system model.
- The Hitachi Command Suite software and the *Hitachi Command Suite User Guide*, or the Hitachi Device Manager - Storage Navigator software and the *System Administrator Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.
- Remote replication and disaster recovery configurations for enterprise storage data centers.

Product version

This document revision applies to:

- VSP Gx00 models, VSP Fx00 models: firmware 83-03-2*x* or later
- SVOS 6.4.1 or later

Release notes

The release notes for this product are available on Hitachi Data Systems Support Connect: https://support.hds.com/en_us/contact-us.html. 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.

Changes in this revision

- Added interoperability information for VSP G400, G600, G800 with NAS modules (System requirements and specifications on page 2-2, Create TC Pairs window on page B-42).
- Added a requirement for the Blocked Path Monitoring remote replica option when iSCSI is used in a remote path (must be at least 40 seconds) (Path group row in System requirements and specifications on page 2-2, Changing remote replica options on page 5-4).
- Corrected the port topology information for extender connection (changed "FC-AL" to "Point-to-Point") (Extender connection on page 3-32).
- Updated the description of system option mode (SOM) 689 (System option modes on page 3-4).

- Updated the list of SSB2 error codes (added SSB2 error codes when SSB1 = B90B on page 10-17, SSB2 error codes when SSB1 = B980 on page 10-17).

Referenced documents

Hitachi Virtual Storage Platform Gx00 and Fx00 documentation:

- *Hitachi Thin Image User Guide*, MK-94HM8011
- *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*, MK-94HM8014
- *System Administrator Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*, MK-94HM8016
- *Hitachi Virtual Storage Platform G200 Hardware Reference Guide*, MK-94HM8020
- *Hitachi ShadowImage® User Guide*, MK-94HM8021
- *Hitachi Virtual Storage Platform G400, G600 Hardware Reference Guide*, MK-94HM8022
- *Hitachi Universal Replicator User Guide*, MK-94HM8023
- *Hitachi Virtual Storage Platform G800 Hardware Reference Guide*, MK-94HM8026
- *Hitachi Virtual Storage Platform F400, F600 Hardware Reference Guide*, MK-94HM8045
- *Hitachi Virtual Storage Platform F800 Hardware Reference Guide*, MK-94HM8046

Document conventions

This document uses the following terminology conventions:

Convention	Description
Hitachi Virtual Storage Platform G200, G400, G600, G800 (VSP G200, G400, G600, G800) VSP Gx00 models	Refers to all models of the Hitachi Virtual Storage Platform G200, G400, G600, G800 storage systems, unless otherwise noted.
Hitachi Virtual Storage Platform F400, F600, F800 (VSP F400, F600, F800) VSP Fx00 models VSP F series	Refers to all models of the Hitachi Virtual Storage Platform F400, F600, F800 storage systems, unless otherwise noted.

This document uses the following typographic conventions:

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

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.
	Important	Provides information that is essential to the completion of a task.

Icon	Label	Description
	Caution	Warns the user of adverse conditions or consequences (for example, disruptive operations).
	WARNING	Warns the user of severe conditions or consequences (for example, destructive operations).

Convention for storage capacity values

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

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

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

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

Accessing product documentation

Product documentation is available on Hitachi Data Systems Support Connect: https://support.hds.com/en_us/documents.html. Check this site

for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

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

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

Comments

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

Thank you!

1

TrueCopy overview

This chapter provides an overview of Hitachi TrueCopy® operations.

Hitachi TrueCopy®

Hitachi TrueCopy® (TC) provides a continuous, nondisruptive, host-independent remote data-replication solution for disaster recovery or data migration purposes. Using the TrueCopy Remote Replication software, you can create and maintain mirror images of production volumes at a remote location. TrueCopy Remote Replication software can be deployed with Hitachi Universal Replicator software's asynchronous replication capabilities to provide advanced data replication among multiple data centers. In addition, TrueCopy Remote Replication software can be integrated with Hitachi ShadowImage® Replication software to enable robust business-continuity solutions. This lets you create a remote copy of primary site or production data that is automatically updated for executing test and development tasks, or for operations against production data.

The TrueCopy primary storage system contains the primary volume (P-VOL) of a copy pair, and the secondary storage system contains the secondary volume (S-VOL). When the primary storage system accepts a write operation for a P-VOL, the data is written on the primary volume and then sent by the primary storage system to the secondary storage system through the dedicated data paths connecting the storage systems. Subsequent write operations are not accepted by the primary volume until acknowledgement is received from the secondary storage system for the previous write operation, ensuring that the data in the secondary volume stays synchronized with the primary volume.

To reduce the overhead associated with these remote copy activities and maximize data transfer, the primary storage system uses a special write command for TrueCopy remote copy operations. This command transfers the control parameters and the FBA-format data for consecutive updated records in a track using a single write operation. The special write command eliminates the overhead required for performing FBA-to-CKD and CKD-to-FBA conversions.

TrueCopy operations can be performed using the TrueCopy Remote Replication software and the Command Control Interface software (CCI) command-line interface software. This document describes and provides instructions for performing TrueCopy operations using the TrueCopy software on Device Manager - Storage Navigator. For details about using CCI to perform TrueCopy operations, see the user documentation for CCI.

System components

TrueCopy operations involve the storage systems and volumes at the primary site and secondary (remote) site, the physical communications paths between these storage systems, and the TrueCopy software. A TrueCopy system configuration consists of the following components:

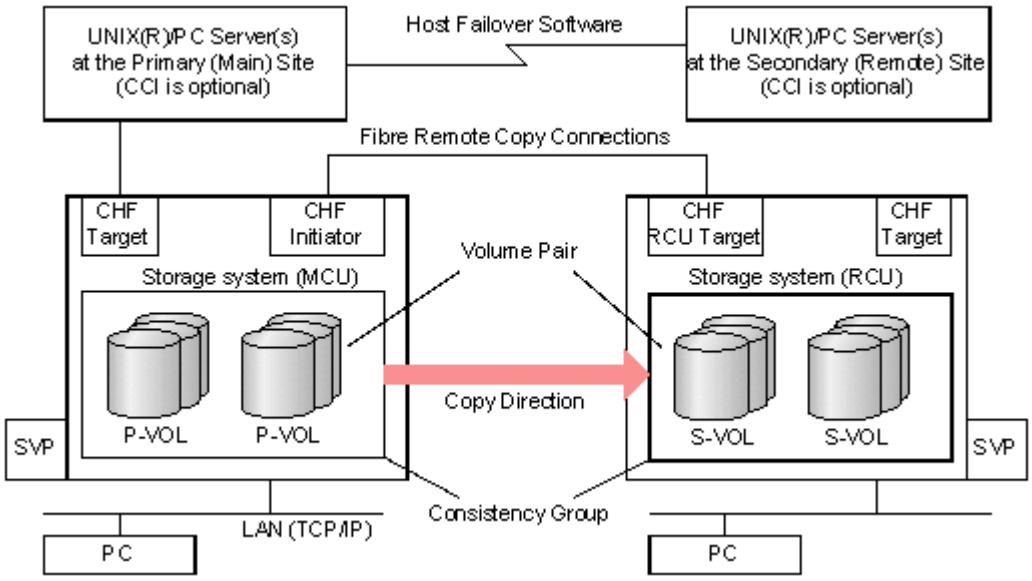
- Primary and secondary storage systems. The primary storage system contains the primary volumes and is connected to the hosts that access the primary volumes. The secondary storage system is connected to the primary storage system using dedicated data paths. TrueCopy supports

remote copy operations between various storage system models. This document provides instructions for performing TrueCopy operations on Hitachi Virtual Storage Platform G200, G400, G600, G800 (VSP G200, G400, G600, G800) and Hitachi Virtual Storage Platform F400, F600, F800 (VSP F400, F600, F800) primary storage systems.

- Main control units (MCUs) and remote control units (RCUs). The MCU is the control unit in the primary storage system that controls the P-VOLs of the TrueCopy pairs. The MCU communicates with the RCU through the dedicated remote copy connections. The MCU controls the host I/O operations to the P-VOLs as well as the TrueCopy remote copy operations between the P-VOLs and S-VOLs. The MCU also manages the TrueCopy pair status and configuration information.

  The RCU is the control unit in the secondary storage system that controls the S-VOLs of the TrueCopy pairs. The RCU assists in managing the TrueCopy pair status and configuration (for example, rejects write I/Os to S-VOLs). The RCU executes the remote copy operations issued by the MCU. The RCUs should be attached to a host system to allow sense information to be reported in case of a problem with a secondary volume or remote storage system and to provide disaster recovery capabilities.
- Hosts. The hosts at the primary site are connected to the primary storage system. Hosts at the secondary site are connected to the secondary storage system for use in disaster recovery operations. If it is not possible to have hosts at the secondary site, the host at the primary site must be in communication with the secondary system.
- Volumes. The primary volumes (P-VOLs) on the primary storage system are copied to the secondary volumes (S-VOLs) on the secondary system. The P-VOLs contain the original data, and the S-VOLs are the mirrored volumes that contain the backup or duplicate data. The primary and secondary volumes must have the same format and capacity. During normal TrueCopy operations, the P-VOL remains available to all hosts at all times for read and write I/O operations and the secondary storage system rejects all host-requested write I/Os for the S-VOLs. The S-VOL write enable option allows write access to an S-VOL while the pair is split, and the S-VOL and P-VOL differential data is used to resynchronize the pair.
- Data paths. Dedicated data paths, also called remote copy connections, are used for data transfer between the primary and secondary storage systems. You should establish at least two independent remote copy connections (one per cluster) between each MCU and RCU to provide hardware redundancy for this critical communications path. The VSP Gx00 models and VSP Fx00 models support Fibre Channel and iSCSI remote copy connections.
- Hitachi TrueCopy® software. The TrueCopy software must be installed on both the primary and secondary storage systems and is used to perform TrueCopy configuration and pair operations.
- CCI. The Command Control Interface (CCI) command-line interface software can also be used for TrueCopy configuration and pair operations as well as disaster recovery operations.

The following figure shows the TrueCopy system components.



Storage systems

TrueCopy operations require Hitachi storage systems at both the primary and the secondary sites.

The primary system manages the P-VOL and the following operations:

- Host I/O operations to the P-VOL.
- Initial copy and update copy operations between the P-VOL and S-VOL.
- Pair status and configuration information.

The secondary system manages the S-VOL and the following operations:

- Secondary copy operations issued by the primary system.
- Assists in managing pair status and configuration (for example, rejects write I/Os to the S-VOL).

The primary system communicates with the secondary system over dedicated Fibre Channel or iSCSI data paths.

Volume pairs

As described previously, original data is stored in the P-VOL and the remote copy is stored in the S-VOL. The pair can be split, resynchronized, reverse resynchronized, and returned to unpaired status.

- When paired, the volumes are synchronized.
- When split, new data is sent to the P-VOL but not the S-VOL.

Note: It will continue writing to P-VOL but copying to S-VOL stops so that pair will not be synchronized.

- If setting S-VOL's write option as enable, Write access from host application of secondary site to S-VOL become possible. If not, it will hold the status at the time of pair split.

- When P-VOL and S-VOL is not synchronized, differential data will be saved as bitmap until P-VOL and S-VOL resynchronizes.

- If you resync pairs, only the data which is not synchronized will be transferred so it will save time for copying.

- When resynchronized, data changed in the P-VOL is copied to the S-VOL.
- When necessary, data in the S-VOL can be copied to the P-VOL.

During normal operations, the P-VOL remains available to the host for read and write I/O operations. The secondary system rejects write I/Os for the S-VOL. The S-VOL can only be written to when the pair is split and when the write-enable option is specified for the S-VOL. In this instance, S-VOL and P-VOL track maps keep track of differential data and are used to resynchronize the pair.

Data path

TrueCopy operations are carried out between primary and secondary storage systems connected by a Fibre Channel or iSCSI interface. The data path, also referred to as the remote copy connection, connects ports on the primary storage system to the ports on the secondary storage system.

One data path connection is required, but two or more independent connections are recommended for hardware redundancy.

Consistency groups

A consistency group is a grouping of pairs upon which copy operations are performed simultaneously, and in which the pairs' status remains consistent. A consistency group can include pairs that reside in storage systems.

You can issue a TrueCopy command to the consistency group so that it is run on all pairs in the group. The pairs' statuses change at the same time, though this depends on the group options you have set. Some pair operations take priority under certain circumstances. Full information is covered in Consistency group planning on page 3-16.

Interfaces

You perform TrueCopy operations using one of the following interfaces:

- Device Manager - Storage Navigator, which is a browser-based interface from which TrueCopy is set up, operated, and monitored. The GUI provides the simplest method for performing operations, requiring no previous experience.

    - The primary system must be LAN-attached to a Device Manager - Storage Navigator computer.
    - The secondary system should also be LAN-attached to a separate Device Manager - Storage Navigator at the remote site. This allows you to perform operations more efficiently on the secondary system in the event that the main site is not available.
    - When you use virtual storage machine volumes, the physical LDEV ID, serial number, and the virtual information for the storage system are displayed on Device Manager - Storage Navigator. However, you cannot add remote connections by specifying the serial number of the virtual storage machine or create pairs by specifying the virtual LDEV ID. When you perform TrueCopy operations using Device Manager - Storage Navigator, specify the physical LDEV ID and serial number of the storage system.
- Command Control Interface, which is a command line interface used to display pair information and perform all copying and pair-managing operations. CCI provides a full scripting capability that can be used to automate replication operations. CCI is required for performing failover operations.
    - When you use virtual storage machine volumes in CCI, you can specify the virtual information and the physical information of the VSP Gx00 models and VSP Fx00 models in the configuration definition files. However, when the primary system is HUS VM, specify the physical information of the VSP Gx00 models and VSP Fx00 models in the configuration definition files.

Failover software

Host failover software is used to transfer information between host servers at the local and remote sites. It is a critical component of any disaster recovery solution.

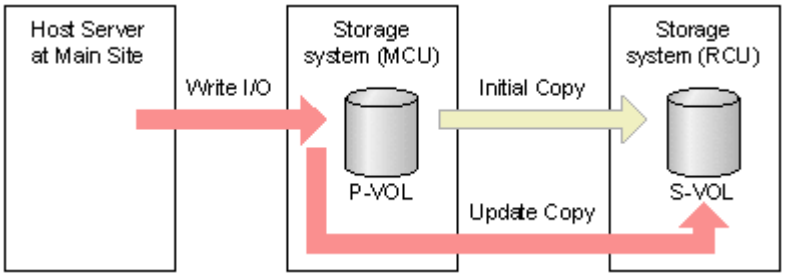
- When TrueCopy is used as a disaster recovery tool, host failover is required to ensure effective recovery operations.
- When TrueCopy is used as a data migration tool, host failover is recommended.

TrueCopy does not provide host failover functions. Use the failover software most suitable for your platform and requirements (for example, Microsoft Cluster Server).

Overview of initial, update copy operations

When you perform the initial copy operation, all the data in the P-VOL is copied into the S-VOL. Thereafter, the primary storage system runs update copy when it receives write instruction from the host. The update operation copies host updates to the S-VOL at the same time that they are copied to the P-VOL.

The following figure illustrates the initial copy and update copy operations.



Initial copy

When a new pair is created, the entire contents of the P-VOL are copied to the S-VOL cylinder by track (this does not include diagnostic and unassigned alternate tracks). The initial copy synchronizes the P-VOL and S-VOL independently of host I/O processes.

During the create pair operation, you can elect to have no data copied if data in the P-VOL and S-VOL are already identical. You can also specify options that affect the speed of data transfer and storage system performance. These are:

- **Copy Pace**. You specify the number of tracks that can be copied simultaneously before the primary system accepts another host request for that P-VOL. If more tracks are copied, the operation completes quicker; if fewer tracks are copied, performance is maintained at a higher level.
- **Maximum Initial Copy Activities**. You specify the maximum number of concurrent initial copies that the system performs.
- **Initial Copy Priority**. You specify the order in which copying is performed on multiple pairs. This is used if more pairs are being created in the operations than the maximum initial copy activity setting.
- **Round Trip Time**. You specify the time limit for data to travel from P-VOL to S-VOL. The value is used by the storage system to control initial copy pace when update copying is in progress.

These options are available on Device Manager - Storage Navigator only.

Update copy

Update copy has a higher priority than initial copy. However, if an initial copy is in progress when updates are sent by the host, the update copy must wait until the initial copy's copy pace completes. For example, if the copy pace is 15 tracks, the update copy may wait up to 15 tracks (1 cylinder).

When the host issues an update after the initial copy is complete, the data is written to the P-VOL and copied to the S-VOL. Subsequent updates are held until the current update is completed in both volumes. This keeps the pair synchronized.

Pair status

The pair status is managed by the primary storage system which manages the P-VOLs.

- The primary storage system is able to change the pair status of the P-VOL and the S-VOL.
- The secondary storage system can change the pair status of the S-VOLs, but cannot change the pair status of the P-VOLs. The primary storage system detects the change of the pair status of S-VOL, and then change the status of P-VOL.
- The pair status changes as follows:
  - If the volume is not assigned to the TrueCopy pair, the volume status is *SMPL*.
  - When the initial copy begins to create a pair, the primary storage system changes the status of both volumes to *COPY* (volumes to be copying).
  - When the initial copy completes, the primary storage system changes the status of both volumes to *PAIR* (volumes become a pair).
  - When user splits the pair from the primary storage system or the secondary storage system, the status of the P-VOL and the S-VOL are changed to *PSUS* (pair suspended-split: split by a command).
  - The primary storage system cannot keep the synchronization of the P-VOL and the S-VOL by some reasons, for example errors, the primary storage system changes the status of the P-VOL and the S-VOL to *PSUE* (pair suspended-error: split by an error).
  - When the user removes the pair from the primary storage system, the primary storage system changes the status of the P-VOL and the S-VOL to *SMPL*.
  - When the user removes the pair from the secondary storage system, the secondary storage system changes the status of the S-VOL to *SMPL*, and then the primary storage system detects the removal of the pair at the secondary system (if the path is normal), the primary storage system changes the status of the P-VOL to *PSUS*.

2

Requirements and specifications

This chapter provides basic system requirements. In addition to the information here, Chapter 3, Planning for TrueCopy on page 3-1 provides many specifications, recommendations, and restrictions for the elements of a TrueCopy system that require attention before setting up and using TrueCopy.

- ☐ System requirements and specifications

System requirements and specifications

The following table describes general system requirements.

Item	Requirement

Control units (CUs)	• VSP G200
	  ◦ Number of CUs: 8
	  ◦ Range of CUs: 0x00 to 0x07
	• VSP G400, VSP F400, VSP G600, and VSP F600
	  ◦ Number of CUs: 16
	  ◦ Range of CUs: 0x00 to 0x0F
	• VSP G800 and VSP F800
	  ◦ Number of CUs: 64
	  ◦ Range of CUs: 0x00 to 0x3F

Device emulation types	OPEN-V
RAID levels	RAID 1, RAID 5, RAID 6
Storage systems	Firmware requirements for connecting VSP Gx00 models or VSP Fx00 models to VSP Gx00 models or VSP Fx00 models: • VSP G200: 83-01-01-20/00 or later • VSP G400, VSP G600: 83-01-01-40/00 or later • VSP G800: 83-01-21-60/00 or later • VSP F400, F600, F800: 83-02-0*x* or later Firmware/microcode requirements for connecting VSP Gx00 models or VSP Fx00 models to Hitachi Unified Storage VM (HUS VM): • VSP G200: 83-01-21-20/00 or later • VSP G400, VSP G600: 83-01-21-40/00 or later • VSP G800: 83-01-21-60/00 or later • VSP F400, F600, F800: 83-02-0*x* or later • HUS VM: 73-03-39-*x*0/00 or later, *x* = 0 or 1 Firmware/microcode requirements for connecting VSP Gx00 models or VSP Fx00 models to VSP G1000: • VSP G200: 83-01-21-20/00 or later • VSP G400, VSP G600: 83-01-21-40/00 or later • VSP G800: 83-01-21-60/00 or later • VSP F400, F600, F800: 83-02-0*x* or later • VSP G1000: 80-04-*xx* or later If you are using a Dynamic Provisioning virtual volume (DP-VOL) with the data direct mapping attribute, you can only connect to VSP Gx00 models or VSP Fx00 models with firmware 83-02-0*x* or later. For disaster recovery, operation is done by the storage system at the secondary site, so we recommend using VSP Gx00 models or VSP Fx00 models for both primary and secondary sites. For more information, contact Hitachi Data Systems customer support.

Item	Requirement
TrueCopy software	• Must be installed on the primary and secondary systems. • Separate license codes are required for each storage system. • Synchronous only. TrueCopy Asynchronous is not supported.
Other software licenses	None. When combining TrueCopy and Dynamic Provisioning, the following licensed capacity limitations apply: • If using a Dynamic Provisioning V-VOL (virtual volume) for the TrueCopy P-VOL or S-VOL, the capacity of the allocated pages for the DP-VOL will be counted as the licensed capacity of TrueCopy. • If the actual licensed capacity exceeds the available licensed capacity, TrueCopy can be used as usual for 30 days. After 30 days, only split or release operations will be allowed.
Additional control memory	• VSP G200: You can use TrueCopy only with control memory in the basic part. Adding control memory expands the capacity of the pairs being created. • VSP G400, G600, G800 and VSP F400, F600, F800: Additional control memory is a prerequisite in both the primary and secondary systems to use TrueCopy. For information on adding control memory and setting the TC-dedicated area, contact Hitachi Data Systems customer support.
Supported host platforms	• HP-UX • IBM AIX • RedHat Linux • Sun Solaris • Windows server 2003 • Windows Server 2008 • VMWare ESX Refer to the Hitachi Data Systems interoperability matrix at https://support.hds.com for the latest information.
Data path	Maximum number of data paths: 8 per storage system The following interfaces are supported: • Fibre Channel • iSCSI Direct, switch, and extender connections are supported. For details, see Data path requirements and configurations on page 3-25.
Remote paths	Remote paths are established for each path group of primary and secondary storage systems. A maximum of 8 remote paths are supported for each path group, and a maximum of 64 path groups are supported. Multiple path groups can be used in the same combination of primary and secondary storage systems.
Path group	Group of remote paths, which allows you to configure multiple paths at the same time.

Item	Requirement

	• Maximum number of path groups: 64 per storage system
	• Path group ID:
	  ◦ 0-255 (0 to FF in hexadecimal) when connected to VSP Gx00 models, VSP Fx00 models, or VSP.
	  ◦ 0 when connected to USP V/VM or HUS VM.
	• Protocol: All remote paths in a path group must be the same protocol, either Fibre Channel or iSCSI. Remote paths for Fibre Channel and iSCSI cannot coexist within the same path group.
	• If iSCSI is used in a remote path, the Blocked Path Monitoring remote replica option must be set to at least 40 seconds (default). If Blocked Path Monitoring is less than 40 seconds, the path might be blocked due to a delay in the network such as many switches in a spanning tree protocol (STP) network or a long distance connection.
	• The path group is specified during the create pair operation. It cannot be changed by the resync pair operation.
	• Path groups can be created and specified using CCI. See configuration setting commands in *Command Control Interface User and Reference Guide* and sample configuration definition files in *Command Control Interface Installation and Configuration Guide*.
	• It is recommended that you specify different paths and path groups for UR secondary systems when using CU Free.

Maximum number of secondary systems (System)	Up to 64 secondary TC or UR systems can be set per primary system.

Pair volumes	• The P-VOL and S-VOL must be equal in size.
	• The maximum size of the P-VOL and S-VOL are:
	  ◦ Dynamic Provisioning virtual volume (DP-VOL), the same as the maximum size of the DP-VOL.
	  See the *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.
	  ◦ Internal volume: 3,145,663 MB (6,442,317,824 blocks).
	  ◦ External volume: 4,194,304 MB (8,589,934,592 blocks).
	• The minimum size for P-VOLs and S-VOLs is 46.875MB (96,000 blocks).
	• A P-VOL can be copied to only one S-VOL.
	• The P-VOL and S-VOL can be shared with other Hitachi software product volumes. See Volume types that can be shared with TrueCopy on page 4-2.
	• The same value must be set for the T10 PI attribute of the P-VOL and S-VOL.
	• You cannot use a volume in a parity group for which accelerated compression is enabled as a pair volume.
	• You cannot use the system LU for Hitachi NAS Platform as a pair volume.
	See Planning pairs and pair volumes on page 3-8 for more information.

Item	Requirement
Number of pairs	Limited per storage system. See Maximum number of pairs supported on page 3-12.
Number of consistency groups	• VSP G200: Maximum: 16 (0x00 to 0x0F) • VSP G400, VSP F400, VSP G600, and VSP F600: Maximum: 64 (0x00 to 0x3F) • VSP G800 and VSP F800: Maximum: 128 (0x00 to 0x7F)
Host failover software	• Required for disaster recovery. • Recommended for data migration. See Host failover software on page 3-25 for more information.
Interfaces	• Device Manager - Storage Navigator ◦ The following HDvM - SN role is required to operate: - Storage Administrator (Remote Copy) ◦ The primary and secondary systems must be LAN-attached to a Device Manager - Storage Navigator computer using a separate LAN. • CCI ◦ A command device is required for each CCI instance. ◦ See the *Command Control Interface User and Reference Guide* for information about setting up and using CCI.

3

Planning for TrueCopy

This chapter provides information and instructions for planning the primary and secondary systems, pair volumes, data paths, and other elements.

- ☐ Storage system preparation
- ☐ System performance considerations
- ☐ Planning pairs and pair volumes
- ☐ Consistency group planning
- ☐ Host failover software
- ☐ Data path requirements and configurations

Storage system preparation

The following preparations are required for the storage systems in a TrueCopy pair relationship.

- Device Manager - Storage Navigator must be LAN-attached to the primary and secondary systems. See the *Hitachi Command Suite User Guide* for information.
- The primary and secondary systems must be set up for TrueCopy operations. See Cache, additional control memory requirements on page 3-2. Make sure to consider the amount of Cache Residency Manager data that will be stored in cache when determining the amount of cache for TrueCopy operations.
- Make sure that each of the primary and secondary storage systems is configured to report sense information to the host. If the storage system cannot be attached to any host, connect the secondary storage system with the host for the primary storage system.
- If power sequence control cables are used, set the power select switch for the cluster to LOCAL to prevent the primary system from being powered off by the host. Make sure the S-VOL is not powered off during TrueCopy operations.
- Install the data path between the primary and secondary systems. Distribute data paths between different storage clusters and extenders or switches to provide maximum flexibility and availability. The remote paths between the primary and secondary systems must be different than the remote paths between the host and secondary system. See Data path requirements and configurations on page 3-25 for more information.

Cache, additional control memory requirements

Cache must be operable for the pair's primary and secondary systems. If not, pairs cannot be created. The secondary system cache should be configured to adequately support TrueCopy remote copy workloads and any local workload activity.

- Hitachi Virtual Storage Platform G200:

  There are three types of control memory: Basic, Extention1, and Extention2. Only Basic control memory can be used with TrueCopy running on VSP G200. Adding control memory expands the capacity of the pairs to be created.
- VSP G400, G600, G800 and VSP F400, F600, F800:

  Additional control memory is a prerequisite in both the primary and secondary systems to use TrueCopy on VSP G400, G600, G800 and VSP F400, F600, F800 storage systems.

For information on adding control memory and setting the TC-dedicated area, contact Hitachi Data Systems customer support.

Note: Neither cache nor control memory can be added to or removed from the storage system when pair status is COPY. When either of these tasks is to

be performed, first split any pairs in COPY status, and then resynchronize the pairs when the cache or control memory operation is completed.

Workflow for adding and removing cache memory

Use the following workflow to add or remove cache memory in a storage system in which TrueCopy pairs already exist:

1. Identify the status of the TrueCopy volumes in the storage system.
2. If a TrueCopy volume is in the COPY status, wait until the status changes to PAIR, or split the TrueCopy pair.

   Do not add or remove cache memory when any volumes are in the COPY status.
3. When the status of all volumes has been confirmed, cache memory can be added to or removed from the storage system by your service representative. Contact Hitachi Data Systems customer support for adding or removing cache memory.
4. After the addition or removal of cache memory is complete, resynchronize the pairs that you split in step 2.

Workflow for adding control memory

Use the following workflow to add control memory to a storage system in which TrueCopy pairs already exist:

1. Identify the status of the TrueCopy volumes in the storage system.
2. If a TrueCopy volume is in the COPY status, wait until the status changes to PAIR, or split the TrueCopy pair.

   Do not add control memory when any volumes are in the COPY status.
3. When the status of all volumes has been confirmed, control memory can be added to the storage system by your service representative. Contact Hitachi Data Systems customer support for adding or removing cache memory.
4. After the addition of control memory is complete, resynchronize the pairs that you split in step 2.

Workflow for removing control memory

Use the following workflow to remove control memory:

Note: For the following cases, you do not need to delete the TC pairs in step 2 because there is no dedicated area for TC, such as bit map areas:

- VSP G200: Control memory is added in Extension2.
- VSP G400, G600, G800: Control memory is added in Extension4.

1. Identify the status of all volumes.
2. If a volume is used by a TrueCopy pair, delete the TrueCopy pair.

3. Control memory can be removed from the storage system by your service representative. Contact Hitachi Data Systems customer support for adding or removing cache memory.

System option modes

To provide greater flexibility, the Hitachi storage systems have additional operational parameters called system option modes (SOMs) that allow you to tailor the storage system to your unique operating requirements. The SOMs are set to their default values at installation and can be changed only by your Hitachi Data Systems representative.

The following table lists and describes the system option modes related to TrueCopy operations. For a complete list of all SOMs, see the *Hardware Guide* for your storage system model. Work with your Hitachi Data Systems team to make sure the appropriate SOMs are set on your storage system.

Note: The SOM information might have changed since this document was published. Contact your Hitachi Data Systems representative for the latest SOM information.

Option mode	Description
689	Allows you to slow the initial copy and resync operations when the write-pending rate on the RCU exceeds 60%. • ON: The initial copy and resync copy operations are slowed down when the write-pending rate on the RCU exceeds 60%. If the write-pending rate of the CLPR to which the initial copy S-VOL belongs is not over 60% but that of the MP PCB to which the S-VOL belongs is over 60%, the initial copy operation is slowed down. • OFF (default): The initial copy and resync copy operations are not slowed down when the write-pending rate on the RCU exceeds 60%. **Notes:** 1. This mode can be set online. 2. The micro-programs on both MCU and RCU must support this mode. 3. This mode should be set when requested by the user. 4. Setting this mode to ON is recommended when GAD is installed, as the performance degradation is more likely to occur due to active-active I/Os. 5. If the write-pending status remains at 60% or higher on the RCU for a long time, it takes extra time for the initial copy and resync copy to be completed due to the slower copy operations. 6. Do not set this mode if the primary or secondary system is connected to USP V/VM with microcode earlier than 60-02-xx-xx/xx. If this mode is applied and the write-pending rate reaches 60%, pair suspend might occur. 7. As this mode is enabled per storage system, in an environment where TC and GAD are used, the mode is applied to both program products. When GAD is installed in a storage system that already uses TC, TC initial copy might take longer time.

Option mode	Description
784	Allows you to reduce RIO MIH time to 5-seconds. As a result, after a remote path error, less time elapses until the operation is retried on an alternate path. (Both RIO MIH time and the Abort Sequence timeout value are combined for this retry time.) • ON: Reduces the RIO MIH time to 5-seconds. Combined with the Abort Sequence timeout value, the total amount of time that elapses before the operation is retried on another path is a maximum of 10-seconds. • OFF: The RIO MIH time that you specified at RCU registration (default=15 seconds) is used with the specified Abort Sequence timeout value. SOM 784 is supported only when the port type of all remote paths in a single remote connection is Fibre. If the port type of all remote paths in a single remote connection is iSCSI or if iSCSI and Fibre are mixed, this SOM is not supported.

System performance considerations

Synchronous copy operations affect I/O performance on the host and on the primary and secondary systems. TrueCopy provides options for minimizing the impact and for maximizing the efficiency and speed of copy operations for the best level of backup data integrity. These options are discussed in:

- Determining Round Trip Time on page 3-5
- Determining Minimum Number of Remote Paths on page 3-7
- Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10

Performance is also optimized with the proper bandwidth. This is discussed in Analyzing workload, planning data paths on page 3-8.

Determining Round Trip Time

You specify a time limit in milliseconds for data to travel from the P-VOL to the S-VOL when you set up the TrueCopy association between primary and secondary systems. **Round Trip Time** is used by the systems to control the initial copy pace when update copying is in progress.

This section provides instructions for determining your system's Round Trip Time.

Note the following Round Trip Time considerations:

- If the difference between Round Trip Time and remote IO response time is significant, the system slows or even interrupts the initial copy operation so that the update copy can continue.

  Example of significant difference between the two: 1ms RT Time and 500ms remote IO response time.

- If the difference between the two is insignificant, initial copying is allowed to run at the specified pace.

  Example of insignificant difference between the two: 1ms RT Time and 5 ms remote IO response time.

To determine Round Trip Time value

The value of **Round Trip time**= round trip time between primary system and secondary system x 2(*) + initial copy response time (ms)
(*) A data transfer between primary and secondary systems involves two response sequences in one command issuance. Therefore, you need to double the round trip time.

- For the "round trip time" in the formula, please ask Hitachi Data Systems customer support, or use a ping command. If you do not use channel extenders between the primary and secondary systems, specify "1".)
- The "initial copy response time" in the formula is the response time required for multiple initial copy operations. With the following formula, determine the initial copy response time using the initial copy pace, the number of maximum initial copies, and the bandwidth of the channel extender communication lines between primary and secondary systems.

Initial copy response time (ms) = (1[MB] / "Data path speed between primary system and secondary system [MB/ms][1]") x ("copy pace"[2]/ 4) x (number of maximum initial copy[3]" / "Number of data paths between primary system and secondary system"[4])
1. When you connect the primary system with the secondary system without extenders, set "Data path speed between primary system and secondary system" to either of below depending on the fiber cable link speed. 2 Gbps: 0.17 MB/ms 4 Gbps: 0.34 MB/ms 8 Gbps: 0.68 MB/ms 16 Gbps: 1.36 MB/ms 2. For "copy pace" in the initial copy response time formula, see the following table. 3. For "number of maximum initial copy", use the value set up per storage system. The default is 64. 4. Even if the "number of maximum initial copy" / "Number of data paths between the primary system and secondary system" is 16 or larger, specify "number of maximum initial copy VOLs" / "Number of data paths between primary system and secondary system" as 16.

The following table shows the initial copy pace used for the response time calculation.

Interface	When executing initial copy only		When executing Initial and Update copy at the same time	
	When initial copy pace specified at the time of pair creation is 1 to 4	When initial copy pace specified at the time of pair creation is 5 to 15	When initial copy pace specified at the time of pair creation is 1 or 2	When initial copy pace specified at the time of pair creation is 3 to 15
Device Manager - Storage Navigator	User-specified value	4	User-specified value	2
CCI	User-specified value	4	User-specified value	2

The following table shows example settings.

Round trip time between primary and secondary systems [ms]	Data path speed between primary and secondary systems (MB/ms)	Number of data paths between primary and secondary systems	Copy Pace	Number of maximum initial copy VOLs	Round trip time specified [ms]
0	0.1	4	4	64	160
30	0.1	4	4	64	220
100	0.1	4	4	64	360

Determining Minimum Number of Remote Paths

You specify the minimum number of remote paths to the secondary system when you set up the TC association between primary and secondary systems. Using the **Minimum Number of Paths** option, you set a minimum value from one to eight paths, with one being the default.

If the number of paths in Normal status drops below the specified minimum, the primary storage system splits the pair to avoid impact to host performance.

- To maintain high performance in the primary storage system, Hitachi recommends setting the minimum number at two.
- For a pair with important data, set the minimum at one. This allows the system to continue update operations to the secondary system.
- You can protect data integrity between P-VOL and S-VOL in the event that the system splits the pair because the number of paths is lower than the minimum. With the Fence Level setting (specified during the initial copy), you decide whether, when the pair is split due to an error, the host

continues to access the P-VOL or is denied access. See Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10 for more information.

Analyzing workload, planning data paths

You optimize copy operations and performance by carefully planning bandwidth, number of data paths and host interface paths, and number of ports. This is discussed in:

Check with Hitachi Data Systems customer support for more information.

- Analyze write-workload. Bottlenecks severely impact performance, but the workload data you collect (MB/s and IOPS) help determine the following key elements that, when sized properly, form a data path that operates free of bottlenecks under all workload levels:
  - Amount of bandwidth.
  - Number of data paths.
  - Number of host-interface paths.
  - Number of ports dedicated for TrueCopy on the primary and secondary systems.
- If you are setting up TrueCopy for disaster recovery, make sure that secondary systems are attached to a host server. This enables both the reporting of sense information and the transfer of host failover information. If the remote site is unattended by a host, you should attach the storage systems to a host server at the main site so that the system administrator can monitor conditions.

Planning pairs and pair volumes

This section discusses requirements, options, and settings you need for setting up pairs and pair volumes. You begin by:

- Identifying data and volumes at the local site that you want to protect with a backup
- Setting up volumes at the remote site that will hold copied data.

The following helps ensure that the pairs you create fit your requirements.

- Pair volume requirements and recommendations on page 3-9
- Allowing I/O to the S-VOL on page 3-10
- Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10
- Differential data on page 3-11
- Maximum number of pairs supported on page 3-12
- Options and settings for number of pairs copied, and their priority, during the initial copy and resync operations. See Priority for initial copy operations and scheduling order on page 3-15

Pair volume requirements and recommendations

The following is provided to help you prepare TrueCopy volumes:

- A volume can be assigned to only one pair.
- Logical units on the primary and secondary storage systems must be defined and formatted prior to pairing.
- The P-VOL and S-VOL must be equal in size.
- TrueCopy requires a one-to-one relationship between the P-VOL and S-VOL. The P-VOL cannot be copied to more than one S-VOL, and an S-VOL cannot have more than one P-VOL.
- Logical Unit(LU) Types
    - TrueCopy supports OPEN V.
    - Pair volumes must consist of LUs of the same type and capacity. The P-VOL and S-VOL LU types display in Device Manager - Storage Navigator.
- TrueCopy operates on volumes rather than on files; multi-volume files require special attention. For complete duplication and recovery of a multi-volume file (for example, a large database file that spans several volumes), make sure that all volumes of the file are copied to TrueCopy S-VOL.
- TrueCopy pair volumes can be shared with non-TrueCopy Hitachi software products. See Chapter 4, Sharing TrueCopy volumes on page 4-1 for more information.
- TrueCopy supports Virtual LVI/LUN. This allows you to configure LUs that are smaller than standard LUs. When custom-size LUs are assigned to a TrueCopy pair, the S-VOL must have the same capacity as the P-VOL. Device Manager - Storage Navigator displays the size of P-VOLs and S-VOL.
- Before creating multiple pairs during the Create Pairs operation, make sure to set up S-VOL LDEVs to allow the system to correctly match them to P-VOLs.

  You must do this because, even though you select multiple volumes as P-VOLs, you specify just one S-VOL. The system automatically assigns subsequent secondary system LDEVs as S-VOLs based on the option you specify for Selection Type. These are the options:

    - Interval: The interval you specify will be skipped between LDEV numbers in the secondary system.

      For example, suppose you specify LU 01 as the initial (base) S-VOL, and specify 3 for Interval. This results in secondary system LDEV 04 being assigned to the next P-VOL, 07 assigned to the subsequent P-VOL, and so on. To use Interval, you set up secondary system LDEV numbers according to the interval between them.
    - Relative Primary Volume. The difference is calculated between the LDEV numbers of two successive P-VOLs. S-VOLs are assigned according to the closest LUN number.

For example, if the LUN numbers of three P-VOLs are 1, 5, and 6; and you set LUN numbers for the initial S-VOL (Base Secondary Volume) at 2, the LUN numbers of the three S-VOLs will be set at 2, 6, and 7, respectively.

- Because the contents of the P-VOL and S-VOL are identical, the S-VOL can be considered a duplicate of the P-VOL. Because the host operating system does not allow duplicate volumes, the host system administrator must take precautions to prevent system problems related to duplicate volumes. You must define the S-VOLs so they do not auto mount or come online to the same host at the same time as the P-VOLs.

  TrueCopy does not allow the S-VOL to be online (except when the pair is split). If the S-VOL is online, the TrueCopy paircreate operation will fail.

Caution: When S-VOLs and P-VOLs are connected to the same hosts, it is strongly recommended that you define the S-VOLs to remain offline. This is because under this condition, the S-VOL is usually offline when a pair is released. If the host is then restarted, the system administrator may be offered both volumes and asked which volume should be left offline. This can be confusing and is prone to error.

Allowing I/O to the S-VOL

The secondary system rejects write I/O to the S-VOL, unless the S-VOL-write operation is enabled. When this option is enabled, read and write I/O is allowed to the S-VOL while the pair is split. In this case, S-VOL and P-VOL track maps keep track of differential data and are used to resynchronize the pair. Enabling S-VOL-write is done during the pairsplit operation.

- You can write to the S-VOL when the split operation is performed from the primary system.
- When you resync a pair with the S-VOL write operation enabled, the secondary system sends S-VOL differential data to the primary system. This data is merged with P-VOL differential data, and out-of sync tracks are determined and updated on both systems, thus ensuring proper resynchronization.

Allowing I/O to the P-VOL after a split—Fence Level options

You can specify whether the host is denied access or continues to access the P-VOL when the pair is split due to an error. This is done with the **Primary Volume Fence Level** setting. You specify one of the following Fence Level options during the initial copy and resync operations. You can also change the Fence Level option outside these operations.

- **Data** – the P-VOL is fenced if an update copy operation fails. This prevents the host from writing to the P-VOL during a failure. This setting should be considered for the most critical volumes for disaster recovery. This setting reduces the amount of time required to analyze the consistency of S-VOL data with the P-VOL during disaster recovery efforts.

- **Status** – the P-VOL is fenced only if the primary system is not able to change S-VOL status to suspended when an update copy operation fails. If the primary system successfully changes S-VOL pair status to suspended, subsequent write I/O operations to the P-VOL will be accepted, and the system will keep track of updates to the P-VOL. This allows the pair to be resynchronized quickly. This setting also reduces the amount of time required to analyze S-VOL consistency during disaster recovery.
- **Never** – the P-VOL is never fenced. This setting should be used when I/O performance out-weighs data recovery. "Never" ensures that the P-VOL remains available to applications for updates, even if all TrueCopy copy operations have failed. The S-VOL may no longer be in sync with the P-VOL, but the primary system keeps track of updates to the P-VOL while the pair is suspended. Host failover capability is essential if this fence level setting is used. For disaster recovery, the consistency of the S-VOL is determined by using the sense information transferred via host failover or by comparing the S-VOL contents with other files confirmed to be consistent.

Differential data

Differential data is managed with bitmaps in units of tracks. Tracks that receive a write instruction while a pair is being split are managed as differential bitmaps.

Although CCI allows you to specify track or cylinder, the VSP G200, G400, G600, G800 and VSP F400, F600, F800 storage systems use only tracks, whether you specify track or cylinder, or if you do not specify either of them.

- If you use a DP-VOL under one of the following conditions, the differential data is managed by the pool to which the TC pair volume is related:
  - You create a TC pair by using a DP-VOL that is larger than 4,194,304 MB (8,589,934,592 blocks).
  - You create a TC pair by using a DP-VOL with the Advanced System Settings No. 5 or No. 6 enabled in Device Manager - Storage Navigator.

    Advanced System Settings No. 5: Manage differential bitmaps in DP pool at pair create and resync operations for 4TB or less TC/UR/GAD pairs.

    Advanced System Settings No. 6: Manage differential bitmaps in DP pool at pair create operations for 4TB or less TC/UR/GAD pairs.
  - You resynchronize a TC pair by using a DP-VOL with the Advanced System Settings No. 5 or No. 6 enabled in Device Manager - Storage Navigator.

Note: Use the following procedure to release the differential data (pages) managed by the pool:

1. Delete all of the pairs that use the V-VOL for which you want to release the pages.

2. Set system option mode 755 to OFF.
   This action enables zero pages to be reclaimed.
3. Restore the blocked pool.
4. Release the V-VOL pages.
   For Device Manager - Storage Navigator, use the **Reclaim Zero Pages** window.
   For CCI, use the **`raidcom modify ldev`** command.
   You need to release differential data pages when you downgrade to the firmware version that does not support TC pair creation with DP-VOLs larger than 4,194,304 MB. The amount of time it takes to release differential data pages depends on the number of specified volumes, DP-VOL capacity, the number of allocated pages, and the storage system's workload. It also depends on the type of storage system. In some cases, it could take days to release all the differential data pages.

- After you create a TC pair with DP-VOL whose size is larger than 4,194,304 MB (8,589,934,592 blocks), data management might fail due to the insufficient pool capacity. In this case, all the P-VOL data is copied to the S-VOL in units of tracks when you perform the TC pair resync operation.

Note: If you enable Advanced System Settings No. 5 or No. 6 in Device Manager - Storage Navigator, the differential data is managed by the pool to which the TC pair volume is related even if the volume is smaller than 4,194,304 MB (8,589,934,592 blocks). This enables the total capacity of the pair volumes to be increased over 1.8 PB. If you want the differential data to be managed by the control memory again after you create pairs whose total capacity is larger than 1.8 PB, you must reduce the total capacity of the pairs that are smaller than 4,194,304 MB(8,589,934,592 blocks) to 1.8 PB by deleting some pairs. When the differential data is managed by the control memory, the total capacity of the TC, UR, and GAD pairs is 1.8 PB. For example, if the total capacity of the TC pairs is already 1.8 PB, you cannot create any UR or GAD pairs.

Maximum number of pairs supported

The maximum number of TrueCopy pairs is as follows:

- VSP G200: 2,048
- VSP G400, VSP G600, and VSP F400, F600: 4,096
- VSP G800 and VSP F800: 16,384

If CCI is used, a command device must be defined for each product; therefore, the maximum number of pairs is as follows:

- VSP G200: 2,047
- VSP G400, G600 and VSP F400, F600: 4,095
- VSP G800 and VSP F800: 16,383

The maximum number of TC pairs depends on the number of LDEVs, not the number of LUs.

Calculating maximum number of pairs

It is necessary to calculate the maximum number of pairs you can have on the storage system. The maximum number is based on the following:

- The number of cylinders in the volumes.
- The number of bitmap areas required for a TrueCopy volume, which is calculated using the number of cylinders.

  If the volume size is larger than 4,194,304 MB (8,589,934,592 blocks), the bitmap area is not used. Therefore, you do not need to calculate the maximum number of pairs when creating TC pairs with a DP-VOL whose size is larger than 4,194,304 MB (8,589,934,592 blocks).

Note: In the following formulas: for `ceil()`, round up the result within the parentheses to the nearest integer, and for `floor()`, round down the result within the parentheses to the nearest integer.

To calculate the maximum number of pairs

1. Calculate the number of cylinders.
   a. Calculate the system's number of logical blocks, which is the volume's capacity measured in blocks.

      ```
      Number of logical blocks = Volume capacity (bytes) / 512
      ```

   b. Calculate the number of cylinders:

      ```
      Number of cylinders = ceil ( (ceil (Number of logical blocks / 512) ) / 15)
      ```

2. Calculate the number of bitmap areas per volume.

   In the following calculation, differential data is measured in bits. 122,752 bits is the amount of differential data per bitmap area.

   ```
   Number of bitmap areas = ceil ( (Number of cylinders x 15) / 122,752)
   ```

Note: Doing this calculation for multiple volumes can result in inaccuracies. Perform the calculation for each volume separately, and then total the bitmap areas. The following examples show correct and incorrect calculations. Two volumes are used: one of 10,017 cylinders and another of 32,760 cylinders

Correct calculation

```
ceil ((10,017 x 15) / 122,752) = 2
ceil ((32,760 x 15) / 122,752) = 5
```

Total: 7

Incorrect calculation

```
10,017 + 32,760 = 42,777 cylinders
ceil ((42,777 x 15) / 122,752) = 6
```

Total: 6

3. Calculate the maximum number of pairs, which is restricted by the following:

   - The number of bitmap areas required for TrueCopy (calculated above).
   - The total number of bitmap areas in the storage system. The number of bitmap areas is as follows:

     VSP G200: 36,000

     VSP G400, VSP G600, VSP G800, and VSP F400, F600, F800: 65,536

     The number of bitmap areas to be used is common to TrueCopy, Universal Replicator, and global-active device. Therefore when you use these software applications together, reduce the number of bitmap areas for each software application from the total number of bitmap areas for the storage system before calculating the maximum number of pairs for TrueCopy in the following formula. For the method of calculating the number of bitmap areas required for each software application, see the relevant user guide.

     Also, when TrueCopy and Universal Replicator share the same volume, regardless of whether the shared volume is primary or secondary, reduce the number of bitmap areas for each software application from the total number of bitmap areas for the storage system before calculating the maximum number of pairs for TrueCopy in the following formula. For more information on calculating the number of bitmap areas required for each software application, see the relevant user guide.

     Use the following formula to find the maximum number of pairs.

     ```
     Maximum number of pairs = floor (Total number of bitmap areas in the storage system / Required number of bitmap areas)
     ```

     Calculate the maximum number of pairs using the already calculated necessary number of bitmap areas and the number of bitmap areas in storage systems listed in the following table. The number of bitmap areas in a storage system is determined by the storage system model and the availability of control memory extended for TC.

Extension status of control memory for TC	Number of bitmap areas in storage systems
No Extension	Depends on the model: • VSP G200: 3,712 • VSP G400, G600, G800, VSP F400, F600, F800: 0
With Extension	Depends on the model: • VSP G200: 36,000 • VSP G800, VSP G400, VSP G600, VSP F400, F600, F800: 65,536

Priority for initial copy operations and scheduling order

Though you can specify a maximum number of initial copies to run concurrently, you are allowed to perform more initial copies than this when creating pairs. If you do this, you will set the scheduling order for the additional operations in the Initial Copy Priority field when creating the pair.

This topic provides two examples in which priority and the pre-set scheduling order are discussed.

Example 1: more initial copies than previously specified

In this example, four initial copies are being created in the same operation, but Maximum Initial Copy Activities is set at 2. In this scenario, the Initial Copy Priority field in the Create TC Pairs window would be set as shown in the following table.

P-VOL	Value set for Initial Copy Priority
LUN 00	2
LUN 01	3
LUN 02	1
LUN 03	4

The order for the initial copy and the Priority for the P-VOLs are shown in the following table.

Order for initial copy	P-VOL	Value set for Initial Copy Priority
1	LUN 02	1
2	LUN 00	2
3	LUN 01	3
4	LUN 03	4

In this case, because the value of Maximum Initial Copy Activities is 2, initial copy operations for LUN 02 and LUN 00 are started. If either one of the initial copy operations for LUN 02 and LUN 00 is completed, the initial copy for LUN 01 is started.

Example 2: initial copy started, new pairs added

The following table shows the Priority value when the initial copy is already begun and two new pairs are then added. The P-VOLs are for the new pairs.

P-VOL	Value set for Initial Copy Priority
LUN 10	2
LUN 11	1

If initial copy is already started, and if a new initial copy is added, the additional initial copy is started after the previously performed initial copy is completed. The priority of all the initial copy operations being performed is shown in the following table.

Starting order for initial copy	P-VOL	Value set for Initial Copy Priority	Remarks
1	LUN 02	1	Previously scheduled.
2	LUN 00	2	Previously scheduled.
3	LUN 01	3	Previously scheduled.
4	LUN 03	4	Previously scheduled.
5	LUN 11	1	Scheduled later.
6	LUN 10	2	Scheduled later.

Initial Copy Priority on the **Edit Remote Replica Options** window is determined within the range of the number of initial copy operations performed at the same time. Therefore, until the first initial copy operations complying with the order set by Priority are completed, the additional initial copy operations are not started.

Consistency group planning

Consistency groups allow you to perform one operation on all pairs in the group. Consistency groups also ensure that all pairs are managed in a consistent status.

A maximum of four storage system pairings can be placed in one consistency group. You determine which pairs to include in a particular consistency group based on business criteria for keeping status consistent across a group of pairs, and for performing operations at the same time on the group.

Consistency group for pairs in one primary and one secondary system

This topic describes how to create, update, and copy TC pairs in a consistency group of one primary storage system and one secondary storage system.

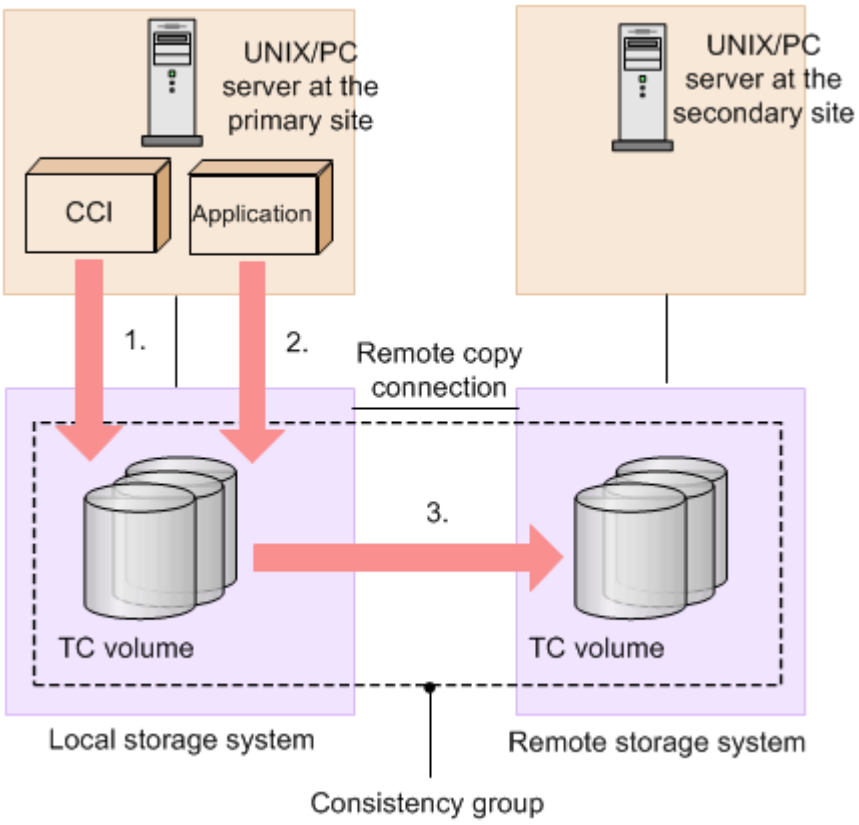


Figure notes:

1. The TC pair is created in the consistency group specified from CCI.
2. I/O requests are received from each application in the open-system server to update data in each volume.
3. The TC copy operation is performed in the consistency group.

For information on creating a TC pair and assigning it to a consistency group using CCI, see the *Command Control Interface User and Reference Guide* and the *Command Control Interface Command Reference*.

Consistency group for pairs in multiple primary and secondary systems

This topic describes how to create, update, and copy TC pairs in a consistency group of multiple primary storage systems and secondary storage systems.

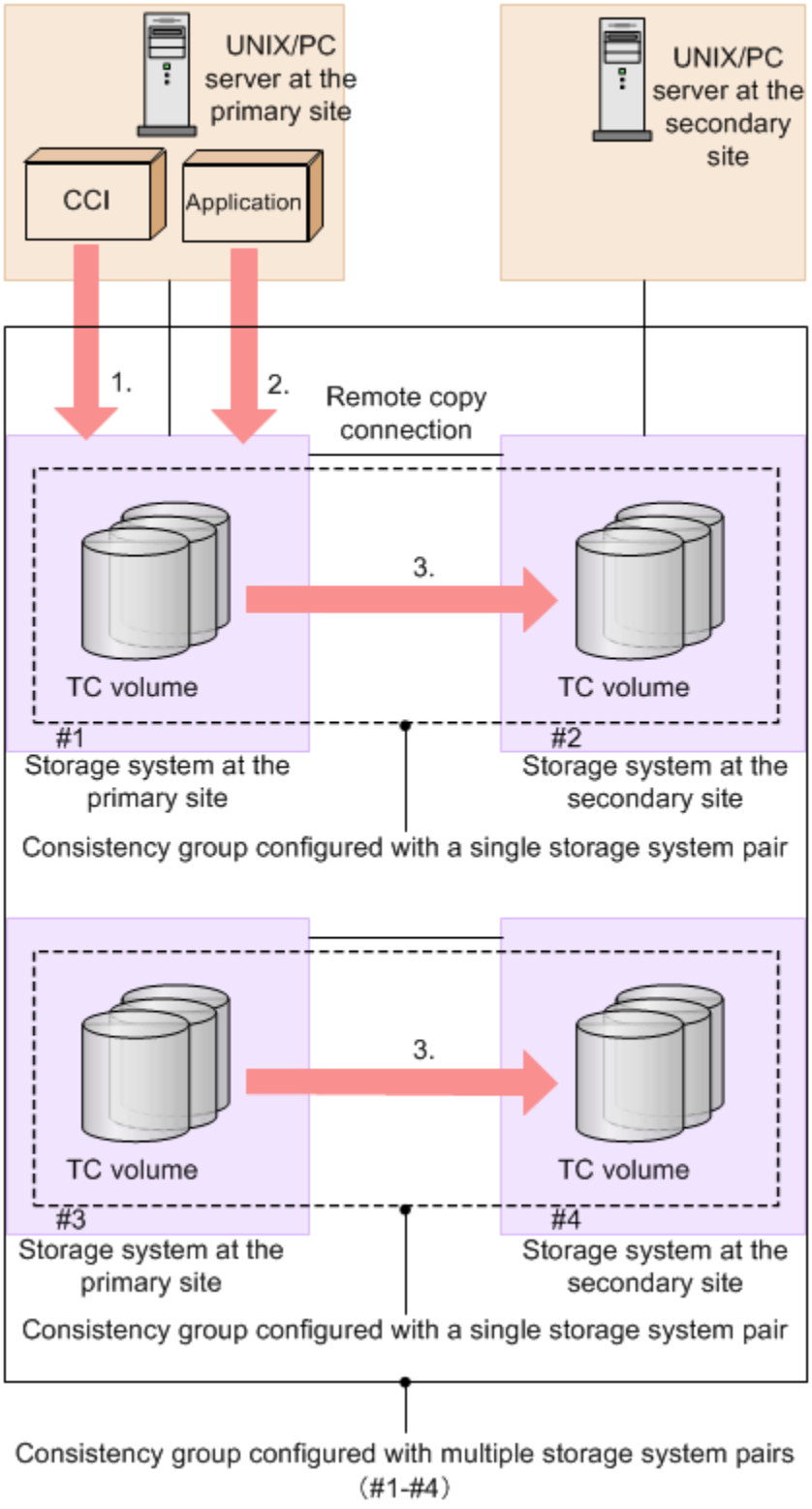


Figure notes:

1. CCI uses a consistency group that consists of multiple primary and secondary storage systems.

2. I/O requests are received from each application in the open-system server to update data in each volume.
3. The TC copy operation is performed in the consistency group.

When a pair is created, the pair is assigned to a consistency group. For information on creating consistency groups of multiple primary and secondary storage systems and assigning TC pairs to a consistency group, see the *Command Control Interface User and Reference Guide* and the *Command Control Interface Command Reference*.

System configurations for consistency groups

The following table shows the system configuration for which data consistency between secondary volumes in a consistency group of multiple primary and secondary storage systems is guaranteed.

Update sequence of data in a higher system*	Guaranteed range of data consistency between secondary volumes
Update sequence of data is guaranteed between servers	TC secondary volumes in multiple storage systems at secondary sites
* If the update sequence of data in a higher system is not guaranteed (data update sequence is unnecessary), data consistency between secondary volumes is not guaranteed.	

Registering pairs to a new consistency group

This topic describes how to configure a consistency group of multiple primary and secondary storage systems, and to register TC pairs.

When creating a new TC pair

1. Create CCI configuration definition file C for a configuration of multiple primary and secondary storage systems.
2. In CCI, specify the consistency group for registration, and register TC pairs using CCI configuration definition file C created in step 1.

When using existing TC pairs

1. To use existing TC pairs from CCI, create CCI configuration definition file A.
2. In CCI, split pairs using CCI configuration definition file A created in step 1.
3. In CCI, resume pair operation using CCI configuration definition file A without specifying a consistency group.
4. In CCI, split pairs using CCI configuration definition file A.
5. Create CCI configuration definition file C for a configuration of multiple pairs of storage systems.
6. In CCI, register pairs to a consistency group, and resume pair operation using CCI configuration definition file C.

Tip: After removing existing TC pairs, perform the procedure above in *When creating a new TC pair*.

Registering pairs to an existing consistency group

This topic describes how to register TC pairs in a consistency group of multiple primary and secondary storage systems to an existing consistency group.

When creating a new TC pair

1. Add information of a TC pair you want to add to CCI configuration definition file B to create CCI configuration definition file C.
2. In CCI, create a TC pair using CCI configuration definition file C.

When using existing TC pairs

1. To use existing TC pairs from CCI, create CCI configuration definition file A.
2. In CCI, split pairs using CCI configuration definition file A.
3. In CCI, resume pair operation using CCI configuration definition file A without specifying a consistency group.
4. In CCI, split pairs using CCI configuration definition file A.
5. Use CCI configuration definition file B to split pairs in the existing configuration of multiple primary and secondary storage systems.
6. Add information of the TC pair you want to add to CCI configuration definition file B for the existing configuration of multiple primary and secondary storage systems to create CCI configuration definition file C.
7. In CCI, create a TC pair using CCI configuration definition file C.

Tip: After deleting existing TC pairs, you can perform the procedure in *When creating a new TC pair*.

Consistency group requirements

Requirements are provided for the following consistency group (CTG) configurations:

- **Requirements for a CTG for one primary and one secondary system**
  - A TC pair cannot be assigned to more than one consistency group.
  - Assign an unused consistency group ID to a consistency group to be registered.
  - See System requirements and specifications on page 2-2 or Maximum number of pairs supported on page 3-12 for the maximum number of consistency groups and the maximum number of TC pairs you can create.

- **Requirements for a CTG for multiple primary and secondary systems**

  In addition to the above requirements, consistency groups of multiple primary and secondary storage systems must satisfy the following requirements:

  - Use VSP Gx00 models, VSP Fx00 models, VSP G1000, or HUS VM in both primary and secondary storage systems.
  - A maximum of four primary and secondary storage systems (respectively) can be used.
  - Use the firmware program that supports the consistency group functionality for multiple primary and secondary storage systems.

    - If a storage system at the primary site does not support the consistency group functionality for multiple primary and secondary storage systems, a pair for a consistency group of one primary and one secondary storage system is created.

    - If a storage system at the secondary site does not support the consistency group functionality for multiple primary and secondary storage systems, no pairs can be created.
  - Use CCI appropriate for operations of consistency groups with multiple primary and secondary systems.
  - Pair operations can be performed only from CCI. Pair operations from Device Manager - Storage Navigator are not supported.
  - Cascade configurations with Universal Replicator are not supported.
  - Combination with Compatible FlashCopy® is not supported.
  - When using a volume in a virtual storage machine, if you want to create a consistency group of one primary and one secondary storage system, use volumes in the same virtual storage machine to create a pair. If you register a pair created in different virtual storage machine volumes to a consistency group, the consistency group is regarded as a consistency group of multiple primary and secondary storage systems.

Split behaviors

This topic describes how to maintain data consistency between secondary volumes of pairs in the same group when a split command is issued during I/O processing, and when I/O processing is requested while a split command is in progress.

Data consistency between secondary volumes of pairs in a group cannot be ensured when all the following conditions exist:

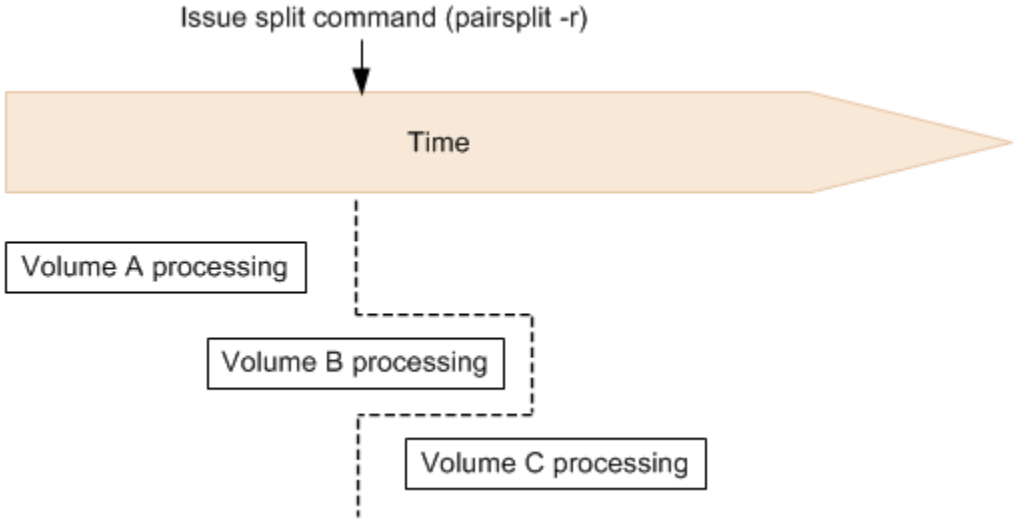
- A split command is in progress
- The host requested I/O processing
- The microprocessor of the connection destination port for the I/O request is blocked

In this case, resynchronize the consistency group, and then run the split command again.

Operation when a split command is issued during I/O processing (for TrueCopy)

The figure below explains how data consistency between secondary volumes of pairs in a group is maintained when a split command is issued during I/O processing.

In TrueCopy, if an I/O request is being processed in a volume when the pairsplit -r command is issued to a consistency group, the volume is split after the I/O processing and data transfer to the secondary volume are completed. Data consistency can be maintained through this operation, as shown in the following figure.



Operation when an I/O request is received while a split command is in progress

When a pair in a consistency group in which a split command is in progress receives an I/O request from a server, if the applicable pair is not split yet, it is split first. The I/O request is accepted after the pair is split. The same operation is performed if a pair in a group is split due to a failure. As a result, data consistency between secondary volumes in a group can be maintained.

Host access after split

You can specify settings for read/write access to the P-VOL/P-VOL and S-VOL/S-VOL in consistency groups after pairs are split. These settings are specified using CCI.

For TC volumes, read access cannot be prohibited regardless of specified options. For details about each option, see the *Command Control Interface User and Reference Guide* and the *Command Control Interface Command Reference*.

- The CCI settings for TC are optional.

The following tables show the effects of the settings on read and write access.

Setting	TC P-VOL	
	Read	Write
Write access prohibited	Y	N
No option selected	Y	Y

Setting	TC S-VOL	
	Read	Write
Read access permitted	Y	N
Read/Write access permitted	Y	Y
No option selected	Y	N

Pair status before and after a split operation

Pairs in the same consistency group must be in PAIR status when you begin the split operation in order to maintain consistency. Otherwise, when the operation completes, pair status will be inconsistent.

Consistency group 127

When you create pairs using Device Manager - Storage Navigator, you can assign the pairs to only one consistency group, CTG 127. (You can also use CCI to assign pairs to CTG 127.) With CTG 127, you can ensure the following:

- When a pair is split or suspended for any reason, you can ensure that all P-VOLs in the group become suspended.
- If data paths between the secondary and primary system fail, you can ensure that all S-VOLs are placed in PSUE status.

For more information, see CTG 127 behavior and restrictions when a pair is suspended on page 3-24.

To assign pairs to CTG 127

1. Turn Function Switch 30 On.
   - Turn on the switch in the primary and secondary systems to get the desired result in each system.
   - Turn on the switch in the system where you want the behavior: either consistent P-VOL suspensions for the primary system, or consistent S-VOL PSUE status for the secondary system.
2. Create the pairs and assign them to CTG 127.
   - In CCI, assign the pairs to this group number when you create the pairs.
   - In Device Manager - Storage Navigator, pairs are automatically assigned to CTG 127 when the pairs are created and function switch 30 is On.

CTG 127 behavior and restrictions when a pair is suspended

Note the following behaviors and restrictions regarding the consistent suspending of all P-VOLs when a pair suspends.

- When a failure occurs or if a pair is suspended by CCI, all P-VOLs will be suspended.
- When P-VOLs and S-VOLs are registered in CTG 127, and both volumes are paired bi-directionally, all of the target pair volumes are registered in CTG No.127 when takeover takes place.
- The maximum number of pairs in CTG 127 is 4,096.
- For P-VOLs to be suspended, a failure must occur, and then a write I/O operation must occur in any of the pairs.
- When P-VOL status is PAIR and S-VOL status is PSUE, if a write I/O is executed, all P-VOLs registered in CTG 127 are suspended by failure.

  When P-VOL status is PAIR and S-VOL status is PSUE, you can restore PAIR status to the S-VOL by suspending the P-VOL and then resynchronizing the pair. With CCI, use the -l option.
- When the S-VOL is suspended due to an intermittent communication failure, the P-VOL might not be suspended (P-VOL with no I/O processing stays in PAIR).

CTG 127 behavior and restrictions when the data path fails

Note the following behaviors and restrictions regarding the consistent changing of all S-VOLs to PSUE status when the secondary system is disconnected.

- S-VOLs must be in PAIR or COPY status in order to change to PSUE status. They cannot be in PSUS or SSUS status.
- All connections to the primary system must be disconnected.

  S-VOLs cannot be changed to PSUE status if the MinimumPath field is set to a value other than 1 on the primary system (RCU Option dialog box).
- Changing status to PSUE may take up to 10-minutes if there are many pairs.
- All S-VOLs will be changed to PSUE even if all data paths are recovered in the middle of the process.
- If the data paths are disconnected for a short time (less than one minute), S-VOLs may not change to PSUE status because the storage system does not detect the disconnection.
- After a power outage, all S-VOLs registered in CTG 127 will be changed to PSUE status.
- If write I/O is executed when the P-VOL is in PAIR status and the S-VOL is in PSUE status, the secondary system does not accept updates, and the primary system suspends the P-VOL.
- Remote I/O (RIO), which is issued during the change to PSUE status, is accepted by the secondary system.
- When a pair's status is changing to PSUE:

- It cannot be resynchronized.
- It cannot be created and registered in CTG 127.

However, a pair can be deleted when status is changing to PSUE.

- In a bi-directional configuration, if all data paths for the primary system of the reverse direction pair are disconnected when pair status is changing to PSUE, the disconnection may not be detected.
- If all the data paths for TrueCopy pairs are disconnected, but the paths used for UR pairs are connected, failure suspend does not occur and S-VOLs cannot be changed to PSUE status.
- If you turn off the power of the primary system when S-VOLs are in PAIR status, all the data paths for the primary system will be disconnected and all the S-VOLs registered in CTG 127 will be changed to PSUE status.

Host failover software

Host failover software transfers information between host servers at the local and remote sites and is a critical component of a disaster recovery solution.

- When TrueCopy is used as a disaster recovery tool, host failover is required to ensure effective recovery operations.
- When TrueCopy is used as a data migration tool, host failover is recommended.

TrueCopy does not provide host failover functions. Use the failover software most suitable for your platform and requirements (for example, Microsoft Cluster Server).

Data path requirements and configurations

A data path must be designed to adequately manage all possible amounts of data that could be generated by the host and sent to the P-VOL and S-VOL. This topic provides requirements and planning considerations for the following key elements of the data path:

- Ports on page 3-26
- Bandwidth requirements on page 3-26
- Fibre Channel data path requirements on page 3-26
- iSCSI data path requirements on page 3-27
- Supported data path configurations on page 3-29

Caution:

- Before replacing a data path (Fibre Channel or iSCSI), first delete the pairs and delete the remote paths that use the data path to be replaced, and then replace the data path. Do not replace a data path that is being used for remote copy operations.
- Use the same protocol for the data paths between the host and storage system and between the primary and secondary storage systems. When

different protocols are used in the data paths (for example, Fibre Channel data paths between the host and storage system and iSCSI data paths between the storage systems), the timeout period for commands between the host and the storage system must be equal to or greater than the timeout period for commands between the storage systems. This requirement applies only to TrueCopy data paths (does not apply to Universal Replicator or global-active device).

Ports

Data is transferred along the connection path from the primary storage system to the secondary system site.

The amount of data each of these ports can transmit and receive is limited. Therefore, you must know the amount of data that will be transferred (write-workload) during peak periods. You can then ensure not only that bandwidth meets data transfer requirements, but that a sufficient number of each system's ports are specified to handle all workload levels.

Bandwidth requirements

Sufficient bandwidth must be present to handle data transfer of all workload levels. The amount of bandwidth required for your TrueCopy system is based on the amount of I/O sent from the host to the primary system. You determine required bandwidth by measuring write-workload. Workload data is collected using performance monitoring software. Consult Hitachi Data Systems customer support for more information.

Fibre Channel data path requirements

For Fibre Channel data paths, direct, switch, and extender connections are supported. The primary and secondary systems must be connected using multimode or single-mode optical fibre cables. As shown in the following table, the distance between the P-VOL and S-VOL storage systems determines the required cable type and data path relay equipment.

Distance	Fibre cable type	Data path relay equipment
0 km to 1.5 km (4,920 feet)	Multimode shortwave Fibre Channel interface cables.	Switch is required for 0.5 km to 1.5 km.
1.5 km to 10 km (6.2 miles)	Single-mode longwave optical fibre cables.	Not required.
10 km to 30 km (18.6 miles)	Single-mode longwave Fibre Channel interface cables.	Switch is required.
Greater than 30 km (18.6 miles)[1]	Communications lines are required.	Approved third-party channel extender products.
1. TrueCopy operations typically do not exceed 30 km.		

With Fibre Channel connections, no special settings are required for the storage system.

Direct connections up to 10 km with single-mode longwave Fibre Channel interface cables are supported. Link speed determines the maximum distance you can transfer data and still achieve good performance. The following table shows maximum distances at which performance is maintained per link speed, over single-mode longwave Fibre Channel.

Link speed	Distance maximum performance maintained
1 Gbps	10 km
2 Gbps	6 km
4 Gbps	3 km
8 Gbps	2 km
16 Gbps	1 km

Hitachi Data Systems customer support can provide the latest information about the availability of serial-channel TrueCopy connections.

iSCSI data path requirements

For iSCSI data paths, direct, switch, and extender connections are supported. The following table describes the considerations for ports and network settings when you configure a system using iSCSI data paths.

Item	Considerations
Ports	• When the parameter settings for an iSCSI port are changed, the iSCSI connection is disconnected temporarily and then reconnected. Change parameter settings only when the I/O load is low to avoid impact to the system. • Although a log might be output in the host if you change the settings of an iSCSI port connected to a host, this does not indicate a failure. In a system that monitors system logs, an alert might be issued. When this happens, change the iSCSI port setting, and then check if the host is reconnected. • **Delayed ACK:** When you use iSCSI for the connection between storage systems, and the same port for the connection to the host, disable the Delayed ACK setting for the port (in the Edit Ports window set Delayed ACK to Disable, default = Enable). If Delayed ACK is set to Enable, it might take time for the host to recognize a volume used by TC pairs. For example, it takes up to 8 minutes for the host to recognize 2,048 volumes. • **Selective ACK:** Make sure Selective ACK is enabled for iSCSI ports. Selective ACK is set to Enable by default (Edit Ports window). Do not change this setting.

Item	Considerations
	• In an environment in which a delay occurs in a line between storage systems, such as long-distance connections, you must set an optimal window size of iSCSI ports in storage systems at the primary and secondary sites after verifying various sizes. The maximum value you can set is 1024 KB. The default window size is 64 KB, so you must change this setting. • iSCSI ports do not support the fragmentation (splitting packets) functionality. When the value for the maximum transfer unit (MTU) of a switch is smaller than the MTU value of the iSCSI port, packets are lost, and communication might not be performed correctly. The MTU value for the switch must be the same as or greater than the MTU value for the iSCSI port. For the MTU setting and value, see the switch manual. The MTU value for the iSCSI port must be greater than 1500. In a WAN environment in which the MTU value is smaller than 1500, fragmented data cannot be sent or received. In this environment, set a smaller value for the maximum segment size (MSS) of the WAN router according to the WAN environment, and then connect the iSCSI port. Alternatively, use iSCSI in an environment in which the MTU value is 1500 or greater. • A port can be used for connections to the host (target attribute) and to a storage system (initiator attribute). However, to minimize the impact on the system if a failure occurs either in the host or in a storage system, you should connect the port for the host and for the storage system to separate front end modules.
Network settings	• Disable the spanning tree setting on the port of a switch connecting to an iSCSI port. If you enable the spanning tree functionality of a switch, packets might not be looped in the network when the link is up or down. If this happens, the packets might be blocked for approximately 30 seconds. If you must enable the spanning tree settings, enable the port fast functionality of the switch. • In a network path between storage systems, if you use a line that has a slower transfer speed than the iSCSI port, packets are lost, and the line quality is degraded. Configure the system so that the transfer speed for the iSCSI ports and the lines is the same. • Delay in a line between storage systems varies depending on the system environment. Therefore, validate the system first, and then check the optimum window size settings of iSCSI ports. If the impact of the line delay is determined to be unacceptable, consider using devices for optimizing or accelerating the WAN speed. • When iSCSI is used, packets are sent or received using TCP/IP. Because of this, the amount of packets might exceed the capacity of a communication line, or packets might be resent. As a result, performance might be greatly affected. Use Fibre Channel data paths for critical systems that require high performance.

Supported data path configurations

Three configurations are supported for TrueCopy:

- Direct connection on page 3-29
- Switch connection on page 3-30
- Extender connection on page 3-32

You can use the GUI (Device Manager - Storage Navigator or Hitachi Command Suite) or the CLI (Command Control Interface) to set ports and topology.

For direct and switch connections, host I/O response time can be improved on long-distance direct connections (longwave, less than 10 km/6.2 miles) by improving the I/O response time between storage systems and by using host mode options (HMOs) 49 and 50, or HMO 51. The following table describes these options. A Hitachi Data Systems-approved channel extender is required. For details about HMOs, see the *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

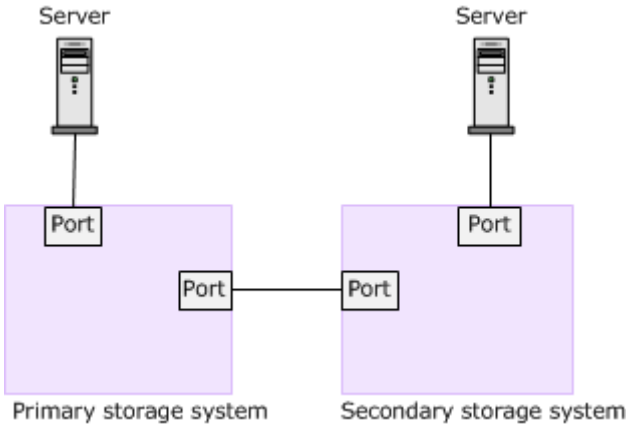
HMO	Title	Description
49	BB Credit Set Up Option 1	Fixes higher values of buffer-to-buffer credits (BBCs) to increase data transfer size over long distances.[1] This host mode option must be used in conjunction with host mode option 50.[2]
50	BB Credit Set Up Option 2	Fixes higher values of buffer-to-buffer credits (BBCs) to increase data transfer size over long distances.[1] This host mode option must be used in conjunction with host mode option 49.[2]
51	Round Trip Set Up Option	Improves host I/O response time for long distance switch connections.[2]

Notes:

1. Up to 10 km for direct connection and 100 km for switch connection.
2. The firmware supporting these functions must be installed on both the primary and secondary systems.

Direct connection

The following figure shows a direct connection, in which two devices are connected directly together.



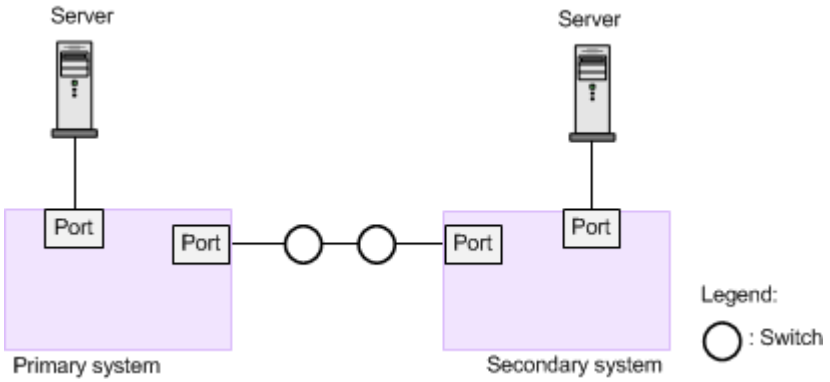
As shown in the following table, fabric settings, topology settings, and available link speed depend on the settings of the packages and protocols used for the storage system connections, as well as whether host mode option 51 is used.

Note: If you connect storage systems using iSCSI, host mode option settings become invalid.

Package name	Protocol	Host mode option 51	Fab	Initiator port and RCU target port topology	Available link speed
4HF8	8GbpsFC	OFF	OFF	FC-AL	• 2 Gbps • 4 Gbps • 8 Gbps
		ON	OFF	Point-to-Point	• 2 Gbps • 4 Gbps • 8 Gbps
2HF16	16GbpsFC	OFF	OFF	FC-AL	• 4 Gbps • 8 Gbps
		ON	OFF	Point-to-Point	• 4 Gbps • 8 Gbps • 16 Gbps
2HS10S	10 Gbps iSCSI	N/A	N/A	N/A	10 Gbps
2HS10B	10 Gbps iSCSI (10G BASE-T)	N/A	N/A	N/A	• 10 Gbps • 1 Gbps

Switch connection

The following figure shows a switch connection, in which up to three optical fibre cables are connected using switches. Two switches can be used.



- Some switch vendors require F port connectivity (for example, McData ED5000).

As shown in the following table, fabric settings, topology settings, and available link speed depend on the settings of the packages and protocols used for the storage system connections, as well as whether host mode option 51 is used.

Note: If you connect storage systems using iSCSI, host mode option settings become invalid.

Package name	Protocol	Host mode option 51	Fab	Initiator port and RCU target port topology	Available link speed
4HF8	8GbpsFC	OFF	ON	Point-to-Point	• 2 Gbps • 4 Gbps • 8 Gbps
		ON	ON	Point-to-Point	• 2 Gbps • 4 Gbps • 8 Gbps
2HF16	16GbpsFC	OFF	ON	Point-to-Point	• 4 Gbps • 8 Gbps • 16 Gbps
		ON	ON	Point-to-Point	• 4 Gbps • 8 Gbps • 16 Gbps
2HS10S	10 Gbps iSCSI	N/A	N/A	N/A	10 Gbps
2HS10B	10 Gbps iSCSI (10G BASE-T)	N/A	N/A	N/A	• 10 Gbps • 1 Gbps

Extender connection

The following figure shows an extender connection, in which channel extenders and switches are used to connect the devices across large distances.

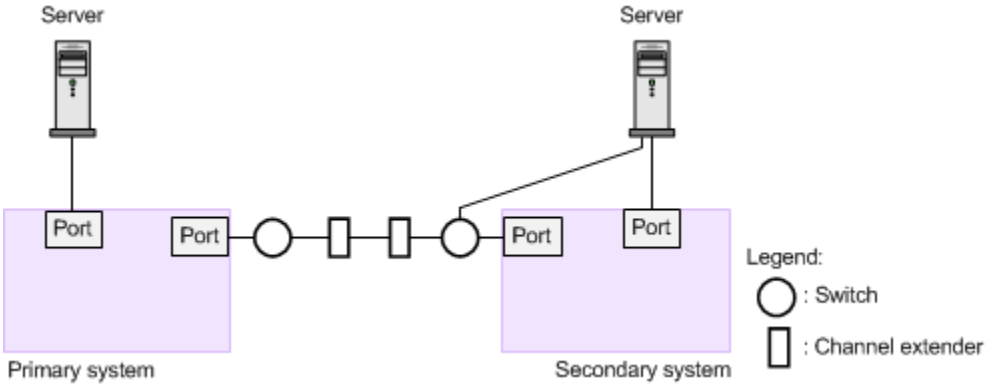


Figure 3-1 Extender Connection

Set port topology to the following:

- Fab on, Point-to-Point

Caution: Data traffic might concentrate on one switch when you perform the following actions:

- Use a switch to connect the primary system and the secondary systems with an extender.
- Gather several remote copy paths in one location.

If you are using a Hitachi switch to make the connection, contact Hitachi Data Systems customer support.

Caution: Make sure that the channel extender supports remote I/Os. Contact Hitachi Data Systems customer support for more information.

Note:

- Best practice is to create at least two independent data paths (one per cluster) between the primary and secondary systems for hardware redundancy for this critical element.
- When 4,000 pairs or more are used, we recommend that you restrict the number of pairs when creating pairs, so that 4,000 pairs or less use one physical path, to distribute load on the physical path.
- The same write-workload would be used in the reverse direction in a disaster recovery scenario. Therefore, when planning TrueCopy for disaster recovery, the same number of secondary-to-primary data paths must be set up as the primary-to-secondary copy paths for normal operations. Reverse direction paths must be set up independently of the primary-to-secondary paths.

- When you set up secondary-to-primary data paths, specify the same combination of CUs or CU Free, and the same path group ID, as specified for the primary-to-secondary paths.

4

Sharing TrueCopy volumes

This chapter helps you plan TrueCopy (TC) pair volumes when they are shared with non-TC volumes. All the software products that can be used with TC are discussed here.

- Volume types that can be shared with TrueCopy
- Data Retention Utility
- Dynamic Provisioning
- LUN Manager
- Performance Monitor
- Universal Replicator
- ShadowImage
- Virtual LUN
- Volume Migration
- Global storage virtualization

Volume types that can be shared with TrueCopy

The following table shows when volumes used by other software can also be used as TC P-VOLs and S-VOLs.

Volume type	Used as TC P-VOL?	Used as TC S-VOL?
Active flash		
DP-VOL	Yes	Yes
Pool-VOL	No	No
Data Retention Utility		
Volume with Read/Write attribute	Yes	Yes
Volume with Read Only attribute	Yes	Yes
Volume with Protect attribute	Yes	Yes
Volume that is disabled for use as an S-VOL	Yes	No
Dynamic Provisioning		
DP-VOL	Yes	Yes
Pool-VOL	No	No
Dynamic Tiering		
DP-VOL	Yes	Yes
Pool-VOL	No	No
Global-active device		
P-VOL	No	No
S-VOL	No	No
Global storage virtualization		
Number of virtual storage machine volumes[3]	Yes	Yes
LUN Manager		
Volume to which a path is defined	Yes	Yes
Volume to which no path is defined	No	No
Volume to which LUN security is applied	Yes	Yes
Quorum disk		
Volume with the GAD Reserved virtual attribute	No	No
ShadowImage (SI)		
P-VOL in PSUS (Delete pair to RCU) status	Yes	Yes[1]
P-VOL in COPY(RS-R)/RCPY status	No	No
SI P-VOL is also used as a UR P-VOL or S-VOL	No	No

Volume type	Used as TC P-VOL?	Used as TC S-VOL?
P-VOL (none of the above)	Yes	Yes[1]
S-VOL in PSUS (Delete pair to RCU) status	Yes	No
S-VOL (none of the above)	No	No
Thin Image (TI)		
P-VOL in all statuses except COPY(RS-R)/ RCPY	Yes	Yes
P-VOL in COPY(RS-R)/RCPY status	No	No
V-VOL	No	No
Pool-VOL	No	No
Universal Replicator		
P-VOL in COPY status	No	No
P-VOL in PAIR status	Yes[4]	No
P-VOL in PSUS status	Yes[4]	No
P-VOL in PSUE status	Yes[4]	No
S-VOL in COPY status	No	No
S-VOL in PAIR status	No	No
S-VOL in PSUS status	Yes[4]	No
S-VOL in SSWS status	Yes[4]	No
S-VOL in PSUE status	Yes[4]	No
Journal volume	No	No
Universal Volume Manager		
Mapped external volume	Yes	Yes
Virtual LUN		
Virtual LUN volume	Yes	Yes
Virtual Partition Manager(VPM)		
Volume belonging to the Virtual Partition Manager CLPR	Yes	Yes
Volume Migration		
Source volume (when volume migration is in progress)	Yes. (If the source volume is a P-VOL, volume migration will stop.)	Yes. (If the source volume is an S-VOL, volume migration will stop.)[2]
Source volume (after volume migration is finished)	Yes	Yes
Target volume	No	No
Notes:		

Volume type	Used as TC P-VOL?	Used as TC S-VOL?
1. If the TC P-VOL and TC S-VOL are DP-VOLs, the TC S-VOL cannot be used as the SI P-VOL. 2. If the TC S-VOL is a DP-VOL, the TC pair cannot be created. Create the TC pair after completing volume migration or stopping the Volume Migration operation. 3. Volumes of which virtual LDEV ID was deleted cannot be used as a TC pair volume. 4. In a 3DC multi-target configuration or 3DC cascade configuration with 3 UR sites, the volume which is shared by 2 UR pairs cannot be used for TrueCopy. Also, the volume used for TrueCopy cannot be used as the volume to share between 2 UR pairs.		

The following topics include additional information about shared volumes.

Data Retention Utility

You can create a TC pair using volumes that have been assigned the access attribute by the Data Retention Utility (DRU). However, you cannot specify a volume with the "S-VOL Disable" attribute as a TC S-VOL.

The following table shows whether a DRU volume with the specified access attribute can be used as a TC P-VOL or S-VOL.

DRU access attribute	Availability of TC P-VOL or S-VOL	
	P-VOL	S-VOL
Read/Write	Yes	Yes
Read Only	Yes	Yes
Protect	Yes	Yes
S-VOL Disable	Yes	No
Read Only and S-VOL Disable	Yes	No
Protect and S-VOL Disable	Yes	No

The following tables show TC volumes and status with Data Retention Utility operations that can be performed using Device Manager - Storage Navigator.

TC Volume	PAIR status	DRU operation				
		Changing access attribute				Referring access attribute
		Read/ Write	Read Only	Protect	S-VOL Disable	
P-VOL	SMPL	Yes	Yes	Yes	Yes	Yes
	COPY	Yes	Yes	Yes	Yes	Yes
	PAIR	Yes	Yes	Yes	Yes	Yes
	PSUS	Yes	Yes	Yes	Yes	Yes

TC Volume	PAIR status	DRU operation				
		Changing access attribute				Referring access attribute
		Read/ Write	Read Only	Protect	S-VOL Disable	
	PSUE	Yes	Yes	Yes	Yes	Yes
S-VOL	SMPL	Yes	Yes	Yes	Yes	Yes
	COPY	No	No	No	No	Yes
	PAIR	No	No	No	No	Yes
	PSUS	Yes	Yes	Yes	Yes	Yes
	PSUE	Yes	Yes	Yes	Yes	Yes

The following tables show TC volumes and status with the Data Retention Utility operations that can be performed using Device Manager - Storage Navigator and CCI.

TC Volume	PAIR status	DRU operation				
		Changing access attribute				Referring access attribute
		Read/ Write	Read Only	Protect	S-VOL Disable	
P-VOL	SMPL	Yes	Yes	Yes	Yes	Yes
	COPY	Yes	Yes	Yes	Yes	Yes
	PAIR	Yes	Yes	Yes	Yes	Yes
	PSUS	Yes	Yes	Yes	Yes	Yes
	PSUE	Yes	Yes	Yes	Yes	Yes
S-VOL	SMPL	Yes	Yes	Yes	Yes	Yes
	COPY	Yes	Yes	Yes	No	Yes
	PAIR	Yes	Yes	Yes	No	Yes
	PSUS	Yes	Yes	Yes	Yes	Yes
	PSUE	Yes	Yes	Yes	Yes	Yes

Dynamic Provisioning

You can create a Universal Replicator pair by specifying a DP-VOL (Dynamic Provisioning virtual volume). DP-VOLs can be assigned to both the TC P-VOL and S-VOL, or to one of them. However, the following restrictions apply:

- You can use DP-VOLs that are also used in a ShadowImage pair, or in a Volume Migration migration plan. Before creating the TC pair, delete the SI pair, or disable the Volume Migration setting. After the pair is created, re-create the pair or migration plan.

- When a DP-VOL has pages allocated to an S-VOL, used pool capacity is temporarily larger than the actual capacity because pages must be reallocated in the DP-VOL. Therefore, before creating the pair, make sure of the following:
  - DP-VOL pool capacity is sufficient.
  - Pool-VOLs that are added to a pool are not blocked. If Pool-VOLs are blocked, restore the volume status, and then create the pair.
- Regarding page and license capacity:
  - If a pair does not include a DP-VOL, volume capacity is counted toward TC license capacity. For a DP-VOL with the data direct mapping attribute, volume capacity is counted toward TC license capacity.

    If a pair includes a DP-VOL, only the allocated page capacity of volume capacity is counted toward TC license capacity.

    If a DP-VOL and a non-DP-VOL are included in a pair, the page capacity and/or license capacity counted in the P-VOL and the S-VOL may be different. This applies even when both P-VOL and S-VOL include DP-VOLs, because the page capacity of the P-VOL or the S-VOL changes by a relocated pool or released page or other action.

For more information, see the *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

LUN Manager

- LUN Manager operations do not affect TC operations.
- Volumes that are under secure ports and/or that are assigned to host groups or iSCSI targets can also be assigned to TC pairs.
- Volumes that are assigned to TC pairs can also be assigned to secure ports and host groups or iSCSI targets for LUN Manager.
- TC S-VOLs cannot be accessed by any UNIX/PC server host except when the pair is split.

For more information, see the *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

Performance Monitor

Performance Monitor software provides detailed information about I/O activity and performance in the storage systems. Storage system usage and performance data is collected and displayed by Performance Monitor. This information helps you to:

- Identify the optimum timing for performing TC operations.
- Determine the best locations for the TC S-VOL (for example, parity groups with less-frequently accessed volumes to avoid bottlenecks of backend activity).

- Monitor system performance during TC operations and during testing activities.

See the *Performance Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models* for more information.

Universal Replicator

As with TrueCopy, Universal Replicator provides remote data replication for backup and disaster recovery purposes. TrueCopy copies data synchronously between the primary and secondary sites to keep the data at both sites identical, whereas Universal Replicator copies data asynchronously, and the data in the secondary site is updated later than the data in the primary site. The TrueCopy primary and secondary sites must be closer to each other than the primary and secondary sites for Universal Replicator, as TrueCopy operations can be affected by the distance between the sites.

By combining Universal Replicator and TrueCopy, you can take advantage of the benefits of each product to achieve better failure and disaster recovery solutions.

For details about configurations that combine Universal Replicator and TrueCopy, see the *Hitachi Universal Replicator User Guide*.

ShadowImage

ShadowImage volumes can be assigned to TC pairs, and TC volumes can be assigned to SI pairs. The following table shows the configurations that are possible.

TC volume	SI P-VOL	SI S-VOL
P-VOL	Yes	Yes
S-VOL	Yes	No

Please note the following when sharing TC volumes with SI volumes.

- L1 and L2 SI pairs can be shared with TC volumes. Both node and leaf S-VOLs are considered secondary volumes by TC.
- SI is recommended for in-system copy operations. However, if SI is not installed, TC can be used to copy within the same storage system. This configuration requires at least one fibre cable loop.
- The SI Quick Restore can be performed when the TC pair is suspended. For information about the Quick Restore operation, see the *Hitachi ShadowImage® User Guide*.

Configurations with ShadowImage P-VOLs

TC can share a SI P-VOL in three configurations:

- In the following figure, the TC P-VOL also functions as a SI P-VOL. This configuration allows you to use SI for on-site data backup in case of TC failure. Or, the TC S-VOL can be used to provide remote backup of the SI P-VOL in case of a SI failure.

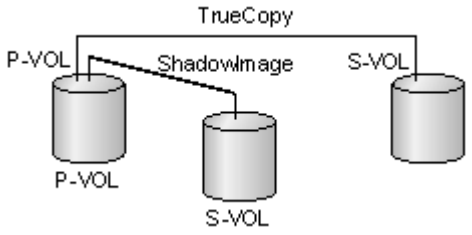


Figure 4-1 Shared TC P-VOL with SI P-VOL

In this configuration, you can only delete TC pairs when the SI P-VOL status is RCPY. The following table shows possibilities of TC pair operations according to the SI P-VOL status.

SI P-VOL status	TC pair operations				
	Create	Split	Resync	Delete	Switch operations between the primary and secondary sites (horctakeover)
COPY(PD)/ COPY COPY(SP)/ COPY COPY(RS)/ COPY	Yes	Yes	Yes	Yes	Yes
PAIR	Yes	Yes	Yes	Yes	Yes
PSUS(SP)/ PSUS	Yes	Yes	Yes	Yes	Yes
PSUS PSUE	Yes	Yes	Yes	Yes	Yes
COPY(RS-R)/RCPY	No	No	No	Yes	No

- In the following figure, the TC S-VOL also functions as a SI P-VOL. In this configuration, SI provides another (or several more) backup copies of a TC P-VOL.

  When a SI P-VOL is shared with the TC S-VOL, the write operation to the TC P-VOL takes a longer time than normal. This is especially true when the SI pair is in the PSUS(SP)/PSUS status and is caused by the SI copying process.

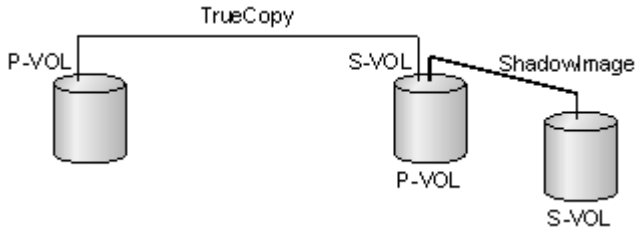


Figure 4-2 Shared TC S-VOL with SI P-VOL

In this configuration, you can only delete TC pairs when the SI P-VOL status is RCPY. The following table shows possibilities of TC pair operations according to the SI P-VOL status.

SI P-VOL status	TC pair operations				
	Create	**Split**	**Resync**	**Delete**	**Switch operations between the primary and secondary sites (horctakeover)**
COPY(PD)/ COPY COPY(SP)/ COPY COPY(RS)/ COPY	Yes*	Yes	Yes	Yes	Yes
PAIR	Yes*	Yes	Yes	Yes	Yes
PSUS(SP)/ PSUS	Yes*	Yes	Yes	Yes	Yes
PSUS PSUE	Yes*	Yes	Yes	Yes	Yes
COPY(RS-R)/RCPY	No	No	No	Yes	No
* If the TC P-VOL and TC S-VOL are DP-VOLs, the TC S-VOL cannot be used as the SI P-VOL.					

- In the following figure, the configurations shown in the previous two figures are combined. Both the TC P-VOL and S-VOL function as SI P-VOLs, providing multiple copies at the local and remote sites.

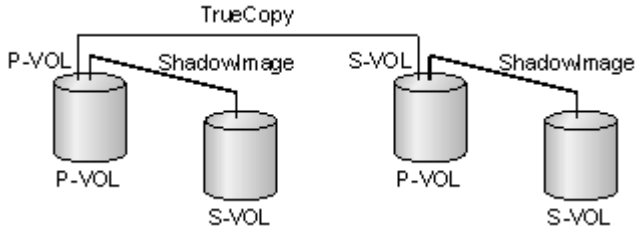


Figure 4-3 Shared TC P-VOL, S-VOL with multiple SI P-VOLs

In this configuration, you can only delete TC pairs when the SI P-VOL status is RCPY. The following table shows possibilities of TC pair operations according to the SI P-VOL status.

SI P-VOL status	TC pair operations				
	Create	Split	Resync	Delete	Switch operations between the primary and secondary sites (horctakeover)
COPY(PD)/ COPY COPY(SP)/ COPY COPY(RS)/ COPY	Yes*	Yes	Yes	Yes	Yes
PAIR	Yes*	Yes	Yes	Yes	Yes
PSUS(SP)/ PSUS	Yes*	Yes	Yes	Yes	Yes
PSUS PSUE	Yes*	Yes	Yes	Yes	Yes
COPY(RS-R)/RCPY	No	No	No	Yes	No
* If the TC P-VOL and TC S-VOL are DP-VOLs, the TC S-VOL cannot be used as the SI P-VOL.					

Configurations with ShadowImage S-VOLs

In the following figure, a SI S-VOL also functions as a TC P-VOL. This configuration requires that the SI pair is split before the TC pair is created.

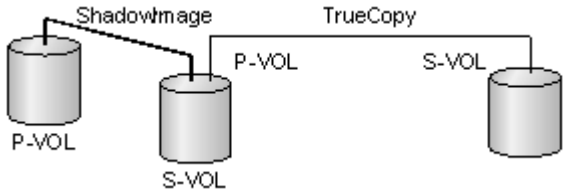


Figure 4-4 Shared SI S-VOL with TC P-VOL

In this configuration, before creating a TC pair, you must set the SI pair in the PAIR status, split the SI pair, and then set it in the PSUS status. The following table shows possibilities of TC pair operations according to the SI S-VOL status.

SI S-VOL status	TC pair operations				
	Create	Split	Resync	Delete	Switch operations between the primary and secondary sites (horctakeover)
COPY(PD)/ COPY COPY(SP)/ COPY COPY(RS)/ COPY	No	No	No	Yes	No
PAIR	No	No	No	Yes	No
PSUS(SP)/ PSUS	No	No	No	Yes	No
PSUS PSUE	Yes	Yes	Yes	Yes	No
COPY(RS-R)/ RCPY	No	No	No	Yes	No

Status reporting and data currency

The following table shows the pair status that is reported for different combinations of shared volumes.

Number of TC pairs	Number of SI S-VOLs	Pair status
0	0	SMPL
0	1	SI pair status
0	2 or more	SI pair status for the S-VOL with lowest LUN
1	0	TC pair status
1	1	TC pair status
1	2 or more	TC pair status

- TC pair status is reported to the host if you query the TC P-VOL or S-VOL. To obtain the SI pair status, query the SI P-VOL pair.
- SI supports multiple S-VOLs for each of its P-VOLs, but when you issue a pair status query, the status is returned only for the pair whose S-VOL has the lowest LUN. To check pair status for the other S-VOLs, direct a host query to the specific S-VOL using the S-VOL's LUN in the host command.

  Device Manager - Storage Navigator displays the status of all S-VOLs.

The following table shows when data is current on a shared TC/SI volume based on the pair statuses.

TC pair status	SI pair status					
	COPY (PD)/ COPY	PAIR	COPY (SP)/ COPY	PSUS	COPY (RS)/COPY, COPY(RS-R)/RCPY	PSUE
COPY	Not Current	Not Current	Not Current	Current	Not Current	Not Current
PAIR	Not Current	Not Current	Not Current	Current	Not Current	Not Current
PSUS (Delete pair to RCU)/ PSUE (pair suspended -error)	Not Current	Current	Current	Current	Current	Not Current

Virtual LUN

Virtual LUN volumes can be assigned to TC pairs, with the following restrictions:

- The S-VOL must have the same capacity as the P-VOL.
- When performing Virtual LUN operations on an existing TC P-VOL or S-VOL, you must release the pair first to return the volume to SMPL status.

For more information, see the *Provisioning Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

Volume Migration

The following table shows when TC volumes may be used as Volume Migration volumes.

Volume/pair status	Used as Volume Migration volume?
P-VOL/S-VOL in COPY status	No
P-VOL/S-VOL in PAIR status	Yes
P-VOL/S-VOL in PSUS status	Yes

Restrictions

The following restrictions must be followed when a TC volume in PAIR status is used as a Volume Migration volume:

- Set I/O rates less than 50 IOPS while migrating volumes; if more than 50 IOPS, volumes may not be migrated.

- If a data path failure occurs, remove the failure, and then migrate the volume.
- If an external volume or a DP-VOL is used, information from before the volume is migrated displays in the secondary system Device Manager - Storage Navigator window. If the Volume Migration is completed and the TC pair is split and resynchronized, the volume's information is updated.
- Do not migrate P-VOL and S-VOL at the same time, or a host I/O timeout will occur.
- Do not change the status of a volume during migration; the status may not change.

Global storage virtualization

You can create TC pairs by using virtual storage machine volumes. The virtual LDEV ID is displayed on Device Manager - Storage Navigator, but you cannot perform pair operations by specifying the virtual LDEV ID. When you perform TC pair operations, specify the physical LDEV ID of the volume. You cannot delete the virtual LDEV ID of the volume used in TC.

5

TC configuration

This chapter provides instructions for configuring TrueCopy.

Configuration workflow

You must have Storage Administrator (Remote Copy) role to perform most TrueCopy operations using Device Manager - Storage Navigator.

Configuration consists of the following operations:

- Check prerequisites for each procedure.
- See Planning pairs and pair volumes on page 3-8.
- On the primary and secondary systems, install the data paths. See Data path requirements and configurations on page 3-25.
- On the primary system, create the TrueCopy association with the secondary system. See Adding remote connections on page 5-2. Remote paths between the systems are added during this procedure.

You may also perform these additional procedures prior to the initial copy:

- Add additional remote paths. See Configuring additional remote paths on page 7-14.
- Specify the number of volumes to copy at one time. See Changing remote replica options on page 5-4.

Adding remote connections

You configure the storage systems for TrueCopy by adding a remote connection from the primary system to the secondary system. Adding the connection and setting up remote paths prepares the systems for TC commands and operations.

Caution: Do not add or delete a remote connection or add a remote path at the same time that the SCSI path definition function is in use.

Prerequisite information

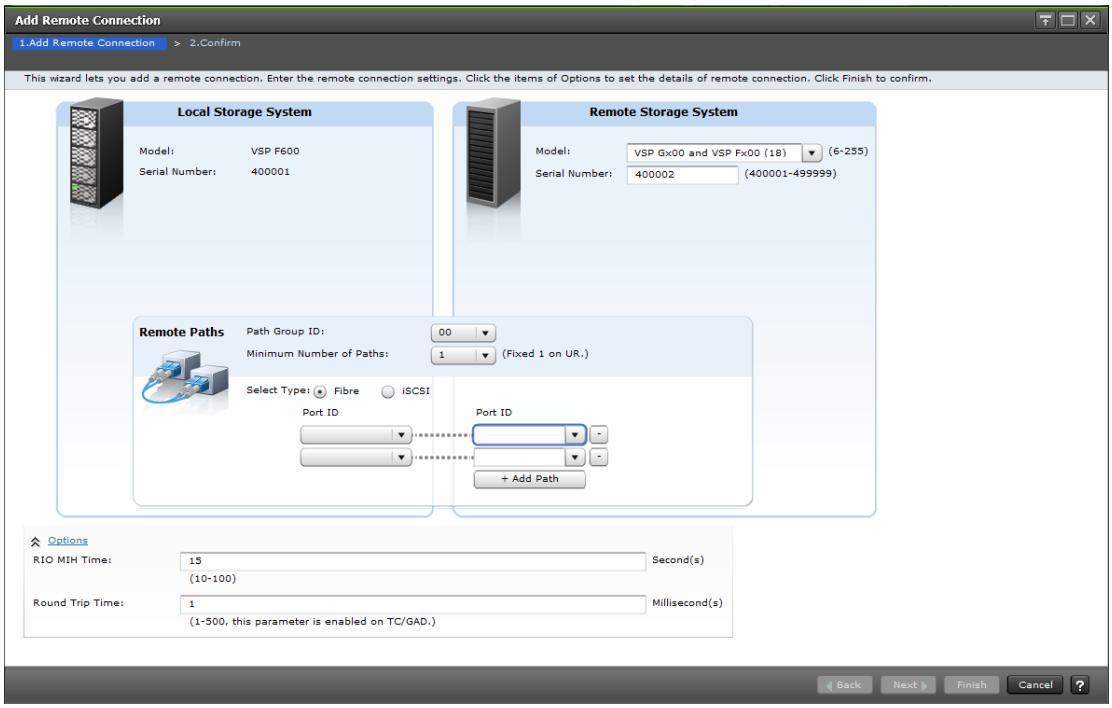
- This procedure is performed on the primary system.
- The data path must be set up. See Data path requirements and configurations on page 3-25.
- The secondary system serial number, LDKC, controller ID, path group ID, and port numbers are required.
- One of the fields, **Round Trip Time**, is covered extensively in Determining Round Trip Time on page 3-5.
- Another field, **Minimum Number of Paths**, is also covered in more detail in Determining Minimum Number of Remote Paths on page 3-7.
- Remote path settings are required to perform TC pair operations and check pair status in Device Manager - Storage Navigator. Make sure to complete the procedure. If you cancel remote path settings, you will be unable to perform operations and check status.

Also, operations involving remote paths cannot be performed when changing the firmware. Make sure a firmware change completes before beginning operations involving remote paths.

- When using virtual storage machine volumes, make sure to specify the physical serial number of the storage system, not the serial number of the virtual storage machine.

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connections**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connections**.
2. In the **Remote Connections** window, click **Connections (To)** tab.
3. In the **Connections (To)** tab, click **Add Remote Connection**.



4. In the **Remote Storage System** box, specify the following:
   a. For **Model**, select the storage system model.
   b. For **Serial Number**, select the serial number.

Note: When using virtual storage machine volumes, make sure to specify the physical serial number of the storage system, not the serial number of the virtual storage machine.

5. In the **Remote Paths** box, specify the following:
   a. For **Path Group ID**, select the path group ID (00-FF). A storage system can have a maximum of 64 registered path group IDs.
   b. For **Minimum Number of Paths**, select the minimum number of paths between the secondary and primary system. If the number of paths drops below the minimum, the primary system splits the pair. The maximum is 8; the default is 1.
   c. For **Select Type**, select the port type, and then select the port to be used for both the local storage system and the remote storage system. If you select **iSCSI**, enter the IP address and the TCP port number for the remote storage system port. You can add more paths by clicking the **Add Path** button. You can also add and delete paths in the **Add Remote Paths** window if necessary.
6. Click **Options** to access additional settings, which are optional.
   a. For **RIO MIH Time**, enter an interval in seconds that, if exceeded, causes the data-transfer operation to be reported as failed by the system. Values range from 10 seconds to 100 seconds; 15 is the default. RIO MIH means "remote I/O missing interrupt handler".
   b. For **Round Trip Time**, enter a time limit for data copy from P-VOL to S-VOL. Range is 1-500 milliseconds.
7. Click **Finish**.
8. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
9. Click **Apply** to save your settings in the system.

Changing remote replica options

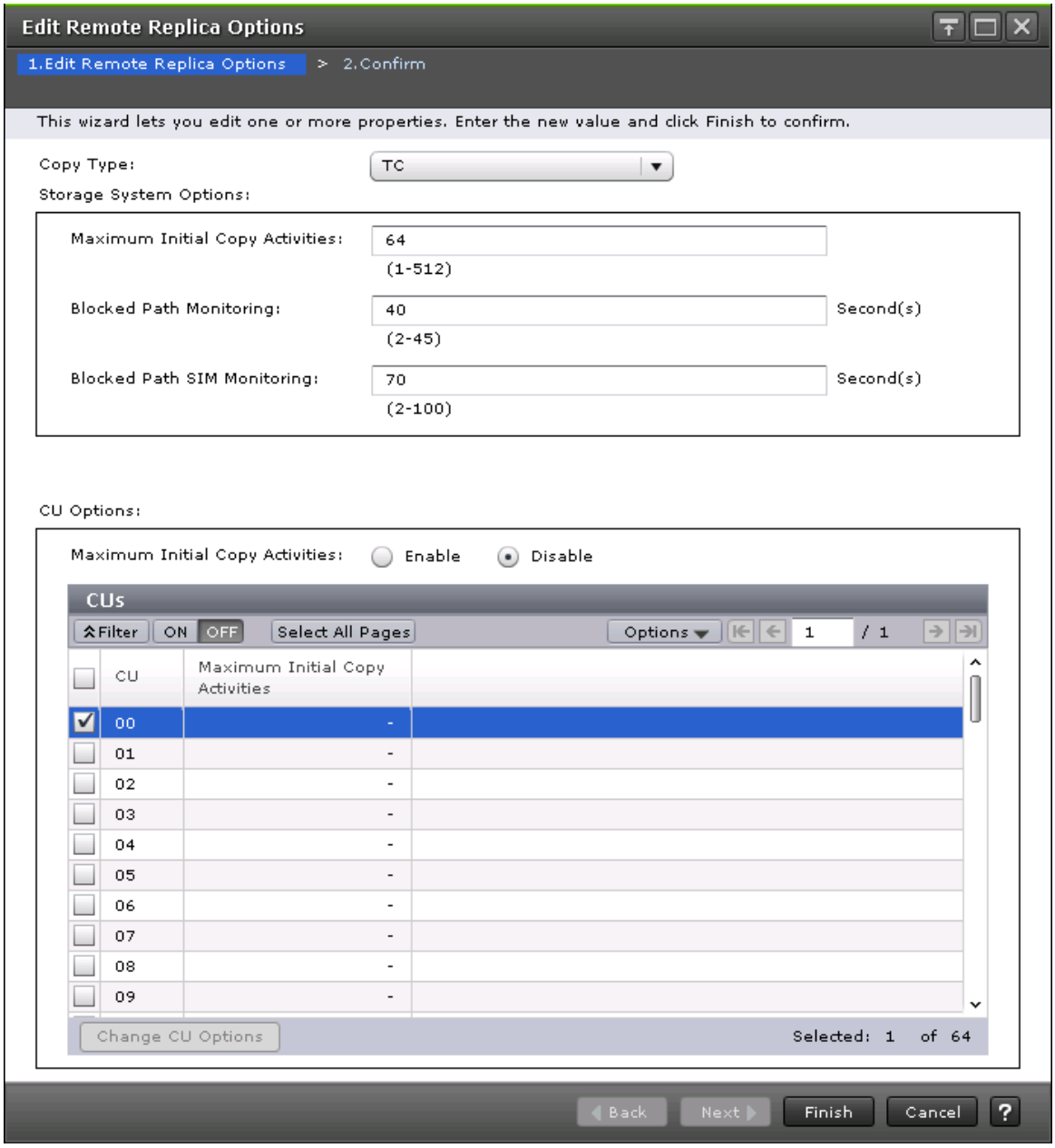
You can specify the following options that affect the TC system. These options can be set at any time (before or after the initial copy).

- The number of volumes that are copied concurrently during the initial copy. Find related information in Priority for initial copy operations and scheduling order on page 3-15.
- The amount of time the system monitors for blocked paths.
- The amount of time the system monitors for path-watch related SIMs.

Note: If iSCSI is used in a remote path, the Blocked Path Monitoring remote replica option must be set to at least 40 seconds (default). If Blocked Path Monitoring is less than 40 seconds, the path might be blocked due to a delay in the network such as many switches in a spanning tree protocol (STP) network or a long distance connection.

Procedure

1. Open the **Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Replication Dashboard**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication**.
2. In the **Replication** window, click **Edit Options > Remote Replication**.
3. In the **Edit Remote Replica Options** window, for **Copy Type**, select **TC**.



4. Change **Storage System Options** as needed. Settings apply to the storage system.

   a. For **Maximum Initial Copy Activities**, specify the number of volumes to be copied concurrently per initial copy operation. The range is from 1 to 512 volumes; 64 is the default. Note the following:

   - This setting may impact performance on the primary system. This depends on the number you specify and the amount of I/O activity. The default may or may not limit the impact on performance, depending on your number of data paths, pairs, and so on. You should consider these factors when making a selection.

   - When you create or resynchronize a greater number of pairs than you specify in Maximum Initial Copy Activities, the system processes

the specified maximum number, and starts additional pairs after one of the specified number is synchronized.

For example, if you specify 70 for **Maximum Initial Copy Activities** and then create 75 pairs, the system starts the first 70 pairs but does not start the 71st pair until one of the pairs is synchronized.

b. For **Blocked Path Monitoring**, enter the number of seconds for the system to monitor blocked paths. The range is from 2 to 45 seconds; 40 is the default.

   If all paths become monitored because of path error, an MIH may occur in the host. Therefore, the time you specify must be less than the host's MIH timer setting.

c. For **Blocked Path SIM Monitoring**, enter the number of seconds for the system to monitor SIMs reported for blocked paths. The range is from 2 to 100 seconds.

d. For **Services SIM of Remote Copy**, specify whether or not services SIMs in the remote CU are reported to the host.

5. Change **CU Options** as needed. Settings apply to the CU only.

   a. Select the **CU** with the options to be changed, and then click **Change CU Options**. If you do not want to change CU options, click **Finish**.

   b. In the **Change CU Options** dialog box, for **Maximum Initial Copy Activities**, specify the number of volumes to be copied concurrently per initial copy operation for the CU. The range is from 1 to 16 volumes.

      This option is available only when **Maximum Initial Copy Activities** is **Enable**.

   c. For **Services SIM of Remote Copy**, specify whether or not services SIMs in the remote CU are reported to the host.

   d. Click **OK**.

6. In the **Edit Remote Replica Options** window, click **Finish**.
7. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
8. Click **Apply** to save your settings in the system.

6

TC pair operations

This chapter provides instructions for performing TrueCopy pair operations.

Pair operations workflow

You must have Storage Administrator (Remote Copy) role to perform TrueCopy operations.

Basic TrueCopy operations consist of the following operations.

- Check prerequisites for each procedure.
- Always check pair status. Each TrueCopy operation requires the pair to be in a specific status.
- Create a pair, in which the S-VOL becomes a duplicate of the P-VOL.
- Split a pair, which separates the P-VOL and S-VOL and allows read/write access to the S-VOL if desired.
- Resynchronize a pair, in which the S-VOL again mirrors the on-going, current data in the P-VOL.
- Delete a pair.

Disaster recovery procedures are discussed in Chapter 9, Disaster recovery on page 9-1.

Note: To perform pair operations or check the pair status, LU paths must be established. If you intend to perform storage or replication management operations, make sure that pairs are deleted before removing LU path definitions.

Note: Pair operations cannot be performed when changing the firmware, nor if firmware changes are cancelled. If you start a firmware change, make sure it completes before performing pair operations.

Note: When the following conditions occur during TC pair duplication, sometimes the split operation prioritizes update I/O rather than TC pair duplication.

- The MP unit processor operation rate to which the P-VOL belongs is 70% or above in the primary system.
- The update I/O inflow of the P-VOL is large in the primary system.
- The MP unit write-pending to which the S-VOL belongs is 65% or above in the secondary system.

When creating or resynchronizing a TC pair, be aware of the storage system load at each site.

Checking pair status

Every TrueCopy operation requires that the pairs have a specific status. Before performing any operation, check pair status.

- Find status requirements under the prerequisite information for each operation.
- To view a pair's current status in the GUI, or review status definitions, see Monitoring pair status, license capacity on page 7-2.

Creating pairs

When you create a pair, all data in the P-VOL on the primary system is copied to the S-VOL on the secondary system. The P-VOL remains available to the host for I/O operations during the initial copy operation.

Prerequisite information

- You must create pairs from the primary system.
- S-VOLs must be offline to all hosts.
- Ports must be configured for TrueCopy.
- The primary and secondary systems must be configured for TrueCopy. See Adding remote connections on page 5-2 for more information.
- The logical units on the primary and secondary storage systems must be defined and formatted prior to pairing.
- The P-VOL capacity and S-VOL capacity must be the same size (same number of blocks). To view the capacity in blocks, click **Options > Capacity Unit > block** in the **Logical Devices** window. If the capacity is displayed in GB or TB, a slight difference in P-VOL and S-VOL capacity might not be displayed.
- Stop Performance Monitor before the initial copy to avoid overloading with TCP/IP traffic.
- During this operation, you select P-VOLs and S-VOLs by Port ID, Host Group ID or iSCSI target ID and LUN.
- During this operation, you can specify multiple P-VOLs to be paired, but only one S-VOL. To plan how the system assigns subsequent S-VOLs, see the bullet, "When creating multiple pairs concurrently...." in Pair volume requirements and recommendations on page 3-9.
- During this operation, you can specify whether to fence the P-VOL when an error occurs. This is discussed in detail in Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10.
- During this operation, you can specify the priority for initial copy operations. When performing more initial copies than specified for Maximum Initial Copy Activities (during configuration), see the discussion in Priority for initial copy operations and scheduling order on page 3-15.

Procedure

1. Open the **Remote Replication** window.

   In Hitachi Command Suite:

   a. On the **Resources** tab, expand the **Storage Systems** tree.

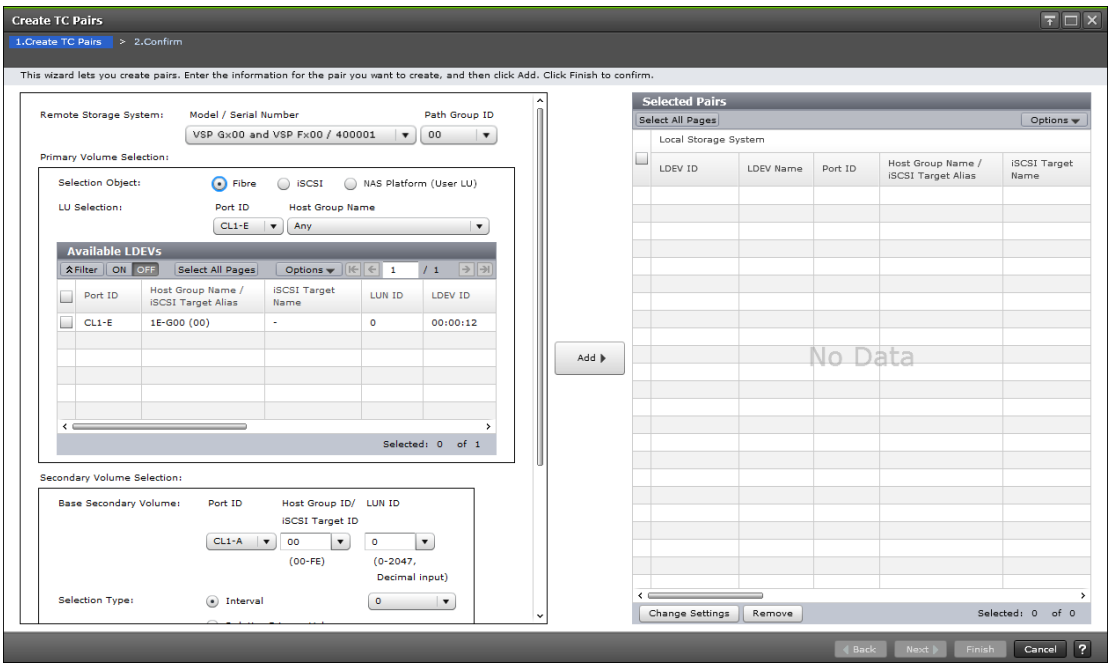
   b. Right-click the target storage system, and click **Remote Replication**.

   In Device Manager - Storage Navigator:

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

   b. In the Storage Systems tree, click **Replication > Remote Replication**.

2. In the **Remote Replication** window, click the **TC Pairs** tab, and then click **Create TC Pairs**.



3. For **Remote Storage System**, select the following:
   - The secondary system's **Model/Serial Number** and **Path Group ID**.

Note: VSP Gx00 is displayed for VSP Gx00 models and VSP Fx00 models.

   - For **Path Group ID**, select the path group ID.
4. In **Primary Volume Selection**, for **Selection Object**, select the port type for the local storage system.
5. In the **Primary Volume Selection** box, for **LU Selection**, select the **Port ID** and **Host Group Name** or **iSCSI Target Alias**. Selecting **Any** places all LUNs within the specified port in the **Available LDEVs** table. No further action is required at this time.

Note: Available LDEVs limitations:

- When using a virtual storage machine, **Available LDEVs** displays the physical LDEV information, not virtual.
- Nondisruptive migration volumes are not displayed in **Available LDEVs**.

6. In the **Secondary Volume Selection** box, specify the following:
   a. For **Base Secondary Volume**, select the initial S-VOL's **Port ID**, **Host Group ID / iSCSI Target ID**, and **LUN ID**. If you are selecting only one P-VOL, this LU is the secondary volume. If you select multiple P-VOLs for pairing, this LUN is the base S-VOL that is assigned to the first P-VOL and from which subsequent S-VOL LUNs are assigned to the list of P-VOLs.

Caution: In the USP V/VM and VSP models, LUN IDs are displayed as hexadecimal numbers. In the VSP Gx00 models and VSP Fx00 models, LUN IDs are displayed as decimal or hexadecimal numbers. If you have selected the decimal notation, when assigning an S-VOL in a USP V/VM or VSP storage system, make sure to convert the hexadecimal LUN ID number to decimal.

b. For **Selection Type**, select the method for assigning S-VOLs when multiple primary volumes are selected.

   - With **Interval**, specify an interval the system skips between secondary system LU numbers.

c. - With **Relative Primary Volume**, the system assigns secondary system LU numbers based on proximity to P-VOL LU numbers.

7. Click **Options** to define the following optional settings:

   a. For **Primary Volume Fence Level**, specify whether the primary system allows or rejects write operations to the P-VOL when the pair is split due to an error.

      - **Data**: The P-VOL cannot be written to.

      - **Status**: The P-VOL can be written to if the primary system can change S-VOL status to PSUE; otherwise it cannot be written to.

      - **Never**: The P-VOL can always be written to.

   b. For **Initial Copy Type**, specify whether to copy data from P-VOL to S-VOL during the operation.

      - **Entire Volume** creates the pair and copies data to the S-VOL. (Default)

      - **None** creates the pair but data is not copied to the S-VOL. This requires that data in the P-VOL and S-VOL are already identical.

   c. For **Copy Pace**, specify the number of tracks to be copied per remote I/O during the operation. The default is 15 (fast copy pace). To change the copy pace, enter a number from 1 to 4. This option affects performance as follows:

      - The speed of 1 is a slow copy pace, and is used to reduce impact on host I/O.

      - The speeds of 2 and 3 are a medium copy pace.

      - The speed of 4 is a fast copy pace, and the host I/O performance might be degraded.

      If you enter a number from 5 to 15, the speed of 4 (fast copy pace) is used.

   d. For **Initial Copy Priority**, specify the scheduling order for the initial copy operation. The range is 1 to 256; 32 is the default.

      If a time-out error occurs during this operation, the order specified in Initial Copy Priority may not run as expected. A time-out error can occur because of the CU configuration or data path error. Review the error, delete the pair with an error, and then retry the operation.

8. Back again in the **Primary Volume Selection** box, select the primary volume to be copied first and click **Add**. The volume and pair information moves to the **Selected Pairs** table.

In the **Selected Pairs** table, you can change pair options by selecting it and clicking **Change Settings**. Remove a pair by selecting it and clicking **Remove**.

9. Click **Finish**.
10. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
11. Click **Apply** to save your settings in the system.

Splitting pairs

You can split a pair, which suspends data copying to the S-VOL.

When a pair is split:

- I/O writes from the host continue to the P-VOL, but stop to the S-VOL.
- Any current update copy operation completes to the S-VOL, ensuring data consistency to the point of the split operation.
- Pair status changes to PSUS.
- The primary system records the updated tracks to the P-VOL that occur after the split as differential data. This data is copied to the S-VOL when the pair is resynchronized.
- You can set an option to block updates to the P-VOL while the pair is split. This results in the P-VOL and S-VOL staying synchronized.
- Another option is to enable system write to the S-VOL from a host. The secondary system records the updated tracks as differential bitmaps. When the pair is resynchronized, the secondary system sends the differential bitmaps to the primary system, which merges all differential bitmaps to determine which tracks are out-of-sync.

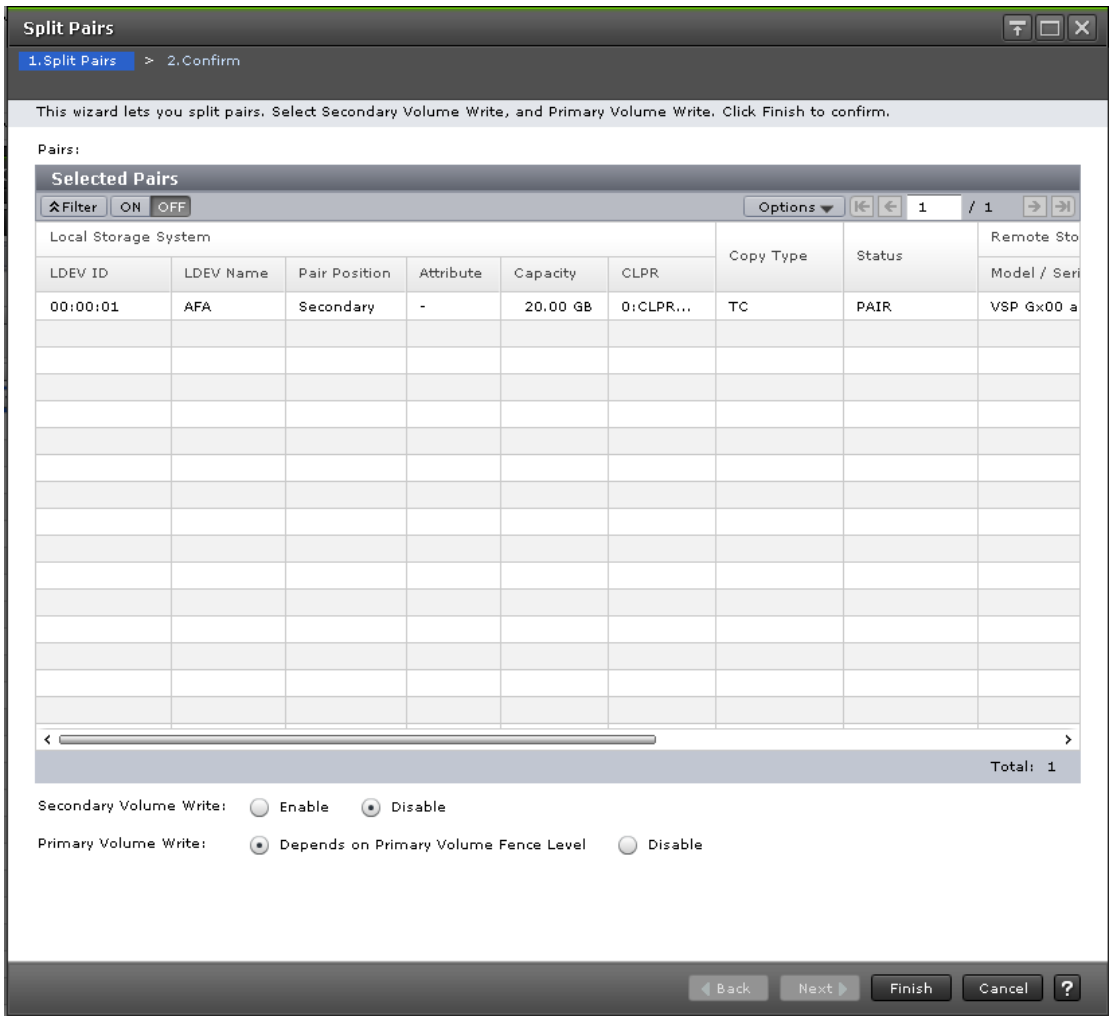
Prerequisite information

- Pair status must be COPY or PAIR.

Procedure

1. Open the **Remote Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, select the pair to be split, and then click **Split Pairs**.

3. In the **Split Pairs** window, ensure that the pair to be split appears in the **Selected Pairs** table.



4. For **Secondary Volume Write**, specify whether the host can write to the S-VOL while the pair is split.
   - **Enable**. Accepts host writes to the S-VOL. Note the following:

     - If you plan to resynchronize the pair after the S-VOL has been written to while split, you must select **Depend on Primary Volume Fence Level** for the **Primary Volume Write** option, below. This ensures that P-VOL and S-VOL bitmaps are merged when the pair is resynchronized.

     - If you specify Enable for this option, and also need the P-VOL to continue accepting host I/O, make sure to select **Depend on Primary Volume Fence Level** for **Primary Volume Write**.

     Enable is only available when performing the split operation from the pair's primary storage system.
   - **Disable** (default), to cause host input to be rejected by the S-VOL while the pair is split.
5. For **Primary Volume Write**, specify whether writing to the P-VOL is enabled while the pair is split.

- **Depend on Primary Volume Fence Level**: Writing to the P-VOL is based on fence level specified during the Create Pairs operation. This is the default.
- **Disable**: Write I/Os to the P-VOL are rejected regardless of the fence level. Select this option to maintain synchronization of the P-VOL and S-VOL. Do not select this option if the P-VOL is necessary for host system operations.

  Disable is only available when performing the split operation from the pair's primary storage system.

6. Click **Finish**.
7. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
8. Click **Apply** to save your settings in the system.

Resynchronizing pairs

While a TrueCopy pair is split, the primary system does not perform update copy operations to the S-VOL. Resynchronizing the pair updates the S-VOL with differential data accumulated since the split, so that its data is again identical with the P-VOL's data. Update copy operations begin again to the S-VOL.

When resynchronizing, TrueCopy pairs can be migrated to High Availability Manager. See the *Hitachi High Availability Manager User Guide*.

Prerequisite information

- Pair status must be PSUS or PSUE.
- This operation is performed from the primary system only.

Procedure

1. Open the **Remote Replication** window.

   In Hitachi Command Suite:

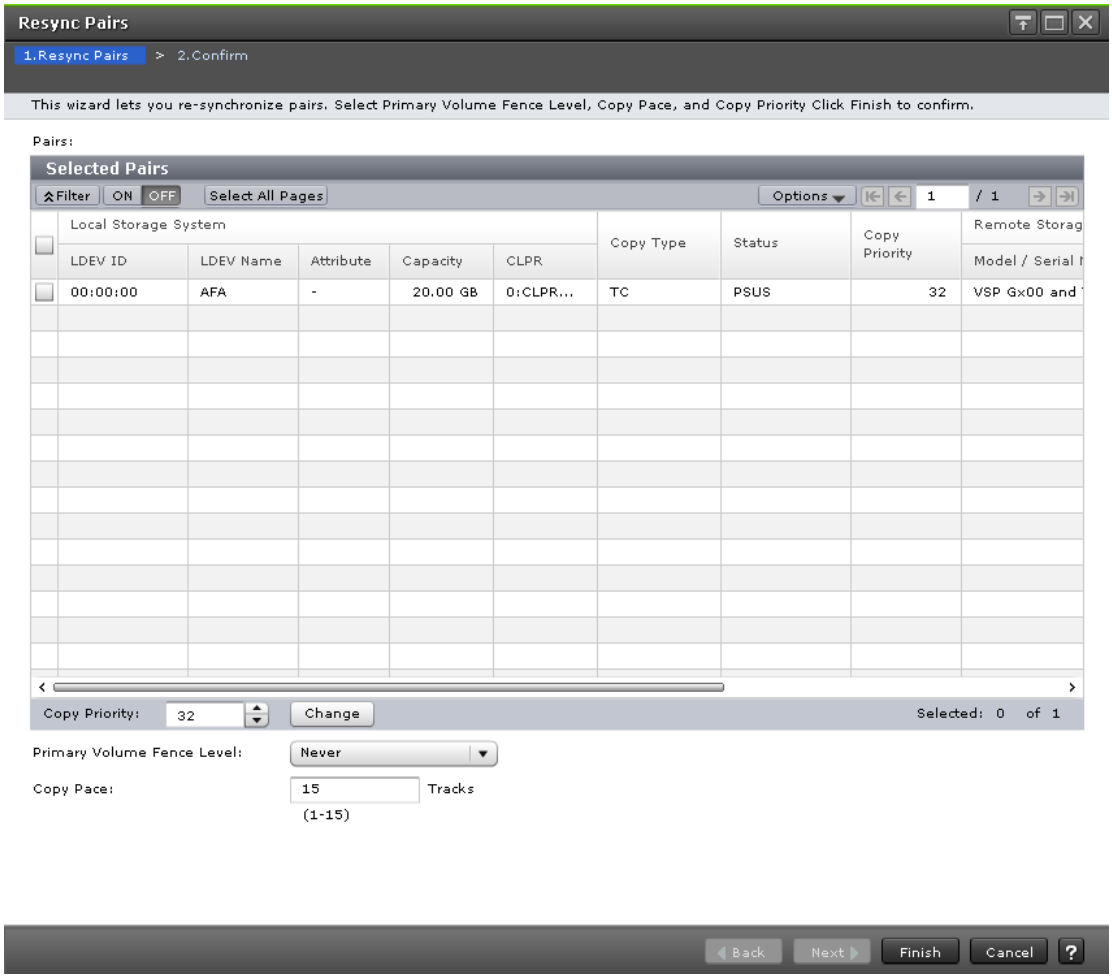
   a. On the **Resources** tab, expand the **Storage Systems** tree.

   b. Right-click the target storage system, and click **Remote Replication**.

   In Device Manager - Storage Navigator:

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

   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, and then select the pairs to be resynchronized.
3. In the **TC Pairs** tab, click **Resync Pairs**.
4. In the **Resync Pairs** window, ensure that the pair to be resynchronized appears in the **Selected Pairs** table.



5. For **Primary Volume Fence Level**, specify whether the primary system rejects write operations to the P-VOL when the pair is split due to an error.
   - - **Status**: The P-VOL cannot be written to only if the primary system is not able to change S-VOL status to PSUE.
   - - **Never**: The P-VOL can always be written to.
   - - **Data**: The P-VOL cannot be written to.

   For more information, see Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10.
6. For **Copy Pace**, specify the number of tracks to be copied during the initial copy. The default is 15 (fast copy pace). To change the copy pace, enter a number from 1 to 4. This option affects performance as follows:
   - The speed of 1 is a slow copy pace, and is used to reduce impact on host I/O.
   - The speeds of 2 and 3 are a medium copy pace.
   - The speed of 4 is a fast copy pace, and the host I/O performance might be degraded.

   If you enter a number from 5 to 15, the speed of 4 (fast copy pace) is used.

7. For **Copy Priority**, enter the priority, or scheduling order, for the resync operation. You can set priority from 1 to 256. The default is 32. For more on priority, see the descriptions in Priority for initial copy operations and scheduling order on page 3-15.
8. Click **Finish**.
9. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
10. Click **Apply** to save your settings in the system.

Deleting pairs

A TrueCopy pair can be deleted. Doing this deletes the TC relationship, though not the volumes or their data.

- When it is no longer necessary to maintain a remote copy of the P-VOL, delete a pair from the primary system only. All update operations are stopped and pair status for both the P-VOL and S-VOL changes to unpaired.

  When a pair is deleted, the primary system continues to accept write I/O to the former P-VOL but does not keep track of the updates.
- Delete a pair from the secondary system only for disaster recovery purposes. When you do this, the secondary system changes the S-VOL pair status to unpaired, and the primary system detects that the S-VOL status is unpaired and then changes the P-VOL status to PSUS (Delete pair to RCU).

  To restart a pair that was deleted from the secondary system, you must delete the pair from the primary system and then create the pair from the primary system.

Note: When you delete a pair from the secondary system, make sure that the S-VOL and P-VOL are identical, including the volume labels. Take all necessary steps to prevent system problems due to duplicate volumes.

Procedure

1. Open the **Remote Replication** window.

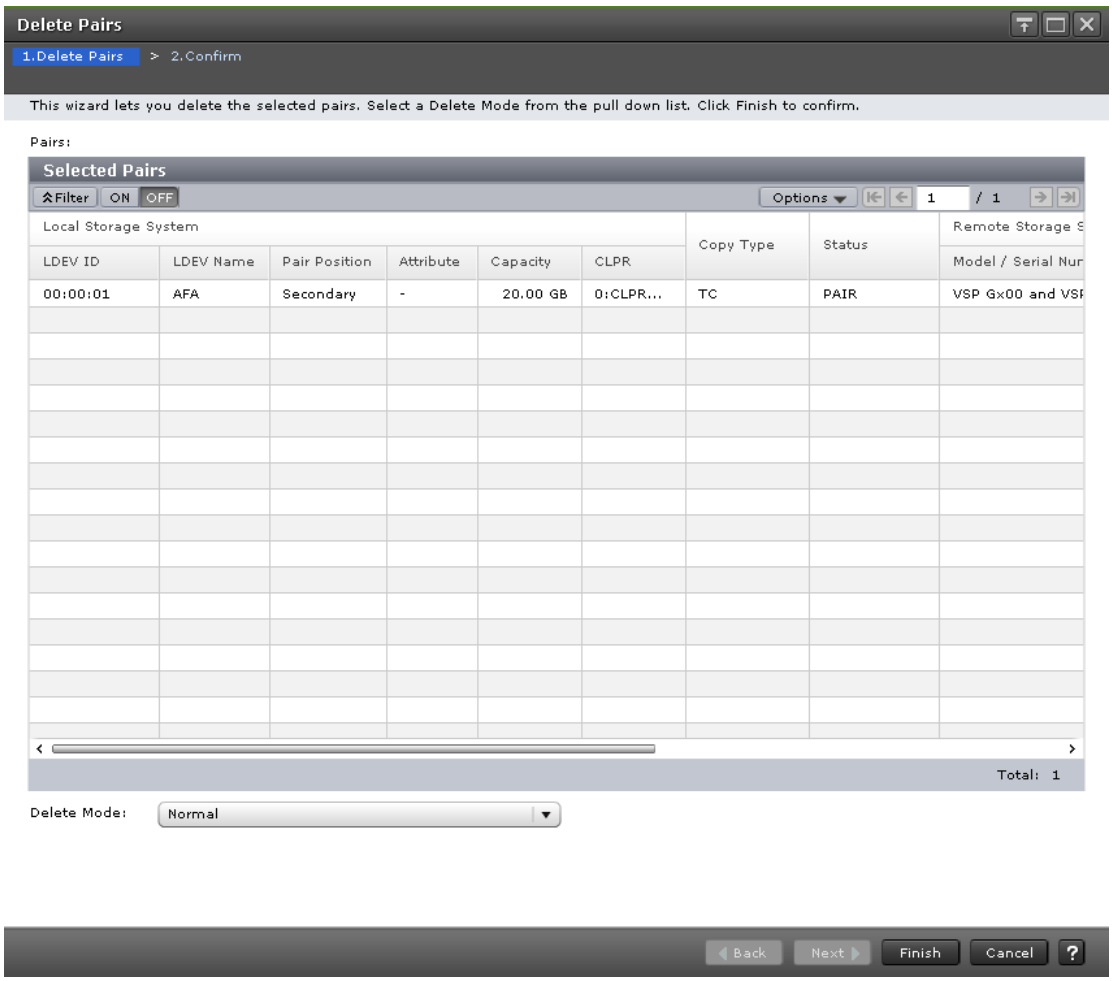
   In Hitachi Command Suite:

   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.

   In Device Manager - Storage Navigator:

   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, and then select the pairs to be deleted.
3. In the **TC Pairs** tab, click **More Actions > Delete Pairs**.

4. In the **Delete Pairs** window, ensure that the pairs to be deleted appear in the **Selected Pairs** table.



5. For **Delete Mode**, specify one of the following:
   - **Normal**: Deletes the pair only if the primary system can change both P-VOL and S-VOL to unpaired volumes.
   - **Force**: Forcibly deletes pairs even when the primary system cannot communicate with the secondary system.
6. Click **Finish**.
7. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
8. Click **Apply** to save your settings in the system.

7

Monitoring and maintaining the TC system

This chapter provides information and instructions for monitoring and maintaining a TrueCopy system.

Monitoring pair status, license capacity

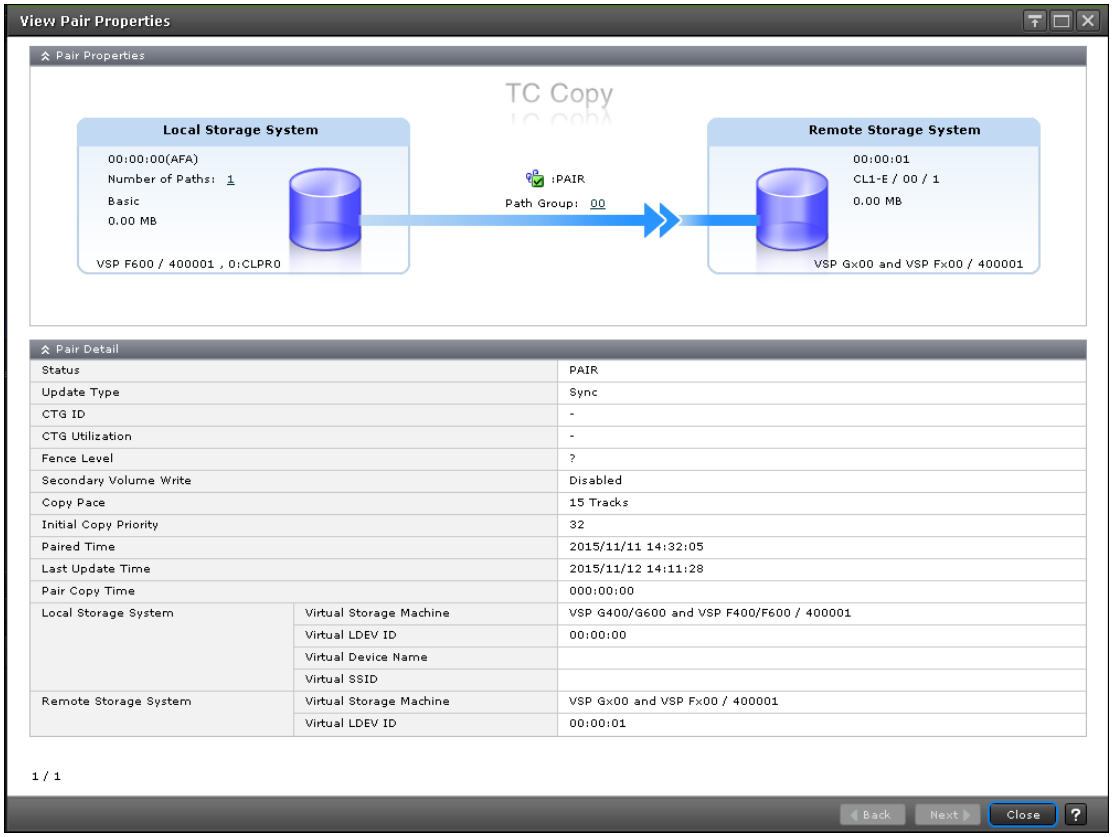
Monitoring the TrueCopy system is an ongoing operation that should be performed frequently to keep track of and maintain your pairs.

- When you want to perform a pair operation, first check the pair's status. Each operation requires a specific status or set of statuses.
- Pair status changes when an operation is performed. Check status to see that pairs are operating correctly and that data is updated from P-VOLs to S-VOLs in PAIR status, or that differential data management is performed in Split status.

Monitoring using the GUI is done manually. Monitoring should be repeated frequently. Email notifications of problems can be set up using the GUI.

Procedure

1. Open the **Remote Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, and then select the pair volume with the status you want to review.
3. In the **TC Pairs** tab, click **More Actions > View Pair Properties** and review **Status**.



For more information, see Pair status definitions on page 7-4.

To monitor license capacity

1. See the **Summary** area in the **Replication** window.

How pair status changes

The primary system changes and maintains the status of the P-VOL and is responsible for keeping the P-VOL and its S-VOL synchronized. The secondary system maintains the status of the S-VOL.

- The primary system can change the status of the P-VOL and S-VOL.
- The secondary system can change the status of the S-VOL but not the P-VOL. When an operation is performed from the secondary system, the primary system detects a status change in the S-VOL and then changes the P-VOL status accordingly.
- The status indicates the state of the volume or pair:
  - When a pair is started, the secondary system changes the status of the P-VOL and S-VOL to COPY. When the initial copy operation is complete, the primary system changes the status of both volumes to PAIR.
  - When you split a pair, the system changes the status of the P-VOL and S-VOL to PSUS.

- When a pair is suspended due to an error condition, the primary/secondary system changes the P-VOL and S-VOL status to PSUE.
- When a pair is deleted from the primary system, that system changes the status of the P-VOL and S-VOL to unpaired.
- When a pair is deleted from the secondary system, that system changes the S-VOL status to unpaired, and the secondary system detects the pair release and changes the P-VOL status to PSUS.

Pair status definitions

Both Device Manager - Storage Navigator and CCI pair status names appear in the **Status** column, except when the names are the same. When they are the same, the CCI status does not appear.

The following table shows both types of status names and their descriptions. In some cases, a particular status has no exact parallel status in the other interface. This is noted.

When checking your pairs' status, click **Refresh** to make sure the data is current. The P-VOL access and S-VOL access columns in the following table indicate whether the volumes accept read/write.

HDvM - SN status	CCI status	Description	P-VOL access	S-VOL access
Unpaired in HDvM - SN	SMPL	This volume is not currently assigned to a TrueCopy pair.	Read/Write	Read/Write
COPY[1]	COPY	The initial copy operation for this pair is in progress. This pair is not yet synchronized.	Read/Write	Read Only
PAIR	PAIR	• The pair is synchronized • Updates from the host to the P-VOL are duplicated in the S-VOL.	Read/Write	Read Only
PSUS (See also Split types on page 7-5.)	SSUS, PSUS	• The pair was split by a user or deleted from the secondary system. The pair is not synchronized. • When you split the pair from the primary system, that system changes the status of the P-VOL and S-VOL to PSUS. • In PSUS status, updates to the S-VOL stop. The storage system keeps track of updates to the P-VOL in order to update the S-VOL when the pair is resynchronized. CCI also shows P-VOL status as PSUS. • When you split the pair from the secondary system, that system changes the status of the S-VOL to PSUS. The primary system detects this and changes P-VOL status to PSUS. CCI shows the S-VOL status as SSUS.	Read/Write	Read only if S-VOL write option is disabled. Read/Write if S-VOL write option is enabled.

HDvM - SN status	CCI status	Description	P-VOL access	S-VOL access
		• When you release the pair from the secondary system, that system changes the S-VOL status to SMPL. The primary system detects this and changes the P-VOL status to PSUS. The pair must be released from the primary system in order to change P-VOL status to SMPL. • CCI PSUS status indicates that although the paired status is retained, the user split the pair. This status is only for the P-VOL. While the pair is split, the storage system keeps track of updates to the P-VOL in the differential bitmaps.		
PSUE (See also Split types on page 7-5.)	PSUE	• If the primary system cannot keep the pair synchronized for any reason, it changes the status of the P-VOL and S-VOL (if possible) to PSUE. • The pair is not synchronized.	Read/Write. Read only if Primary Volume Fence Level is Data.	Read Only
[1] When pair status is COPY, neither cache nor control memory can be added to or removed from the storage system. When either of these tasks is to be performed, first split any pairs in COPY status, and then resynchronize when the cache or control memory operation is completed.				

Split types

This topic discusses pairs that are split by user operation (PSUS), and pairs that are suspended by the system because of failure (PSUE).

- You can split a pair when the initial copy operation is complete.
  - You must split a pair to access the S-VOL (when S-VOL write is enabled).
  - When you split a pair, the primary system ensures synchronization by completing any pending update copy operation before changing the status to PSUS.
- Pairs are split by the primary system only, for any of the following reasons:
  - You released the pair from the secondary system.
  - An error condition related to the secondary system, the S-VOL, or an update-copy operation.
  - The primary system cannot communicate with the secondary system.

Split types appear in the Status field on the View Pair Properties window. The following table describes the split types.

PSUS type	Volume applies to	Description
Primary Volume by Operator	P-VOL	The user split the pair from the primary system specifying Disable for Primary Volume Write. The S-VOL split type is "by MCU".
Secondary Volume by Operator	P-VOL S-VOL	The user split the pair from the primary or secondary system specifying Disable for Primary Volume Write.
by MCU	S-VOL	The secondary system received a request from the primary system to split the pair. The P-VOL split type is Primary Volume by Operator or Secondary Volume by Operator.
Delete pair to RCU	P-VOL	The primary system detected that the S-VOL status changed to SMPL because you released the pair from the secondary system. The pair cannot be resynchronized because the S-VOL does not have the PSUE/PSUS status.
by RCU	P-VOL S-VOL	The primary system detected an error condition at the secondary system (RCU), that caused the primary system to split the pair. The S-VOL split type is S-VOL Failure by Local Storage System.
S-VOL failure	P-VOL S-VOL	The primary system detected an error during communication with the secondary system, or an error during update copy. In this case, the S-VOL split type is usually S-VOL Failure. This split type is also used when the number of paths falls below the minimum number of paths setting on the Add Remote Connection window.
MCU IMPL	P-VOL S-VOL	The primary system could not find valid control information in its nonvolatile memory during IMPL. This condition occurs only if the primary system is without power for more than 48 hours (that is, power failure and fully discharged backup batteries).
Initial copy failed	P-VOL S-VOL	The pair was split before the initial copy operation was complete. The data on the S-VOL is not identical to the data on the P-VOL.

System behavior

Note the following behaviors for split pairs:

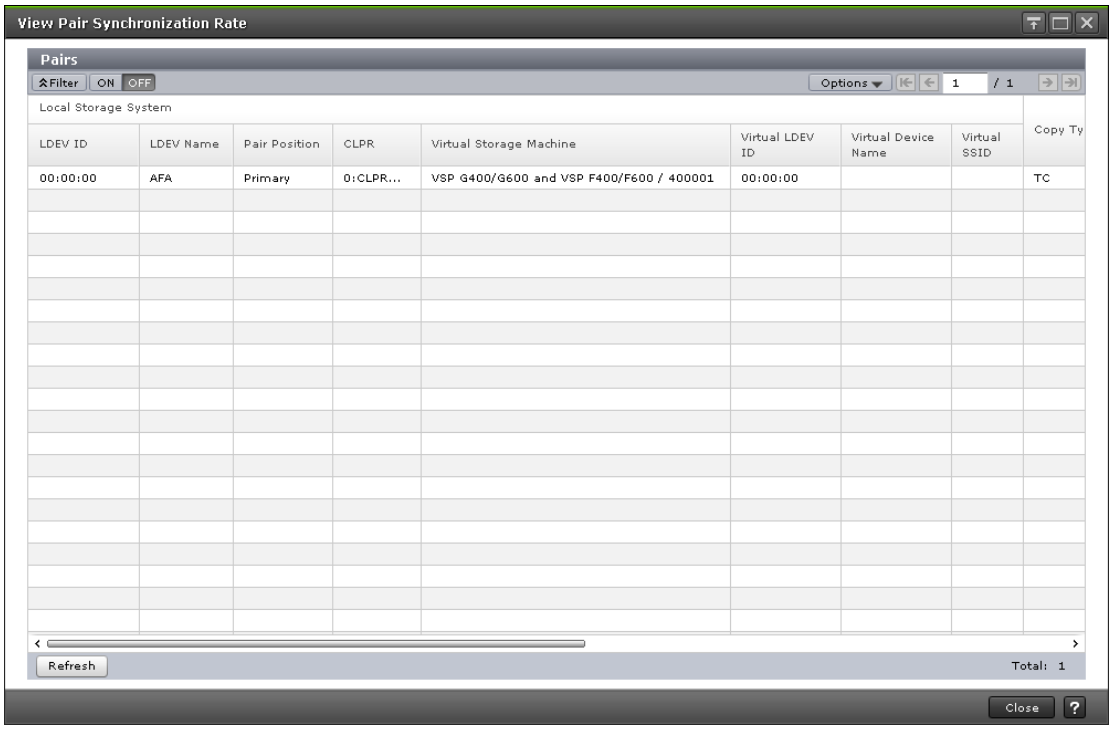
- The primary system stops performing update operations to the S-VOL. It may or may not continue accepting write I/Os to the P-VOL depending on the P-VOL fence level setting.
- If an update fails, the primary system reports a unit check and notifies the host that Write fails. This ensures that both the host system and application program regard the write operation to the P-VOL as failed.
- If the primary system accepts subsequent write I/Os for a split P-VOL, the system records the updated data in the P-VOL tracks as differential data. When a split pair is resynchronized, the primary system copies the out of sync P-VOL tracks to the S-VOL as differential data.

Monitoring TC pair synchronization rate

You can check on the percentage of synchronized data between the P-VOL and S-VOL.

Procedure

1. Open the **Remote Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, and then select the pair whose rate you want to display.
3. In the **TC Pairs** tab, click **More Actions > View Pair Synchronization Rate**.



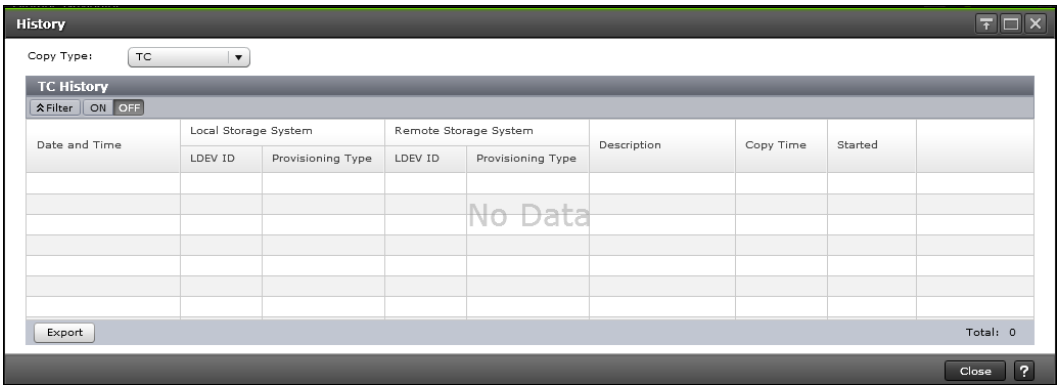
   Clicking **Refresh** displays the latest synchronization rate.

Monitoring TC operations history

You can review a pair's history of operations, including the operation's description, date and time it took place, primary and secondary system information, and other details.

To view a pair's operation history

1. Open the **Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Replication Dashboard**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication**.
2. In the **Replication** window, click **View History > Remote Replication**.
3. In the **History** window, for **Copy Type** click **TC**.



4. The **Description** column displays operations. They are explained below.

Note the following when viewing histories:

- Operation rows may not appear in descending, chronological order.
- A maximum of 8,192 operation histories can be displayed.
- If a failed split occurred with two or more LDEVs at the same time, the number of pairs showing Pair Suspend (Failure) may not match the actual number of pairs in which the failure occurs.
- Even when performing TC pair operations to virtual storage machine volumes with CCI, LDEV ID displays the physical LDEV ID of the volume.
- If you use 1,000 or more pairs concurrently, some operation history might not be recorded.

Operation descriptions

The following table describes the operations shown in the History window.

Operation Displayed	Description
Pair Add Start	Creation of the pair started.
Pair Add Complete	Creation of the pair completed.

Operation Displayed	Description
Pair Delete	The pair was deleted.
Pair Suspend (Operation)	The pair was split.
Pair Suspend (Failure)	The pair was split (suspended) because of a failure.
Pair Resync. start	Resynchronization of the pair was started.
Pair Resync. Complete	Resynchronization of the pair was completed.

Changing the Fence Level

You can change the fence level for each pair.

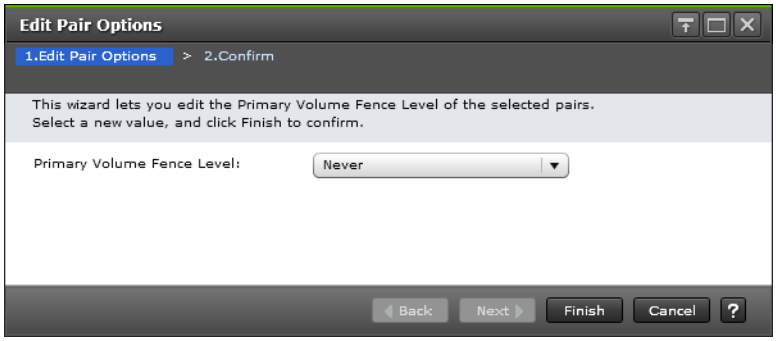
For more information on fence levels, see Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10.

Prerequisite information

- Pair status must be COPY or PAIR.
- The Edit Pair Options window is used for the following procedure. If you select multiple pairs, the values do not display but are blank. When you change a value, the change applies to all selected pairs

Procedure

1. Open the **Remote Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click the **TC Pairs** tab, and then select the pair whose options are to be changed.
3. In the **TC Pairs** tab, click **More Actions > Edit Pair Options**.
4. In the **Edit Pair Options** window, for **Primary Volume Fence Level** box, select the fence level for the pairs.
   - **Never**: The P-VOL can always be written to.
   - **Data**: The P-VOL cannot be written to.
   - **Status**: The P-VOL cannot be written to only if the primary system is not able to change S-VOL status to PSUE.



5. Click **Finish**.
6. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
7. Click **Apply** to save your settings in the system.

Forcibly deleting pairs

You forcibly delete a pair for the following reasons:

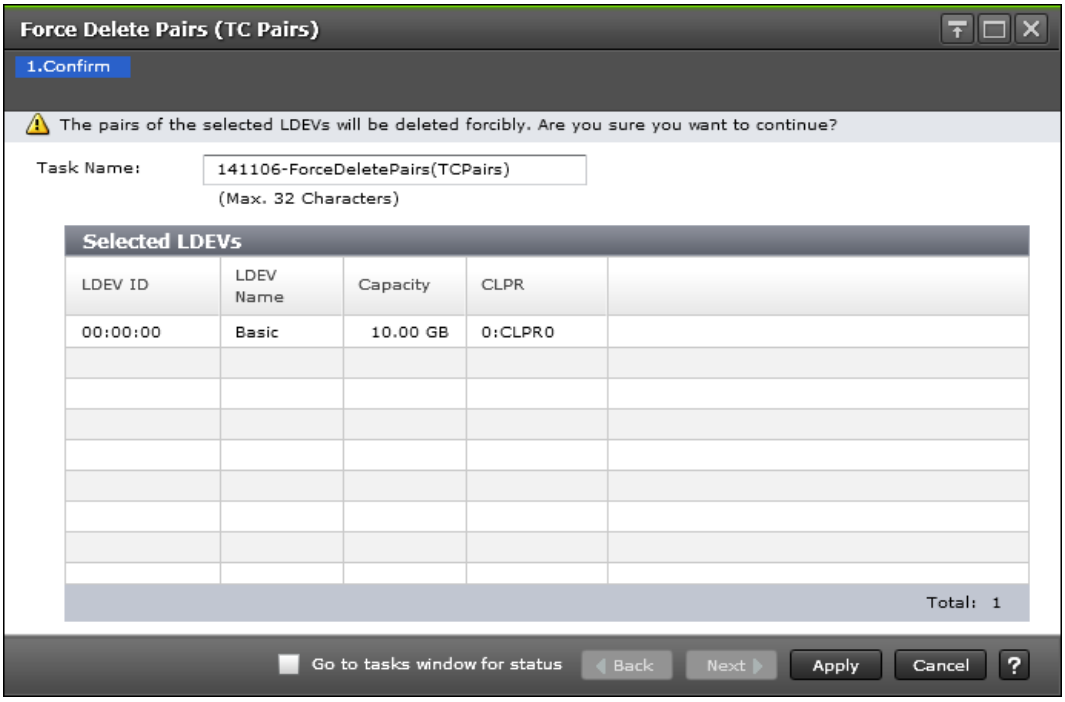
- A currently unpaired volume that was previously in a pair is unusable because previous pair information is still in the volume.
- The pair cannot be connected to the secondary system because of a communication error. In this case, delete the pair forcibly in both primary and the secondary systems.

Prerequisite information

- The volume must be unpaired.

Procedure

1. Open the **Logical Devices** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Expand the target storage system, right-click **Volume**, and then click **System GUI**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Logical Device**.
2. Click the **LDEVs** tab, and then select the pair to be forcibly deleted.
3. In the **LDEVs** tab, click **More Actions > Force Delete Pairs (TC Pairs)**.
4. In the **Force Delete Pairs (TC Pairs)** window, ensure that the volume is in the **Selected LDEV** table.



5. Click **Apply**.

Saving pair information to a text file

You can save pair status and other information to a tab-delimited TSV file.

Procedure

1. Open the **Remote Replication** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Replication**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Replication**.
2. In the **Remote Replication** window, click **More Actions > Export**.
3. If necessary, follow the instructions in online Help.

Monitoring and maintaining remote connections and paths

- Viewing remote connection status and path information on page 7-12
- Configuring additional remote paths on page 7-14

- Changing minimum paths, round trip time, other remote connection options on page 7-15
- Replacing a data path on page 7-17
- Deleting remote paths on page 7-17

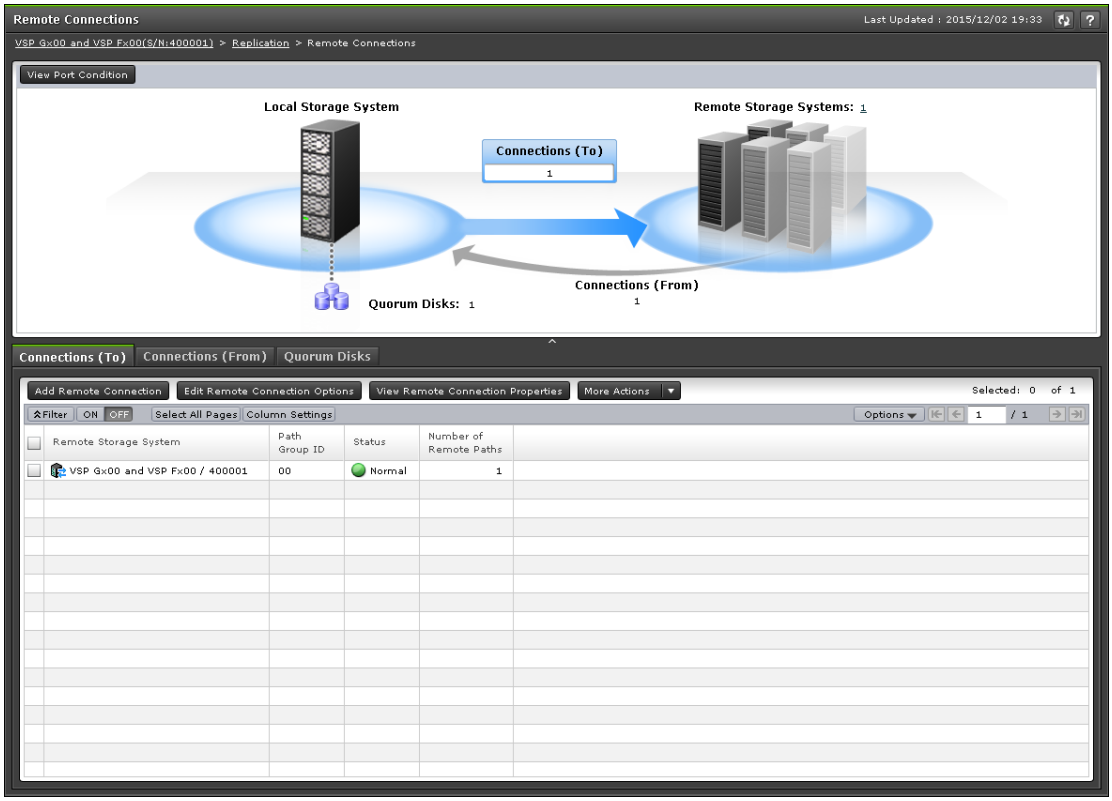
Caution: Do not add or delete a remote connection, or add a remote path at the same time that the SCSI path definition function is in use.

Viewing remote connection status and path information

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connection**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connection**.
2. Click **View Remote Connection Properties** to view connection properties and path information.

3. To check path and port information, from the Storage Systems tree, click **Replication > Remote Connections > Connections (To)**.
   Check connections under **View Port Condition**.
   Check **Status** and other details in the **Connections (To)** tab.



Configuring additional remote paths

You can configure additional remote paths as needed. A maximum of eight remote paths are supported.

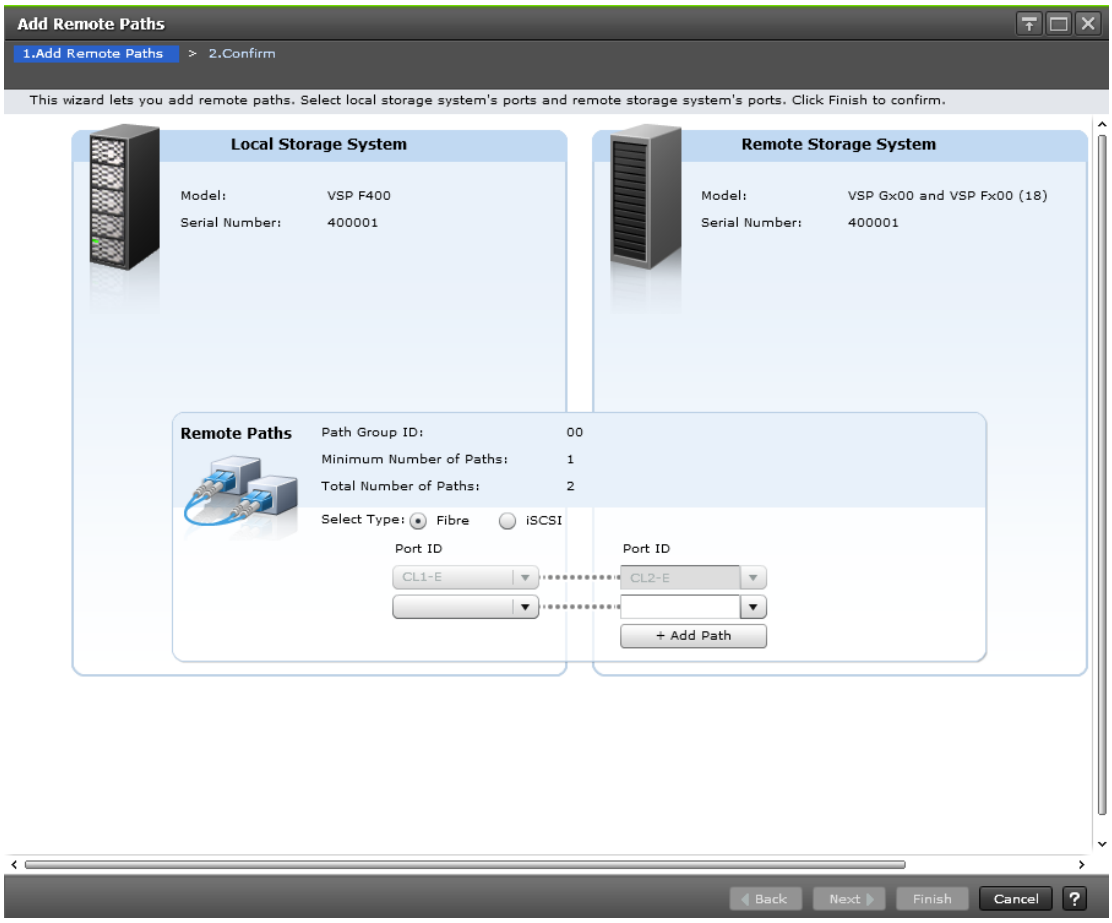
Prerequisite information

- Review the path-related prerequisites in Adding remote connections on page 5-2.

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connections**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connections**.
2. In the **Remote Connections** window, click the **Connections (To)** tab.
3. In the **Connections (To)** tab, select the remote connection where the remote path is to be added.

4. In the **Connections (To)** tab, click **More Actions > Add Remote Paths**.
5. In the **Add Remote Paths** window, select the port type for **Select Type**, and then select the port to be used for both the local storage system and the remote storage system. If you select **iSCSI**, enter the IP address and the TCP port number for the remote storage system port. If you are adding 2 or more paths, click the **Add Path** button.



6. Click **Finish**.
7. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
8. Click **Apply** to save your settings in the system.

Changing minimum paths, round trip time, other remote connection options

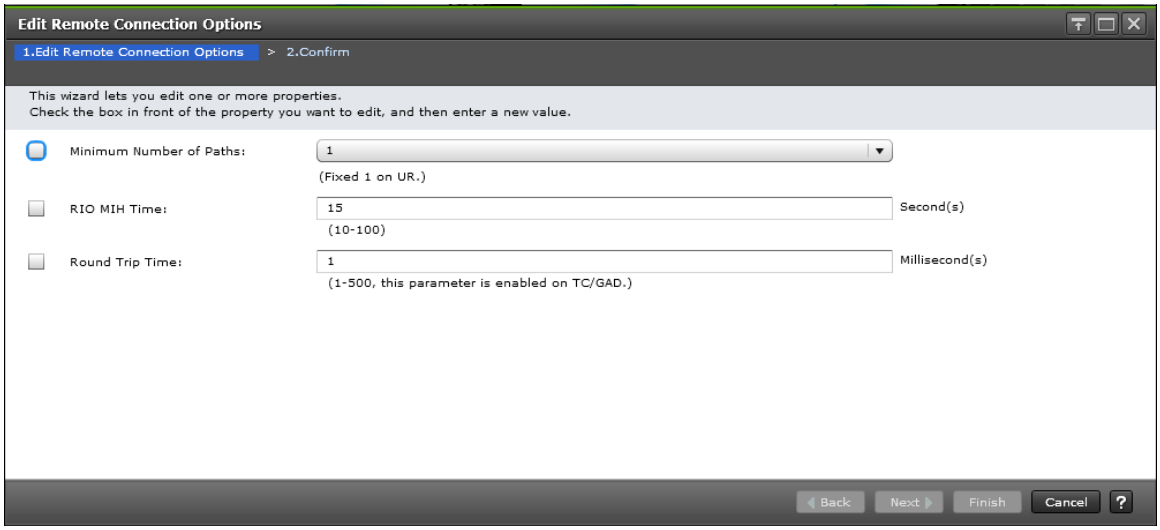
You can change remote connection options that affect how the system runs your copy operations. These are:

- Number of minimum paths for a pair. You can find detailed information in Determining Minimum Number of Remote Paths on page 3-7
- The interval for data transfer to complete (RIO MIH Time).

- Round trip time, the time limit for copying data to the S-VOL. For more information, see Determining Round Trip Time on page 3-5 for more information.

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connections**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connections**.
2. Click the **Connections (To)** tab, and then select the remote connection whose options you want to change.
3. In the **Connections (To)** tab, click **Edit Remote Connection Options**.
4. In the **Edit Remote Connection Options** window, for **Minimum Number of Paths** select the minimum number of paths between the remote and primary system.



5. For **RIO MIH Time**, enter an interval in seconds that, if exceeded, causes the data-transfer operation to be reported as failed by the system. The range is from 10 to 100 seconds; 15 is the default.
6. For **Round Trip Time**, enter a time limit for data copy from P-VOL to S-VOL. Range is 1-500 milliseconds.
7. Click **Finish**.
8. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
9. Click **Apply** to save your settings in the system.

Replacing a data path

Before replacing a data path (Fibre Channel or iSCSI), first delete the pairs and delete the remote paths that use the data path to be replaced, and then replace the data path. Do not replace a data path that is being used for remote copy operations.

Deleting remote paths

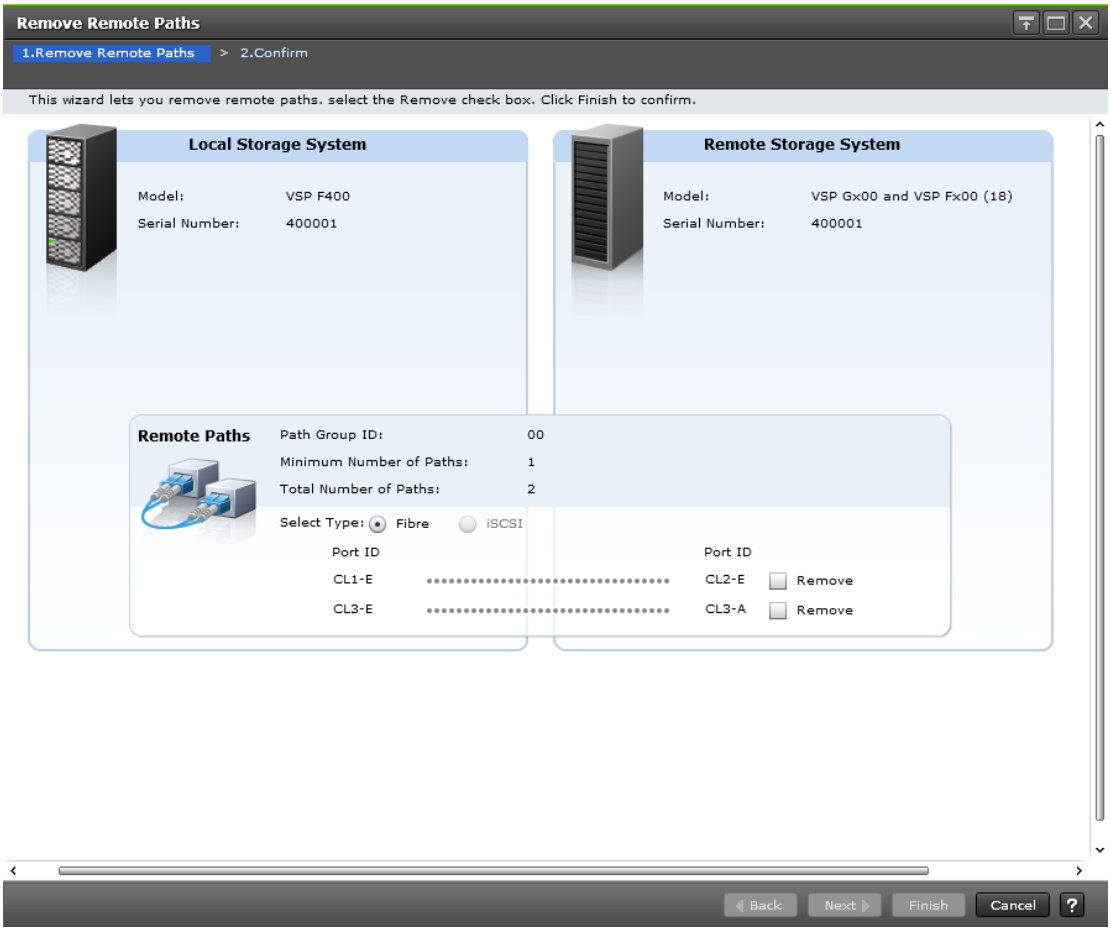
You can delete a remote path between a primary system and secondary system.

Prerequisite information

- Delete remote paths from the primary system.
- Make sure that the remaining number of paths is equal to or greater than the minimum number of paths setting on the Add Remote Connection window, otherwise the delete path operation will fail.

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connections**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connections**.
2. In the **Remote Connections** window, click the **Connections (To)** tab.
3. In the **Connections (To)** tab, select the remote connection with the path to be deleted.
4. From the **Actions** menu, click **Remote Connections > Remove Remote Paths**.
5. In the **Remove Remote Paths** window, click **Remove** for the remote paths to be removed. Note that remote paths become unselectable when the minimum number of paths is reached.



6. Click **Finish**.
7. In the **Confirm** window, review the settings and enter a task name in the **Task Name** box.
8. Click **Apply** to save your settings in the system.

Deleting TrueCopy remote connections

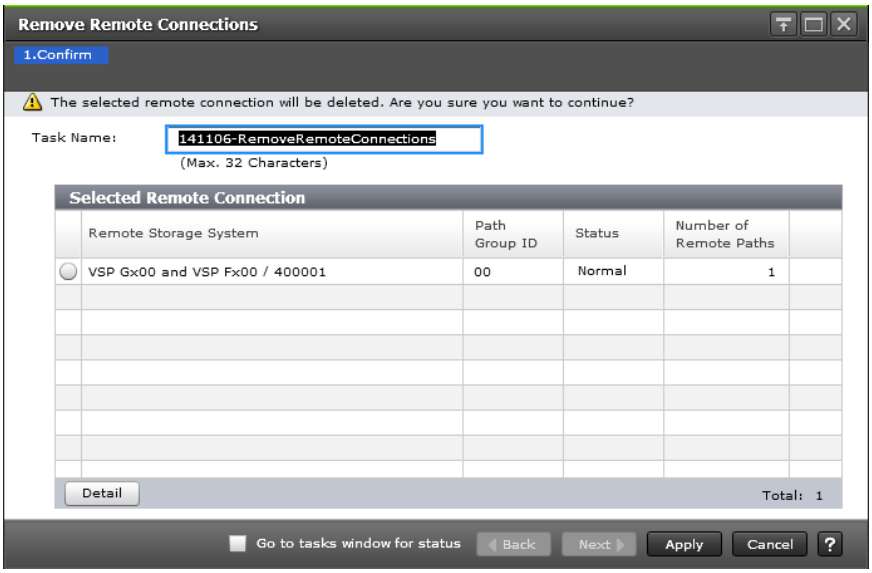
You can delete the TrueCopy relationship between the primary and secondary systems. This is done by deleting remote connections.

Prerequisite information

- All TC pairs must be deleted before removing the connection.
- When the remote connection is deleted, all remote paths are deleted.
- Deleting the TC relationship with a specific secondary system does not affect TC operations between other primary systems and the secondary system.
- After a secondary system is deleted, you can reconfigure the remote path to then connect another secondary system to the primary system. You can also delete the remote connection and reconfigure the primary system ports to provide additional host channels for the primary system.

Procedure

1. Open the **Remote Connections** window.
   In Hitachi Command Suite:
   a. On the **Resources** tab, expand the **Storage Systems** tree.
   b. Right-click the target storage system, and click **Remote Connections**.
   In Device Manager - Storage Navigator:
   a. Click **Storage Systems**, and then expand the **Storage Systems** tree.
   b. In the Storage Systems tree, click **Replication > Remote Connections**.
2. In the **Remote Connections** window, click the **Connections (To)** tab.
3. In the **Connections (To)** tab, select the remote connections to be deleted.
4. From the **Actions** menu, click **Remote Connections > Remove Remote Connections**.
5. In the **Remove Remote Connections** window, from the **Selected Remote Connection** table, select the connection to be removed.



   (You can review information about the connection by clicking **Detail**.)
6. Click **Apply**.

Managing power-off for systems and network devices

Though you are responsible for controlling power-off activities, it is advisable to check with Hitachi Data Systems customer support.

The following topics provide information for planned outages when TrueCopy is present.

General information

Please review the following system behaviors regarding powering off:

- TC pairs are not affected when power is removed from a primary system while operations are in progress.
- When power is restored on the primary system, the system communicates with the secondary systems to confirm S-VOL pair status(es). Make sure that TC communications are fully restored (all paths have normal status) before beginning I/O operations to the P-VOL.

  If the primary system accepts an I/O for a P-VOL before this, all communications are restored, and the primary system splits the pair and changes P-VOL status to PSUE-by Remote Storage System. The primary system cannot change the pair status of the S-VOL.
- If power is removed from a secondary system or from a data path component while TC operations are in progress, the primary system detects the communication failure, splits all affected pairs, and generates SIMs reporting the failures. The primary system changes the P-VOL status to PSUE-by Remote Storage System but cannot change the status of the S-VOLs.
- If a primary is powered off and the backup batteries are fully discharged while pairs are split, differential data is retained to SSD. In this unlikely case, the primary system copies differential data to the secondary system when the pairs are resynchronized.

Planned outage of the primary system

A planned outage of the primary system does not affect TrueCopy.

Planned outage of the secondary system or remote path

You must split the pairs in a secondary system prior to a planned outage of the system or to a data path component (for example, switch, channel extender).

To perform a planned outage of a secondary system or data path component

1. Identify the P-VOLs that are paired with S-VOL in the secondary system that is to be powered off.

   For data path outage, identify all P-VOLs in the primary system that use the path or component to be powered off.

   You need to know the primary system, CU, and ID (Port, Host Group ID or iSCSI Target ID, LUN) for each of the P-VOLs.
2. Connect to each primary system that contains affected P-VOLs, and split all affected pairs. Confirm the changed pair status.
3. Perform the planned outage of the secondary system or data path.
4. When the secondary system is fully powered on and ready, resynchronize the affected pairs at each primary system. Confirm the pair status changes.

Planned outage of both primary and secondary systems

When you plan an outage of the TrueCopy primary and secondary systems at the same time, the primary system must be powered off first and then powered on last.

To perform a planned outage of the primary and secondary systems

1. Perform the planned outage of the primary system first. Because a planned outage does not affect pairs, nothing out of the ordinary must be done regarding the TC system or operations.
2. If a secondary system to be powered off is connected to a primary system that is not powered off, split the pairs before powering off the secondary system. Confirm that the pair status changes.
3. Perform the planned outage of the secondary systems as described in Planned outage of the secondary system or remote path on page 7-20.
4. Power on the secondary systems. Make sure that they are fully operational and ready to resynchronize operations before powering on the primary system.
5. Power on the primary system, and make sure it is ready to resynchronize operations. If you split any pairs in step 2, you can also resynchronize those pairs now.

8

Data migration

This chapter discusses using TrueCopy to migrate data from one storage system to another.

Migration overview

TrueCopy can be used to move data from one system to another. Data is typically migrated for the following reasons:

- To copy data to a new volume
- To temporarily move data from an LU to accommodate other activities (for example, to make repairs)
- To relocate LUs in order to balance workloads and distribute I/O activity evenly within or across storage systems

You do not need to use host migration software is unnecessary for data migration when using TrueCopy. Also, TrueCopy data migration does not affect the host.

In a data migration, the entire contents of a volume are copied to the secondary volume (P-VOL to S-VOL). The volumes are identical when the copy operation completes. The volumes are then usually released from the TrueCopy pair.

If you need to migrate data from other vendors' storage systems to a VSP G200, G400, G600, G800 or VSP F400, F600, F800 storage system, contact Hitachi Data Systems customer support.

Migrating data

1. Make sure that the data path is installed, and TrueCopy configuration procedures are completed. See Chapter 5, TC configuration on page 5-1 for details.
2. Vary the target volume (S-VOL) offline from all attached hosts. The source volume (P-VOL) can remain online.
3. In the storage system having the volume to be migrated, add a remote connection and register the secondary system.
4. Monitor the progress status of the initial copy operation and the pair status. Open the **Remote Replication** window and **View Pair Synchronization Rate** window and update the windows as necessary. Wait until the initial copy operation is completed and the status changes from COPY to PAIR. When the status changes to PAIR, the primary and secondary volumes become identical.
5. If you are not using CCI commands and host software to complete the migration, continue the following procedure to stop using the P-VOLs and switch to the S-VOLs:
    a. Stop all host updates to the P-VOLs.
    b. When all update activity to the P-VOLs has stopped, connect to the primary system, select the correct CU, and release the TrueCopy pairs.
    c. If the P-VOL and S-VOL are attached to the same host, vary the P-VOL offline, and then vary the S-VOL online. Use this order because the P-VOL and S-VOL have the same volume labels and cannot be online to the same host at the same time.

d. If you want to keep the volumes synchronized, establish the same TrueCopy pairs in the reverse direction using the None initial copy option. If the original P-VOLs will be temporarily unavailable for update copy operations, you can split the new pairs (pairsplit-r) so that the new primary system keeps track of changes.

e. Start the applications with the S-VOLs. When the original P-VOLs become available, you can resynchronize the pairs.

If the original P-VOL is temporarily unavailable for update copy operations, split the new pair so that the new primary system keeps track of changes.

9

Disaster recovery

This chapter discusses disaster recovery.

Disaster recovery overview

Preparing for disaster recovery involves the following major steps:

1. Identify the volumes and groups that contain important files and data for disaster recovery.
2. Create TrueCopy pairs, paying special attention to the options in P-VOL Fence Level Settings to ensure that the system responds the way you want in the event of a failure (see Allowing I/O to the P-VOL after a split—Fence Level options on page 3-10).
3. Install and configure host failover software between the local and remote sites.
4. Establish file and database recovery procedures. These procedures for recovering volumes due to control unit failure should already be in place.
5. Make sure that the host system at the primary site is configured to receive sense information from the primary storage system (for example, using CCI or SNMP). This should also be done at the remote site if a host is connected to it.

Note: Procedures for disaster recovery involve releasing pairs. However, when using CCI you can perform disaster recovery without releasing pairs. To do this, when setting up TrueCopy, add a remote connection from the secondary system to the primary system. Use the same path group ID as you used from the primary to secondary system connection.

Remote copy and disaster recovery procedures are complex. Consult Hitachi Data Systems customer support on sense-level settings and recovery procedures.

Sense information shared between sites

When the primary system splits a TrueCopy pair due to an error condition, the primary and secondary systems send sense information with unit check status to the appropriate hosts. This is used during disaster recovery to determine the consistency of the S-VOL, and must be transferred to the secondary site via the host failover software.

File and database recovery

File recovery procedures for disaster recovery should be the same as those used for recovering a data volume that becomes inaccessible due to control unit failure.

TrueCopy does not provide a procedure for detecting and retrieving lost updates. To detect and recreate lost updates, you must check other current information (for example, database log file) that was active at the primary system when the disaster occurred.

The detection and retrieval process can take some time. Your disaster recovery scenario should be designed so that detection and retrieval of lost

updates is performed after the application has been started at the remote site.

You should prepare for file and database recovery using files for file recovery (for example, database log files that have been verified as current).

Switching operations to the secondary site

If a disaster or failure occurs at the primary (local) site, the first disaster recovery activity is to switch your operations to the secondary (remote) site. S-VOLs are recovered individually based on the pair status and P-VOL fence level information for each pair.

You can switch operations to the secondary site either by deleting pairs and then re-establishing them when recovery is completed, or by not deleting pairs. Both methods are presented below.

To switch operations to the secondary site by deleting pairs

1. Record the pair status and fence level of each S-VOL.
2. Analyze the consistency of the S-VOLs, based on pair status and P-VOL fence level setting. See Checking S-VOL consistency with the P-VOL on page 9-4.
3. Perform file recovery as needed.
4. Split all pairs from the S-VOLs using one of the following commands:
   - CCI pairsplit
   - BCM YKSUSPND
   - PPRC CSUSPEND
5. Release all pairs using one of the following commands:
   - CCI pairsplit -S
   - BCM YKRECOVER
   - PPRC CRECOVER

   If you are not using these tools, connect to each secondary system with Device Manager - Storage Navigator to split and release the pairs.

Note: When the S-VOL is no longer paired, it cannot be distinguished it from a non-TrueCopy volume. Use the appropriate means to change the S-VOL volume labels.

6. Complete file recovery procedures.
7. Vary the S-VOLs online.
8. At the secondary site, start critical host operations, with the previous S-VOLs now the P-VOLs.

To switch operations to the secondary site by not deleting pairs

1. Record the pair status and fence level of each S-VOL.

2. Analyze the consistency of the S-VOLs, based on pair status and P-VOL fence level setting. See Checking S-VOL consistency with the P-VOL on page 9-4.
3. Perform file recovery as needed.
4. Run the CCI horctakeover or pairsplit-RS on the S-VOL.
5. Complete file recovery procedures.
6. Vary the S-VOLs online.
7. At the secondary site, start critical host operations, with the previous S-VOLs now the P-VOLs.

Checking S-VOL consistency with the P-VOL

An S-VOL's consistency refers to whether S-VOL data is identical to data in the P-VOL. This is dependent on your Fence Level setting, which determines whether data is copied to the P-VOL if an error occurs during an update to the S-VOL.

The following table shows S-VOL consistency information, based on Device Manager - Storage Navigator pair status and the P-VOL fence level setting.

S-VOL status	Type	Fence level	Consistency of S-VOL
Unpaired	--	Data, Status, Never	Not consistent. The S-VOL does not belong to a pair. Even if you have created a pair using this volume, if the pair status is still unpaired, you must regard its data as not consistent with the P-VOL.
COPY	--	Data, Status, Never	Not consistent. The S-VOL is not synchronized because not all tracks have been copied from the P-VOL yet. This S-VOL must be initialized (or copied from the P-VOL at a later time).
PAIR	--	Data, Status	Consistent. The S-VOL is synchronized with its P-VOL.
		Never	Needs to be analyzed*. The S-VOL requires further analysis to determine its level of consistency.
PSUE	Initial copy failed	Data, Status, Never	Not consistent. The S-VOL is not synchronized because not all tracks have been copied from the P-VOL yet. The S-VOL must be initialized (or copied from the P-VOL at a later time).
PSUS	S-VOL by operator	Data, Status, Never	Suspect. The S-VOL is not synchronized with its P-VOL if any write I/Os were issued to the P-VOL after the pair was split. The pair should be released and restarted using **Entire Volume** for the Initial Copy Type option. If you are sure that no data on the P-VOL changed, you can use **None** for Initial Copy Type.
PSUS or PSUE	All other types	Data	Consistent. The S-VOL is synchronized with its P-VOL.
		Status, Never	Suspect. The S-VOL is not synchronized with its P-VOL if any write I/Os were issued to the P-VOL after the pair was split. Restore the consistency of the S-VOL and update it, if required. The time of suspension indicated on the Last Update Time field of the Detailed Information

S-VOL status	Type	Fence level	Consistency of S-VOL
			dialog box (MCU SVP time) will help to determine the last time the S-VOL was updated.
For pairs with a P-VOL fence level setting of **Never**, further analysis is required to determine the S-VOL consistency. This can be determined by using sense information transferred via host failover, or by comparing the contents of the S-VOL with other files that are confirmed to be consistent (for example, database log files). The S-VOLs should be recovered using the files that are confirmed to be consistent. Actual data recovery must be done using recovery point data in the database operation log.			

Transferring operations back to the primary site

When host operations are running at the secondary site, the primary site should be restored and operations transferred back.

In the following procedure, you will establish TC pairs at the secondary site, with data flow moving from the secondary site to the primary. After the pairs are synchronized and in PAIR status, they will be released, and then new pairs will be created at the primary site with data flow moving from primary to secondary, as originally set up.

Select the appropriate procedure below based on whether you deleted pairs to switch operations to the secondary site, or ran the CCI Run horctakeover or pairsplit-RS to the S-VOL command.

To transfer operations to the primary site—if pairs were deleted when operations were switched to the secondary site

1. At the primary site, bring up the host. Make sure that TC components are operational.
2. At the primary system, release all pairs on the primary system.

   The Delete Pair by Force option must be used because the paired S-VOLs are in the SMPL state at the secondary site.
3. At the primary system, delete the TC association with the secondary systems (Remove Remote Connections). In Device Manager - Storage Navigator, connect to each primary system to make sure that all RCUs are deleted.
4. At the primary and secondary systems, change path and port settings.

   - To use the same switches, change the operating mode to the opposite direction.

   - To use the same extenders, change the operating mode to the opposite direction. The boxes/nodes connected to the primary system must be set to channel-mode, and the boxes/nodes connected to the secondary systems must be set to device-mode.
5. At the secondary system, set up the TC system with the remote site as the primary system, and the local site as the secondary system.
6. At the secondary system create the pairs, with the S-VOLs at the primary site. Make sure to use **Entire Volume** for the Initial Copy Type option. Confirm that the pairs are created and that status is PAIR.

7. At the secondary system, halt host operations and vary the P-VOL offline. This maintains synchronization of the pairs.
8. At the secondary site, split the pairs. Confirm that the pairs are split and status is PSUS before proceeding. If an error occurs, resolve it before proceeding.
9. At the secondary system, release the pairs. You do not need to use the Delete Pair by Force option.
10. At the primary and secondary systems, change the path and port settings.

    - To use the same switches, change the operating mode back to the original direction.

    - To use the same channel extenders, change the operating mode back to the original direction. The boxes/nodes connected to the primary system must be set to channel-mode, and the boxes/nodes connected to the secondary systems must be set to device-mode.
11. At the primary system, perform configuration tasks in preparation for creating the pairs.
12. At the primary system, establish consistency groups and create the TrueCopy pairs in the original direction. You may use **None** for the Initial Copy Type option because all P-VOLs and S-VOLs are synchronized. If there is any possibility that the volumes are not 100% synchronized, use **Entire Volume** for Initial Copy Type.
13. Vary the primary system and P-VOLs online, and start host operations.

Below is the procedure to transfer operation back to the primary site without deleting pairs.

1. At the primary site, bring up the host. Make sure that TC components are operational.
2. Run the CCI pairresync-swaps to the S-VOL command. If the pair data flow is already set in the opposite direction and the pair is in PAIR or COPY status, the pairresync-swaps needs not to be run.
3. At the secondary system, halt host operations and vary the P-VOL offline. This maintains synchronization of the pairs.
4. Run the horctakeover to the P-VOL command.
5. Vary the primary system and P-VOLs online, and start host operations.

10

Troubleshooting

This chapter provides TrueCopy troubleshooting information.

Error codes and messages

Device Manager - Storage Navigator displays messages when error conditions occur during TrueCopy operations. The message describes the error and provides a part code and error code. See *Device Manager - Storage Navigator Messages* for a list of the error codes.

If you need to contact Hitachi Data Systems customer support, please report the error codes. For details about contacting Hitachi Data Systems customer support, see Getting help on page xiv.

General troubleshooting

The following table lists general error conditions and provides recommended action for each condition.

Condition	Recommended action
The Device Manager - Storage Navigator computer hangs, or TrueCopy operations do not function properly.	• Make sure that the problem is not being caused by the PC or Ethernet hardware or software, and restart the PC. Restarting the Device Manager - Storage Navigator computer does not affect storage system operations. • Make sure that all TrueCopy requirements and restrictions are met (for example, same LU type). • Make sure that the primary and secondary systems and data paths are powered on and fully operational (NVS, cache). • Check all input values and parameters to make sure that you entered the correct information about the Device Manager - Storage Navigator computer (for example, secondary system S/N and ID, path parameters, P-VOL and S-VOL IDs).
An initiator channel-enabled LED indicator (on the storage system's control panel) is off or flashing.	Contact Hitachi Data Systems customer support (see Getting help on page xiv).
The pairs and/or remote systems are not displaying correctly.	Make sure that the correct CU is selected.
A TrueCopy error message displays on the PC.	Resolve the error, and then try the TrueCopy operation again.
The remote system path status is not normal.	Check the path status (**View Remote Connection Properties** window), and see Remote path status problems on page 10-3.
Pair status is PSUE.	See Split pair problems on page 10-5.
The paircreate or pairresync operation resulted in a timeout error.	• Hardware failure: If the timeout error was caused by a hardware failure, a SIM is generated. If this occurs, call service personnel, and then retry TrueCopy operations after the problem is fixed.

Condition	Recommended action
	• Heavy workload: If no SIM was generated, wait 5 or 6 minutes, and then check the pair's status. - If status changed correctly, the failed operation completed after the timeout message was issued. - If the pair status did not change as expected, heavy workload might have prevented the operation from being completed. Retry the operation when the system has a lighter workload. • A communication error may have occurred between the Device Manager - Storage Navigator computer and SVP. See the *Hitachi Command Suite User Guide* for information and instructions.
There is a pinned track on a TrueCopy volume.	See Pinned track recovery on page 10-18 for more information.
Monitoring data is not updated though the Monitoring Switch option is set to Enable.	Because the time setting of SVP is changed, the monitoring data might not be updated. Disable Monitoring Switch, and then enable again. For more information about Monitoring Switch, see the *Performance Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

Remote path status problems

The following table provides a list of remote path status problems.

Path status	Description	Corrective action
Normal	This path has been successfully established and can be used for TrueCopy copy activities.	None required.
Initialization Failed	The link initialization procedure to the secondary system failed because the physical path connection was missing between the primary and secondary systems.	• Make sure that the primary and secondary systems are physically and correctly connected. • Make sure that you entered the correct secondary system S/N, Controller ID, and primary and secondary system port numbers. • Make sure the primary and secondary system ports are configured correctly.
Communication Time Out	Communication between the primary and secondary systems timed out.	• Make sure the secondary system is powered on and that NVS and cache are fully functional. • Make sure that network relay devices are properly configured and functional. This

Path status	Description	Corrective action
		includes cables, connectors, switches, extender devices, communication lines, and all other devices connected to the extenders.
Port Rejected	The primary system rejected the logical path link control function because all logical path resources in the primary system are being used for other connections.	• Delete all remote paths in the **Remove Remote Paths** window. • Remove all remote storage systems currently not in use in the **Remove Remote Connection** window.
Serial Number Mismatch	The secondary system's S/N does not match the specified S/N.	• Make sure that you entered the correct secondary system S/N and Controller ID, and primary and secondary system port numbers. • Make sure the primary and secondary system ports are configured correctly. • Make sure that data path relay equipment is properly configured and functional. This includes cables, connectors, switches, extender devices, communication lines, and all other devices connected to the extenders.
Invalid Port	The specified local storage system port is in the following status: • Not mounted. • The port attribute is not Initiator. • A remote path is already added.	• Make sure that no remote path between the local and remote storage systems with the same port number settings is already added. • Make sure that you entered the correct secondary system S/N and Controller ID, and primary and secondary system port numbers. • Make sure that the primary and secondary system ports are configured correctly. • Make sure that data path relay equipment is properly configured and functional. This includes cables, connectors, switches, extender devices, communication lines, and all other devices connected to the extenders.
Communication Failed	The primary system connected to the secondary system successfully, but logical communication timeout occurred.	• Make sure that the secondary system port and the relay equipment are configured correctly. • Make sure that data path relay equipment is properly configured and functional. This includes cables, connectors, switches, extender devices, communication lines, and all other devices connected to the extenders.

Path status	Description	Corrective action
Path Blockade	Blockaded due to continual path or link failure.	See the following.
	The primary system port does not work.	Repair the port on the primary system, then restore the path*.
	The secondary system port does not work.	Repair the port on the secondary system, then restore the path*.
	The path relay equipment does not work.	Repair the path relay equipment, then restore the path*.
	The connection cable is physically broken.	Replace the broken cable, then restore the path*.
Program Error	A program error is detected.	Restore the path*.
In Progress	Paths are being created or deleted.	Wait until processing is completed.
* To restore a path, delete and then add the path again. It may be necessary to delete and then add the RCU again. To delete the RCU or path, see Deleting TrueCopy remote connections on page 7-18 or Deleting remote paths on page 7-17. To re-register, see Adding remote connections on page 5-2. If you cannot restore the path after performing these operations, contact Hitachi Data Systems customer support.		

Split pair problems

The following table provides a list of split pair problem types.

Pair status/ type	Applies to	Description	Corrective action
PSUE (pair suspended-error) / by RCU	P-VOL	The primary system detected an error condition at the secondary system, which caused the primary system to split the pair. The S-VOL split type is S-VOL Failure.	Clear the error condition at the secondary system or S-VOL, and then resynchronize the pair from the primary system. If you need to access the S-VOL to clear the error conditions, release the pair from the secondary system. After you clear the error conditions from S-VOL, restart the pair.
PSUE / S-VOL Failure	P-VOL	The primary system detected an error during communication with the secondary system, or detected an I/O error during update copy. In this case, the split type	• Check the path status on the Remote Connections window. If errors occurred on the path, clear the error conditions. • Clear any error conditions at the secondary system or S-VOL, and

Pair status/ type	Applies to	Description	Corrective action
		for the S-VOL is usually S-VOL Failure.	then resynchronize the pair from the primary system. • If you need to access the S-VOL to clear the error conditions, release the pair from the secondary system. After you clear the error conditions, recreate the pair.
PSUE (pair suspended-error)/ MCU IMPL	P-VOL, S-VOL	The primary system could not find valid control information in its nonvolatile memory during the IMPL procedure. This error occurs only if the system is without power for more than 48 hours (for example, power failure or fully discharged batteries).	Resynchronize the pair from the primary system. An entire initial copy operation will be performed in response to the **pairresync** request.
PSUE / Initial Copy Failed	P-VOL, S-VOL	The primary system split this pair during the initial copy operation. The data on the S-VOL is not identical to the data on the P-VOL.	Release the pair from the primary system. Clear all error conditions on the primary system, P-VOL, secondary system, and S-VOL. Recreate the pair.

Troubleshooting using CCI

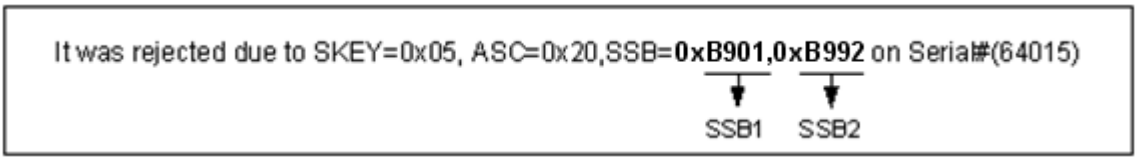
When an error occurs in pair operations using CCI, you can identify the cause of the error by referring to the CCI operation log file. This file is stored in the following directory by default:

```
/HORCM/log*/curlog/horcmlog_HOST/horcm.log
```

Where:

- * is the instance number.
- *HOST* is the host name.

Example:



Error codes appear on the right of the equal symbol (=).

Review CCI error codes in the following topics.

SSB2 error codes when SSB1 = 2E31/B901/B90A/B90B/B912/D004

Error code (SSB2)	Description
4A96	The pair cannot be created because the specified P-VOL belongs to a different CLPR than the registered consistency group CLPR.
9100	The command cannot be executed because the user authentication is not performed.
B920	The pair cannot be created because the system identifier is not correct (left-most number in the 6-digit serial number).
B923	The consistency group paircreate or pairresync was rejected because supported and unsupported software is used in the DKC.
B927	You cannot run the following operations to a pair in a 2DC configuration: Swap Suspend Takeover
B928	The pair cannot be created because the Mirror ID is invalid.
B929	The pair operation was rejected because the firmware is being replaced.
B92A	The pair cannot be created because the specified volume is a command device.
B934	The pair cannot be created because TC is not installed.
B935	S-VOL hide mode is not supported.
B936	The required shared memory for operating TrueCopy is not installed.
B93B	The specified volume is a P-VOL. The pair cannot be released because the P-VOL is specified as an S-VOL.
B941	The specified volume is an S-VOL. The pair cannot be released because the S-VOL is specified as a P-VOL.
B945	The command was rejected because the volume is unpaired.
B952	The specified LU is not defined. The DKC configuration might have been changed. Restart CCI.
B97B	The operation cannot run because pair status is either PSUS (by user) or PSUE (because of failure).
B97C	The command was rejected because the volume is unpaired.
B990	The pair cannot be created because the consistency group ID is greater than is allowed. If this error occurred when you did not specify the consistency group ID, contact Hitachi Data Systems customer support (see Getting help on page xiv).
B992 (SSB1=B901)	The pair cannot be created because the DKC type does not support TrueCopy Asynchronous.
B992 (SSB1=B90A)	The consistency group information cannot be acquired because TrueCopy or Universal Replicator is not installed.

Error code (SSB2)	Description
B994	The Swap Resync operation cannot be performed because the S-VOL is not in PSUS or SSWS status. (Swap Resync resynchronizes differential data when the S-VOL is swapped for the P-VOL.)
B998	The pair cannot be created because the secondary system path setting is invalid.
B99B	The pair cannot be created because TC Asynchronous is not supported.
B9BD	The DKC LDEV configuration might have been changed while starting CCI. Restart CCI.
B9C0	The source of the command device has run out. In LUN Manager, set the command device to OFF, then to ON.
C162	The pair cannot be resynchronized because the pair was not in the Suspend status.
C16B	The pair cannot be created because the S-VOL is not available.
C184	A request for a Pairsplit-S operation was rejected because the status change of the S-VOL failed.
C189	A request for a Pairsplit-S operation was rejected because the pair status was invalid.
C18A	A request for a Pairsplit-S operation was rejected because the corresponding volume or group was changing status.
C194	The pair cannot be split because the S-VOL pair status was in transition.
C195	A request for a Pairsplit-r operation was rejected because the pair status was already PSUS (by user) PSUS (because of failure).
C198	Pair split cannot run because the group includes no pair that can be split.
C199	A request for a Pairsplit-r operation was rejected because the corresponding volume or group was changing status.
C1BE	The pair's status cannot be changed during the power-on processing of the DKC.
C1D6	The command was rejected because it was issued to a non-TC volume.
C211	The command was rejected because the specified volume is a P-VOL. If the error occurs when the volume is unpaired, select the volume in Device Manager - Storage Navigator, release the pair using the **Force Delete Pairs (TC Pairs)** window, and then run the command again.
C212	The command was rejected because the specified volume is an S-VOL. If the error occurs when the volume is unpaired, select the volume in Device Manager - Storage Navigator, release the pair using the **Force Delete Pairs (TC Pairs)** window, and then run the command again.
C214	The command was rejected because the secondary system is not registered, or the registered information is invalid.
C215	The command was rejected because an internal logical error has occurred.
C218	The command was rejected because the pair status is invalid.
C21A	The command was rejected because the P-VOL status is other than PSUS (by user) PSUS (because of failure).
C21C	The command was rejected because the secondary system is not registered, or the registered information is invalid.

Error code (SSB2)	Description
C22A	The command was rejected because the pair release was run on a volume other than P-VOL.
C22C	The command was rejected because the volume is unpaired.
C22D	The command was rejected because the specified volume is the volume other than the P-VOL.
C22E	The command was rejected because the pairsplit command specifying -P option (write protection of P-VOL) was issued to a volume whose status is not PAIR.
C233	The command was rejected because the S-VOL status is unpaired.
C234/C235/ C236/C237	The command was rejected because an internal logical error has occurred.
C238	The command was rejected because the specified volume is the volume other than the P-VOL.
C239	The command was rejected because the pair resync was operated on a volume whose status is other than PSUS (by user) PSUS (because of failure).
C23A	The command was rejected because an internal logical error has occurred.
C23B	The command was rejected because the volume is unpaired.
C23C	The command was rejected because the volume status is other than PAIR or COPY.
C23D	The command was rejected because the command for TC asynchronous was issued to the TC asynchronous volume.
C267	The pair cannot be created because the command was issued to the command device.
C271	The command was rejected because the specified consistency group ID is invalid.
C28B	The command was rejected because the takeover command was issued to a volume whose status is not SSWS.
C28C	The command was rejected because the secondary system is not registered, or the registered information is invalid.
C28D	There is no volume to which the takeover command can run.
C28E	The command was rejected because an internal logical error has occurred.
C297	The command was rejected because the specified volume is used as an S-VOL.
C2A0	The pair cannot be created because the capacity that is used by software products other than TC exceeds license capacity.
C2A1	The command was rejected because an internal logical error has occurred.
C2A3	The pair cannot be created because the used capacity exceeds the license capacity.
C2B3	The command was rejected because DP-VOL capacity is changing.
C2B4	The command was rejected because an internal logical error has occurred.
C2B5	The pair cannot be created because the TC P-VOL is being initialized by ShadowImage.
C2B6	The command was rejected because the releasing pages in DP-VOL is in progress.
C300	The TC pair associated with a UR pair cannot be created because the Remote Replication Extended program product is not installed on the primary system.

Error code (SSB2)	Description
C301	The TC pair associated with a UR pair cannot be created because the Remote Replication Extended program product is not installed on the secondary system.
C304	The pair cannot be created because the S-VOL is a DP-VOL.
C305	The pair cannot be created because the capacity that is used by TC in the secondary system exceeds license capacity. Check license capacity, including for related software products.
C30D	The volume in the secondary system or another volume that belongs to the same group is changing to Simplex or Suspend status. Retry the operation after several minutes.
C312	The P-VOL is not in unpaired status.
C313	The P-VOL is not in PSUS or PSUE status.
C314	The P-VOL is not in unpaired status.
C315	The P-VOL includes PIN data.
C316	The P-VOL is in the process of drive copy for failure assistance.
C317	The P-VOL is in the process of drive copy for an SVP request.
C318	The P-VOL is terminating the copy task.
C319	The P-VOL is in the process of correction copy.
C31A	The P-VOL is in the process of correction access.
C31B	The create or resync TC pair command was rejected because the physical volume with the specified P-VOL is blocked.
C31C	The P-VOL is blocked and impossible to access.
C31D	The P-VOL is being formatted.
C31E	The P-VOL is read only.
C320	The number of remote paths is 0 (not specified).
C321	The number of remote paths is smaller than the minimum required.
C322	The DKC type of the primary system does not support TC.
C324	The secondary system's sequence number or CU are invalid.
C327	The pair cannot be created because the P-VOL is not available for remote copy.
C328	The track formats of the P-VOL and the S-VOL do not match.
C32A	The S-VOL is protected by the Data Retention Utility.
C32B	The P-VOL is protected by the Data Retention Utility.
C32C	The S-VOL is protected by the Data Retention Utility.
C32D	The S-VOL is protected by the Data Retention Utility.
C32E	A request for a Paircreate operation was rejected because the specified secondary system is an unsupported product.
C32F	The number of P-VOL cylinders is not the same or smaller than the number of S-VOL cylinders.)

Error code (SSB2)	Description
C330	The pair cannot be created or resynchronized because P-VOL and S-VOL capacities are not the same.
C332	S-VOL cache is unavailable.
C335	The S-VOL is the TC P-VOL.
C336	The S-VOL includes PIN data.
C337	The S-VOL is in reserve status.
C338	Copy pair cannot be created because of the either of the following reasons. • The S-VOL is in the intervention-required condition, protected, or unusable status. • The S-VOL is the S-VOL or Reserved volume of ShadowImage, Reserved volume of Volume Migration, or the volume of UR pair.
C339	The S-VOL is not available.
C33A	A request for a Paircreate operation was rejected because the secondary system is a not supported by TC.
C33B	The corresponding volume cannot be specified as an S-VOL because the volume is used as another pair's S-VOL.
C33C	A request for a Paircreate operation was rejected because the specified S-VOL was not mounted.
C33E	The pair cannot be created because the S-VOL is not implemented or is blocked (DEV NOT READY status).
C33F	The corresponding volume cannot be specified as an S-VOL because the volume is already specified as a TC pair volume.
C35C	The P-VOL is not accessible.
C370	There are fewer paths than the required minimum following a path failure or because an invalid path was specified.
C371	The process that is performed after the copying process of Volume Migration in the S-VOL is in progress. Retry the operation several minutes later.
C372	The process that is performed after the copying process of Volume Migration in the P-VOL is in progress. Retry the operation several minutes later.
C373	A request for a Paircreate operation was rejected because the specified S-VOL is a ShadowImage Reserved volume.
C379	There are fewer paths than the required minimum following a path failure or because an invalid path was specified.
C37A	An internal error occurred.
C37B	The S-VOL is not available.
C37E	The S-VOL cache is unavailable.
C380	The primary system cache is in transition to blockage on one side.
C381	The primary system cache is in the process of being restored.
C382	The primary system cache is either in transition to blockage on one side or in the process of being restored on one side.

Error code (SSB2)	Description
C388	The pair cannot be created because the emulation type is not available for the specified volume.
C38B	The secondary system is already used by TC.
C38D	The S-VOL is not available.
C38E	The S-VOL is not supported by TC.
C390	The S-VOL status is not PSUS or PSUE.
C391	The S-VOL cannot be copied to because it is in the wrong pair status.
C392	The volume cannot be used as an S-VOL because it is in reserve status, is already being used by TC, or is being used by UR.
C393	The S-VOL includes PIN data.
C395	The create or resync TC pair command was rejected due to blockage of the specified S-VOL, physical volume with the S-VOL being blocked, correction access, or other reasons.
C398	The pair cannot be created because the emulation type is not available for the specified volume.
C39B	An internal error occurred.
C39E	The pair cannot be created because the capacity of the P-VOL exceeded the maximum volume capacity allowed to create a TC pair.
C39F	The pair cannot be created because the capacity of the S-VOL exceeded the maximum volume capacity allowed to create a TC pair.
C3A0	The P-VOL is a device not supported by TC.
C3A6	The CU number of the secondary system is invalid.
C3A8	The device type combination between the P-VOL and S-VOL is invalid.
C3AA	The secondary system's cache is blocked on one side.
C3AB	The secondary system's cache is blocked on one side.
C3AC	TC is not supported for this controller emulation type of the secondary system.
C3AD	The secondary system capacity exceeds the license capacity.
C3AE	TC is not installed on the secondary system.
C3AF	The DKC type of the secondary system is not supported by TC.
C3B1	The number of paths is smaller than the required minimum number of paths.
C3B3	An internal error occurred.
C3B5	The configuration combination of P-VOL and S-VOL is invalid
C3B6	The P-VOL is a SI volume.
C3B7	The S-VOL is a SI volume.
C3B8	An internal error occurred.

Error code (SSB2)	Description
C3B9	The specified S-VOL LUN is not defined; or the LUN includes a CU LDEV that is not supported by the primary system.
C3BC	TC is not installed on the secondary system.
C3BE	These volumes cannot be specified as a TC S-VOL: SI S-VOL not in PSUS status SI reserved volume SI P-VOL in the process of reverse copy
C3BF	A TC S-VOL cannot be specified as a SI S-VOL, reserved volume, or P-VOL in the process of reverse copy.
C3C7	A request for a Paircreate operation was rejected because the specified volume was already part of a TC or UR pair (including journal volumes).
C3CA	The S-VOL is reserved; or a secondary system, S-VOL, or the path between primary system and secondary system is in the BUSY status.
C3CD	The S-VOL is a SI volume.
C3D2	The DKC type of the secondary system is not supported by TC.
C3D4	A pair cannot be created because the P-VOL is being used by Volume Migration.
C3D6	The specified S-VOL is unavailable because the connecting port cannot recognize it.
C3D7	The pair status of the S-VOL is invalid.
C3D8	The pair cannot be created because the volume specified for the S-VOL is a system volume.
C3D9	The pair cannot be created if the TC S-VOL corresponds to any of the following: The volume is a DP-VOL; the pair using the volume is an SI, Thin Image, or Copy-on-Write Snapshot pair, or a Volume Migration reserve volume. The volume is a DP-VOL and an addition to volume capacity is in progress, or pages are being released. The capacity of the volume is different from the capacity of the P-VOL The volume is initialized by SI
C3DB	S-VOL pair status is not PSUS or PSUE.
C4DE	The pair cannot be created because the remote path is not valid.
C4FC	The required amount of shared memory for the operation is not installed in the secondary system.
CB12	TC and UR cannot be mixed in the consistency group.
CB19	The secondary system consistency group cannot be deleted because the Takeover command reversing operations between the P-VOL and S-VOL failed.
CB1A	The secondary system consistency group was abnormally terminated because the Takeover command reversing operations between the P-VOL and S-VOL failed.
CB1D	No dummy volume can be created in the S-VOL.
CB1F	The secondary system does not support TC.

Error code (SSB2)	Description
CB20	In referring to the function bit, the system information reference was abnormally terminated.
CB21	In a pairresync operation, all difference setting was abnormally terminated.
CB23	An internal error occurred.
CB60	TC is not installed in the secondary system.
CB66	A TC pair cannot be created or resynchronized because the bitmap areas are not available for either of the following reasons: • Free space in shared memory is insufficient in the secondary system. • The pool capacity is insufficient in the DP pool of the volume specified as S-VOL.
CB67	An additional shared memory is not installed in the secondary system.
CB68	A TC pair cannot be created or resynchronized because free space of the shared memory in the primary system is insufficient and the differential bitmap areas are not available.
CB69	The number of pairs exceeds the maximum number that can be created in a single consistency group.
CB6E	The Paircreate operation cannot run because the P-VOL is an external storage system volume.
CB6F	The Paircreate operation cannot run because the S-VOL is an external storage system volume.
CB71	The pair cannot be created because the P-VOL is a migration volume of another vendor's storage system.
CB73	The pair cannot be created because the S-VOL is a migration volume of another vendor's storage system.
CB75	The device is not recognized correctly.
CB76	The Paircreate operation cannot run because the paths are specified per storage system.
CB77	The used capacity of the Data Retention Utility software product on the secondary system exceeds the license capacity.
CB78	The Paircreate operation cannot run because the specified S-VOL is defined as the command device.
CB7E	A request for a Paircreate operation was rejected because the specified S-VOL belongs to a different CLPR than the registered consistency group's CLPR.
CB9E	A request for a paircreate operation was rejected in the RCU because the configuring function for one or more of the specified consistency groups on the MCU and/or RCU is unsupported.
CBD7	The storage system is in internal processing. Try the operation again.
CBD8	A pair cannot be created because the specified primary system is one of the following: • A journal volume used for UR. • A UR secondary volume that is in a status other than Suspend.
CBDA	The Paircreate operation cannot run because the used capacity of the Data Retention Utility on the secondary system exceeds the license capacity.

Error code (SSB2)	Description
CBDC	A request for a Paircreate operation was received in the TC-UR combination status. However, the command was rejected because the Mirror ID of UR was 0.
CBDD	In configuring a TC-UR multi-target configuration, a request for a TC Paircreate operation was rejected because the UR pair was in the process of copying.
CBDE	The Paircreate operation cannot run because the P-VOL is used by Thin Image or Copy-on-Write Snapshot.
CBDF	The Paircreate operation cannot run because the S-VOL is used by Thin Image or Copy-on-Write Snapshot.
CBE0	The Paircreate operation cannot run because the P-VOL is a Thin Image or Copy-on-Write Snapshot virtual volume.
CBE1	The Paircreate operation cannot run because the S-VOL is a Thin Image or Copy-on-Write Snapshot virtual volume.
CBE2	The Paircreate operation cannot run because the P-VOL is a Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot Pool-VOL.
CBE3	The Paircreate operation cannot run because the S-VOL is a Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot Pool-VOL.
CBE7	More than 65,280 pairs cannot be created in one storage system.
CBEB	The pair cannot be created because the specified P-VOL is being shredded by Volume Shredder.
CBEC	The pair cannot be created because the specified S-VOL is being shredded by Volume Shredder.
CBED	The paircreate operation cannot run because of one of the following reasons: • The specified S-VOL is the volume for a UR S-VOL. • The specified S-VOL is the volume for a UR journal volume. • An attempt was made to create the 2DC or 3DC configuration using the specified S-VOL, but a storage system that does not support 2DC or 3DC is included in the configuration.
CBEE	The command was rejected because the pair is already created for the specified P-VOL by one of the following purpose. • For differential resync of UR. • For primary site of 3DC multi-target configuration with 3 UR sites.
CBF3	The pair was not created because the specified P-VOL is either of the following: • An external volume mapped for moving data online • An external volume of which data direct mapping attribute is enabled
CBF7	An attempt was made to create the 2DC or 3DC configuration using the specified P-VOL, but the paircreate operation cannot run because a storage system that does not support the 2DC or 3DC configuration is included.
CBF8	The pair cannot created because the model or the software version of the primary or secondary system is not supported.
CBFC	The pair cannot be created because the consistency group ID is not within the supported range.

Error code (SSB2)	Description
CBFF	The pair cannot be created because the remote path is not valid.
FD01	The pair cannot be created because the virtual LDEV ID is not set for the volume specified as S-VOL.
FD02	The pair cannot be created because the virtual LDEV ID is not set for the volume specified as P-VOL.
FD03	The pair cannot be created because the specified virtual information does not match with the virtual information registered in the secondary system.
FD04	The specified secondary system does not support global storage virtualization.
FD05	The specified primary system does not support global storage virtualization.
FD07	The pair cannot be created because the volume specified as P-VOL is used with a GAD pair.
FD08	The pair cannot be created because the volume specified as S-VOL is used with a GAD pair.
FD09	The pair cannot be created because the volume specified as P-VOL is a GAD reserve volume.
FD0A	The pair cannot be created because the volume specified as S-VOL is a GAD reserve volume.
FD0B	Internal process is taking time for the specified P-VOL. Retry the operation after about 5 minutes.
FD0C	A TC pair cannot be created or resynchronized because the bitmap areas are not available for either of the following reasons: • Free space in shared memory is insufficient in the primary system. • The pool capacity is insufficient in the DP pool of the volume specified as P-VOL.
FD0E	Internal process is taking time for the specified S-VOL. Retry the operation after about 5 minutes.
FD0F	The pair was not created because the data direct mapping attribute of the specified P-VOL is enabled, and the function of R-DKC for mapping external volumes larger than 4 TB is not supported.
FD10	TrueCopy pair operation failed. T10 PI attribute settings of the P-VOL and of the S-VOL are different.
FD12	The pair was not created because the specified S-VOL operates as the system LU of NAS.

SSB2=B992 error codes when SSB1 = B901 or B90A

Error Code (SSB1)	Error Code (SSB2)	Description
B901	B992	Pair cannot be created because DKC type does not support TC Asynchronous.
B90A	B992	Consistency group information cannot be retrieved because TC or UR is not installed.

SSB2 error codes when SSB1 = B90B

Error Code (SSB1)	Error Code (SSB2)	Description
B90B	B9E0	The command was rejected because the function for deleting pairs forcibly is not supported.

SSB2 error codes when SSB1 = B912

Error Code (SSB1)	Error Code (SSB2)	Description
B912	B96D	The command was rejected because the volume status is SMPL.

SSB2 error codes when SSB1 = B980

Error Code (SSB1)	Error Code (SSB2)	Description
B980	B901	The command was rejected because the specified port is for NAS Platform (system LU).
B980	B903	The command was rejected because the selected resource belongs to NAS_Platform_System_RSG.

Service Information Messages (SIMs)

The VSP G200, G400, G600, G800 and VSP F400, F600, F800 storage systems generate a service information message (SIM) to notify users of a possible service requirement for the storage system. SIMs can be generated by the system's channel and storage path microprocessors or the service processor (SVP). The SVP reports all SIMs related to TrueCopy operations.

All SIMs are recorded on the SVP and displayed in the **Alert** tab of the Device Manager - Storage Navigator **Storage System** window.

For more information, see the *System Administrator Guide for Hitachi Virtual Storage Platform Gx00 and Fx00 Models*.

During TrueCopy operations, the primary and secondary systems generate a service SIM when P-VOL or S-VOL pair status changes for any reason, including normal status transitions (for example, COPY to PAIR).

- SIMs generated by the primary system include the P-VOL device ID (byte 13).
- SIMs generated by the secondary system include the S-VOL device ID (byte 13).

If SNMP is installed and operational on the storage system, each SIM results in an SNMP trap being sent to the appropriate hosts.

For details about SNMP operations, see the *Hitachi SNMP Agent User Guide*, or contact Hitachi Data Systems customer support.

Pinned track recovery

This procedure ensures the pair's full data integrity while recovering the pinned track.

To recover a pinned track

1. Connect to the primary system of the pair containing a volume with the pinned track.
2. Release the pair that contains the volume with the pinned track.
3. Perform your usual procedure for recovering data from a pinned track. See the pinned track recovery procedures for your OS, or contact Hitachi Data Systems customer support in recovering the pinned track.
4. Resynchronize the pair from **Create TC Pair** Window. Make sure to use **Entire Volume** in the **Initial Copy Type** option.

Calling Hitachi Data Systems customer support

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

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

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to Hitachi Data Systems Support Connect for contact information: https://support.hds.com/en_us/contact-us.html.

A

TC CLI reference

This appendix provides commands and options for command line user interfaces and the Device Manager - Storage Navigator GUI.

Configuration commands and options

The following table shows the commands and options for configuring TC. For details about the CCI commands, see the *Command Control Interface Command Reference*.

Operation	Option	Available in HDvM - SN	CCI command and options
Add Remote Connection	Remote Storage System	Yes	raidcom add rcu -rcu *serial# mcu# rcu# id*
	Remote Paths	Yes	raidcom add rcu -cu_free *serial# id pid*
	RIO MIH Time	Yes	raidcom modify rcu -rcu_option *mpth rto rtt*[fzd|fze]
Edit Remote Replica Options	Copy Type	Yes	none
	Maximum Initial Copy Activities	Yes	none
	Blocked Path Monitoring	Yes	none

Consistency group commands and options

The following table shows the commands and options for setting up and managing consistency groups for TC.

Note: Consistency group commands and options are not available from HDvM - SN.

Operation	CCI command name
Reserve CTGs	paircreate -f[g] *fence*[CTG ID]
Add pair to the CTG	paircreate -f[g] *fence*[CTG ID]
Split pairs in CTG (no reservation time)	pairsplit -S*
Resync pairs in CTG	pairresync -f[g] *fence*[CTG ID]
Delete pairs in CTG	pairsplit -S
* Volumes to be split at the same time need to be included in the same consistency group in advance.	

Pair operation commands and options

The following table shows the commands and options for performing TC pair operations.

Operation	Option	Available in HDvM - SN	CCI command and options
Create Pairs	Copy Type	Yes	paircreate none
	LU Selection	Yes	paircreate none
	CTG ID	Yes	paircreate -f[g] *fence* [CTG ID]
	Initial Copy Type	Yes	paircreate [-nocopy | -nocsus]
	Initial Copy Priority	Yes	paircreate none
Split Pairs	Secondary Volume Write	Yes	pairsplit -rw
Resync Pairs	none	Yes	pairresync none
Delete Pairs	none	Yes	pairsplit -S

Monitoring commands and options

The following table shows the commands and options for viewing TC pair information.

Operation	Options	Available in HDvM - SN	CCI command and options
View Pair Properties	none	Yes	pairdisplay -m *mode*
View Pair Synchronization Rate	none	Yes	pairdisplay -m *mode*
View Remote Connection Properties	none	Yes	pairdisplay -m *mode*

Maintenance commands and options

The following table shows the commands and options for maintaining TC pairs.

Note: Maintenance commands and options are not available from CCI.

Operation	Options	Available in HDvM - SN
Edit Pair Options	none	Yes
Edit Remote Connection Options	RIO MIH Time	Yes
Add Remote Paths	none	Yes
Remove Remote Paths	none	Yes
Remove Remote Connections	none	Yes

B

TC GUI reference

This appendix describes Device Manager - Storage Navigator windows and fields used for TrueCopy. The following key topics are covered:

Important: Procedures in this manual are tailored to the Device Manager - Storage Navigator (HDvM - SN) GUI. When using this GUI, "Local Storage System" displays for the system you have accessed on the HDvM - SN server.

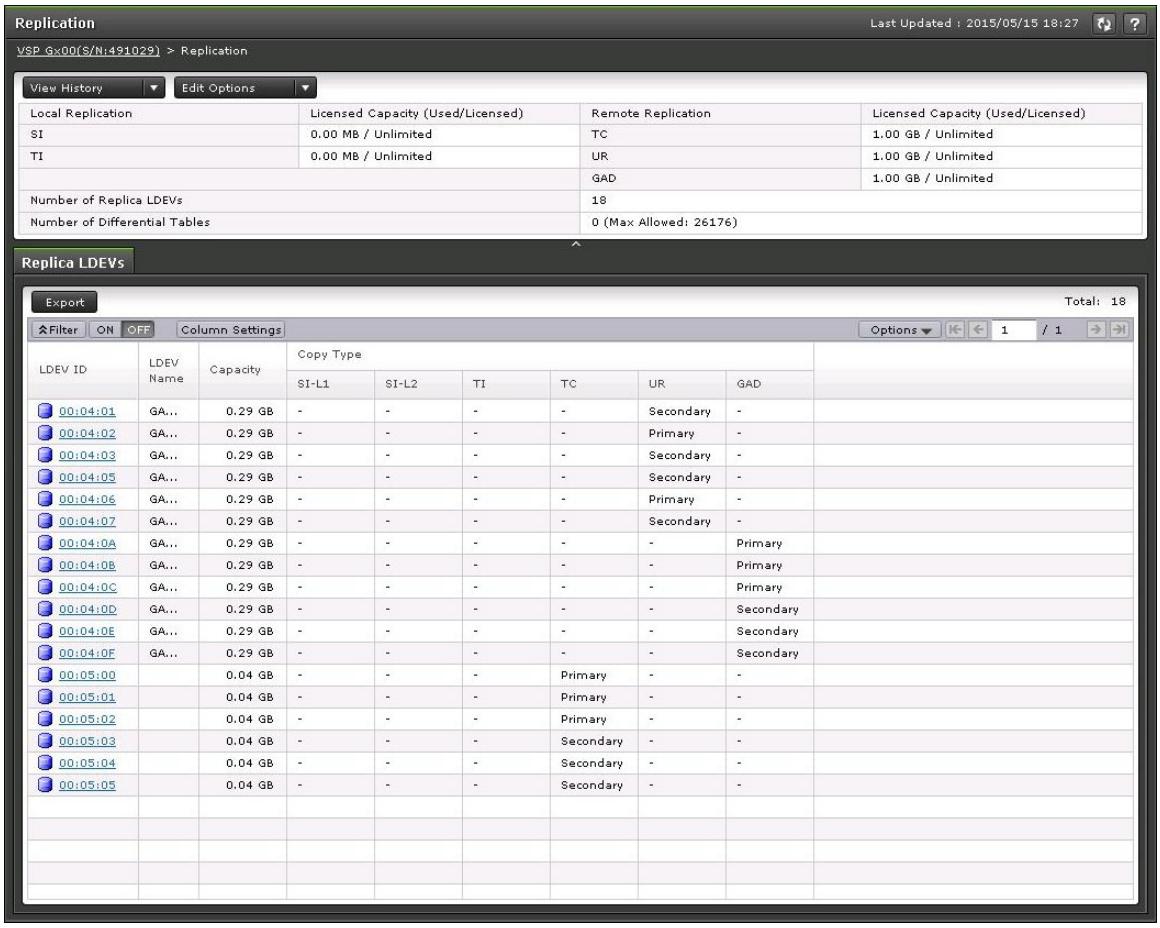
As a result, if you access the remote site's HDvM - SN server, the GUI displays information for the pair's remote (secondary) system under "Local Storage System". Likewise, the GUI in this case identifies the storage system connecting to the accessed system as the "Remote Storage System".

However, this manual uses the terms "primary storage system" or "primary system" for the storage system in which the primary volume (P-VOL) is located in the local site, and "secondary storage system" or "secondary system" for the storage system in which the secondary volume (S-VOL) is located in the remote site, unless otherwise noted.

- Remove Remote Paths wizard
- Edit Remote Replica Options wizard
- Create Pairs wizard
- Split Pairs wizard
- Resync Pairs wizard
- Delete Pairs wizard
- Force Delete Pairs (TC Pairs) window
- Edit Pair Options wizard
- View Pair Properties window
- View Pair Synchronization Rate window
- History window

Replication window

Use this window to view information about pairs and pair volumes.



In this topic, you can view the following tables.

- Summary section on page B-3
- Replica LDEVs tab on page B-4

Summary section

Item	Description
Licensed Capacity (Used/ Licensed)	Used capacity and licensed capacity for each local and remote replication program product.
Number of Replica LDEVs	Number of LDEVs used in replication.
Number of differential tables	Number of differential tables used by local replication and the maximum number. The number of differential tables used by remote replication is not included. In addition, differential tables are not used for the operations below. Therefore, the number of tables does not change if you perform either of the following operations: • ShadowImage pair operation for DP-VOL over 4 TB

Item	Description
	• Thin Image pair operations
View History - Local Replication	Opens the History window for local replication.
View History - Remote Replication	Opens the History window for remote replication.
Edit Options - Local Replication	Opens the Edit Local Replica Options window.
Edit Options - Remote Replication	Opens the Edit Remote Replica Options window.

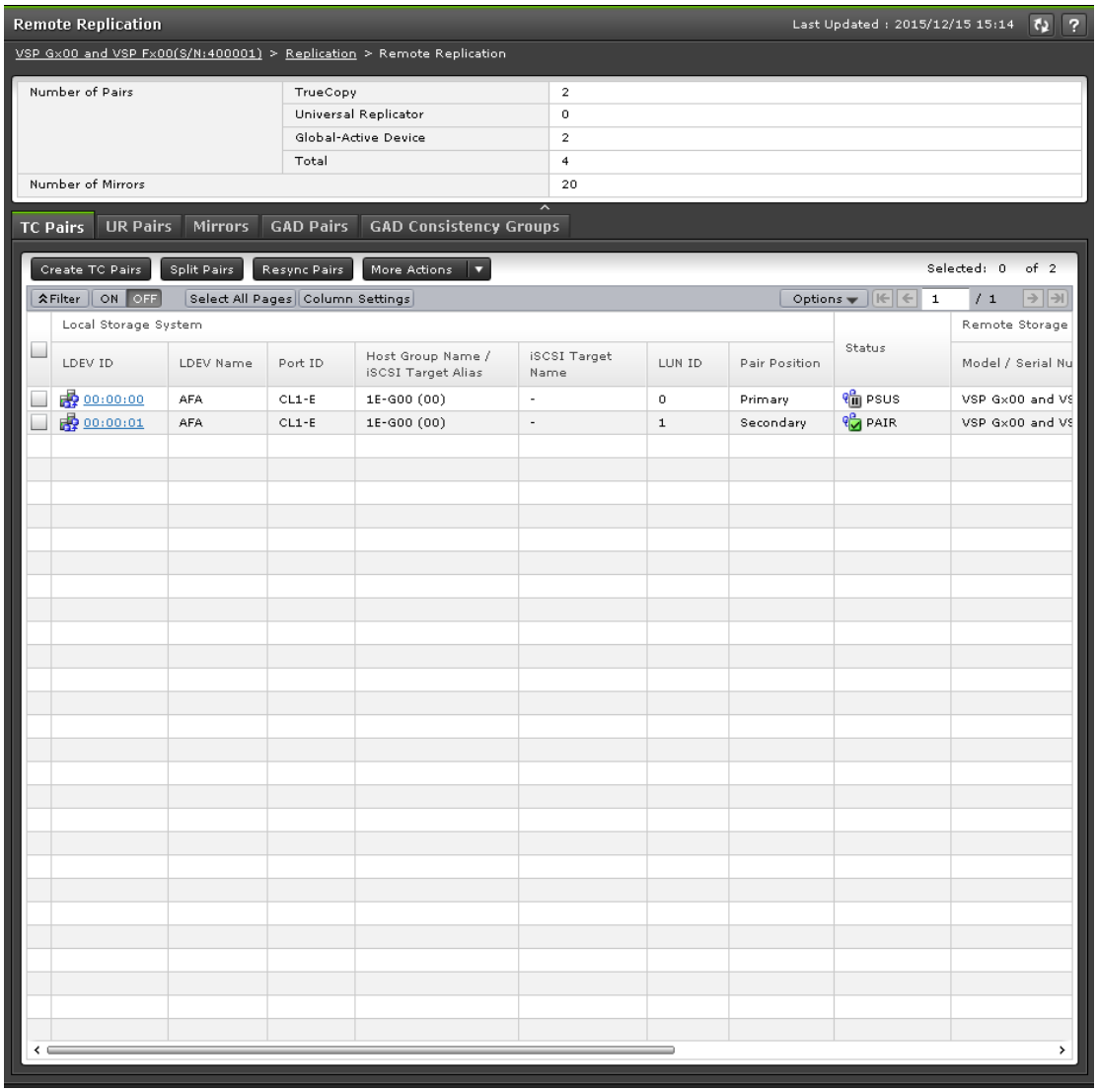
Replica LDEVs tab

Item	Description
LDEV ID	LDEV identifier. Clicking the link opens the **LDEV Properties** window.
LDEV Name	LDEV name.
Emulation Type	LDEV's emulation type.
Capacity	LDEV's capacity.
Copy Type	Copy and volume type of the pair. • SI-L1: ShadowImage L1 pair • SI-L2: ShadowImage L2 pair • TI: Thin Image • TC: TrueCopy • UR: Universal Replicator • GAD: global-active device
Virtual Storage Machine*	Information about the LDEV's virtual storage machine and about the LDEV. • Model type/Serial number: Model type and serial number. • LDEV ID: Volume's virtual LDEV identifier. • Device Name: Volume's virtual device name, in the format: virtual emulation type/number of virtual LUSE volumes/ virtual CVS attribute - Only attributes that are specified display. - "CVS" displays at the end of the device name, if the virtual CVS attribute is specified. - A blank indicates no values are specified. • SSID: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.
Export	Opens the window for exporting the table information.

Item	Description
* This item does not appear in the table by default. To display this item, click **Column Settings**.	

Remote Replication window

Use this window to view information about remote replication pairs and mirrors (UR only).



In this topic, you can view the following tables.

- Summary section on page B-6
- TC Pairs tab on page B-6
- UR Pairs tab on page B-8
- Mirrors tab on page B-11

- GAD Pairs tab on page B-13

Summary section

Item	Description
Number of Pairs	Number of pairs for each remote replication product and the total of all pairs.
Number of Mirrors	UR only Number of mirrors.

TC Pairs tab

Item	Description

Local Storage System	Information about volumes in the accessed storage system.
	• LDEV ID: LDEV identifier. Clicking the link opens the **LDEV Properties** window.
	• LDEV Name: LDEV name.
	• Port ID: Port identifier. TC only.
	• Host Group Name / iSCSI Target Alias: Host group name or iSCSI Target Alias.
	• iSCSI Target Name: Volume's iSCSI target name.
	• LUN ID: LUN identifier. TC only.
	• Pair Position: Whether the volume is a primary or secondary volume.
	• Provisioning Type[1]: Volume's provisioning type.
	• Attribute[1]: Volume's LDEV attribute.
	• Capacity[1]: Volume's capacity.
	• CLPR[1]: Volume's CLPR.
	• Encryption[1]: Encryption information.
	  ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled.
	  ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled.
	  ◦ Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled.
	Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.

Item	Description

	A hyphen (-) is displayed for an external volume or a migration volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked.
	• T10 PI[1]: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.
	  ◦ Disabled: Volume's T10 PI attribute is disabled.
	• Virtual storage machine[1]: Virtual storage machine's model type and serial number.
	• Virtual LDEV ID[1]: Volume's virtual LDEV identifier. When the virtual LDEV ID is not assigned, this item is blank.
	• Virtual Device Name[1]: Volume's virtual device name, in the format:
	virtual emulation type/number of virtual LUSE volumes/ virtual CVS attribute
	- Only attributes that are specified display.
	- "CVS" displays at the end of the device name, if the virtual CVS attribute is specified.
	- A blank indicates no values are specified.
	• Virtual SSID[1]: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.

Copy Type	• TC: TrueCopy
Status	Pair status. For status definitions, see Pair status definitions on page 7-4
Remote Storage System	Information about volumes in the storage system connected to the accessed system. • Model / Serial Number: Remote system's model and serial number. • LDEV ID: LDEV identifier. • Port ID: Port identifier when specifying an LDEV ID at pair creation. Note that this field does not change if the remote system path settings are changed. • Host Group ID / iSCSI Target ID: Host group or iSCSI target identifier. • LUN ID: LUN identifier. • Virtual storage machine[1]: Virtual storage machine's model type and serial number. • Virtual LDEV ID[1]: Volume's virtual LDEV identifier.
Path Group ID	Path group identifier.
Update Type[1]	One of the following: • Sync: It is a TC pair which is not assigned to consistency group. • Sync (Specified CTG): It is a TC pair created by specifying consistency group.

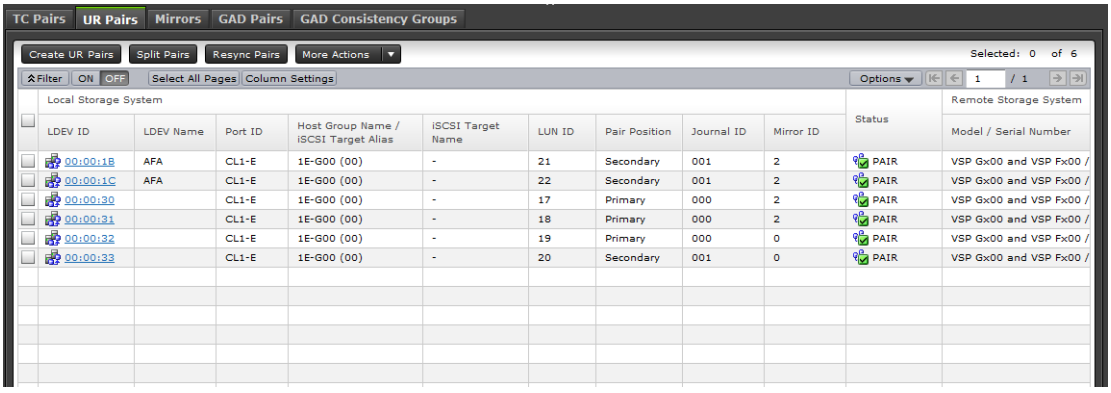
Item	Description
CTG ID[1]	Pair's consistency group identifier.
CTG Utilization[1]	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Fence Level[1]	Fence level setting.
Create TC Pairs	Opens the **Create TC Pairs** window.
Split Pairs	Opens the **Split Pairs** window.
Resync Pairs	Opens the **Resync Pairs** window.
View Pair Synchronization Rate[2]	Opens the **View Pair Synchronization Rate** window when the pair's primary system is accessed.
View Pair Properties[2]	Opens the **View Pair Properties** window.
View Remote Connection Properties[2]	Opens the **View Remote Connection Properties** window.
Edit Pair Options[2]	Opens the **Edit Pair Options** window.
Delete Pairs[2]	Opens the **Delete Pairs** window.
Export[2]	Opens the window for exporting the table information.

Note:

1. This item does not appear in the table by default. To display this item, click **Column Settings**.
2. Displays when you select **More Actions**.

UR Pairs tab

UR only.



Item	Description
Local Storage System	Information about volumes in the accessed storage system. • LDEV ID: LDEV identifier. Clicking the link opens the LDEV Properties window. • LDEV Name: LDEV name. • Port ID: Port identifier. • Host Group Name / iSCSI Target Alias: Host group name or iSCSI Target Alias. • iSCSI Target Name: Volume's iSCSI target name. • LUN ID: LUN identifier. • Pair Position: Whether the volume is a primary or secondary volume. • Journal ID: Journal identifier. • Mirror ID: Mirror identifier. • Provisioning Type[1]: Volume's provisioning type. • Attribute[1]: Volume's LDEV attribute. • Capacity[1]: Volume's capacity. • CLPR[1]: Volume's CLPR. • Encryption[1]: Encryption information. ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled. ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled. ◦ Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled. **Note:** Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled. A hyphen (-) is displayed for an external volume or a migration volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked. • Journal Encryption[1]: Journal's encryption status. ◦ Enabled: The journal contains encrypted volumes. ◦ Disabled: The journal contains unencrypted volumes. ◦ Mixed: The journal contains both encrypted and unencrypted volumes. **Note:** Encryption of data is not ensured in an LDEV with the Mixed encryption status. To

Item	Description

	manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	A hyphen (-) is displayed if the pool to which the journal volume belongs is either an external volume or blocked.
	• T10 PI[1]: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.
	  ◦ Disabled: Volume's T10 PI attribute is disabled.
	• Virtual storage machine[1]: Virtual storage machine's model type and serial number.
	• Virtual LDEV ID[1]: Volume's virtual LDEV identifier. When the virtual LDEV ID is not assigned, this item is blank.
	• Virtual Device Name[1]: Volume's virtual device name, in the format:
	virtual emulation type/number of virtual LUSE volumes/virtual CVS attribute
	- Only attributes that are specified display.
	- "CVS" displays at the end of the device name, if the virtual CVS attribute is specified.
	- A blank indicates that no values are specified.
	• Virtual SSID[1]: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.

Status	Pair status.
Remote Storage System	Information about volumes in the system connected to the system you accessed. • Model / Serial Number: Remote system's model and serial number. • LDEV ID: LDEV identifier. • Port ID: Port identifier. • Host Group ID / iSCSI Target ID: Host group or iSCSI target identifier. • LUN ID: LUN identifier. • Journal ID: Journal's identifier. • Virtual storage machine[1]: Virtual storage machine's model type and serial number. • Virtual LDEV ID[1]: Volume's virtual LDEV identifier.
Path Group ID	Path group identifier.
CTG ID[1]	Consistency group identifier.
Error Level[1]	The error level.
Create UR Pairs	Opens the **Create UR Pairs** window.
Split Pairs	Opens the **Split Pairs** window.
Resync Pairs	Opens the **Resync Pairs** window.

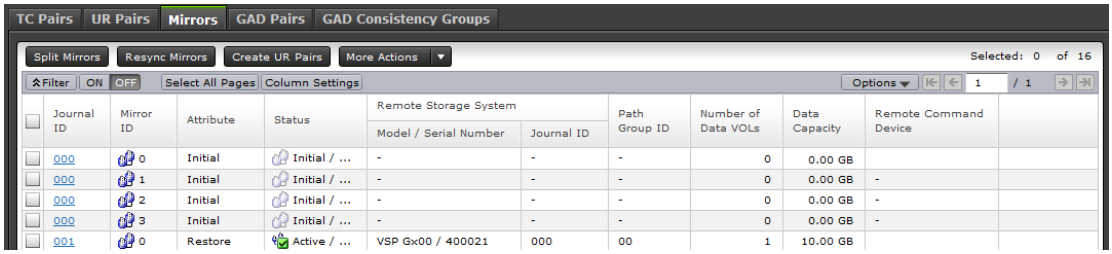
Item	Description
View Pair Synchronization Rate[2]	Opens the **View Pair Synchronization Rate** window when the pair's primary system is accessed.
View Pair Properties[2]	Opens the **View Pair Properties** window.
View Remote Connection Properties[2]	Opens the **View Remote Connection Properties** window. Displays only if **Pair Position** is **Primary**.
Edit Pair Options[2]	Opens the **Edit Pair Options** window.
Delete Pairs[2]	Opens the **Delete Pairs** window.
Split Mirrors[2]	Opens the **Split Mirrors** window.
Resync Mirrors[2]	Opens the **Resync Mirrors** window.
Delete Mirrors[2]	Opens the **Delete Mirrors** window.
Export[2]	Opens the window for exporting the table information.

Note:

1. This item does not appear in the table by default. To display this item, change the **Column Settings**.
2. Displays when you select **More Actions**.

Mirrors tab

UR only.



Item	Description
Journal ID	Journal identifier. Clicking opens the Journal Volumes window.
Mirror ID	Mirror identifier.
Attribute	Whether the journal is Master, Restore, or Initial-registered but with no pair volumes assigned to it.
Status	Mirror status. For mirror descriptions, see *Hitachi Universal Replicator User Guide*.
Remote Storage System	• Model / Serial Number: Remote system model and serial number. • Journal ID: Remote system journal identifier
Path Group ID	Path group identifier.

Item	Description
Number of Data VOLs	Number of volumes associated with the mirror.
Data Capacity	Total capacity of all the associated volumes.
Remote Command Device	LDEV ID of the remote command device if it is assigned to the mirror. • The column is blank if the remote command device is not assigned to the mirror. • A hyphen (-) indicates the remote command device cannot be assigned to the mirror.
CTG ID[1]	Displays the consistency group ID.
CTG Utilization[1]	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Path Watch Time[1]	Displays the path watch time.
Path Watch Time Transfer[1]	Specifies whether to forward the Path Watch Time value of the master journal to the secondary mirror. If the Path Watch Time value is forwarded from the master journal to the secondary mirror, both the primary and secondary mirrors will have the same Path Watch Time value. • Yes: The Path Watch Time value will be forwarded to the secondary mirror. • No: The Path Watch Time value will not be forwarded to the secondary mirror.
Copy Pace[1]	Indicates the speed of initial copy of a volume. Slower, Medium, or Faster is displayed. A hyphen (-) is displayed if the journal is a restore journal.
Transfer Speed[1]	Specifies the transfer speed in Mbps (megabits per second). Specify one of the following: 256, 100, 10, or 3.
Delta Resync Failure[1]	Indicates the processing that should be performed if delta resync cannot be performed. • Entire Copy: Copies all data in the primary volume to the secondary volume if delta resync cannot be performed. • No Copy: Does not perform any processing if delta resync cannot be performed. Does not update the secondary volume.
Split Mirrors	Opens the **Split Mirrors** window.
Resync Mirrors	Opens the **Resync Mirrors** window.
Create UR Pairs	Opens the **Create UR Pairs** window.
Edit Mirror Options[2]	Opens the **Edit Mirror Options** window.
View Remote Connection Properties[2]	Opens the **View Remote Connection Properties** window when the value for **Attribute** is "Master".

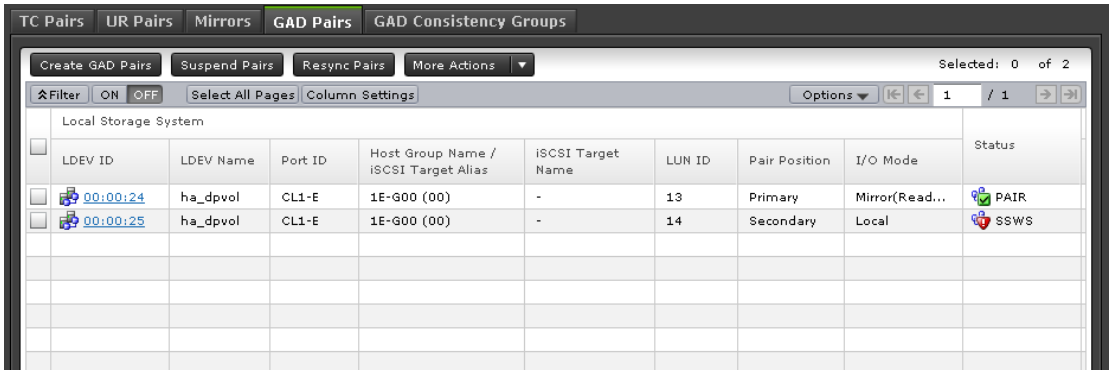
Item	Description
Delete Mirrors[2]	Opens the **Delete Mirrors** window.
Assign Remote Command Devices[2]	Opens the **Assign Remote Command Devices** window.
Release Remote Command Devices[2]	Opens the **Release Remote Command Devices** window.
Export[2]	Opens the window for exporting the table information.

Note:

1. This item does not appear in the table by default. To display this item, click **Column Settings**.
2. Displays when you select **More Actions**.

GAD Pairs tab

Only the pairs to which the volumes of the local storage system are allocated for each user are displayed.



Item	Description
Local Storage System	Information about volumes in the Local Storage System. • LDEV ID: LDEV identifier. Clicking the link opens the LDEV Properties window. • LDEV Name: LDEV name. • Port ID: Port identifier. • Host Group Name / iSCSI Target Alias: Host group name or iSCSI Target Alias. • iSCSI Target Name: Volume's iSCSI target name. • LUN ID: LUN identifier. • Pair Position: Whether the volume is a primary or secondary volume. • Attribute[1]: Volume's LDEV attribute. • Provisioning Type[1]: Volume's provisioning type. • Capacity[1]: Volume's capacity. • CLPR[1]: Volume's CLPR.

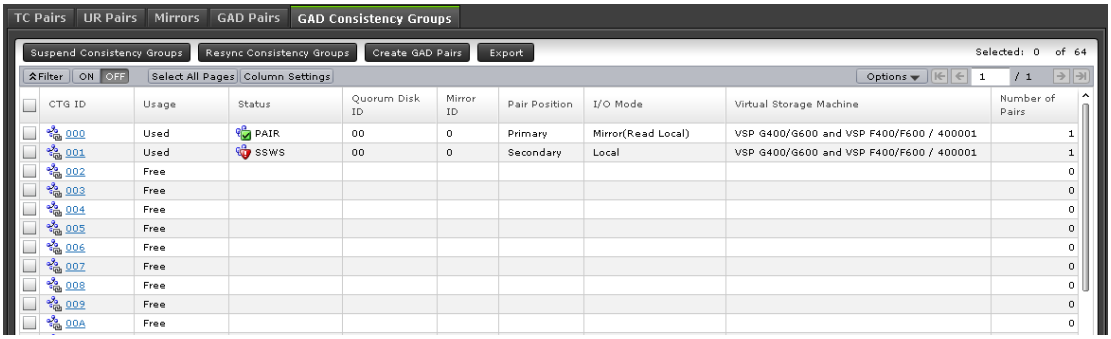
Item	Description

	• Encryption[1]: Encryption information.
	  ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled.
	  ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled.
	  ◦ Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled.
	  Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	  A hyphen (-) is displayed for an external volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked.
	• I/O Mode: Volume's I/O Mode.
	• ALUA Mode: Volume's ALUA mode information.
	• T10 PI[1]: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.
	  ◦ Disabled: Volume's T10 PI attribute is disabled.

Status	Pair status.
Failure Factor[1]	Failure factor. The failure factors are: • Local Volume Failure: A failure is detected on a volume in the local storage system. • Remote Path Failure: A failure is detected on the remote path. • Quorum Disk Failure: A failure is detected on the quorum disk. • Internal Error: An internal error is detected. • Not Failure: No failure is detected. The pair is suspended when the local storage system is turned on. • Remote Volume Failure: A failure is detected on a volume in the remote storage system. • Remote Side Unidentified Failure: A failure due to an unidentified factor is detected on a volume in the remote storage system. If this cell is blank, no failure is detected.
Remote Storage System	Information about volumes in the Remote Storage System. • Model / Serial Number: Remote system's model and serial number. • LDEV ID: LDEV identifier.

Item	Description
	• Port ID: Port ID when specifying an LDEV ID at pair creation. Note that this field does not change if the remote system path settings are changed. • Host Group ID / iSCSI Target ID: Host group ID or iSCSI target ID when specifying an LDEV ID at pair creation. This field does not change even if the remote system path settings are changed. • LUN ID: LUN identifier when specifying an LDEV ID at pair creation. Note that this field does not change even if the remote system path settings are changed.
Path Group ID	Path group identifier.
Mirror ID	Mirror identifier.
Quorum Disk ID	Quorum Disk identifier.
CTG ID	Consistency group identifier.
Virtual Storage Machine	Information about the LDEV's virtual storage machine. • Model type/Serial number: Model type and serial number. • LDEV ID: Volume's virtual LDEV identifier. • Device Name: Volume's virtual device name, in the format: virtual emulation type/number of virtual LUSE volumes/virtual CVS attribute. o Only attributes that are specified will display. o "CVS" displays at the end of the device name, if the virtual CVS attribute is specified. o A blank indicates no values are specified. • SSID: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.
Create GAD Pairs	Opens the **Create GAD Pairs** window.
Suspend Pairs	Opens the **Suspend Pairs** window.
Resync Pairs	Opens the **Resync Pairs** window.
View Pair Synchronization Rate[2]	Opens the **View Pair Synchronization Rate** window when the pair's primary system is accessed.
View Pair Properties[2]	Opens the **View Pair Properties** window.
View Remote Connection Properties[2]	Opens the **View Remote Connection Properties** window. Displays only when **Pair Position** is **Primary**.
Delete Pairs[2]	Opens the **Delete Pairs** window.
Export[2]	Opens the window for exporting the table information.
Notes: 1. This item does not appear in the window by default. To display this item, change the **Column Settings**. 2. Displays when you select **More Actions**.	

GAD Consistency Groups tab



Item	Description
CTG ID	Consistency group identifier.
Usage	Displays whether a consistency group is used. • Used • Free
Status	Consistency group status. For details about the statuses, see the *Global-Active Device User Guide*.
Quorum Disk ID	Quorum Disk identifier.
Mirror ID	Mirror identifier.
Pair Position	Displays whether the GAD pair volume registered in the consistency group is a P-VOL or S-VOL.
I/O Mode	Displays the I/O mode of the GAD pair registered in the consistency group.
Virtual Storage Machine	Displays the model name and the serial number of the virtual storage machine.
Number of Pairs	Displays the number of pairs registered in the consistency group.
Suspend Consistency Groups	Opens the **Suspend Consistency Groups** window.
Resync Consistency Groups	Opens the **Resync Consistency Groups** window.
Create GAD Pairs	Opens the **Create GAD Pairs** window.
Export	Opens the window for exporting the table information.

Remote Connections window

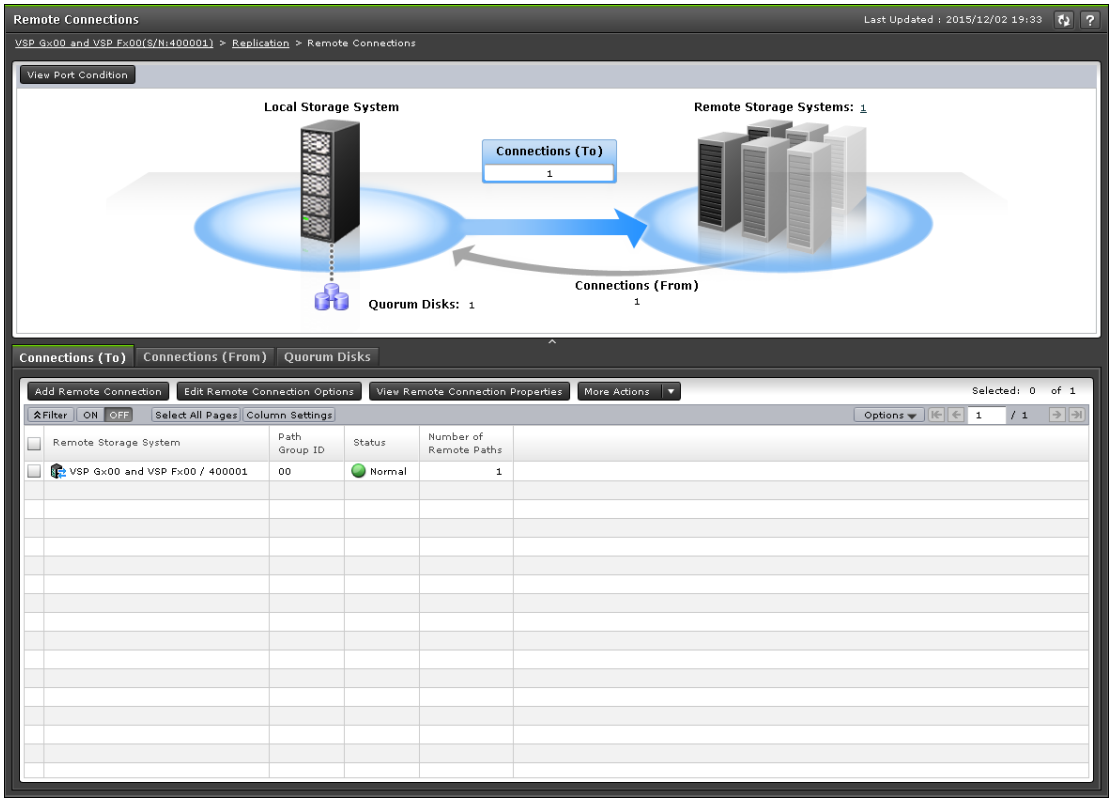
Use this window to view information about remote connections and paths, and add additional remote connections and paths.

For complete information and instructions, see Monitoring and maintaining remote connections and paths on page 7-11.

In this topic you can review the following tables:

- Connections (To) tab on page B-17

- Connections (From) tab on page B-18
- Remote Connections window on page B-16



Item	Description
View Port Condition	Opens the **View Port Condition** window.
Connections (To)	Number of connections from local to remote system.
Remote Storage Systems	Number of remote systems connected to the local system.
Connections (From)	Number of connections from remote to local system. Only displays the number of remote connections used for TC pairs.
Quorum Disks	Number of quorum disks.

Connections (To) tab

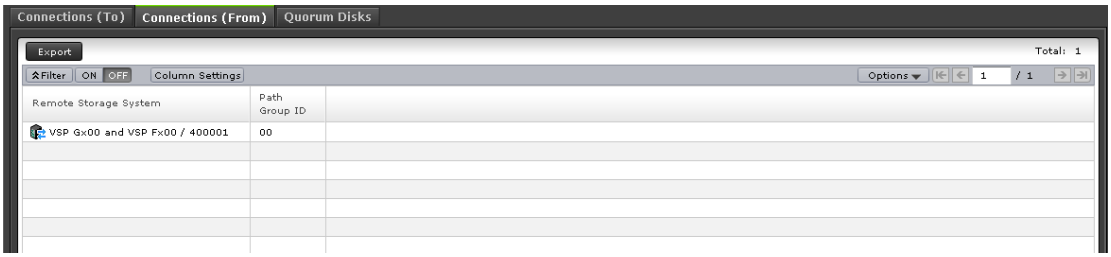
Use this tab to view information about the remote system.

Item	Description
Remote Storage System	Remote Storage System's model and serial number.
Path Group ID	Path group identifier.
Status	Remote connection status. • Normal: All remote paths are normal. • Failed: All remote paths are abnormal.

Item	Description
	• Warning: Some remote paths are abnormal.
Number of Remote Paths	Number of remote paths.
Minimum Number of Paths[1]	The specified minimum number of paths.
RIO MIH Time (sec.)[1]	The specified RIO MIH time in seconds.
Roundtrip Time (msec.)[1]	The specified roundtrip time in milliseconds.
Add Remote Connection	Opens the **Add Remote Connection** window.
Edit Remote Connection Options	Opens the **Edit Remote Connection Options** window.
View Remote Connection Properties	Opens the **View Remote Connection Properties** window.
Add Remote Paths[2]	Opens the **Add Remote Paths** window.
Remove Remote Paths[2]	Opens the **Remove Remote Paths** window.
Remove Remote Connections[2]	Opens the **Remove Remote Connections** window.
Export[2]	Opens the window for exporting the table information.
Note: 1. This item does not appear in the table by default. To display this item, click **Column Settings**. 2. Displays when **More Actions** is clicked.	

Connections (From) tab

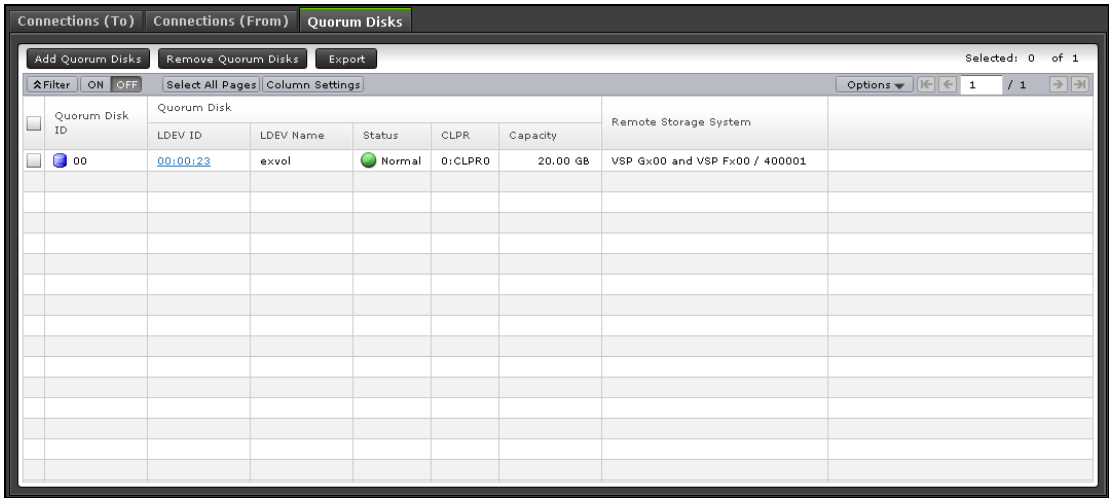
Use this tab to view information about the systems, as seen from the remote system. Remote storage system (MCU) information displays when remote connections are used for TC pairs.



Item	Description
Remote Storage System	Remote Storage System's model and serial number.
Path Group ID	Path group identifier.
Export	Opens the window for exporting the table information.

Quorum Disks tab

Only the quorum disks allocated to users are displayed.



Item	Description
Quorum Disk ID	Quorum Disk identifier.

Quorum Disk	Information about quorum disks.
	• LDEV ID: Volume's virtual LDEV identifier. LDEV Property window displays by clicking LDEV ID.
	• LDEV Name: Volume's LDEV Name.
	• Status: Displays the volume status.
	  ◦ Normal: Volume is in normal status.
	  ◦ Blocked: Volume is blocked. Access cannot be made from the host.
	  ◦ Warning: Volume has a problem.
	  ◦ Formatting: Volume is being formatted.
	  ◦ Preparing Quick Format: Preparation for quick formatting is in progress.
	  ◦ Quick Formatting: Volume is under quick formatting.
	  ◦ Correction Access: Access attribute is being corrected.
	  ◦ Copying: Volume data is being copied.
	  ◦ Read Only: Volume is in Read Only status. Data cannot be written.
	  ◦ Shredding: Volume is being shredded.
	  ◦ A blank indicates that the volume is in a status other than the above.
	• CLPR: Volume's CLPR.
	• Capacity: Volume's capacity.

Item	Description
Remote Storage System	Model/Serial number of Remote Storage System.
Add Quorum Disks	Opens the window for adding Quorum Disks.
Remove Quorum Disks	Opens the window for removing Quorum Disks.
Export	Opens the window for exporting table information.

Add Remote Connection wizard

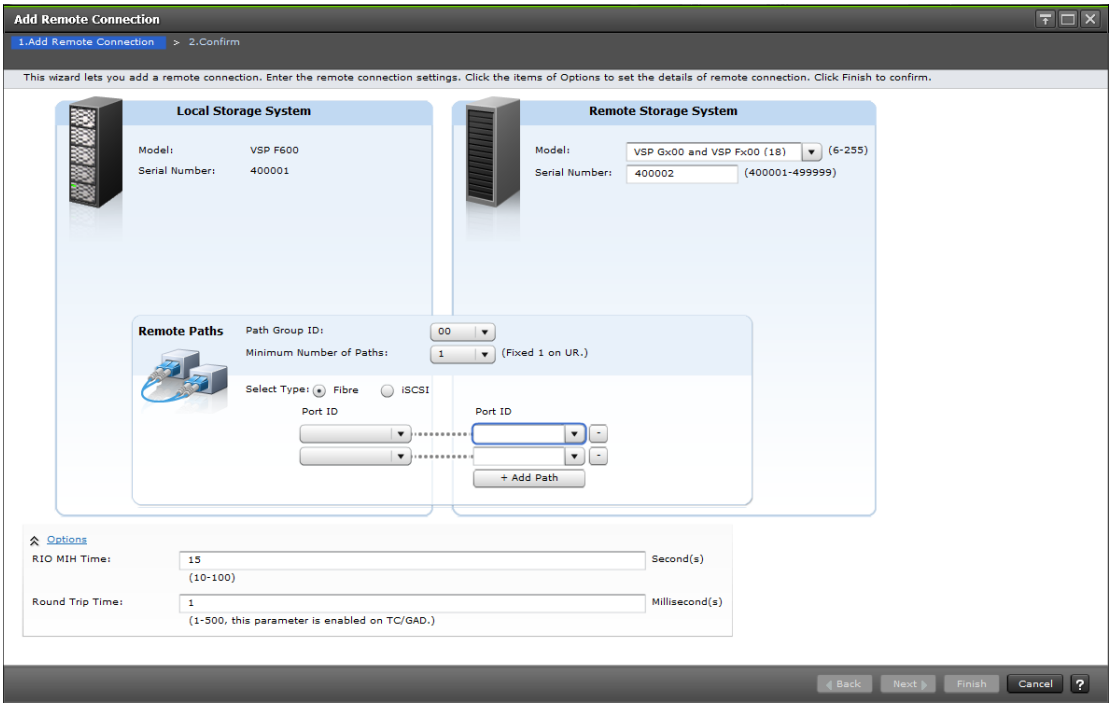
Use this wizard to set up storage systems for replication.

Add Remote Connection window

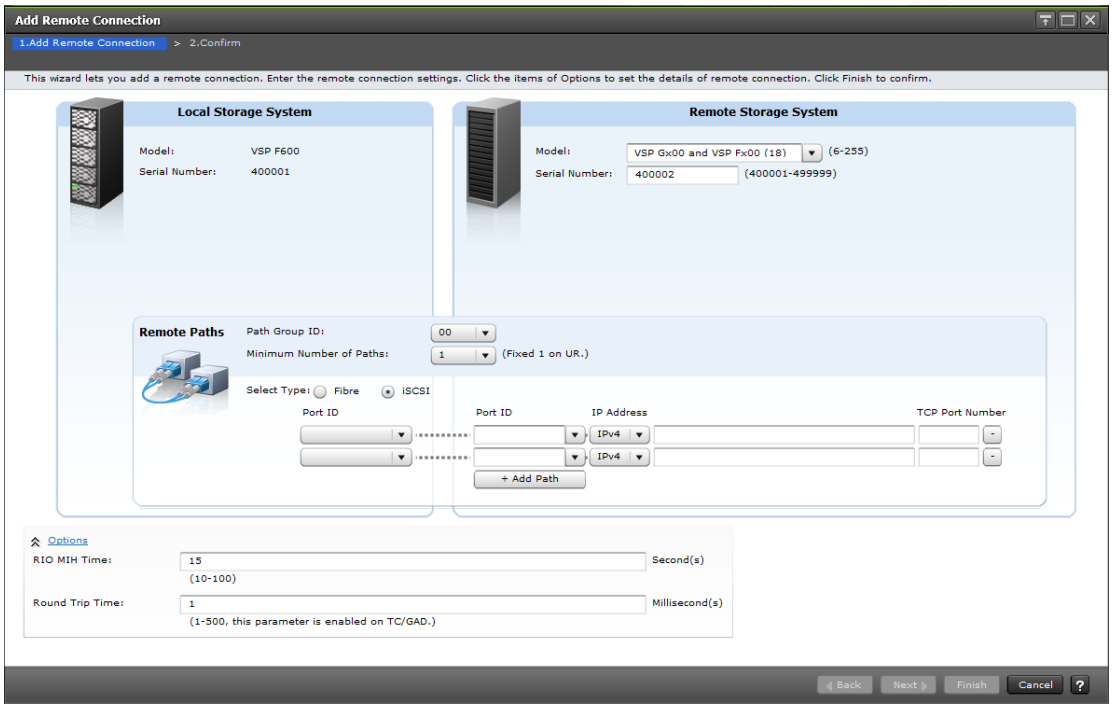
Use this window to connect storage systems for remote replication.

For complete information and instructions, see Adding remote connections on page 5-2.

When you select **Fibre** for **Select Type** the following screen is displayed.



When you select **iSCSI** for **Select Type** the following screen is displayed.



In this topic, you can view the following tables.

Local Storage System

Item	Description
Model	Local model.
Serial Number	Local serial number.

Remote Storage System

Item	Description
Model	• VSP Gx00 and VSP Fx00 (18) Specify the same value for VSP Gx00 and VSP Fx00 models. • HUS VM (19) • VSP G1000 (7) If you specify a value other than the above, it is assumed to be a storage system to be supported in the future. In that case, such a model is enclosed in parentheses when displayed on the **Remote Connections** window.

Item	Description
Serial Number	Serial number of the remote storage system in decimal. • VSP Gx00: 400001 to 499999 • VSP Fx00: 400001 to 499999 • HUS VM: 200001 to 265535 • VSP G1000: 1 to 99999 • Future storage systems: 0 to 999999 **Note:** When using virtual storage machine volumes, specify the serial number of the storage system. Do not specify the serial number of the virtual storage machine.

Remote Paths

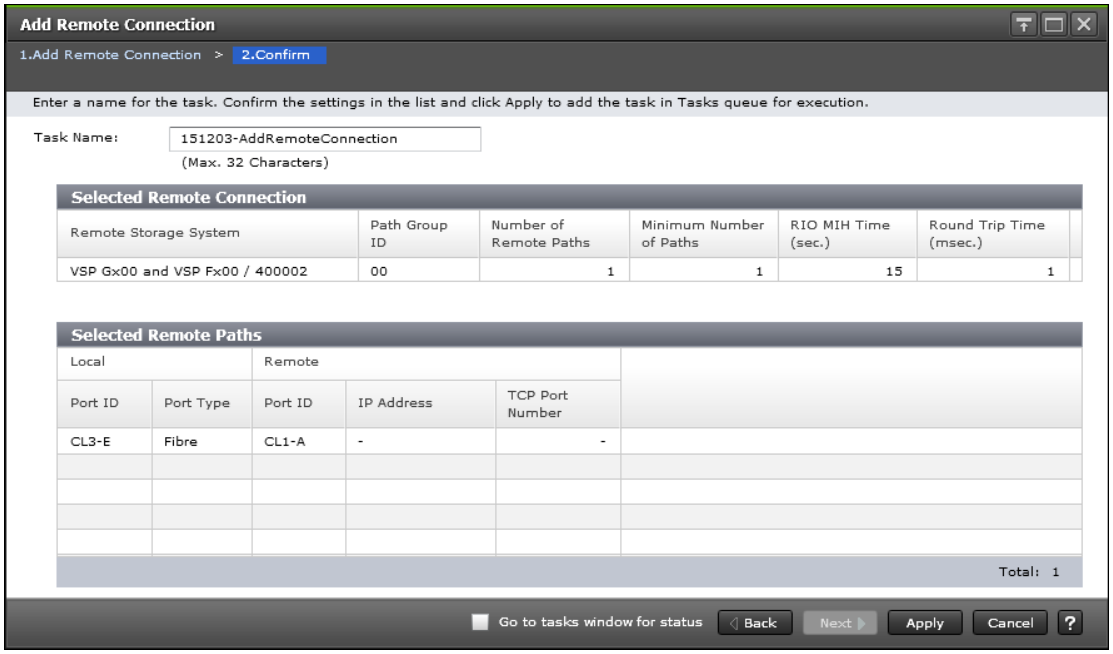
Item	Description
Path Group ID	Path group identifier (00 to FF). Up to 64 path group IDs can be registered per storage system.
Minimum Number of Paths	Minimum number of remote paths. • TC: Range is from 1 to 8. Default value is 1. • UR: The minimum number is 1, regardless of the number entered.
Select Type	Select the port type. • Fibre • iSCSI
Port ID (local storage system)	Select the port ID of the local storage system.
Port ID (remote storage system)	Select the port ID of the remote storage system. A hyphen (-) button displays when the number of valid paths are more than the minimum number of path. The port text box for local and remote storage system can be deleted by clicking the hyphen (-) button.
IP Address	Select the port's IP type (IPv4 or IPv6) of the remote storage system, and then enter the IP address. Only displays when selecting **iSCSI** for **Select Type**.
TCP Port Number	Enter the TCP port number of the remote storage system. Only displays when selecting **iSCSI** for **Select Type**.
Add Paths	Opens a dialog box for creating additional paths (maximum of eight).

Options

Item	Description
RIO MIH Time	Time limit between 10 and 100 seconds for the data-transfer operation to complete (15 is the default).

Item	Description
Roundtrip Time	TC and GAD only. Time limit between 1 and 500 milliseconds for data copy from P-VOL to S-VOL (1 is the default).

Add Remote Connection confirmation window



In this topic, you can view the following tables.

- Selected Remote Connection table on page B-23
- Selected Remote Paths table on page B-24

Selected Remote Connection table

Item	Description
Remote Storage System	Remote storage system's model and serial number.
Path Group ID	Specified path group identifier.
Number of Remote Paths	Specified number of remote paths.
Minimum Number of Paths	Specified minimum number of remote paths.
RIO MIH Time (sec.)	Specified RIO MIH time.
Roundtrip Time (msec.)	Specified roundtrip time.

Selected Remote Paths table

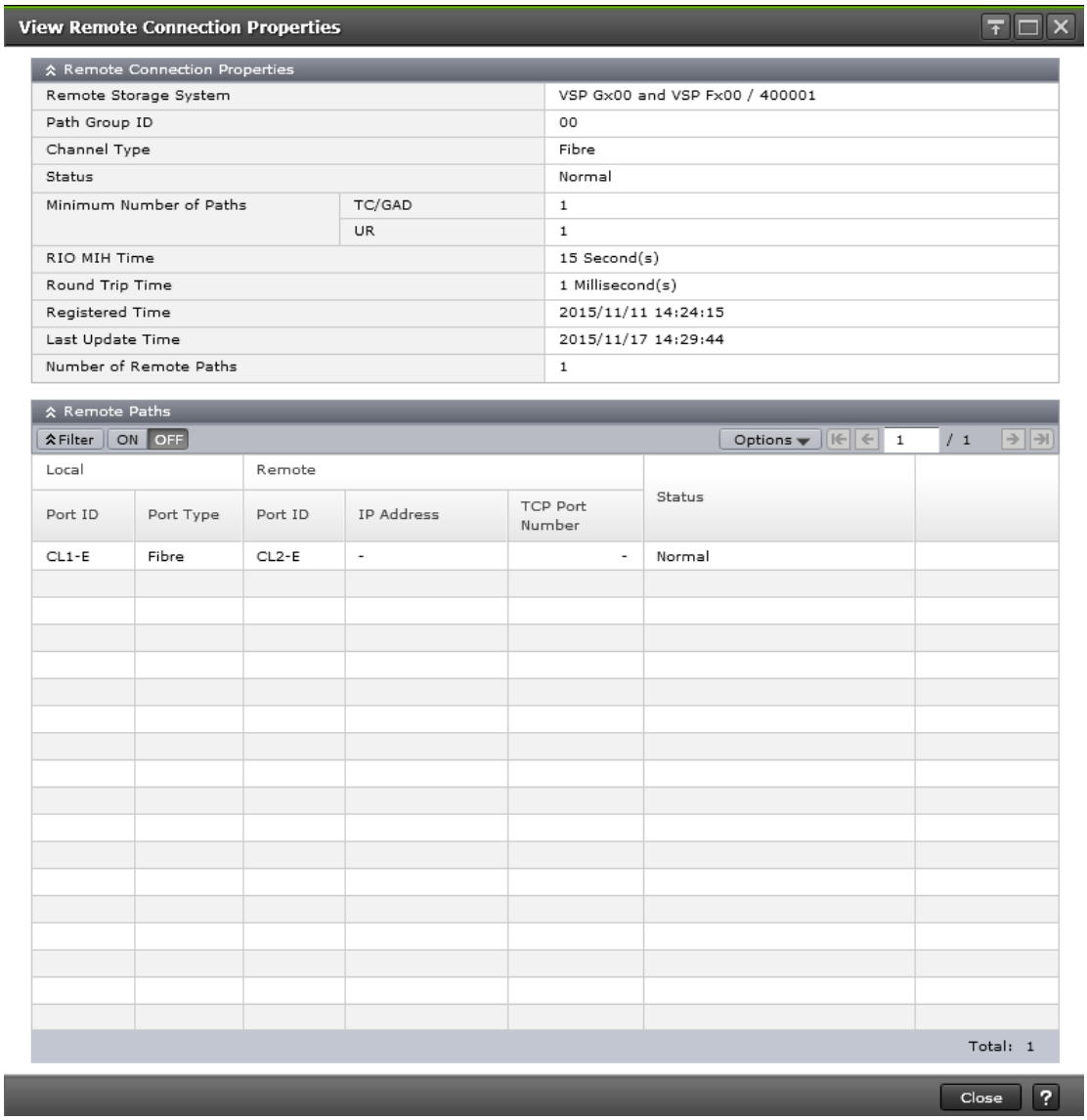
Item	Description

Local	Information about the local storage system port.
	• Port ID: Displays the port identifier.
	• Port Type: Displays the port type.
	  ◦ Fibre
	  ◦ iSCSI

Remote	Information about the remote storage. • Port ID: Displays the port identifier. • IP Address: Displays the IP address of the port when Port Type is iSCSI. • TCP Port Number: Displays the TCP port number when Port Type is iSCSI.

View Remote Connection Properties window

Use this window to view information about remote connections and paths.



In this topic, you can view the following tables.

- Remote Connection Properties table on page B-25
- Remote Paths table on page B-26

Remote Connection Properties table

Item	Description
Remote Storage System	Remote storage system's model and serial number.
Path Group ID	Path group identifier.
Channel Type	Type of data path. • Fibre: All remote path port types within remote connection are Fibre. • iSCSI: All remote path port types within remote connection are iSCSI.

Item	Description
	• Mixed: Both Fibre and iSCSI exist within remote connection.
Status	Remote connection status. • Normal: All remote path within remote connection are fine. • Failed: All remote path within remote connection has problem. • Warning: Some remote path within remote connection has problem.
Minimum Number of Paths	• TC/GAD: The minimum number of TC and GAD paths. • UR: The minimum number of UR paths.
RIO MIH Time	The specified RIO MIH time in seconds.
Roundtrip Time	The specified roundtrip time in milliseconds.
Registered Time	Date and time the connection was established.
Last Update Date	Date and time of the last update.
Number of Remote Paths	Number of paths specified in the remote connection.

Remote Paths table

Item	Description

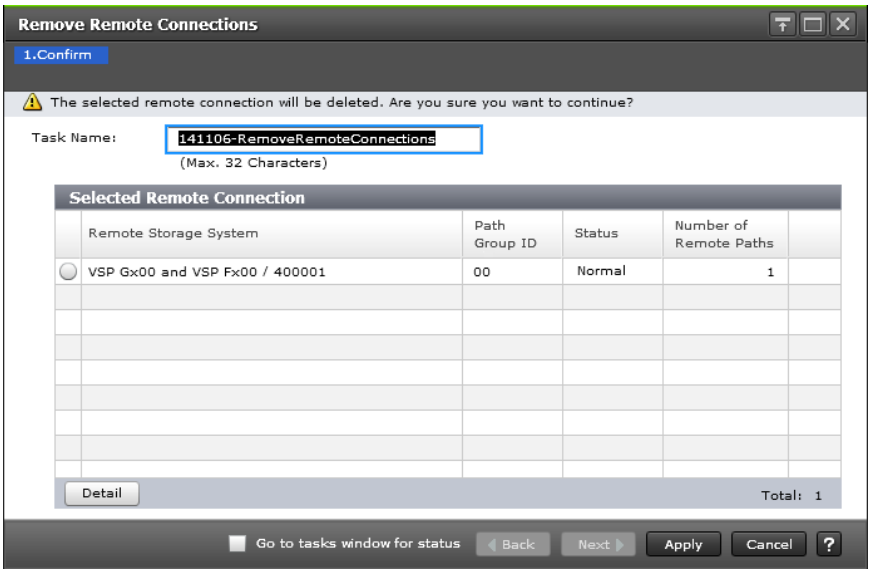
Local	Information about the local storage system port.
	• Port ID: Displays the port identifier.
	• Port Type: Displays the port type.
	  ○ Fibre
	  ○ iSCSI

Remote	Information about the remote storage system port. • Port ID: Displays the port identifier. • IP Address: Displays the IP address of the port when Port Type is iSCSI. • TCP Port Number: Displays the TCP port number when Port Type is iSCSI.
Status	Remote path status.

Remove Remote Connections window

Use this window to remove remote connections.

For complete information and instructions, see Deleting TrueCopy remote connections on page 7-18.



Selected Remote Connection table

Item	Description
Remote Storage System	Information about the remote system's model and serial number.
Path Group ID	Path group identifier.
Channel Type	• Fibre: All remote path port types within remote connection are Fibre. • iSCSI: All remote path port types within remote connection are iSCSI. • Mixed: Both Fibre and iSCSI exist within remote connection.
Status	Path status.
Number of Remote Paths	Number of remote paths subtracting those to be deleted.
Detail	Opens the **View Remote Connection Properties** window.

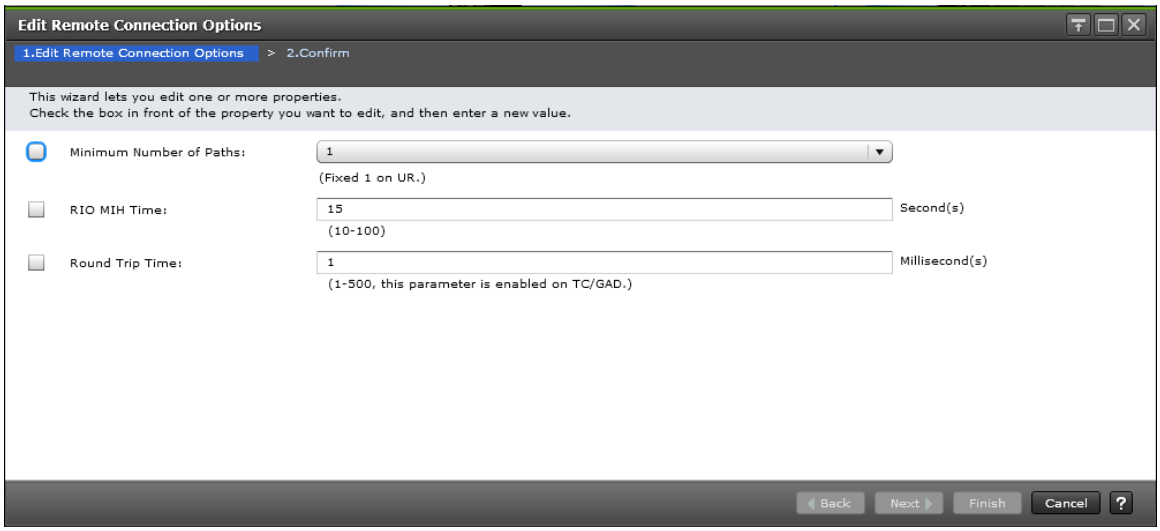
Edit Remote Connection Options wizard

Use this wizard to edit remote connection options.

Edit Remote Connection Options window

Use this window to edit remote connection options, such as minimum paths and round trip time.

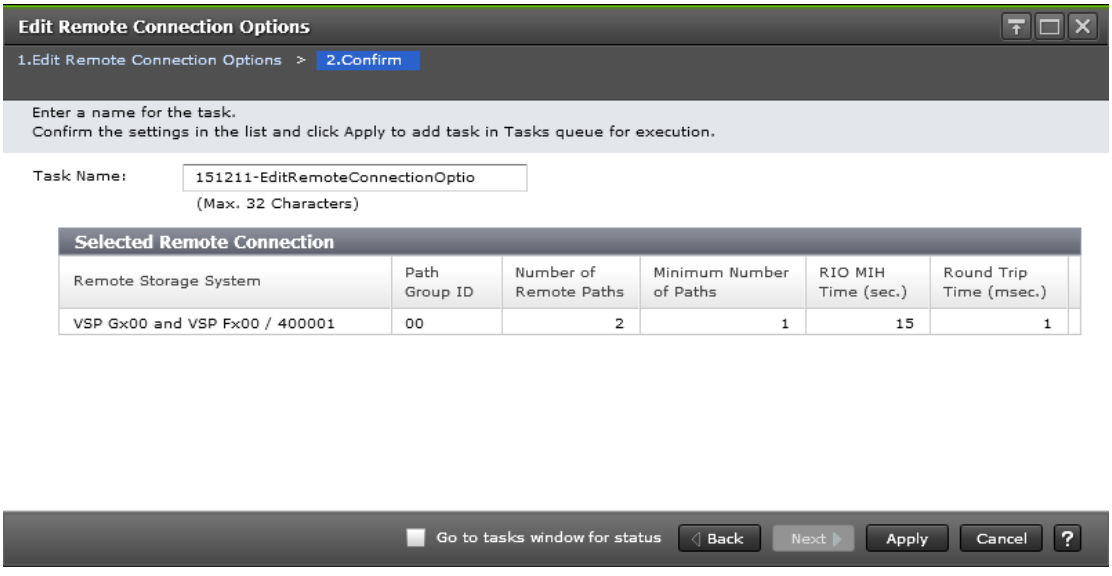
For complete information and instructions, see Changing minimum paths, round trip time, other remote connection options on page 7-15.



Selected Remote Connection table

Item	Description
Minimum Number of Paths	Minimum number of remote paths. • TC: Range is from 1 to 8. • UR: The minimum number is 1, regardless of the number entered.
RIO MIH Time	Time limit between 10 and 100 seconds for the data-transfer operation to complete (15 is the default).
Round Trip Time	TC and GAD only. Time limit between 1 and 500 milliseconds for data copy from P-VOL to S-VOL (1 is the default).

Edit Remote Connection Options confirmation window



Selected Remote Connection table

Item	Description
Remote Storage System	Information about the remote system's model and serial number.
Path Group ID	Path group identifier.
Number of Remote Paths	Number of remote paths including those being added.
Minimum Number of Paths	Minimum number of remote paths. • TC: Range is from 1 to 8. • UR: The minimum number is 1, regardless of the number entered.
RIO MIH Time	Time limit between 10 and 100 seconds for the data-transfer operation to complete (15 is the default).
Roundtrip Time (msec.)	Time limit between 1 and 500 milliseconds for data copy from P-VOL to S-VOL (1 is the default).

Add Remote Paths wizard

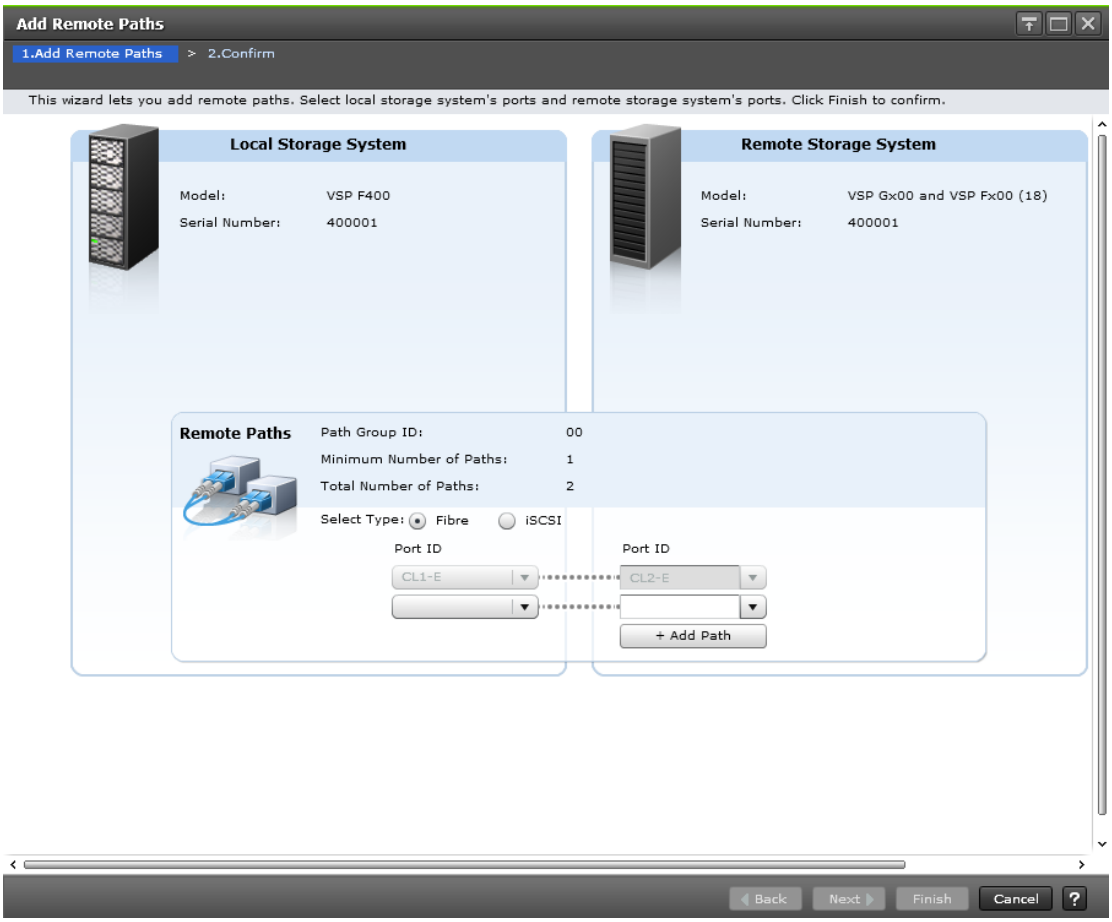
Use this wizard to add remote paths to a remote connection.

Add Remote Paths window

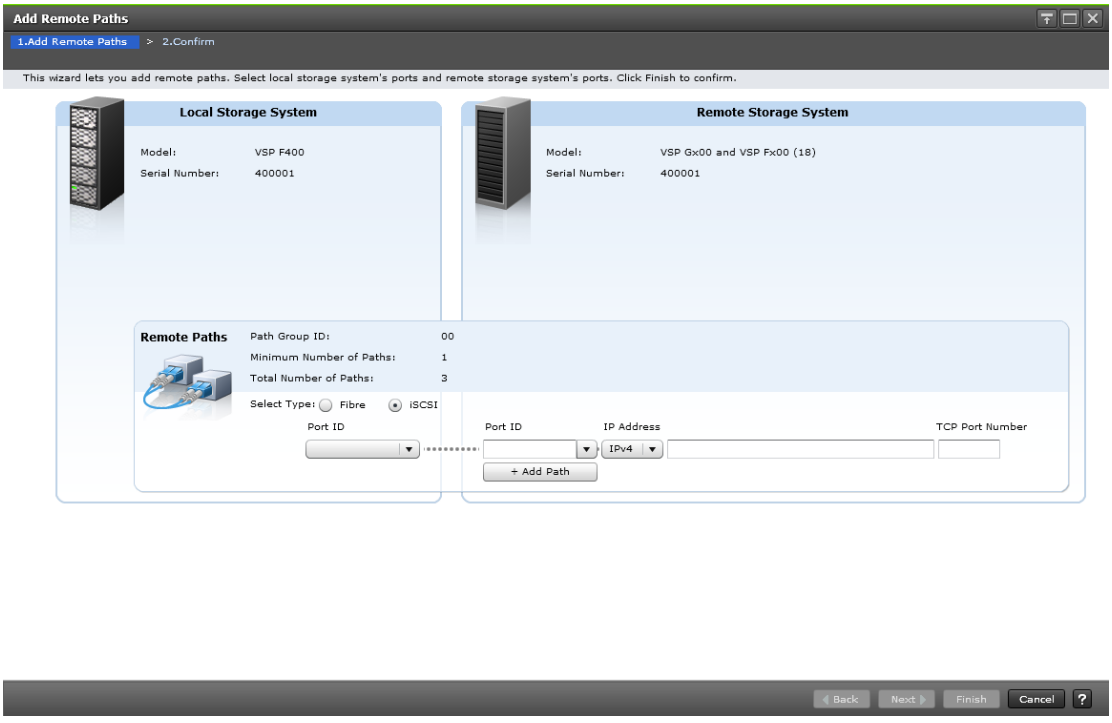
Use this window to add remote paths to a remote connection.

For complete information and instructions, see Configuring additional remote paths on page 7-14.

When you select **Fibre** for **Select Type** the following screen is displayed.



When you select **iSCSI** for **Select Type** the following screen is displayed.



In this topic, you can view the following tables.

Local Storage System

Item	Description
Model	Local system model.
Serial Number	Local system serial number.

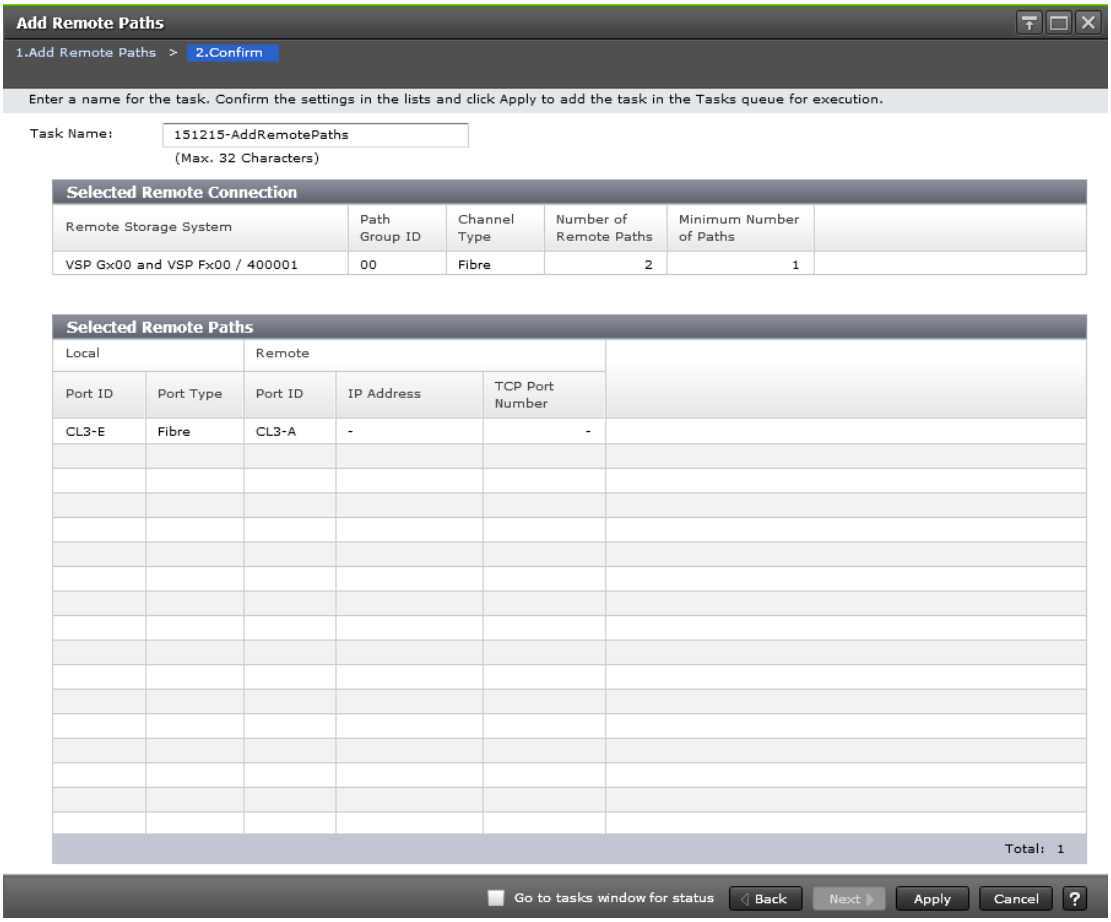
Remote Storage System

Item	Description
Model	Remote system model.
Serial Number	Remote system serial number.

Remote Paths

Item	Description
Path Group ID	Path group identifier. A hyphen (-) is displayed for CU connection.
Minimum Number of Paths	Specified minimum number of remote paths.
Total Number of Paths	Displays the total number of path registered to remote connection and path to be added (includes blank line).
Select Type	Select the port type. • Fibre • iSCSI
Port ID (local storage system)	Displays the port ID of the local storage system.
Port ID (remote storage system)	Displays the port ID of the remote storage system.
IP Address	Displays the port's IP address of the remote storage system. Only displays when selecting **iSCSI** for **Select Type**.
TCP Port Number	Displays the TCP port number of the remote storage system. Only displays when selecting **iSCSI** for **Select Type**.
Add Paths	Clicking adds more paths, up to eight.

Add Remote Paths confirmation window



In this topic, you can view the following tables.

- Selected Remote Connection table on page B-32
- Selected Remote Paths table on page B-33

Selected Remote Connection table

Item	Description
Remote Storage System	Information about the remote system's model and serial number.
Path Group ID	Path group identifier.
Channel Type	• Fibre: All remote path port types within remote connection are Fibre. • iSCSI: All remote path port types within remote connection are iSCSI. • Mixed: Both Fibre and iSCSI exist within remote connection.
Number of Remote Paths	Number of remote paths including those being added.
Minimum Number of Paths	Specified minimum number of remote paths.

Selected Remote Paths table

Item	Description

Local	Information about the local storage system port.
	• Port ID: Displays the port identifier.
	• Port Type: Displays the port type.
	  ◦ Fibre
	  ◦ iSCSI

Remote	Information about the remote storage system port. • Port ID: Displays the port identifier. • IP Address: Displays the IP address of the port when Port Type is iSCSI. • TCP Port Number: Displays the TCP port number when Port Type is iSCSI.

Remove Remote Paths wizard

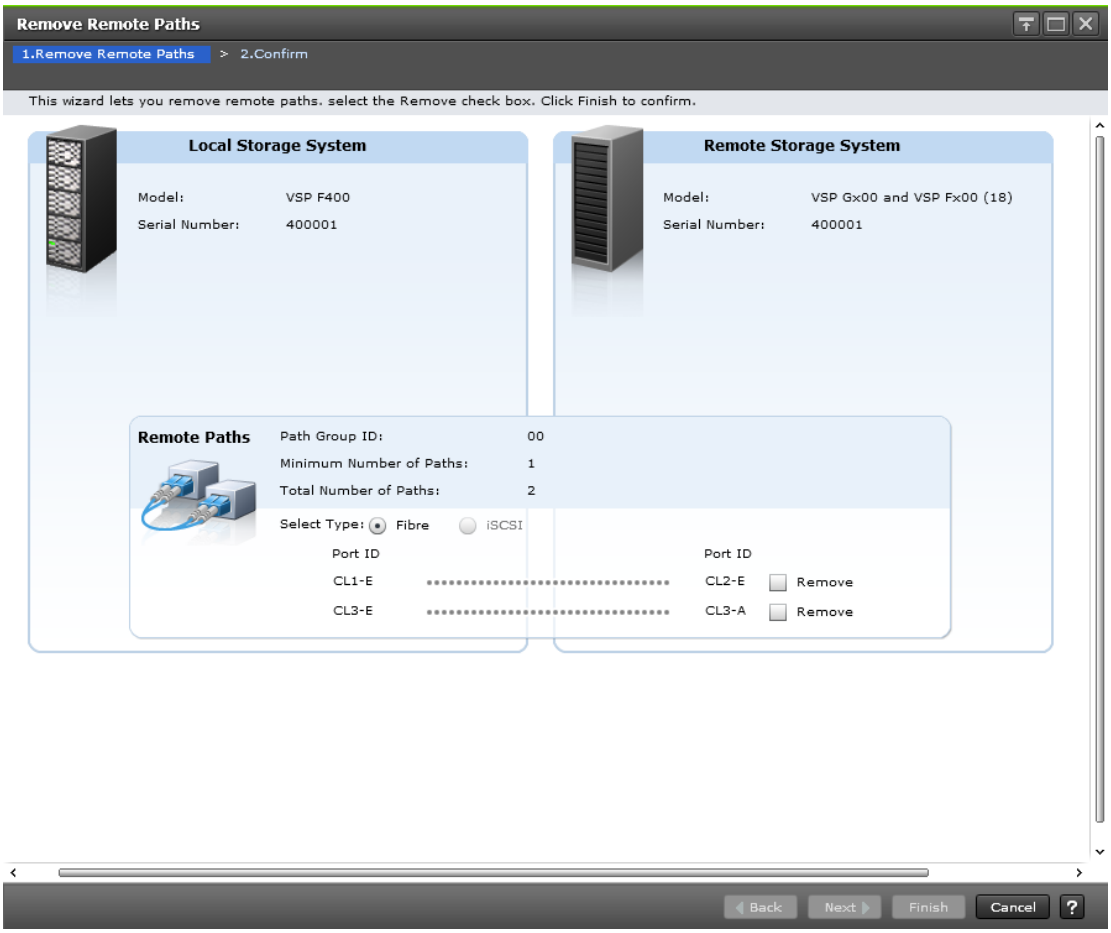
Use this wizard to remove paths from a remote connection.

Remove Remote Paths window

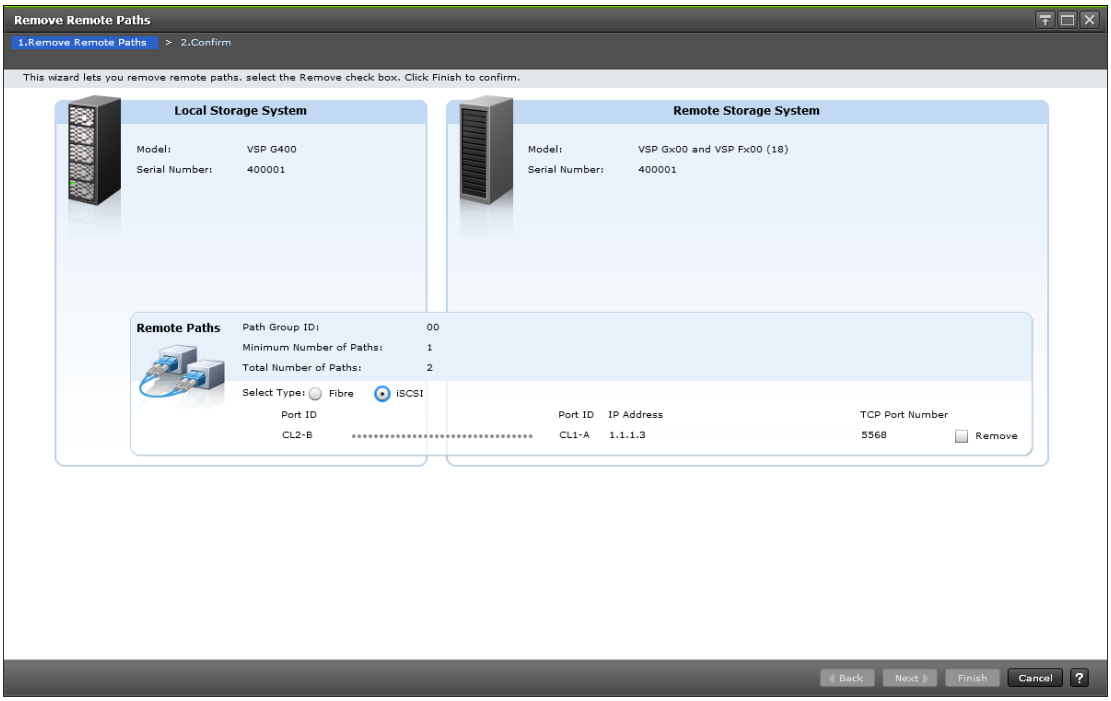
Use this window to remove paths from a remote connection.

For complete information and instructions, see Deleting remote paths on page 7-17.

When you select **Fibre** for **Select Type** the following screen is displayed.



When you select **iSCSI** for **Select Type** the following screen is displayed.



In this topic, you can view the following tables.

Local Storage System

Item	Description
Model	Local system model.
Serial Number	Local system serial number.

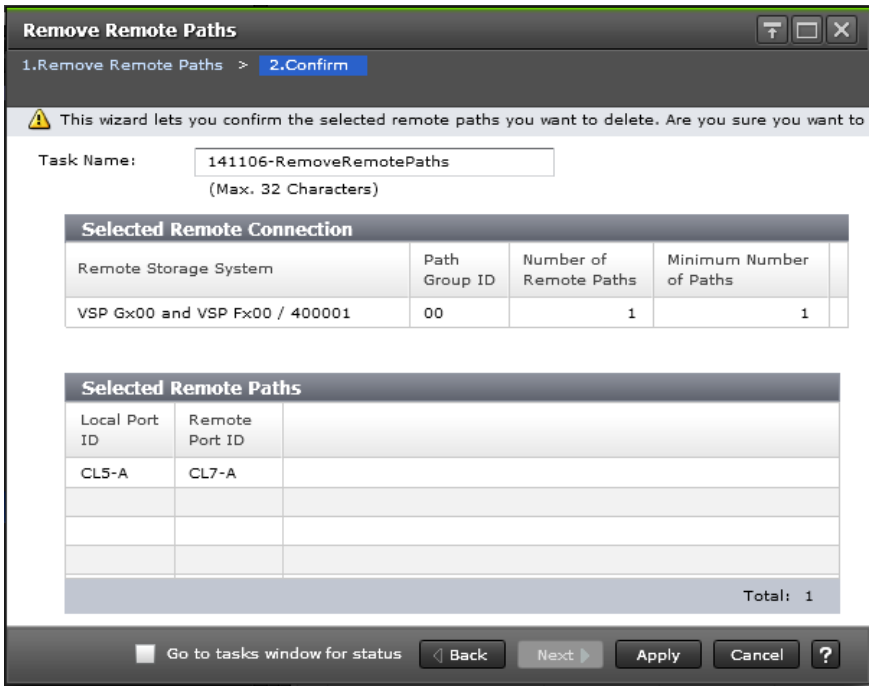
Remote Storage System

Item	Description
Model	Remote system model.
Serial Number	Remote system serial number.

Remote Paths

Item	Description
Path Group ID	Path group identifier. A hyphen (-) is displayed for CU connection.
Minimum Number of Paths	Specified minimum number of remote paths.
Total Number of Paths	Displays the total number of path registered to remote connection and path to be added (includes blank line).
Select Type	Select the port type. • Fibre • iSCSI
Port ID (local storage system)	Displays the port ID of the local storage system.
Port ID (remote storage system)	Displays the port ID of the remote storage system.
IP Address	Displays the port's IP address of the remote storage system. Only displays when selecting **iSCSI** for **Select Type**.
TCP Port Number	Displays the TCP port number of the remote storage system. Only displays when selecting **iSCSI** for **Select Type**.
Remove	Check box for deleting the path from the remote connection.

Remove Remote Paths confirmation window



In this topic, you can view the following tables.

- Selected Remote Connection table on page B-36
- Selected Remote Paths table on page B-36

Selected Remote Connection table

Item	Description
Remote Storage System	Information about the remote system's model and serial number.
Path Group ID	Path group identifier.
Channel Type	• Fibre: All remote path port types within remote connection are Fibre. • iSCSI: All remote path port types within remote connection are iSCSI. • Mixed: Both Fibre and iSCSI exist within remote connection.
Number of Remote Paths	Number of remote paths subtracting those to be deleted.
Minimum Number of Paths	Specified minimum number of remote paths.

Selected Remote Paths table

Item	Description
Local	Information about the local storage system port. • Port ID: Displays the port identifier.

Item	Description

	• Port Type: Displays the port type.
	  ◦ Fibre
	  ◦ iSCSI

Remote	Information about the remote storage system port. • Port ID: Displays the port identifier. • IP Address: Displays the IP address of the destination port when Port Type is iSCSI. • TCP Port Number: Displays the TCP port number of the destination when Port Type is iSCSI.

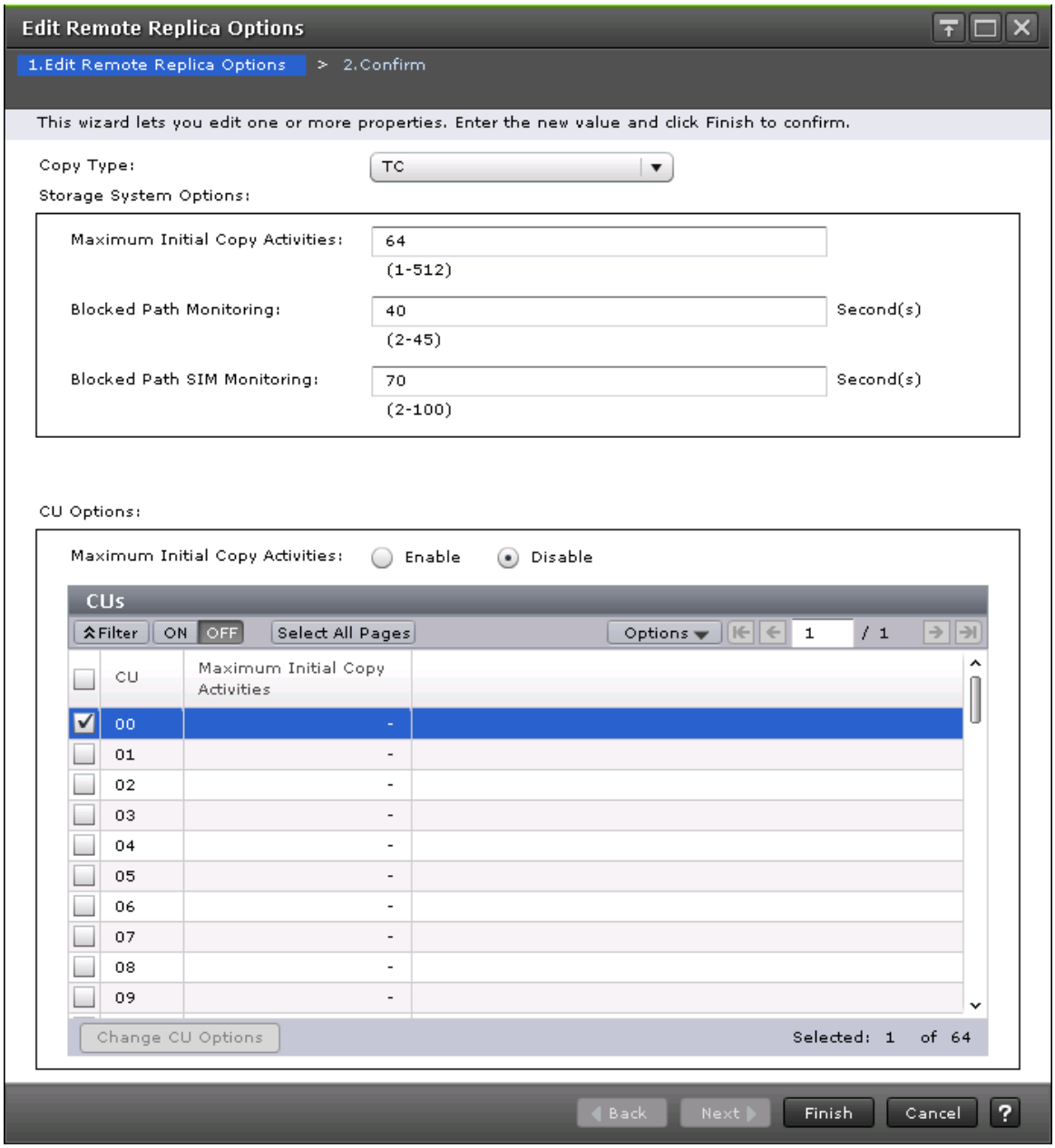
Edit Remote Replica Options wizard

Use this wizard to change options that affect the replication system.

Edit Remote Replica Options window

Use this window to change options that affect the replication system.

For complete information and instructions, see Changing remote replica options on page 5-4.



In this topic, you can view the following tables.

- Setting Fields on page B-38
- Storage System Options on page B-39
- CU Options on page B-39

Setting Fields

Item	Description
Copy Type	Type of pair: • TC: TrueCopy • UR: Universal Replicator

Item	Description
	• GAD: global-active device
Maximum Initial Copy Activities	Number of volumes that can be copied per initial copy operation (1 to 512). Displayed only when GAD is selected for **Copy Type**.

Storage System Options

This area is not displayed when GAD is selected for **Copy Type**.

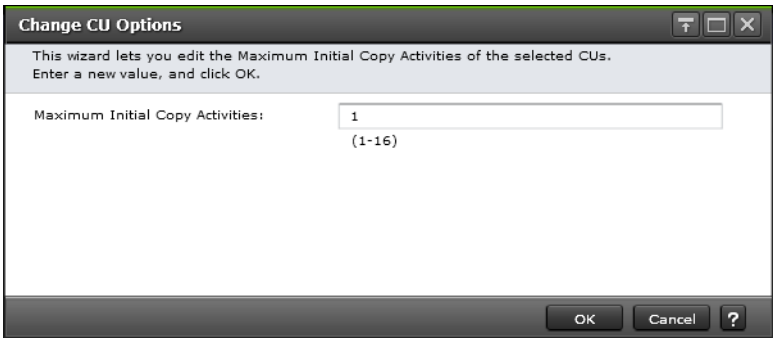
Item	Description
Maximum Initial Copy Activities	Number of volumes that can be copied per initial copy operation. The default is 64. When TC is selected for **Copy Type**: 1 to 512. When UR is selected for **Copy Type**: 1 to 128.
Blocked Path Monitoring	Number of seconds for the system to monitor blocked paths (2 to 45). You must select TC for **Copy Type** to display this option, but this setting also applies when you are monitoring the path blockade in UR or GAD.
Blocked Path SIM Monitoring	Number of seconds for the system to monitor SIMs reported for blocked paths (2 to 100). You must select TC for **Copy Type** to display this option, but this setting also applies when you are monitoring the SIM reported by path blockade in UR or GAD.

CU Options

This window is displayed only when TC is selected for **Copy Type**.

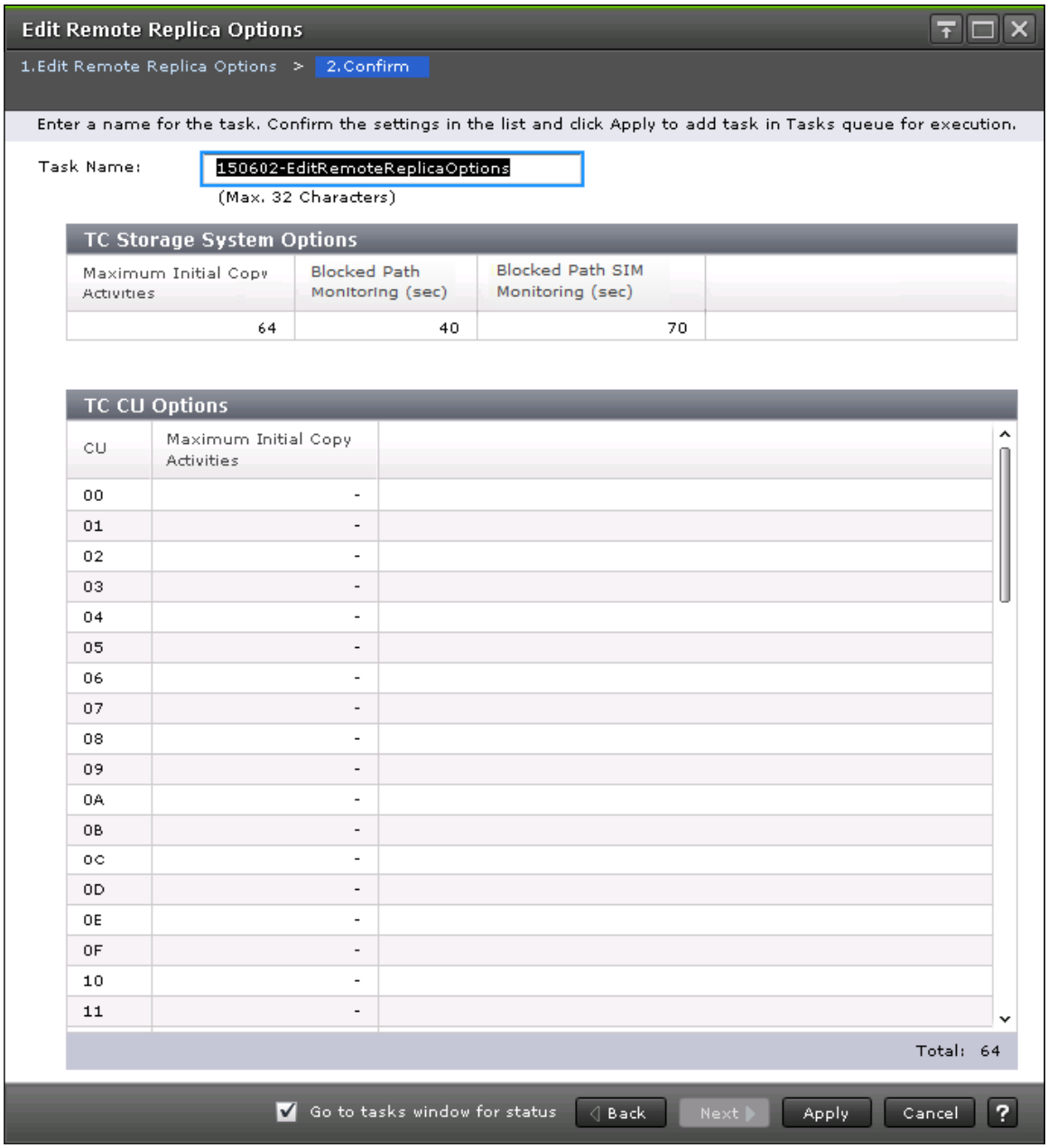
Item	Description
Maximum Initial Copy Activities	TC only. **Enable**: Enables maximum initial copy activities. **Disable**: Disables maximum initial copy activities.
CU	CU number.
Maximum Initial Copy Activities	TC only. Maximum initial copy activities. A hyphen (-) is displayed if **Disable** is selected in **Maximum Initial Copy Activities**.
Change CU Options	Opens the **Change CU Options** window. If you select **Disable** in **Maximum Initial Copy Activities**, you cannot select this button.

Change CU Options window



Item	Description
Maximum Initial Copy Activities	Number of volumes that can be copied per initial copy operation (1 to 16). This can be specified only when you select **Enable** for **Maximum Initial Copy Activities** in **CU Options** of the **Edit Remote Replica Options** window.

Edit Remote Replica Options confirmation window



In this topic, you can view the following tables.

- Storage System Options on page B-41
- CU Options on page B-42

Storage System Options

Item	Description
Maximum Initial Copy Activities	Number of volumes that can be copied per initial copy operation.

Item	Description
Blocked Path Monitoring (sec)	TC only. Number of seconds for the system to monitor blocked paths
Blocked Path SIM Monitoring (sec)	TC only. Number of seconds for the system to monitor SIMs reported for blocked paths

CU Options

CU Options are for TC only.

Item	Description
CU	CU number.
Maximum Initial Copy Activities	Number of volumes that can be copied per initial copy operation.

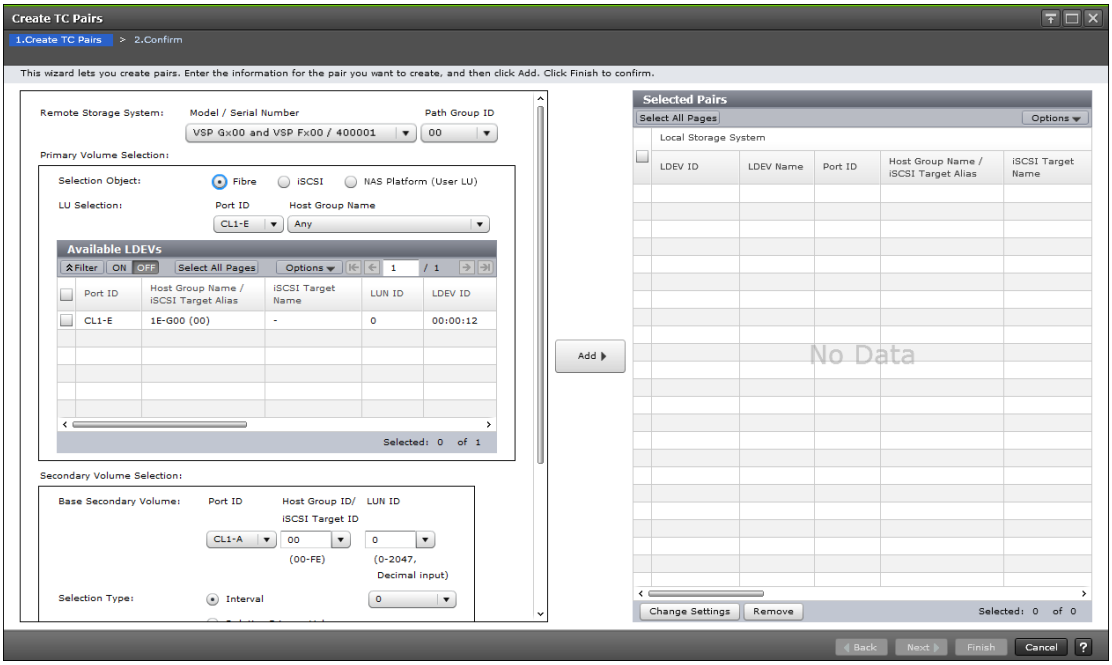
Create Pairs wizard

Use this wizard to create pairs.

Create TC Pairs window

Use this window to create pairs.

For complete information and instructions, see Creating pairs on page 6-3.



In this topic, you can view the following tables.

Settings

Item	Description
Remote Storage System	Selections in the remote system. • Model / Serial Number: Model and serial number. **Note:** VSP Gx00 is displayed for VSP Gx00 models and VSP Fx00 models. • Path Group ID: Select the ID of the path group.

Primary Volume Selection

Item	Description
Use Existing Volumes of UR Pairs	Displayed only for UR pairs. Select whether to use the volume which is being used by the UR pair. • Yes: Creates a pair using the volume used by the UR pair. Select Yes to create a pair in a 3DC multi-target or cascade configuration with three UR sites. • No: Creates a pair without using the volume used by the UR pair. Select No not to create a pair in a 3DC multi-target or cascade configuration with three UR sites.
Selection Object	Select the port type in the local storage system. • Fibre: Select when specifying LU for Fibre port. • iSCSI: Select when specifying LU for iSCSI port. • NAS Platform (User LU): Select when specifying LU for NAS port. Displayed only when NAS modules are installed. This option is not displayed for VSP G200. Ports without LUs cannot be selected. If only one port type (Fibre, iSCSI, or NAS Platform) has an LU, the port type is selected automatically.
LU Selection	TC and UR only. • Port ID: Local system's port identifier. • Host Group Name: Host group name. Displays only when Fibre port is selected in Port Name. • iSCSI Target Alias: Selections for iSCSI target alias. All the LUNs in the indicated port for Available LDEVs if Any is selected. Displays when iSCSI port is selected for Port Name.

Item	Description

Available LDEVs	Displayed only for TC pairs.
	Information about P-VOLs.
	• Port ID: Port identifier.
	• Host Group Name / iSCSI Target Alias: Host group name or iSCSI target alias.
	• iSCSI Target Name: Volume's iSCSI target name.
	• LUN ID: LUN identifier.
	• LDEV ID: LDEV identifier.
	• LDEV Name: LDEV name.
	• Provisioning Type: Whether the volume is Basic (internal) or External.
	• Attribute (TC only):
	  ◦ ALU: Volume with ALU attribute.
	  ◦ SLU: Volume with SLU attribute.
	  ◦ Data Direct Mapping: Volume with the data direct mapping attribute.
	  ◦ NAS Platform (User LU): User LU for NAS.
	If the attribute is not set, a hyphen (-) is displayed.
	• Capacity: LDEV's capacity.
	• CLPR: CLPR ID.
	• Encryption: Encryption information.
	  ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled.
	  ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled.
	  ◦ Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled.
	Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	A hyphen (-) is displayed for an external volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked.
	• T10 PI: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.
	  ◦ Disabled: Volume's T10 PI attribute is disabled.

Available Primary Volumes	Displayed only for UR pairs. • Port ID: Port identifier. • Host Group Name / iSCSI Target Alias: Host group name or iSCSI target alias.

Item	Description
	• iSCSI Target Name: Volume's iSCSI target name. • LUN ID: LUN identifier. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Identifies the volume as primary or secondary. A blank is displayed if the volume is not used by a pair. • Journal ID: Journal identifier. A blank is displayed if the volume is not used by a pair. • Mirror ID: Mirror ID. A blank is displayed if the volume is not used by a pair. • Provisioning Type: Whether the volume is Basic (internal) or External. • Attribute: o ALU: Volume with ALU attribute. o SLU: Volume with SLU attribute. o Data Direct Mapping: Volume with the data direct mapping attribute. o NAS Platform (User LU): User LU for NAS. If the attribute is not set, a hyphen (-) is displayed. • Capacity: LDEV's capacity. • CLPR: CLPR ID. • Encryption: Encryption information. o Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled. o Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled. o Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled. **Note:** Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled. A hyphen (-) is displayed for an external volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked. • Paired Volume: Paired volume information. A blank is displayed if the volume is not used by a pair. o Model / Serial Number: Model and serial number. o LDEV ID: LDEV identifier. o Port ID: Port identifier of the volume.

Item	Description
	○ Host Group ID / iSCSI Target ID: Host group ID or iSCSI target ID. ○ LUN ID: LUN identifier of the volume.

Secondary Volume Selection

Item	Description
Base Secondary Volume	Information about Base Secondary Volume. • Port ID: Port identifier. • Host Group ID / iSCSI Target ID: Host group or iSCSI target identifier. • LUN ID: LUN identifier.
Selection Type	Default is Interval. • Interval: Interval for allocating S-VOLs. • Relative Primary Volume: S-VOLs paired with P-VOLs relative to LUN or LDEV numbers.

Mirror Selection

UR only.

Item	Description
Master Journal	Select the master journal to which you allocate the primary volume. Registered journal IDs (except for those of restore journals) are displayed.
Mirror ID	Mirror's identifier.
Restore Journal	Select the restore journal to which you allocate secondary volumes. All journal IDs (000 to 0FF) are displayed.
Current Number of Master Journal Mirrors	Number of mirrors in the master journal.
Total Number of Master Journal Mirrors	Displays the following: • Number of mirrors in the master journal. • Number of mirrors added during the Create UR Pairs operation. • Number of mirrors for the selected volume in Selected Pairs table.
CTG ID	Displays consistency groups registered in the storage system. An asterisk indicates it is assigned to a pair in the Select Pairs table.

Options

Item	Description
Primary Volume Fence Level	TC only Whether the P-VOL can be written to when the pair is split due to error. • Data: Cannot be written to. • Status: Can be written to only if the primary system can change S-VOL status to PSUE; otherwise no. • Never: Can be written to. The default.
Initial Copy Type	Whether data is copied to the S-VOL during this operation. • Entire Volume: Data is copied. The default. • None: Data is not copied. • Delta: Data is not copied. UR only.
Copy Pace	TC and GAD only Number of tracks to be copied per remote I/O during the operation. The default is 15. To change the copy pace, enter a number from 1 to 4: • 1 is slow. This setting limits the impact on host I/O to maintain storage system performance. • 2 and 3 is medium. • 4 is fast. This setting increases the impact on host I/O and might result in decreased storage system performance. If you enter a number from 5 to 15, the speed of 4 (fast copy pace) is used.
Initial Copy Priority	Scheduling order for the initial copy operation. Range is 1 to 256; default is 32. For GAD pairs, this is not displayed.
Error Level	UR only. Whether to split all pairs in the mirror if a failure occurs during this operation: • Mirror: Pairs in the mirror are split. • LU: Only the failed pair is split.

Selected Pairs table

Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Port ID: Port identifier. • Host Group Name / iSCSI Target Alias: Host group name or iSCSI target alias. • iSCSI Target Name: Volume's iSCSI target name.

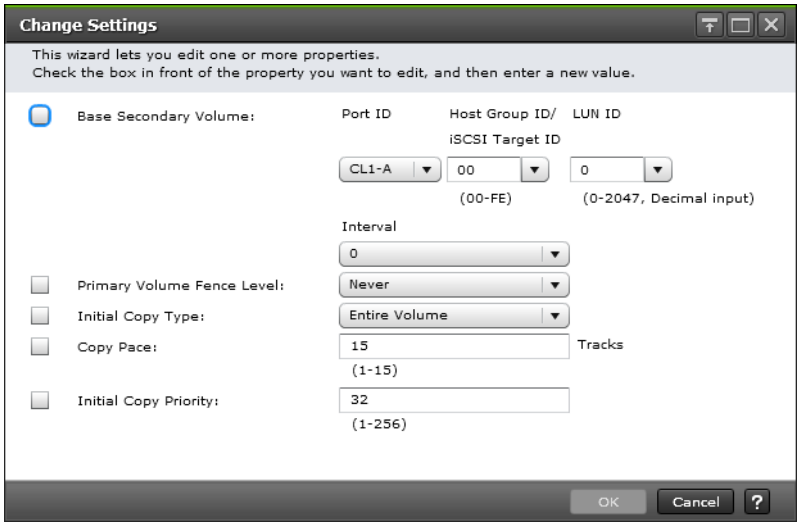
Item	Description

	• LUN ID: LUN identifier.
	• Pair Position (UR only): Whether volume is a P-VOL or S-VOL.
	• Attribute:
	  ◦ ALU: Volume with ALU attribute
	  ◦ SLU: Volume with SLU attribute
	  ◦ Data Direct Mapping: Volume with the data direct mapping attribute
	  If the attribute is not set, a hyphen (-) is displayed.
	• Journal ID: Journal's identifier.
	• Mirror ID: Mirror identifier.
	• Capacity: Volume's capacity.
	• CLPR: Volume's CLPR.
	• Encryption: Encryption information.
	  ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled.
	  ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled.
	  ◦ Mixed: The pool to which the LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled.
	  Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	  A hyphen (-) is displayed for an external volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked.
	• Journal Encryption: Journal's encryption status (displayed only for UR pairs).
	  ◦ Enabled: The journal contains encrypted volumes.
	  ◦ Disabled: The journal contains unencrypted volumes.
	  ◦ Mixed: The journal contains both encrypted and unencrypted volumes.
	  Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	  A hyphen (-) is displayed if the pool to which the journal volume belongs is either an external volume or blocked.
	• T10 PI: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.

Item	Description
	○ Disabled: Volume's T10 PI attribute is disabled.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • Port ID: Port identifier. • Host Group ID / iSCSI Target ID: Host group or iSCSI target identifier. • LUN ID: LUN identifier. • Journal ID: Journal's identifier. UR only.
Path Group ID	Path group ID.
Fence Level	TC only. Fence level setting.
CTG ID	UR only. Consistency group identifier.
Initial Copy Type	Type of the pair create operation.
Copy Pace	TC only Number of tracks copied per remote I/O operation.
Initial Copy Priority	Scheduling order for pair create operation.
Error Level	UR only. Whether all pairs in the mirror are split if a failure occurs during this operation.
Change Settings	Opens the **Change Settings** window.
Delete	Deletes the specified pair from the table.

Change Settings window

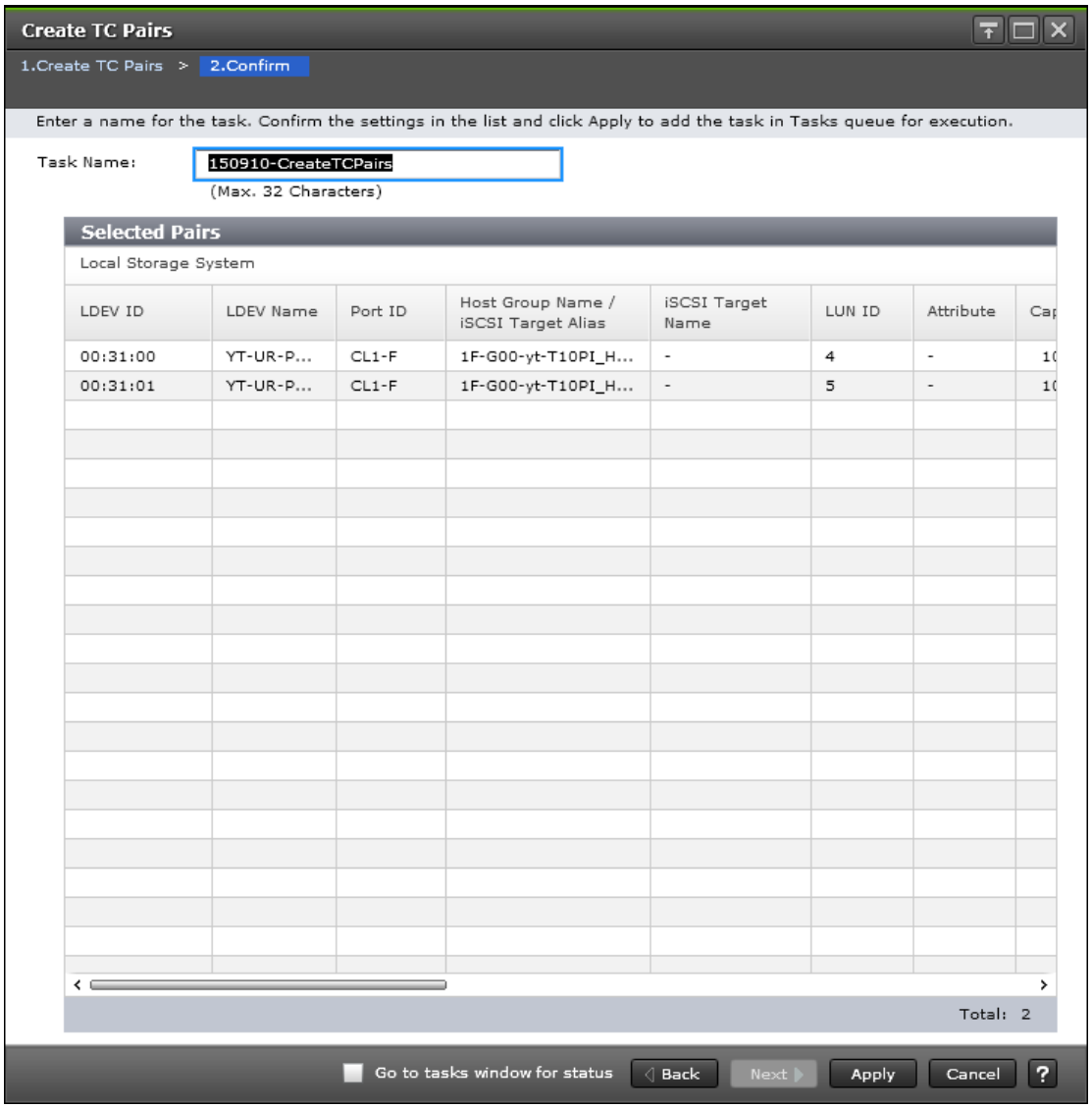
Use this window in the pair creation wizard to change options that affect how the pair is created.



Item	Description
Base Secondary Volume	Select when changing Base Secondary Volume setting. • Port ID: Port identifier. • Host Group ID / iSCSI Target ID: Host group or iSCSI target identifier. • LUN ID: LUN identifier. • Interval: Interval.
Primary Volume Fence Level	TC only Whether the P-VOL can be written to when the pair is split due to error. • Data: The P-VOL cannot be written to. • Status: The P-VOL can be written to only if the primary storage system can change S-VOL status to PSUE; otherwise no. • Never: The P-VOL can be written to.
Initial Copy Type	Whether data is copied to the S-VOL when the pair is created. • Entire Volume: Data is copied. The default. • None: Data is not copied. If you choose this option, you should confirm the data be equal between the P-VOL and S-VOL. • Delta: Data is not copied. UR only. If the pair is Universal Replicator pair, the status will be changed to HOLD or HOLDING as a pair for delta resync.
Copy Pace	TC and GAD only Number of tracks to be copied per remote I/O during the operation. The default is 15. To change the copy pace, enter a number from 1 to 4: • 1 is slow. This setting limits the impact on host I/O to maintain storage system performance. • 2 and 3 is medium. • 4 is fast. This setting increases the impact on host I/O and might result in decreased storage system performance. If you enter a number from 5 to 15, the speed of 4 (fast copy pace) is used.
ALUA Mode	GAD only Whether to enable ALUA mode: • Enable: Use LDEV by ALUA. • Disable: Does not use LDEV by ALUA.
Initial Copy Priority	Scheduling order for the initial copy operation. Range is 1 to 256; default is 32. For GAD pairs, this is not displayed.
Error Level	UR only Whether to split all pairs in the mirror if a failure occurs during this operation:

Item	Description
	• LU: Only the failed pair is split. • Mirror: Pairs in the mirror are split.

Create TC Pairs confirmation window



Selected Pairs table

Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Port ID: Port identifier.

Item	Description

	• Host Group Name / iSCSI Target Alias: Host group name or iSCSI target alias.
	• iSCSI Target Name: Volume's iSCSI target name.
	• LUN ID: LUN identifier.
	• Pair Position (UR only): Whether volume is a P-VOL or S-VOL.
	• Journal ID: Journal's identifier. UR only.
	• Mirror ID: Mirror identifier. UR only.
	• Capacity: Volume's capacity.
	• Attribute: LDEV attribute. A hyphen (-) is displayed if the attribute is not set.
	• CLPR: Volume's CLPR.
	• Encryption: Encryption information.
	  ◦ Enabled: The parity group encryption to which LDEV belongs is enabled, or a V-VOL is associated with a pool in which a pool volume has encryption enabled.
	  ◦ Disabled: The parity group encryption to which LDEV belongs is disabled, or a V-VOL is associated with a pool in which a pool volume has encryption disabled.
	  ◦ Mixed: The pool to which P-VOL's LDEV belongs contains both pool volumes for which encryption is enabled and pool volumes for which encryption is disabled.
	  Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	  A hyphen (-) is displayed for an external volume. For DP-VOLs, the pool to which the LDEV belongs is either an external volume or blocked.
	• Journal Encryption: Journal's encryption status (displayed only for UR pairs).
	  ◦ Enabled: The journal contains encrypted volumes.
	  ◦ Disabled: The journal contains unencrypted volumes.
	  ◦ Mixed: The journal contains both encrypted and unencrypted volumes.
	  Note: Encryption of data is not ensured in an LDEV with the Mixed encryption status. To manage data encryption, use an LDEV for which Encryption is Enabled or Disabled.
	  A hyphen (-) is displayed if the pool to which the journal volume belongs is either an external volume or blocked.
	• T10 PI: Volume's T10 PI attribute information.
	  ◦ Enabled: Volume's T10 PI attribute is enabled.
	  ◦ Disabled: Volume's T10 PI attribute is disabled.

Item	Description
Remote Storage System	Information about volumes in the system connected to the system you accessed. • Model / Serial Number: Model and serial number. • Port ID: Port identifier. • Host Group Name / iSCSI Target Alias: Host group name or iSCSI target alias. • LUN ID: LUN identifier. • Journal ID: Journal's identifier. UR only.
Path Group ID	Path group identifier.
CTG ID	UR only. Consistency group identifier.
Fence Level	TC only Fence level setting.
Initial Copy Type	Type of initial copy operation.
Copy Pace	TC only Number of tracks to be copied per remote I/O during the operation.
Initial Copy Priority	Scheduling order for the initial copy operation. Range is 1 to 256; default is 32.
Error Level	UR only. Whether to split all pairs in the mirror if a failure occurs during this operation: • Mirror: Pairs in the mirror are split. • Volume: Only the failed pair is split.

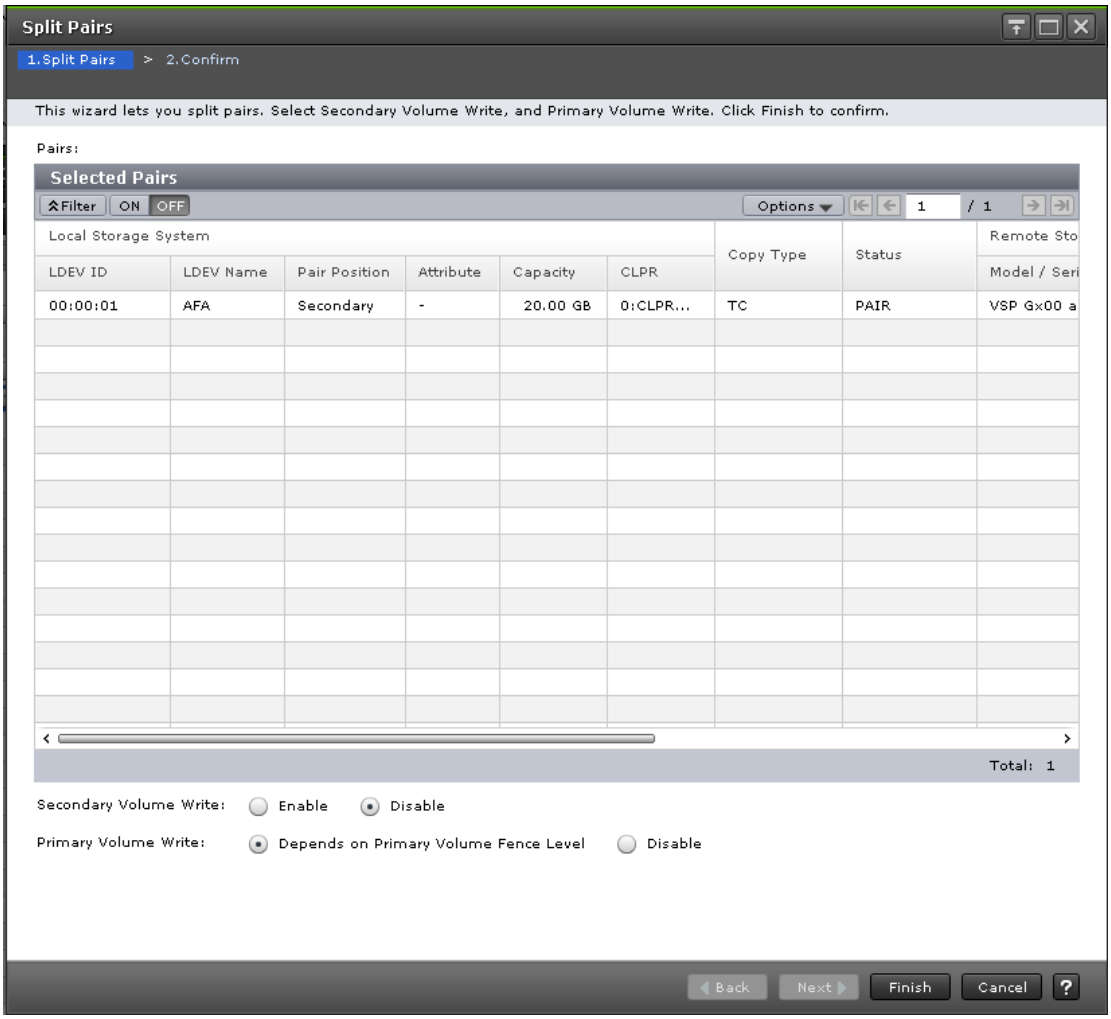
Split Pairs wizard

Use this wizard to split pairs.

Split Pairs window

Use this window to split pairs.

For complete information and instructions, see Splitting pairs on page 6-6.



In this topic, you can view the following tables.

- Selected Pairs table on page B-54
- Setting Fields on page B-55

Selected Pairs table

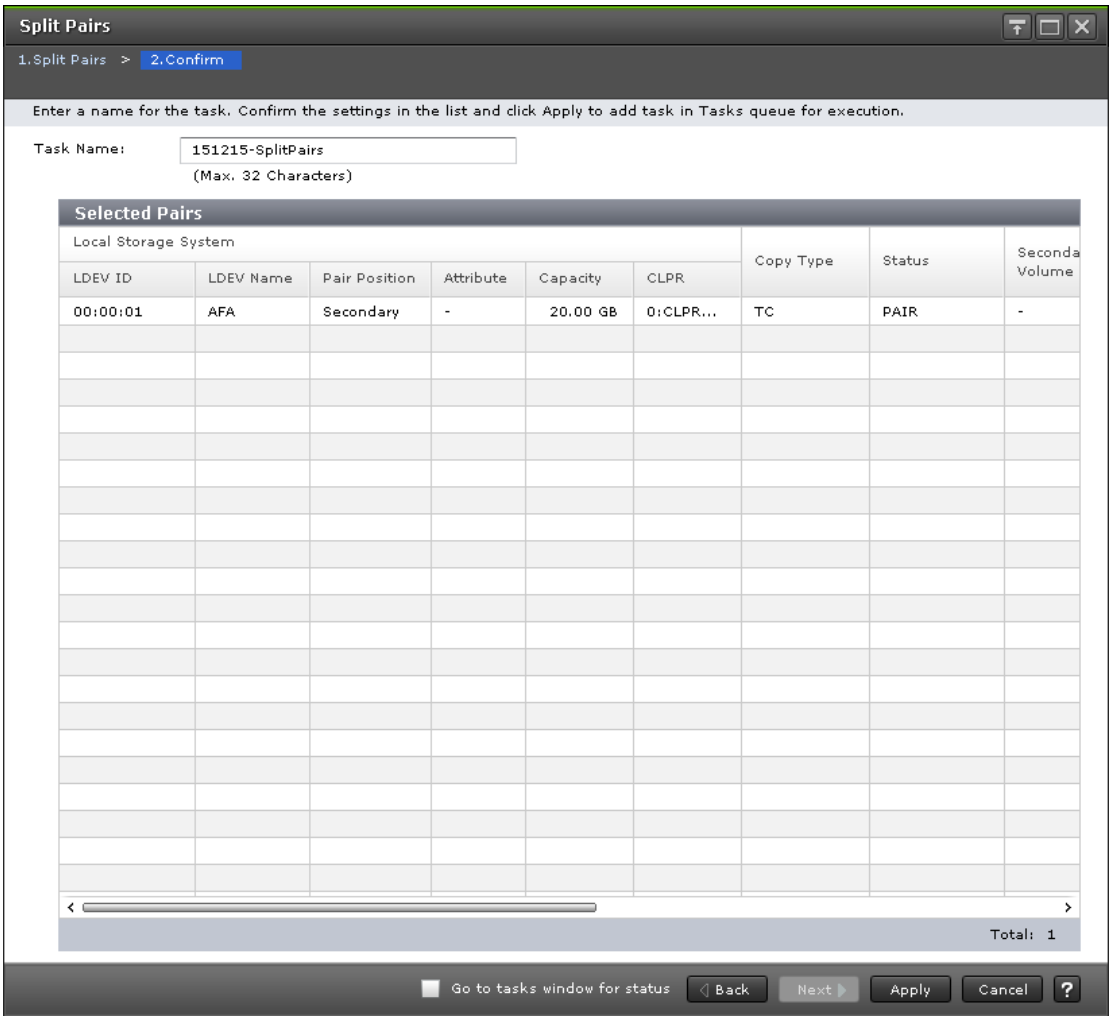
Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Whether volume is a P-VOL or S-VOL. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy

Item	Description
Status	Pair status.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Fence Level	Fence level setting.

Setting Fields

Item	Description
Secondary Volume Write	Whether the S-VOL can be written to while the pair is split. • Enabled: Can write to S-VOL. Available only when performing the split operation from the pair's primary storage system. • Disabled: Prevents writing to S-VOL. Default.
Primary Volume Write	Whether the P-VOL can be written to while the pair is split. • Depend on Primary Volume Fence Level: Writing to P-VOL depends on the Primary Volume Fence Level Setting. Default. • Disable: Prevents writing to the P-VOL. Available only when performing the split operation from the pair's primary storage system.

Split Pairs confirmation window



Selected Pairs table

Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Whether volume is a P-VOL or S-VOL. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Status	Pair status.
Secondary Volume Write	Whether the S-VOL can be written to while the pair is split. • Enabled: Can write to S-VOL.

Item	Description
	• Disabled: Prevents writing to S-VOL. Default. A hyphen (-) is displayed if performing the split operation from the pair's secondary storage system, regardless of the selected option.
Primary Volume Write	Whether the P-VOL can be written to while the pair is split. • Depend on Primary Volume Fence Level: Writing to P-VOL depends on the Primary Volume Fence Level Setting. Default. • Disable: Prevents writing to the P-VOL. A hyphen (-) is displayed if performing the split operation from the pair's secondary storage system, regardless of the selected option.
Fence Level	Fence level setting.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.

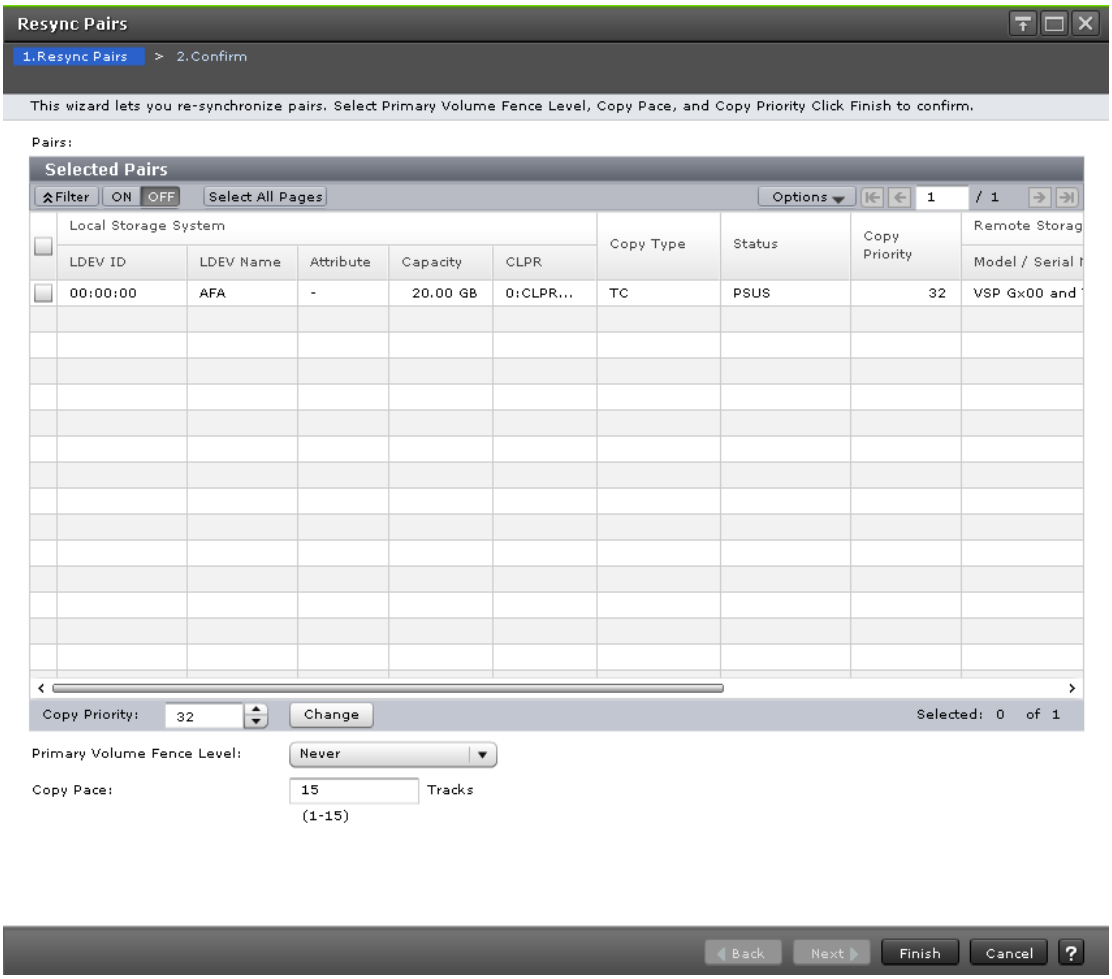
Resync Pairs wizard

Use this wizard to resynchronize pairs.

Resync Pairs window

Use this window to resynchronize pairs.

For complete information and instructions, see Resynchronizing pairs on page 6-8.



In this topic, you can view the following tables.

- Selected Pairs table on page B-58
- Setting Fields on page B-59

Selected Pairs table

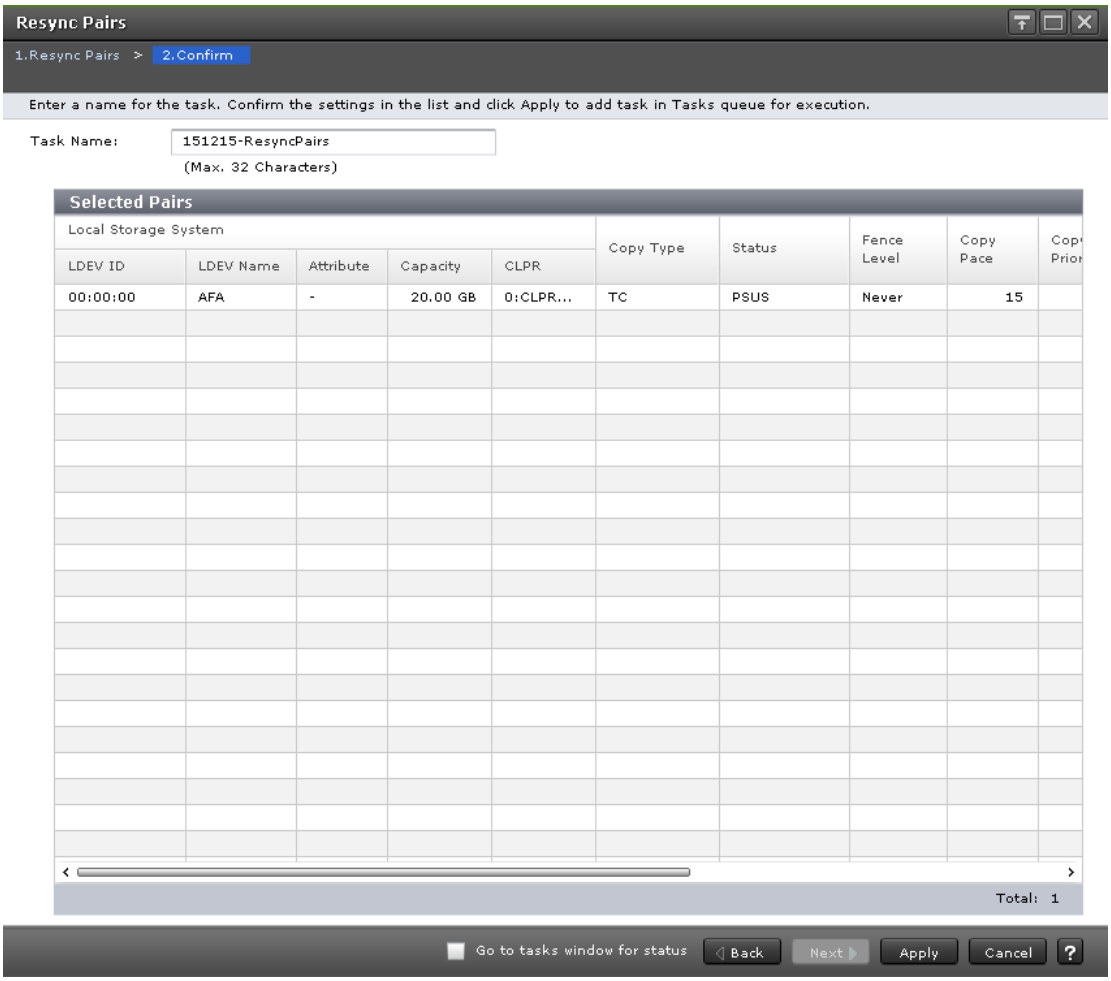
Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Status	Pair status.
Copy Priority	Order that pairs are resynchronized.

Item	Description
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Copy Priority	Order that pairs are resynchronized.

Setting Fields

Item	Description
Primary Volume Fence Level	Whether the P-VOL can be written to when the pair is split due to error. • Data: The P-VOL cannot be written to. • Status: The P-VOL can be written to only if the primary storage system can change S-VOL status to PSUE; otherwise no. • Never: The P-VOL can be written to. This is the default.
Copy Pace	Number of tracks to be copied per remote I/O during the operation. The default is 15. To change the copy pace, enter a number from 1 to 4: • 1 is slow. This setting limits the impact on host I/O to maintain storage system performance. • 2 and 3 is medium. • 4 is fast. This setting increases the impact on host I/O and might result in decreased storage system performance. If you enter a number from 5 to 15, the speed of 4 (fast copy pace) is used.

Resync Pairs confirmation window



Selected Pairs table

Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Status	Pair status.
Fence Level	Whether the P-VOL can be written to when the pair is split due to error. • Data: Cannot be written to. • Status: Can be written to only if the local system can change S-VOL status to PSUE; otherwise no.

Item	Description
	• Never: Can be written to.
Copy Pace	Number of tracks to be copied per remote I/O during the operation.
Copy Priority	Order that pairs are resynchronized.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.

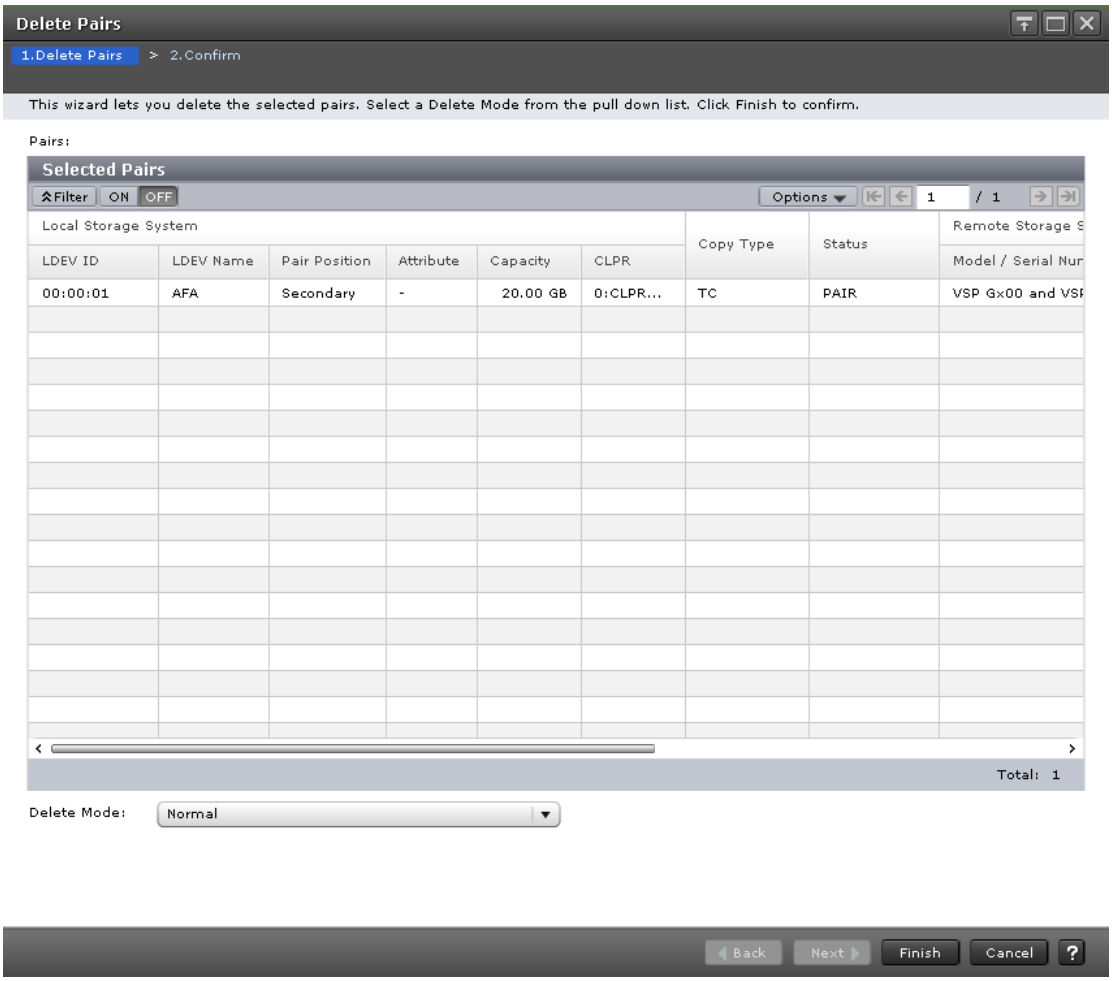
Delete Pairs wizard

Use this wizard to delete pairs.

Delete Pairs window

Use this window to delete pairs.

For complete information and instructions, see Deleting pairs on page 6-10.



In this topic, you can view the following tables.

- Selected Pairs table on page B-62
- Settings on page B-63

Selected Pairs table

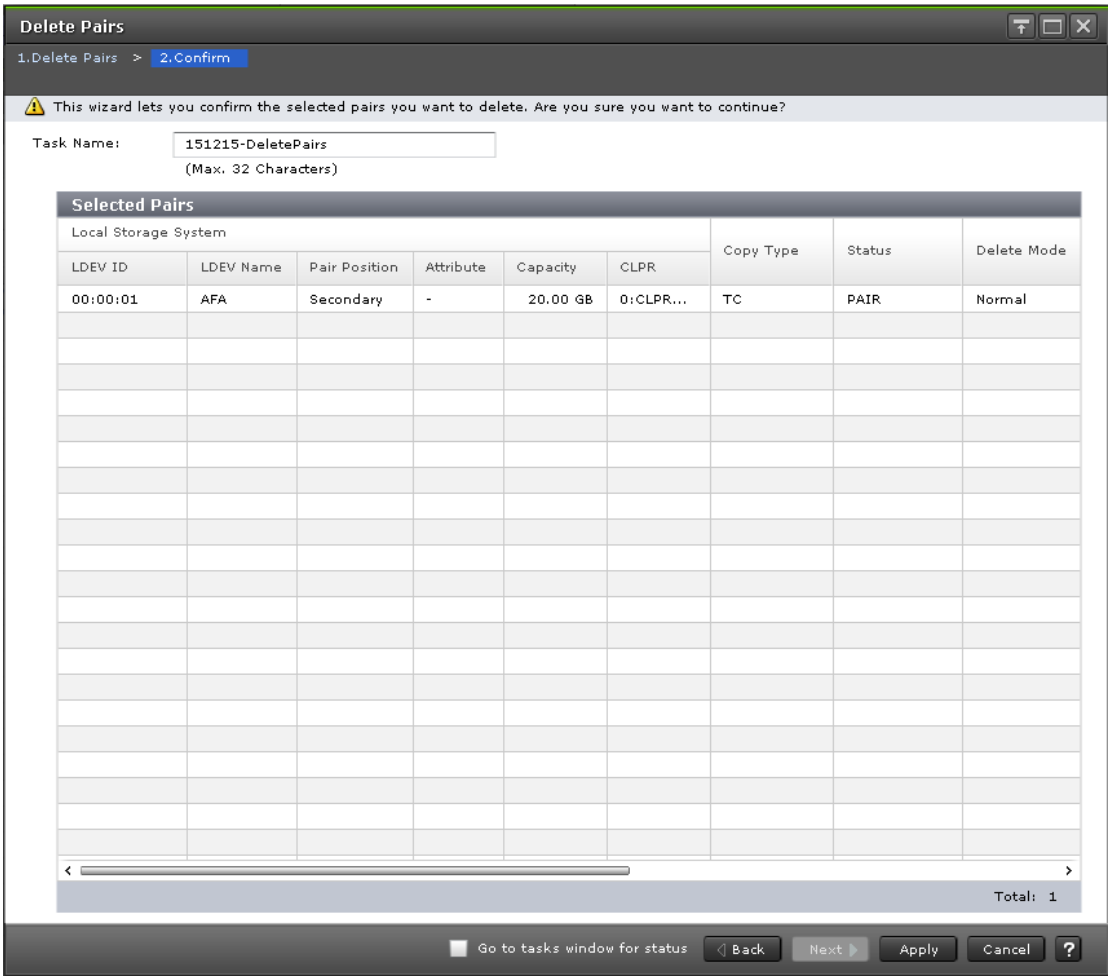
Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Whether volume is a P-VOL or S-VOL. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Status	Pair status.

Item	Description
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Fence Level	Whether the P-VOL can be written to when the pair is split due to error. • Data: The P-VOL cannot be written to. • Status: The P-VOL can be written to only if the primary storage system can change S-VOL status to PSUE; otherwise no. • Never: The P-VOL can be written to.

Settings

Item	Description
Delete Mode	How the pair is deleted. • Normal: Deletes the pair if the local system can change both P-VOL and S-VOL to unpaired volumes. Default. • Force: Deletes the pair even when the local system cannot communicate with the remote system.

Delete Pairs confirmation window



Selected Pairs table

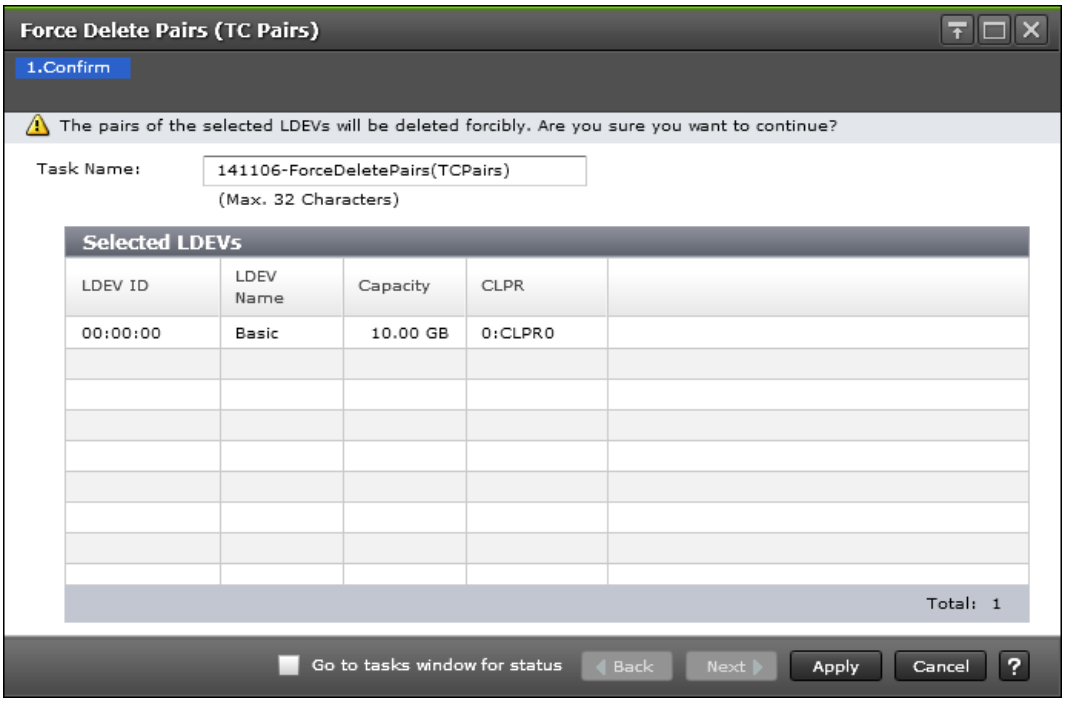
Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Whether volume is a P-VOL or S-VOL. • Capacity: Volume's capacity. • Attribute: LDEV attribute. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Status	Pair status.
Delete Mode	How the pair is deleted.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number.

Item	Description
	• LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.
CTG ID	Pair's consistency group identifier.
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Fence Level	Fence level setting.

Force Delete Pairs (TC Pairs) window

Use this window to forcibly delete pairs.

For complete information and instructions, see Forcibly deleting pairs on page 7-10.



Selected LDEVs table

Item	Description
LDEV ID	LDEV identifier.
LDEV Name	LDEV name.

Item	Description
Capacity	Capacity.
CLPR	CLPR ID.

Edit Pair Options wizard

Use this wizard to change pair options.

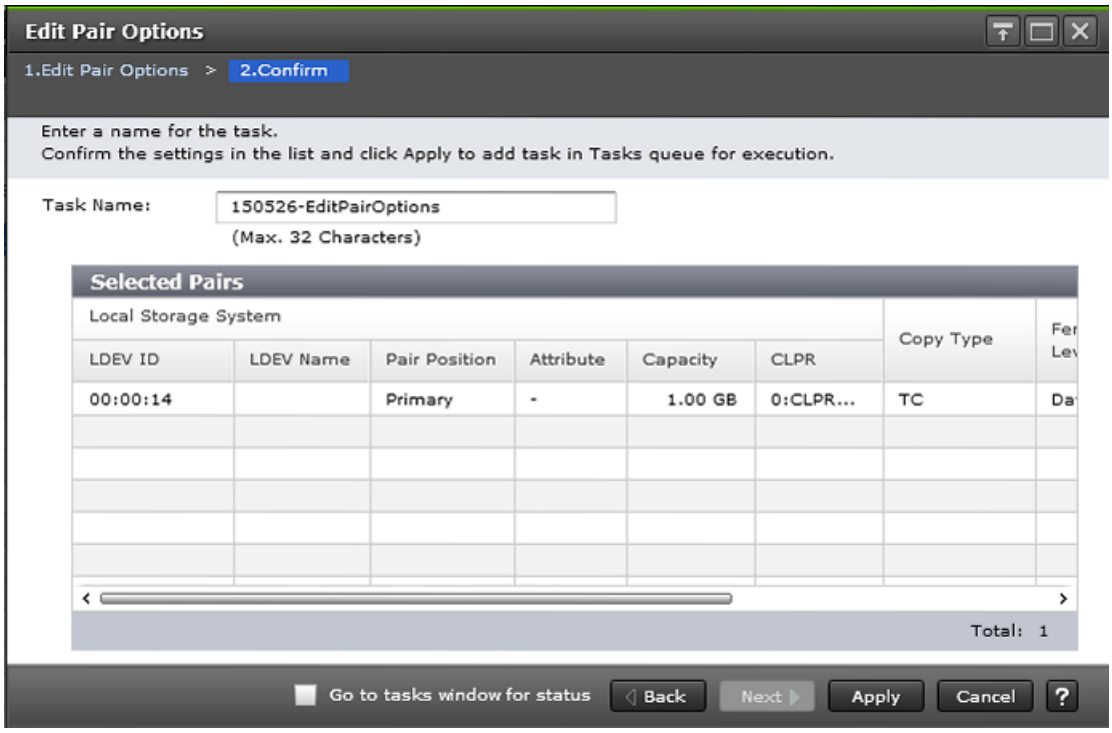
Edit Pair Options window

Use this window to change pair options.

For complete information and instructions, see Changing the Fence Level on page 7-9.

Item	Description
Primary Volume Fence Level	Whether the P-VOL can be written to when the pair is split due to error. • Data: The P-VOL cannot be written to. • Status: The P-VOL can be written to only if the primary storage system can change S-VOL status to PSUE; otherwise no. • Never: The P-VOL can be written to. The value set for the selected pair is the default.

Edit Pair Options confirmation window



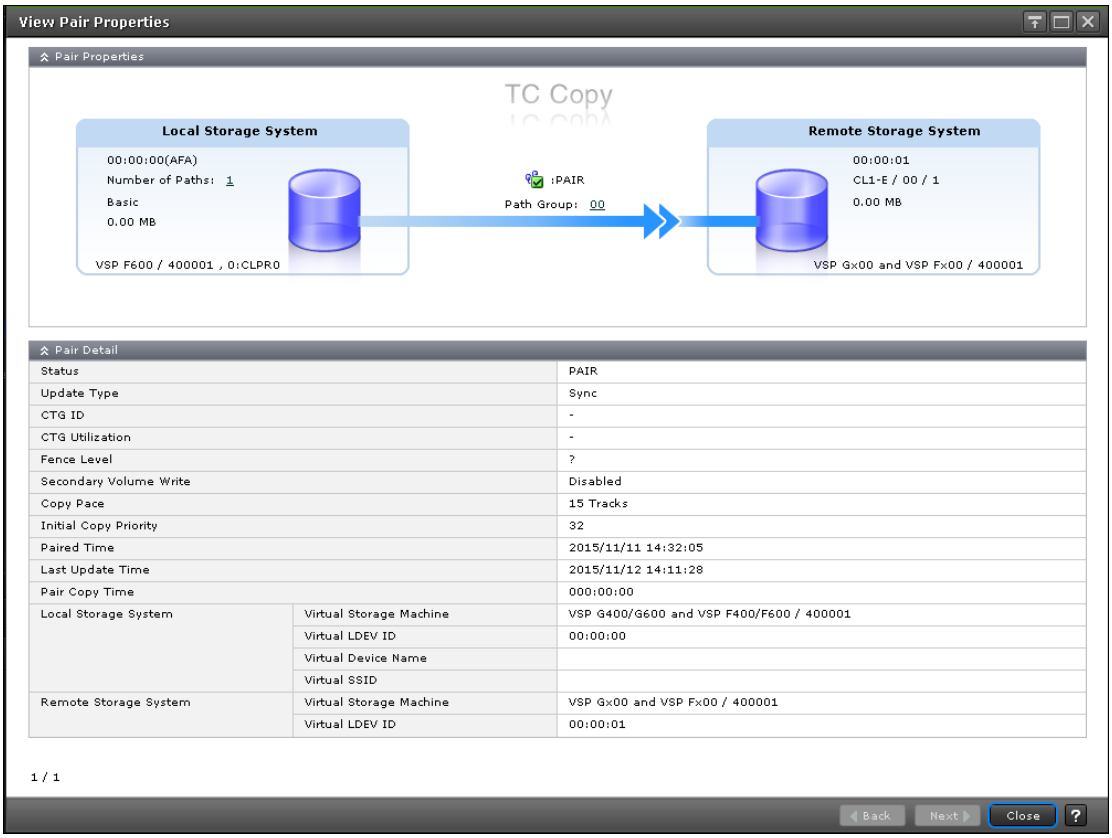
Selected Pairs table

Item	Description
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • LDEV Name: LDEV name. • Pair Position: Whether volume is a P-VOL or S-VOL. • Attribute: LDEV attribute. • Capacity: Volume's capacity. • CLPR: Volume's CLPR.
Copy Type	Type of pair: • TC: TrueCopy
Fence Level	Fence level setting.
Remote Storage System	Information about the remote system. • Model / Serial Number: Model and serial number. • LDEV ID: LDEV identifier.
Path Group ID	Path group identifier.

View Pair Properties window

Use this window to view the data related to pairs and their volumes.

For complete information and instructions, see Monitoring pair status, license capacity on page 7-2.



In this topic, you can view the following tables.

- Pair Properties on page B-68
- Pair Detail on page B-69

Pair Properties

Item	Description
Local Storage System box	Displays the following information about the local system. • LDEV ID (LDEV name): P-VOL's LDEV identifier and name, which displays when you hover the mouse over it. • Number of Paths: Number of data paths between primary and secondary systems. • Provisioning type, encryption status, T10 PI: The provisioning type, encryption status, and T10 PI attribute of the local storage system's volume. The encryption status appears only when volume encryption is Enabled or Mixed. The T10 PI attribute information is displayed only when the T10 PI attribute is enabled. If ... is displayed, place the cursor on ... to open the hidden contents as a tooltip. • Attribute, capacity: Local system's volume attribute and capacity. If the volume does not have an attribute, only the capacity is displayed.

Item	Description
	• Model/Serial number, CLPR ID:CLPR name: Local system's model, serial number, CLPR ID, and CLPR name.
Copy Type	Pair's copy type.
Status	Pair's status.
Path Group	Pair's path group. If the P-VOL is in the primary storage system, clicking the path group ID displays the remote path list.
Remote Storage System	Displays the following information about the remote system. • LDEV ID: S-VOL's LDEV identifier and name, which displays when you hover the mouse over it. • Port ID/Host Group ID or iSCSI Target ID/LUN ID: Port, host group or iSCSI target, and LUN identifiers. Information is useful when specifying an LDEV ID at pair creation. It does not change, even if path settings are changed. TC only. • Capacity: Remote storage system's volume capacity. • Model/Serial number: Remote system's model, serial number.

Pair Detail

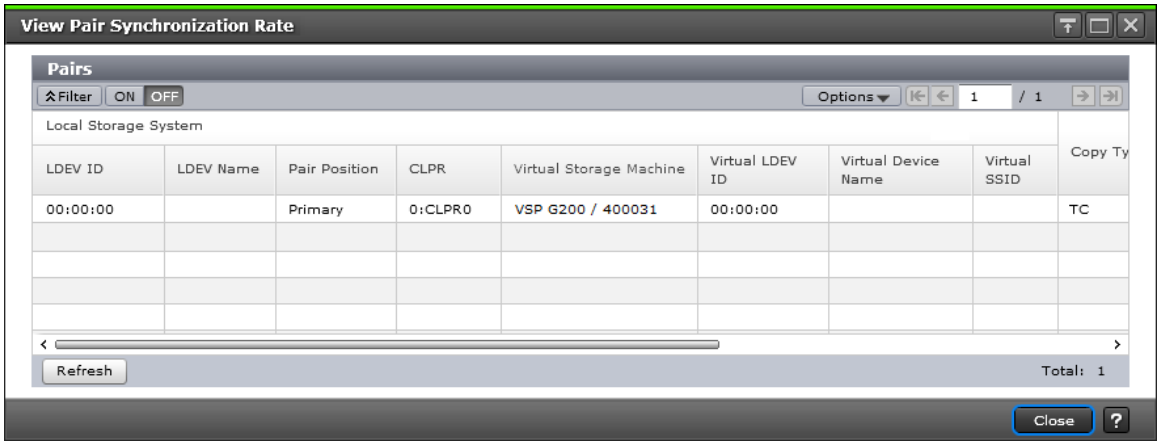
Item	Description
Status	Pair's status
Update Type	One of the following: • Sync: It is a TC pair which is not assigned to consistency group. • Sync (Specified CTG): It is a TC pair created by specifying consistency group.
CTG ID	Consistency group identifier
CTG Utilization	Whether the consistency group is shared by multiple pairs of primary and secondary systems. • Single: The consistency group consists of a single pair of primary and secondary storage systems. • Multi: The consistency group consists of multiple pairs of primary and secondary systems.
Fence Level	Whether the P-VOL can be written to when the pair is split due to error. • Data: The P-VOL cannot be written to. • Status: The P-VOL can be written to only if the primary storage system can change S-VOL status to PSUE; otherwise no. • Never: The P-VOL can be written to.
Secondary Volume Write	Whether data can be written (Enabled) or not written (Disabled) to the S-VOL. The pair must be split for Enabled to display. If the volume accessed is an S-VOL and can be written to, Enabled/Received or Enabled/Not Received is displayed. Indicates whether a write operation is received from the host or not.
Copy Pace	Speed that data is copied.

Item	Description
Initial Copy Priority	Scheduling order for the initial copy operation. Range is 1 to 256.
Paired Time	Date and time pair-creation was completed.
Last Update Time	Date and time that the last update was run.
Pair Copy Time	Elapsed time for paircreate or pairresync operation.
Local Storage System	• Virtual Storage Machine: Virtual storage machine's model type and serial number. • Virtual LDEV ID: Volume's virtual LDEV identifier. • Virtual Device Name: Volume's virtual device name, in the format: virtual emulation type/number of virtual LUSE volumes/virtual CVS attribute - Only attributes that are specified display. - "CVS" displays at the end of the device name, if the virtual CVS attribute is specified. - A blank indicates no values are specified. • Virtual SSID: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.
Remote Storage System	• Virtual Storage Machine: Virtual storage machine's model type and serial number. • Virtual LDEV ID: Volume's virtual LDEV identifier.

View Pair Synchronization Rate window

Use this window to view the percentage of synchronized data between P-VOL and S-VOL.

For complete information and instructions, see Monitoring TC pair synchronization rate on page 7-7.



Pairs table

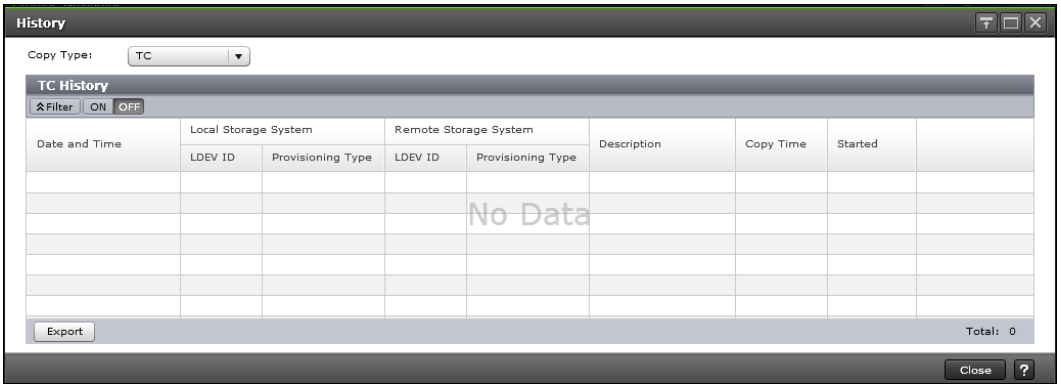
Item	Description
Local Storage System	Information about volumes in the local storage system. • LDEV ID: LDEV identifier. Clicking the link opens the **LDEV Properties** window. • LDEV Name: LDEV name. • Pair Position: Whether the volume is a primary or secondary volume. • CLPR: Volume's CLPR. • Virtual Storage Machine: Virtual storage machine's model type and serial number. • Virtual LDEV ID: Volume's virtual LDEV identifier. • Virtual Device Name: Volume's virtual device name, in the format: virtual emulation type/number of virtual LUSE volumes/ virtual CVS attribute - Only attributes that are specified display. - "CVS" displays at the end of the device name, if the virtual CVS attribute is specified. - A blank indicates no values are specified. • Virtual SSID: Volume's virtual SSID. A blank indicates that no virtual SSID is specified.
Copy Type	TC Pairs tab: • TC: TrueCopy
Status	Pair status. For status definitions, see Pair status definitions on page 7-4
Synchronization Rate (%)	Displays the synchronization rate between the P-VOL and the S-VOL. • Initial copy progress rate displays when the initial copy is processing. • The data synchronization rate of the P-VOL and S-VOL displays when the pairs are split. • **(Queuing)** displays if pair volume processing has not started. When the volume in the local storage system is primary, synchronization rate (%) displays regardless of the pair status. When the volume in the local storage system is secondary, synchronization rate (%) displays only when the pair status is other than COPY.
Remote Storage System	Information about volumes in the system connected to the system you accessed. • Model / Serial Number: Remote system's model and serial number. • LDEV ID: LDEV identifier. • Virtual Storage Machine: Virtual storage machine's model type and serial number.

Item	Description
	• Virtual LDEV ID: Volume's virtual LDEV identifier.
Path Group ID	Path group identifier.
Refresh	Updates the information.

History window

Use this window to review the operations that have been performed on a pair.

For complete information and instructions, see Monitoring TC operations history on page 7-7.



In this topic, you can view the following tables.

- Settings on page B-72
- History table when UR is selected on page B-73

Settings

Item	Description
Copy Type	Type of pair: • TC: TrueCopy • UR: Universal Replicator • GAD: global-active device

History table when TC is selected

Item	Description
Date and Time	Date and time of the operation.
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • Provisioning Type: Volume's provisioning type.

Item	Description
Remote Storage System	Information about volumes in the system connected to the system you accessed. • LDEV ID: LDEV identifier. • Provisioning Type: Volume's provisioning type.
Description	Describes the operation.
Copy Time	Elapsed time for create or resync pairs operation. When the Description is other than **Pair Add Complete** or **Pair Resync. Complete**, a hyphen (-) is displayed.
Started	Start time of create or resync pairs operation. When the Description is other than **Pair Add Complete** or **Pair Resync. Complete**, a hyphen (-) is displayed. TC only.
Export	Opens the window for exporting table information.

History table when UR is selected

Item	Description
Date and Time	Date and time of the operation.
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • Provisioning Type: Volume's provisioning type. • Journal ID: Journal's identifier. • Mirror ID: Mirror's identifier.
Remote Storage System	Information about volumes in the system connected to the system you accessed. • LDEV ID: LDEV identifier. • Provisioning Type: Volume's provisioning type.
Description	Describes the operation.
Copy Time	Elapsed time for create or resync pairs operation. When the Description is other than **Pair Add Complete** or **Pair Resync. Complete**, a hyphen (-) is displayed.
Export	Opens the window for exporting table information.

History table when GAD is selected

Item	Description
Date and Time	Date and time of the operation.
Local Storage System	Information about volumes in the accessed system. • LDEV ID: LDEV identifier. • Pair Position: Whether the volume is a primary or secondary volume. • Provisioning Type: Volume's provisioning type.

Item	Description
Remote Storage System	Information about volumes in the system connected to the system you accessed. • Model / Serial Number: Remote Storage System's model and serial number. • LDEV ID: LDEV identifier. • Provisioning Type: Volume's provisioning type.
Mirror ID	Mirror identifier.
Quorum Disk ID	Quorum Disk identifier.
Virtual Storage Machine	Information about volumes in the Virtual Storage Machine. • Model / Serial Number: Virtual Storage System's model and serial number. • LDEV ID: Volume's LDEV identifier.
Description Code	Description Code.
Description	Describes the operation.
Copy Time	Elapsed time for create or resync pairs operation. When the Description is other than **Pair Add Complete** or **Pair Resync. Complete**, a hyphen (-) is displayed.
Export	Opens the window for exporting table information.

Glossary

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

#

2DC
two-data-center. Refers to the primary and secondary sites, or data centers, in which TrueCopy (TC) and Universal Replicator (UR) combine to form a remote replication configuration.
In a 2DC configuration, data is copied from a TC primary volume at the local site to the UR master journal volume at an intermediate site, and then replicated to the UR secondary volume at the remote site. Since this configuration side-steps the TC secondary volume at the intermediate site, the intermediate site is not considered a data center.

3DC
three-data-center. Refers to the local, intermediate, and remote sites, or data centers, in which TC and UR combine to form a remote replication configuration. A 3DC configuration can also combine three UR sites.
In a 3DC configuration, data is copied from a local site to an intermediate site and then to a remote site (3DC cascade configuration), or from a local site to two remote sites (3DC multi-target configuration).

A

ACK
acknowledgement

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

administrative logical unit (ALU)
An LU used for the conglomerate LUN structure, a SCSI architecture model. In the conglomerate LUN structure, all host access is through the ALU, which functions as a gateway to sort the I/Os for the subsidiary logical units (SLUs) grouped under the ALU. The host requests I/Os by using SCSI commands to specify the ALU and the SLUs grouped under the ALU. An ALU is called a Protocol Endpoint (PE) in vSphere.
See also *subsidiary logical unit (SLU)*.

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

array
Another name for a RAID storage system.

array group
See *RAID group*.

async
asynchronous

ATTIME suspend
A consistency group task in which multiple pairsplit operations are performed simultaneously at a pre-determined time using BCM or CCI.

audit log
Files that store a history of the operations performed from Device Manager - Storage Navigator and the service processor (SVP), commands that the storage system received from hosts.

B

base emulation type
Emulation type that is set when drives are installed. Determines the device emulation types that can be set in the RAID group.

BC
business continuity

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

BLK, blk
block

bmp
bitmap

C

C/T
See *consistency time (C/T)*.

ca
cache

cache logical partition (CLPR)
Consists of virtual cache memory that is set up to be allocated to different hosts in contention for cache memory.

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

cascade configuration
In a 3DC cascade configuration for remote replication, data is copied from a local site to an intermediate site and then to a remote site using TrueCopy and Universal Replicator. See also *3DC*.
In a ShadowImage cascade configuration, two layers of secondary volumes can be defined for a single primary volume. Pairs created in the first and second layer are called cascaded pairs.

cascade function
A ShadowImage function for open systems that allows a primary volume (P-VOL) to have up to nine secondary volumes (S-VOLs) in a layered configuration. The first cascade layer (L1) is the original ShadowImage pair with one P-VOL and up to three S-VOLs. The second cascade layer (L2) contains ShadowImage pairs in which the L1 S-VOLs are functioning as the P-VOLs of layer-2 ShadowImage pairs that can have up to two S-VOLs for each P-VOL.
See also *root volume*, *node volume*, *leaf volume*, *level-1 pair*, and *level-2 pair*.

cascaded pair
A ShadowImage pair in a cascade configuration. See *cascade configuration*.

shared volume
A volume that is being used by more than one replication function. For example, a volume that is the primary volume of a TrueCopy pair and the primary volume of a ShadowImage pair is a shared volume.

CCI
Command Control Interface

CFW
cache fast write

CH
channel

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

CHAP
challenge handshake authentication protocol

CL
cluster

CLI
command line interface

CLPR
cache logical partition

cluster
Multiple-storage servers working together to respond to multiple read and write requests.

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

configuration definition file
Defines the configuration, parameters, and options of Command Control Interface operations. A text file that defines the connected hosts and the volumes and groups known to the Command Control Interface instance.

consistency group (CTG)
A group of pairs on which copy operations are performed. Specifying a consistency group ID performs a specific operation for all pairs belonging to the consistency group simultaneously while keeping data consistency. See also *extended consistency group (EXCTG)*.

consistency time (C/T)
Shows a time stamp to indicate how close the target volume is to the source volume. C/T also shows the time stamp of a journal and extended consistency group.

control memory
Another name for shared memory.

controller
The component in a storage system that manages all storage functions. It is analogous to a computer and contains a processors, I/O devices, RAM, power supplies, cooling fans, and other sub-components as needed to support the operation of the storage system.

copy-after-write
Point-in-time snapshot copy of a data volume within a storage system. Copy-after-write snapshots only store changed data blocks, therefore the amount of storage capacity required for each copy is substantially smaller than the source volume.

copy pair
A pair of volumes in which one volume contains original data and the other volume contains the copy of the original. Copy operations can be synchronous or asynchronous, and the volumes of the copy pair can be located in the same storage system (local copy) or in different storage systems (remote copy).
A copy pair can also be called a volume pair, or just pair.

CTG
See *consistency group (CTG)*.

CTL
controller

CU
control unit

currency of data
The synchronization of the volumes in a copy pair. When the data on the secondary volume (S-VOL) is identical to the data on the primary volume (P-VOL), the data on the S-VOL is current. When the data on the S-VOL is not identical to the data on the P-VOL, the data on the S-VOL is not current.

CYL, cyl
cylinder

cylinder bitmap
Indicates the differential data (updated by write I/Os) in a volume of a split or suspended copy pair. The primary and secondary volumes each have their own cylinder bitmap. When the pair is resynchronized, the cylinder bitmaps are merged, and the differential data is copied to the secondary volume.

D

DASD
direct-access storage device

data consistency
When the data on the secondary volume is identical to the data on the primary volume.

data path
The physical paths used by primary storage systems to communicate with secondary storage systems in a remote replication environment.

data pool
One or more logical volumes designated to temporarily store original data. When a snapshot is taken of a primary volume, the data pool is used if a data block in the primary volume is to be updated. The original snapshot of the volume is maintained by storing the to-be-changed data blocks in the data pool.

DB
database

DBMS
database management system

delta resync
A disaster recovery solution in which TrueCopy and Universal Replicator systems are configured to provide a quick recovery using only differential data stored at an intermediate site.

device
A physical or logical unit with a specific function.

DEVN
device number

DFW
DASD fast write

DHCP
dynamic host configuration protocol

differential data
Changed data in the primary volume not yet reflected in the copy.

disaster recovery
A set of procedures to recover critical application data and processing after a disaster or other failure.

disk array
Disk array, or just array, is another name for a RAID storage system.

disk controller (DKC)
The hardware component that manages front-end and back-end storage operations. The term DKC is sometimes used to refer to the entire RAID storage system.

DKC
disk controller. Can refer to the RAID storage system or the controller components.

DKCMAIN
disk controller main. Refers to the firmware/microcode for the RAID storage system.

DKP
disk processor. Refers to the microprocessors on the back-end director features of the Universal Storage Platform V/VM.

DKU
disk unit. Refers to the cabinet (floor model) or rack-mounted hardware component that contains data drives and no controller components.

DMP
Dynamic Multi Pathing

DRU
Hitachi Data Retention Utility

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

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

E

EC
error code

emulation group
A set of device emulation types that can be intermixed within a RAID group and treated as a group.

env.
environment

ERC
error reporting communications

ESCON
Enterprise System Connection

EXG
external volume group

ext.
external

external application
A software module that is used by a storage system but runs on a separate platform.

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

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

F

failback
The process of switching operations from the secondary path or host back to the primary path or host, after the primary path or host has recovered from failure. See also *failover*.

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

FC
fibre channel

FICON
Fibre Connectivity

free capacity
The amount of storage space (in bytes) that is available for use by the host system(s).

FSW
fibre switch

FTP
file-transfer protocol

G

GID
group ID

GUI
graphical user interface

H

HA
high availability

HACMP
High Availability Cluster Multi-Processing

HDP
Hitachi Dynamic Provisioning

HDS
Hitachi Data Systems

H-LUN
host logical unit

HORC
Hitachi Open Remote Copy. Another name for Hitachi TrueCopy®.

HORCM
Hitachi Open Remote Copy Manager. Another name for Command Control Interface.

host failover
The process of switching operations from one host to another host when the primary host fails.

host group
A group of hosts of the same operating system platform.

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

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

HUR
Hitachi Universal Replicator

I

IMPL
initial microprogram load

initial copy
An initial copy operation is performed when a copy pair is created. Data on the primary volume is copied to the secondary volume.

in-system replication
The original data volume and its copy are located in the same storage system. ShadowImage in-system replication provides duplication of logical volumes; Thin Image provides "snapshots" of logical volumes that are stored and managed as virtual volumes (V-VOLs).

intermediate site (I-site)
A site that functions as both a TrueCopy secondary site and a Universal Replicator primary site in a 3-data-center (3DC) cascading configuration.

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

IO, I/O
input/output

I/O mode
I/O actions on the P-VOL and S-VOL of the global-active device pair.

IOPS
I/Os per second

J

JNL
journal

journal
In a Universal Replicator system, journals manage data consistency between multiple primary volumes and secondary volumes. See also *consistency group (CTG)*.

journal volume
A volume that records and stores a log of all events that take place in another volume. In the event of a system crash, the journal volume logs are used to restore lost data and maintain data integrity.
In Universal Replicator, differential data is held in journal volumes until it is copied to the S-VOL.

L

L1 pair
See *layer-1 (L1) pair*.

L2 pair
See *layer-2 (L2) pair*.

LAN
local-area network

layer-1 (L1) pair
In a ShadowImage cascade configuration, a layer-1 pair consists of a primary volume and secondary volume in the first cascade layer. An L1 primary volume can be paired with up to three L1 secondary volumes. See also *cascade configuration*.

layer-2 (L2) pair
In a ShadowImage cascade configuration, a layer-2 (L2) pair consists of a primary volume and secondary volume in the second cascade layer. An L2 primary volume can be paired with up to two L2 secondary volumes. See also *cascade configuration*.

LBA
logical block address

LCP
local control port; link control processor

LCU
logical control unit

LDEV
logical device

LDKC
See *logical disk controller (LDKC)*.

leaf volume
A level-2 secondary volume in a ShadowImage cascade configuration. The primary volume of a layer-2 pair is called a node volume. See also *cascade configuration*.

LED
light-emitting diode

license key
A specific set of characters that unlocks an application and allows it to be used.

local copy
See *in-system replication*.

local storage system)
A storage system at a local site that contains primary volumes of remote replication pairs. The local system is configured to send remote I/Os to the remote site, which contain the secondary volumes of the pairs.

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

logical disk controller (LDKC)
A group of 255 control unit (CU) images in the RAID storage system that is controlled by a virtual (logical) storage system within the single physical storage system.

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

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

logical volume
See *volume*.

LU
logical unit

LUN
logical unit number

LUNM
Hitachi LUN Manager

LV
logical volume

M

master journal (M-JNL)
Holds differential data on the primary Universal Replicator system until it is copied to the restore journal (R-JNL) on the remote system. See also *restore journal (R-JNL)*.

Mb/sec, Mbps
megabits per second

MB/sec, MBps
megabytes per second

migration volume
A volume used to migrate data from a different storage system, such as Hitachi Unified Storage VM.

MIH
missing interrupt handler

mirror
In Universal Replicator, each pair relationship in and between journals is called a "mirror". Each pair is assigned a mirror ID when it is created. The mirror ID identifies individual pair relationships between journals.

M-JNL
master journal

MP
microprocessor

MP unit
Blade containing an I/O processor. Performance in the storage system is tuned by allocating a specific MP unit to each I/O-related resource (LDEV, external volume, or journal). Specific blades are allocated, or the storage system can automatically select a blade.

MSS
maximum segment size

MTU
maximum transfer unit

MU
mirror unit

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

N

node volume
A level-2 primary volume in a ShadowImage cascade configuration. The secondary volume of a layer-2 pair is called a leaf volume. See also *cascade configuration*.

NVS
nonvolatile storage

O

OPEN-V
A logical unit (LU) of user-defined size that is formatted for use by open-systems hosts.

OPEN-*x*
A logical unit (LU) of fixed size (for example, OPEN-3 or OPEN-9) that is used primarily for sharing data between mainframe and open-systems hosts using Hitachi Cross-OS File Exchange.

P

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

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

parity group
See *RAID group*.

path failover
The ability of a host to switch from using the primary path to a logical volume to the secondary path to the volume when the primary path fails. Path failover ensures continuous host access to the volume in the event the primary path fails.
See also *alternate path* and *failback*.

physical device
See *device*.

pinned track
A track that cannot be read or written to because of failure.

PiT
point-in-time

point-in-time (PiT) copy
A copy or snapshot of a volume or set of volumes at a specific point in time. A point-in-time copy can be used for backup or mirroring application to run concurrently with the system.

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

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

port block
A group of four fibre-channel ports that have the same port mode.

port mode
The operational mode of a fibre-channel port. The three port modes for fibre-channel ports on the Hitachi RAID storage systems are standard, high-speed, and initiator/external MIX.

PPRC
Peer-to-Peer Remote Copy

Preview list
The list of requested operations on Device Manager - Storage Navigator.

primary site
The physical location of the storage system that contains the original data to be replicated and that is connected to one or more storage systems at the remote or secondary site via remote copy connections. The primary site can also be called the "local site".

The term "primary site" is also used for host failover operations. In that case, the primary site is the host computer where the production applications are running, and the secondary site is where the backup applications run when the applications at the primary site fail, or where the primary site itself fails.

primary storage system
The local storage system.

primary volume
The volume in a copy pair that contains the original data to be replicated. The data in the primary volume is duplicated synchronously or asynchronously on the secondary pairs.
The following Hitachi products use the term P-VOL: Device Manager - Storage Navigator, Thin Image, ShadowImage, TrueCopy, and Universal Replicator.
See also *secondary volume (S-VOL)*.

P-site
primary site

P-VOL
See *primary volume*.

Q

quick format
The quick format feature in Virtual LVI/Virtual LUN in which the formatting of the internal volumes is done in the background. This allows system configuration (such as defining a path or creating a TrueCopy pair) before the formatting is completed. To execute quick formatting, the volumes must be in blocked status.

quick restore
A reverse resynchronization in which no data is actually copied: the primary and secondary volumes are swapped.

quick split
A split operation in which the pair becomes split immediately before the differential data is copied to the secondary volume (S-VOL). Any remaining differential data is copied to the S-VOL in the background. The benefit is that the S-VOL becomes immediately available for read and write I/O.

quorum disk
Used to determine the volume in the global-active device pair on which server I/O should continue when a failure occurs in a path or a storage system. Quorum disk is installed in an external storage system.

R

R/W, r/w
read/write

RAID
redundant array of inexpensive disks

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

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

RCP
remote control port

remote control port (RCP)
A serial-channel (ESCON) port on a TrueCopy main control unit (MCU) that is configured to send remote I/Os to a TrueCopy remote control unit (RCU).

remote copy connections
The physical paths that connect a storage system at the primary site to a storage system at the secondary site. Also called data path.

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

remote site
See *secondary site*.

remote storage system
The system containing the copy in the remote location of a remote replication pair.

restore journal (R-JNL)
Holds differential data on the secondary Universal Replicator system until it is copied to the secondary volume.

resync
"Resync" is short for resynchronize.

RIO
remote I/O

R-JNL
restore journal

root volume
A level-1 primary volume in a ShadowImage cascade configuration. The secondary volume of a layer-1 pair is called a node volume. See also *cascade configuration*.

RPO
recovery point objective

R-SIM
remote service information message

RTC
real-time clock

RTO
recovery time objective

R/W
read/write

S

S/N, SN
serial number

secondary site
The physical location of the storage system that contains the secondary volumes of remote replication pairs at the remote site. The remote storage system is connected to the local storage system via remote copy connections. The remote site can also be called the "secondary site". See also *primary site*.

secondary storage system
The remote storage system

secondary volume
The volume in a copy pair that is the copy. The following Hitachi products use the term "secondary volume": Device Manager - Storage Navigator, Thin Image, ShadowImage, TrueCopy, and Universal Replicator.
See also *primary volume*.

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

service processor (SVP)
The computer inside a RAID storage system that hosts the Device Manager - Storage Navigator software and is used by service personnel for configuration and maintenance of the storage system.

severity level
Applies to service information messages (SIMs) and Device Manager - Storage Navigator error codes.

SI
Hitachi ShadowImage®

sidefile
An area of cache memory that is used to store updated data for later integration into the copied data.

SIM
service information message

size
Generally refers to the storage capacity of a memory module or cache. Not usually used for storage of data on disk or flash drives.

SM
shared memory

SMTP
simple mail transfer protocol

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

SNMP
simple network management protocol

SOM
system option mode

SSB
sense byte

SSL
secure socket layer

steady split
In ShadowImage, a typical pair split operation in which any remaining differential data from the P-VOL is copied to the S-VOL, and then the pair is split.

subsidiary logical unit (SLU)
An LU used for the conglomerate LUN structure, a SCSI architecture model. An SLU is an LU that stores actual data. You can use a DP-VOL or snapshot data (or a V-VOL allocated to snapshot data) as an SLU. All host access to SLUs is through the administrative logical unit (ALU). An SLU is called a virtual volume (VVol) in vSphere. See also *administrative logical unit (ALU)*.

S-VOL
See *secondary volume*.

SVOS
Storage Virtualization Operating System

SVP
See *service processor (SVP)*.

sync
synchronous

system LU
Dedicated volume on which the NAS Unified firmware resides.

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

T

TB
terabyte

TC
TrueCopy

TID
target ID

total capacity
The aggregate amount of storage space in a data storage system.

U

update copy
An operation that copies differential data on the primary volume of a copy pair to the secondary volume. Update copy operations are performed in response to write I/Os on the primary volume after the initial copy operation is completed.

UR
Hitachi Universal Replicator

USP
Hitachi TagmaStore® Universal Storage Platform

USP/NSC
Hitachi TagmaStore® Universal Storage Platform and Hitachi TagmaStore® Network Storage Controller

USP V/VM
Hitachi Universal Storage Platform V/VM

USP VM
Hitachi Universal Storage Platform VM

V

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

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

virtual volume (V-VOL)
A logical volume that has no physical storage space. Hitachi Thin Image uses V-VOLs as secondary volumes of copy pairs. In Dynamic Provisioning, Dynamic Tiering, and active flash, V-VOLs are referred to as DP-VOLs.

VLL
Hitachi Virtual LVI/LUN

VLVI
Hitachi Virtual LVI

VM
volume migration; volume manager

VOL, vol
volume

volser
volume serial number

volume
A logical device (LDEV) that has been defined to one or more hosts as a single data storage unit. An open-systems volume is called a logical unit. (LU).

volume pair
See *copy pair*.

V-VOL
virtual volume

V-VOL management area
Contains the pool management block and pool association information for Thin Image, Dynamic Provisioning, Dynamic Provisioning for Mainframe, Dynamic Tiering, and Dynamic Tiering for Mainframe operations. The V-VOL management area is created automatically when additional shared memory is installed and is required for the program product operations.

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