Hitachi Virtual Storage Platform
Hitachi TrueCopy® User Guide

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Hitachi Data Systems
MK-90RD7029-14
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Preface

Hitachi TrueCopy® helps you create and maintain a synchronous backup of critical data in a remote location. This document describes and provides instructions for planning, configuring, and maintaining a TrueCopy system on Hitachi Virtual Storage Platform (VSP) storage systems.

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

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

This document is intended for system administrators, HDS representatives, and authorized service providers who are involved in installing, configuring, and operating the VSP storage system.

Readers of this document should meet the following requirements:

• You should have a background in data processing and understand RAID storage systems and their basic functions.

• You should be familiar with the VSP storage system, and you should have read the Hitachi Virtual Storage Platform User and Reference Guide.

• You should be familiar with the Storage Navigator software for the VSP, and you should have read the Hitachi Storage Navigator User Guide.

Product version

This document revision applies to VSP microcode 70-06-1x or later.

Document revision level

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Changes in this revision

• Support for Hitachi Virtual Storage Platform G1000 (VSP G1000) is added throughout.

• Information is added regarding using Business Continuity Manager to resynchronize or delete pairs in a consistency group in the requirements listed in Consistency group between one primary and secondary system on page 3-16.
Referenced documents

Hitachi Virtual Storage Platform documentation:
- *Hitachi Thin Image User Guide*, MK-90RD7179
- *Hitachi Compatible FlashCopy® User Guide*, MK-90RD7017

Document organization

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

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<td>Provides an overview of Hitachi TrueCopy®.</td>
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<td>Requirements and specifications on page 2-1</td>
<td>Provides basic system requirements and specifications.</td>
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<td>Planning for TrueCopy on page 3-1</td>
<td>Provides information and instructions for planning primary and secondary system, pair volumes, data paths, and other elements.</td>
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<td>Provides planning information for sharing TrueCopy pair volumes with non-TrueCopy volumes.</td>
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<td>Configuration on page 5-1</td>
<td>Provides instructions and information for setting up a TrueCopy system.</td>
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<td>Pair operations on page 6-1</td>
<td>Provides instructions for performing TrueCopy pair operations.</td>
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<td>Monitoring and maintenance on page 8-1</td>
<td>Provides information and instructions for monitoring and maintaining a TrueCopy system.</td>
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<td>Data migration on page 7-1</td>
<td>Discusses using TrueCopy to migrate data from one storage system to another.</td>
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<td>Disaster recovery on page 10-1</td>
<td>Provides instructions for using TrueCopy for disaster recovery.</td>
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<td>Troubleshooting on page 9-1</td>
<td>Provides troubleshooting information for TrueCopy.</td>
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Document conventions

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

<table>
<thead>
<tr>
<th>Icon</th>
<th>Meaning</th>
<th>Description</th>
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<tr>
<td><img src="image" alt="Tip" /></td>
<td>Tip</td>
<td>Provides helpful information, guidelines, or suggestions for performing tasks more effectively.</td>
</tr>
<tr>
<td><img src="image" alt="Note" /></td>
<td>Note</td>
<td>Calls attention to important and/or additional information.</td>
</tr>
<tr>
<td><img src="image" alt="Caution" /></td>
<td>Caution</td>
<td>Warns users of adverse conditions and consequences, such as disruptive operations.</td>
</tr>
<tr>
<td><img src="image" alt="WARNING" /></td>
<td>WARNING</td>
<td>Warns users of severe conditions and consequences, such as destructive operations.</td>
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### Convention for storage capacity values

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

<table>
<thead>
<tr>
<th>Physical capacity unit</th>
<th>Value</th>
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<tbody>
<tr>
<td>1 KB</td>
<td>1,000 bytes</td>
</tr>
<tr>
<td>1 MB</td>
<td>1,000² bytes</td>
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</table>
Logical storage capacity values (such as, logical device capacity) are calculated based on the following values:

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<th>Value</th>
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<tbody>
<tr>
<td>1 GB</td>
<td>$1,000^3 \text{ bytes}$</td>
</tr>
<tr>
<td>1 TB</td>
<td>$1,000^4 \text{ bytes}$</td>
</tr>
<tr>
<td>1 PB</td>
<td>$1,000^5 \text{ bytes}$</td>
</tr>
<tr>
<td>1 EB</td>
<td>$1,000^6 \text{ bytes}$</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Logical capacity unit</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>1 KB</td>
<td>1,024 bytes</td>
</tr>
<tr>
<td>1 MB</td>
<td>1,024 KB or $1,024^2 \text{ bytes}$</td>
</tr>
<tr>
<td>1 GB</td>
<td>1,024 MB or $1,024^3 \text{ bytes}$</td>
</tr>
<tr>
<td>1 TB</td>
<td>1,024 GB or $1,024^4 \text{ bytes}$</td>
</tr>
<tr>
<td>1 PB</td>
<td>1,024 TB or $1,024^5 \text{ bytes}$</td>
</tr>
<tr>
<td>1 EB</td>
<td>1,024 PB or $1,024^6 \text{ bytes}$</td>
</tr>
<tr>
<td>1 block</td>
<td>512 bytes</td>
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**Accessing product documentation**

The VSP user documentation is available on the HDS Support Portal: [https://hdssupport.hds.com](https://hdssupport.hds.com). Please check this site for the most current documentation, including important updates that may have been made after the release of the product.

**Getting help**

The HDS customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to the HDS Support Portal for contact information: [https://hdssupport.hds.com](https://hdssupport.hds.com)

**Comments**

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision. Please refer to specific sections and paragraphs whenever possible.

**Thank you!** (All comments become the property of HDS.)
TrueCopy overview

A TrueCopy system creates and maintains a mirror image of a production volume at a remote location. Data in a TrueCopy backup stays synchronized with the data in the local Virtual Storage Platform storage system. This happens when data is written from the host to the local storage system then to the remote storage system, via the Fibre Channel data path. The host holds subsequent output until acknowledgement is received from the remote storage system for the previous output.

TrueCopy can be teamed with Hitachi ShadowImage® or Hitachi Universal Replicator, on either or both local and remote sites. These copy tools allow restoration from one or more additional copies of critical data.

This guide provides instructions for planning, configuring, operating, maintaining, and troubleshooting a TrueCopy system.

- How TrueCopy works
- Typical components
- Storage systems
- Volume pairs
- Data path
- Consistency groups
- Interfaces
- Failover software
- Overview of initial, update copy operations
How TrueCopy works

A pair is created when you:

- Select a volume on the local storage system that you want to copy.
- Create or identify the volume on the secondary system that will contain the copy.
- Connect the local and remote storage systems with a Fibre Channel channel data path.
- Copy all primary volume data to the secondary volume.

During a typical initial copy, all data written to the primary volume (P-VOL) is copied to the secondary volume (S-VOL), ensuring that the secondary copy is a complete and consistent backup.

When a pair is split, writes to the primary volume continue but are no longer copied to the secondary side, and the pair is no longer synchronous.

- If a special S-VOL write option is enabled, the secondary volume becomes available for read/write access by secondary host applications. Otherwise the S-VOL remains as it was at the time of the split.
- Changes to primary and secondary volumes (if applicable) are tracked by differential bitmaps until the primary and secondary volumes are resynchronized.
- When resynchronization takes place, only the changed data is transferred, reducing copy time.

The VSP storage system transfers control parameters and FBA-format data for consecutive, updated records in a track using a single write operation. This eliminates the overhead that is usually required for performing FBA-to-CKD and CKD-to-FBA conversions.

When TrueCopy operations and other storage system processing are performed at the same time, performance is affected.

To plan and implement a TrueCopy system an understanding of its components is required. This is provided in the following sections.

Typical components

A typical configuration consists of the following components. Many but not all require user setup.

- The local VSP storage system is connected to a host. The remote storage system is connected to the local system via Fibre Channel data paths. The secondary system may be another VSP or a USP V/VM, TagmaStore USP/TagmaStore NSC, HUS VM or a vendor storage system.
- A host at the local site, connected to the local storage system. It is also highly desirable to have a host at the secondary site connected to the secondary system for use in a disaster recovery. If this is not possible, the local host must be in communication with the secondary system.
A primary volume (P-VOL) on the local storage system that is copied to the secondary volume (S-VOL) on the secondary system. The primary and secondary volumes may be composed of expanded LUs using LUN Expansion.

- Fibre Channel data paths for data transfer between primary and secondary system.
- Target, initiator, and RCU target ports for the Fibre Channel interface.
- Storage Navigator graphical user interface software, used to perform TrueCopy configuration and pair operations. Command Control Interface (CCI) software may also be used for most pair operations and disaster recovery operations.

The following figure shows a typical TrueCopy environment.

Storage systems

This guide documents TrueCopy operations in which the primary system is a VSP and the secondary system is a VSP G1000, VSP, Universal Storage Platform V/VM, TagmaStore USP/TagmaStore NSC, or HUS VM.

- The primary system consists of a main control unit (MCU) and service processor (SVP).
- The secondary system consists of the remote control unit (RCU) and the SVP.

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

Primary (MCU) and secondary (RCU) systems

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:
• Remote 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 VSP CU can function simultaneously as a primary system for one or more P-VOLs, and as a secondary system for one or more S-VOLs. This kind of configuration requires that data paths and Fibre Channel ports are configured for both copy directions.

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 SMPL status.
• When paired, the volumes are synchronized.
• When split, new data is sent to the P-VOL but not the S-VOL.
• When resynchronized, data that changed while the pair was split 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.

Logical units on the local and remote storage systems must be defined and formatted prior to pairing.

Data path

TrueCopy operations are carried out between local and remote storage systems connected by a Fibre Channel interface. The data path, also referred to as the remote copy connection, connects ports on the local VSP storage system to the ports on the remote storage system. The ports are assigned attributes that allow them to send and receive data.

One data path connection is required, but two or more independent connections are recommended, for hardware redundancy. A maximum of eight paths per control unit (CU) can be used.

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 from one to four primary and secondary systems.
When you issue a TrueCopy command on the consistency group, it is run on all pairs in the group. The pairs’ status changes 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 3-13.

Interfaces

You perform TrueCopy operations using one of the following interfaces:

- **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 Storage Navigator computer.
  - The secondary system should also be LAN-attached to a separate 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.
- **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.

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, TrueCopy and the primary and secondary systems run update copy as often as updates are sent by 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.

In an initial copy, 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 provide additional flexibility between the speed of data transfer and storage system performance.

- The **copy pace** option allows you to 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.
- The **priority** option allows you to specify the order in which copying is performed on multiple pairs. This is used if more pairs are being created than the maximum initial copy activity setting.
- The **maximum initial copy activity** option allows you to specify the maximum number of concurrent initial copy and resync copy operations that each primary system performs (not pair specific).
- The **Round Trip Time** option allows you to specify the time limit for data to travel from P-VOL to S-VOL. This value is used by the storage system to control initial copy pace when update copying is in progress.

These options are available on Storage Navigator only.

**Update copy**

If 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.

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).
Requirements and specifications

This chapter provides basic system requirements. In addition to the information here, 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.

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
</table>
| **Virtual Storage Platform**| • Number of CUs: 255  
• Range of CUs: 0x00 to 0xFE                                                   |
<p>| <strong>Supported device emulation types</strong> | All LU types that VSP supports (OPEN-3, OPEN-8, OPEN-9, OPEN-K, OPEN-E, OPEN-L, and OPEN-V). |
| <strong>RAID levels supported</strong>   | RAID 1, RAID 5, and RAID6 configurations.                                    |
| <strong>Storage systems</strong>         | VSP can be connected to:                                                    |
|                             | • VSP G1000 (80-01-01-xx/xx or later)                                      |
|                             | • VSP (70-01-01-xx/xx or later)                                            |
|                             | • USP V/VM (60-07-51-xx/xx or later)                                       |
|                             | • HUS VM (73-01-31-xx/xx or later)                                         |
|                             | • TagmaStore USP or TagmaStore NSC (50-09-98-xx/xx or later)                |
|                             | When pairs in a consistency group belong to multiple VSPs, USP V/VM, TagmaStore USP, and TagmaStore NSC cannot be used. |
|                             | See <a href="#">Requirements for VSP with earlier model storage systems on page 3-3</a> for more information. |
| <strong>TrueCopy</strong>                | • Must be installed on primary and secondary system.                        |
|                             | • Separate license codes are required for each storage system.              |
|                             | • Synchronous only. VSP does not support Asynchronous.                      |
|                             | • Can co-exist with TrueCopy for Mainframe.                                |
|                             | For information about exceeding licensed capacity and license expiration, see the <a href="#">Hitachi Storage Navigator User Guide</a>. |
| <strong>Other required licenses</strong> | None.                                                                       |
|                             | However, when combining TrueCopy and Dynamic Provisioning, the following licensed capacity limitations apply: |
|                             | • If using a Dynamic Provisioning DP-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. |
| <strong>Additional shared memory</strong>| Required. Contact your Hitachi Data Systems account team for assistance.   |
| <strong>Data path</strong>               | Maximum of eight data paths supported from primary system to secondary system.  |
|                             | Fibre Channel, direct or with switch connections. See <a href="#">Data path requirements and configurations on page 3-23</a>. |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
</table>
| Logical paths | • Maximum of eight logical paths supported from primary system to secondary system.  
• Logical paths are established separately for primary and secondary system CUs.  
• Maximum number of logical paths allowed for a primary system is 32 (8 paths per secondary system X 4 secondary system per primary system). |
| Path group | Groups of logical paths, which allows you to configure or change the configuration of multiple paths at the same time.  
• A maximum of 64 path groups can be set in a storage system.  
• The following values can be set as the path group ID:  
  o 0-255 (0 to FF in hexadecimal) when connected to VSP  
  o 0 only when connected to USP V/VM, HUS VM, TagmaStore USP, or TagmaStore NSC  
• 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 *Hitachi Command Control Interface User and Reference Guide* and sample configuration definition files in *Hitachi Command Control Interface Installation and Configuration Guide*.  
• It is recommended that you specify different paths and path groups for UR and URz secondary systems when using CU Free. |
| Maximum number of secondary systems (CU) | • Maximum of four secondary systems are supported per primary system.  
• Each secondary system CU must be added separately to a primary system. |
| Maximum number of secondary systems (CU Free) | Up to 64 TC, TCz, UR, and URz secondary systems (CU Free) can be set per primary system. |
| Pair volumes | • The P-VOL and S-VOL must be equal in size.  
• The maximum size of P-VOL and S-VOL is 4,194,304.000MB (8,589,934,592 blocks). However, when primary or secondary system is TagmaStore USP/TagmaStore NSC, the max. size is 2,949,120.000MB (6,039,797,760 blocks).  
• The minimum size of P-VOL and S-VOL is 46.875MB (96,000 blocks) for OPEN-V. For all other emulation types, minimum size is 35.156MB (72,000 blocks).  
• One P-VOL may be copied to only one S-VOL.  
• 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*.  
See *Planning pairs and pair volumes on page 3-6* for more information. |
| Number of pairs | Limited per VSP storage system. See *Maximum number of pairs supported on page 3-10*. |
| Number of consistency groups | Maximum: 128 (0x00 to 0x7F) |
### Host failover software
- Required for disaster recovery.
- Recommended for data migration.
See Host failover software on page 3-23 for more information.

### Interfaces
- Storage Navigator is required.
  - The following SN roles are required to operate:
    - Storage Administrator (Remote Copy)
    - Storage Administrator (System Resource Management)
    - Storage Administrator (Provisioning)
  - The primary system must be LAN-attached to a Storage Navigator computer.
  - The secondary system should be attached using a separate LAN at the remote site.
- CCI is optional.
  - A command device is required for each CCI instance
  - See the Hitachi Command Control Interface User and Reference Guide for information about setting up and using CCI.
Planning for TrueCopy

This chapter provides information and instructions for planning primary and secondary system, 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.

- You can pair the volumes on Virtual Storage Platform with volumes on another VSP, USP V/VM, or TagmaStore USP/TagmaStore NSC. However, if pairing with volumes on an earlier model, see the restrictions in Requirements for VSP with earlier model storage systems on page 3-3.

- Storage Navigator must be LAN-attached to the primary and secondary system. See the Hitachi Storage Navigator User Guide for information.

- The primary and secondary system must be set up for TrueCopy operations. See Cache, additional shared 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 the primary system is configured to report sense information to the host. The secondary system should also be attached to a host server to report sense information in the event of a problem with an S-VOL or secondary system. If the storage system is not attached to a host, it should be attached to a primary system host server so that monitoring can be performed.

- 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 system. Distribute data paths between different storage clusters and extenders or switches to provide maximum flexibility and availability. The logical paths between the primary and secondary system must be different than the logical paths between the host and secondary system. See Data path requirements and configurations on page 3-23 for more information.

Cache, additional shared memory requirements

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

Additional shared memory is prerequisite in both of the primary and secondary system.

Note: Neither cache nor shared 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; then resynchronize the pairs when the cache or shared memory operation is completed.
Requirements for VSP with earlier model storage systems

You can pair volumes on the VSP with volumes on USP V/VM and TagmaStore USP/TagmaStore NSC, unless you create a consistency group using multiple storage systems. In that case, pair volumes on a VSP cannot be paired with volumes on USP V/VM and TagmaStore USP/TagmaStore NSC.

- The following table shows the number of CUs and the CU range for each storage system:

<table>
<thead>
<tr>
<th>Storage system</th>
<th># of CUs</th>
<th>CU range</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSP</td>
<td>255</td>
<td>0x00 to 0xfe</td>
</tr>
<tr>
<td>USP V/VM</td>
<td>255</td>
<td>0x00 to 0xfe</td>
</tr>
<tr>
<td>TagmaStore USP/TagmaStore NSC</td>
<td>64</td>
<td>0x00 to 0x3f</td>
</tr>
</tbody>
</table>

- When you connect the VSP with USP V/VM, the ranges for ports, LUNs and CUs that can be specified are unrestricted, because both storage systems have the same number for these resources.
- When you connect the VSP with TagmaStore USP/TagmaStore NSC, the ranges for port numbers, LUNs and CUs are restricted. Both storage systems are limited to the following ranges:

<table>
<thead>
<tr>
<th>Port numbers</th>
<th>LUN</th>
<th>CU:LDEV *</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A to GR</td>
<td>0x0000 to 0x03FF</td>
<td>0x00:00 to 0x3F:FF</td>
</tr>
</tbody>
</table>

* The LDKC number, 00, is also used in the CU # for VSP and USP V/VM.

- Any model can be the MCU or RCU.
- When connecting VSP with TagmaStore USP/TagmaStore NSC or USP V/VM, contact your HDS representative for information regarding the supported microcode versions.
- If you are creating a pair using the previous model storage system at the remote site, make sure that the primary and secondary system each have a unique 5-digit serial number.

System options

You can tailor VSP storage systems to enable options not specifically set at the factory. System option modes related to TrueCopy are shown in the following table.

VSP option mode are set to their default values at installation, and can be changed only by your HDS representative.
Remote synchronous copy operations affect I/O performance on the host and primary and secondary system. TrueCopy provides options for minimizing the impact on performance, 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**
- **Fence Level options for I/O to the P-VOL after suspension on page 3-9**

You can also optimize copy operations and performance with the following. Check with your HDS service provider 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 system.
- 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

<table>
<thead>
<tr>
<th>Option mode</th>
<th>Description</th>
</tr>
</thead>
</table>
| 689 | Allows you to slow the initial copy operation when the write-pending level to the S-VOL is 60% or higher.  
  - Mode 689 ON: When the S-VOL MP blade WritePending is 60% or higher, the initial copy operation is inhibited.  
  - Mode 689 OFF: Though the S-VOL MP blade WritePending is 60% or higher, the initial copy operation is not inhibited.  
  Do not set this mode if the local storage system is connected to TagmaStore USP, TagmaStore NSC, or earlier models, or to USP V/VM with microcode earlier than 60-02-xx-xx/xx; otherwise TrueCopy pairs may suspend. |
| 784 | Allows you to reduce RIO MIH time to 5-seconds. As a result, after a data path error, the total amount of time that elapses is reduced before the operation is retried on an alternate path. (Both RIO MIH time and the Abort Sequence timeout value are combined for this retry time.)  
  - Mode 784 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.  
  - Mode 784 OFF: The RIO MIH time that you specified at RCU registration (default=15 seconds) is used with the specified Abort Sequence timeout value. |
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.

**Determining Round Trip Time**

When you set up the TrueCopy association between primary and secondary system, you specify a time limit in milliseconds for data to travel from the P-VOL to the S-VOL. **Round Trip Time** is used by the systems to control the initial copy pace when update copying is in progress. (To review the Round Trip Time step, see Configuring storage systems, defining logical paths on page 5-4.)

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 : 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 : 5 ms

**To determine Round Trip Time value**

<table>
<thead>
<tr>
<th>The value of Round Trip time = round trip time between MCU-RCU x 2(*) + initial copy response time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(*) A data transfer between primary and secondary system involves two response sequences in one command issuance. Therefore, you need to double the round trip time.</td>
</tr>
</tbody>
</table>

- For the “round trip time” in the formula, please ask your service provider, or use a ping command. If you do not use channel extenders between the primary and secondary system, 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 copy VOLs, and the bandwidth of the channel extender communication lines between primary and secondary system.

```
Initial copy response time (ms) = (1[MB] / “Data path speed between MCU-RCU[MB/ms]“) x (“initial copy pace(2 / 15) x (number of maximum initial copy VOLs3 “ / “Number of data paths between MCU-RCU“)
```
The following table shows the initial copy pace used for the response time calculation.

<table>
<thead>
<tr>
<th>Interface</th>
<th>Initial copy only in progress</th>
<th>Initial, update copy in progress</th>
<th>When initial copy pace specified at the time of pair creation is 1 to 8</th>
<th>When initial copy pace specified at the time of pair creation is 9 to 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCI</td>
<td>User-specified value</td>
<td>User-specified value</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Storage Navigator</td>
<td>User-specified value</td>
<td>User-specified value</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

The following table shows example settings.

<table>
<thead>
<tr>
<th>Round trip time between MCU RCU [ms]</th>
<th>Data path speed between MCU/RCU (MB/ms)</th>
<th>Number of data paths between MCU/RCU</th>
<th>Initial copy pace</th>
<th>Number of maximum initial copy VOLs</th>
<th>Round trip time specified [ms]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.1</td>
<td>4</td>
<td>15</td>
<td>64</td>
<td>160</td>
</tr>
<tr>
<td>30</td>
<td>0.1</td>
<td>4</td>
<td>15</td>
<td>64</td>
<td>220</td>
</tr>
<tr>
<td>100</td>
<td>0.1</td>
<td>4</td>
<td>15</td>
<td>64</td>
<td>360</td>
</tr>
</tbody>
</table>

### 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 3-7**
- **Preparations for allowing I/O to the S-VOL on page 3-8**
- **Fence Level options for I/O to the P-VOL after suspension on page 3-9**
- **Differential data options on page 3-9**
- **Maximum number of pairs supported on page 3-10**
• 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 3-12

Pair volume requirements and recommendations

The following is provided to help you prepare TrueCopy volumes:

• A volume can be assigned to only one pair.

• 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
  o TrueCopy supports the basic LU types that can be configured on the VSP (for example, OPEN 3, OPEN E, OPEN 8, OPEN 9, OPEN L, OPEN V).
  o Pair volumes must consist of LUs of the same type and capacity (for example, OPEN 3 to OPEN 3). The P-VOL and S-VOL LU types display in Storage Navigator.
  o Multi-platform volumes (for example, 3390 3A/B/C) cannot be assigned to pairs. Contact your HDS account team for the latest information about supported devices for your platform.

• 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 Sharing TrueCopy volumes on page 4-1 for more information.

• TrueCopy supports LUN Expansion (LUSE). This allows you to configure expanded LUs using two or more contiguous LDEVs (up to 36).
  o If two LUSE volumes are paired with TrueCopy, a LUSE P-VOL must be paired with an S-VOL of the same size and structure. For example, if a LUSE P-VOL is connected with volumes of 1GB, 2GB, and 3GB in this order, you must specify a LUSE volume that has exactly the same size and the same connection order as the S-VOL.
  o The number of LDEV pairs in a TrueCopy LUSE pair equals the number of LDEVs in each LUSE volume.
  o When the status of all LDEV pairs within one TrueCopy LUSE pair is not the same (for example, one LDEV pair is suspended), the pair status of the TrueCopy LUSE pair changes to PDUB.

• TrueCopy also supports Virtual LVI/LU N. 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. Storage Navigator displays the size of P-VOLs and S-VOL.
• When creating multiple pairs concurrently, make sure that you set up S-VOL LUNs in a way that allows the system to correctly match them to your selected P-VOLs.

Even though you select multiple volumes as P-VOLs in the Storage Navigator Paircreate procedure, only one of them displays in the dialog box—the one with the lowest LUN. Because of this, you are able to specify only one S-VOL. The system automatically assigns LUs on the secondary system as S-VOLs for the other selected P-VOLs according to LUN.

For example, three LUs have been set up on the secondary system to become an S-VOL, named LUN001, LUN002, and LUN003. During the Paircreate operation, you select three volumes as P-VOLs, and then select LUN001 as the S-VOL. The system will then assign LUN002 and LUN003 as the S-VOLs for the other two P-VOLs. Therefore, make sure that you assign LUNs to your S-VOL that will be selected in the proper order.

• 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 (OS) 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. |

---

**Preparations for allowing I/O to the S-VOL**

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

• The S-VOL write option is available when the split operation is performed from the primary system.

• When you resync a pair with the S-VOL write option 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.
Fence Level options for I/O to the P-VOL after suspension

The P-VOL Fence Level setting determines whether the host is denied access or continues to access the P-VOL when the pair is suspended due to an error. 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 currency of the S-VOL during disaster recovery efforts. This setting is also designed for applications that can continue to operate with another device pair.

- **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 currency 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 currency 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 current.

Differential data options

You specify how differential data is managed during the Paircreate operation. Differential data is update data that is collected when the pair is split. This data is stored in units of tracks or cylinders until the pair is resynchronized. It is then restored to the S-VOL.

When you start the initial copy, you will specify whether to manage differential data by Tracks or Cylinders. In Storage Navigator, you also have the Auto option. With Auto, either Cylinder or Track is used, depending on the basic size of the LU.

- When managing differential data by cylinders, sharing volumes with Compatible FlashCopy(R) is restricted. See Hitachi Compatible FlashCopy® User Guide for more information.

- When creating a pair with CCI, the Auto option is not available. If you do not specify anything, Track is used.

- If VLL is used, the number of cylinders that you set with VLL software is used to determine the Auto setting.
If the P-VOL has 10,019 or more cylinders, Cylinder is set.
If the volume has less than 10,019 cylinders, Track is set.

**Maximum number of pairs supported**

TrueCopy supports a maximum of 32,768 pairs, which is the maximum number of pairs supported by the VSP storage system. If CCI is used, a command device must be defined for each product; therefore, the maximum number of pairs in VSP is calculated by subtracting the number of command devices from 32,768.

When Universal Replicator and High Availability Manager pairs exist in the same storage system as TrueCopy pairs, the total number of these pairs is the maximum number of pairs.

- The maximum number of pairs is determined by the number of LDEVs, not LUs.
- If a pair or pairs include LUSE pairs, the maximum number of pairs decreases, because a LUSE volume consists of multiple LDEVs.

**Calculating maximum number of pairs**

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

- 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.

| Note: | In the following formulas, ceil() indicates that the result within the parentheses should be rounded up to the nearest integer, and floor() indicates that it should be rounded down to the nearest integer. |

**To calculate the maximum number of pairs**

1. 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

2. Calculate the number of cylinders:
   
   For OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, OPEN-K:
   
   Number of cylinders = ceil ( (ceil (Number of logical blocks / 96) ) / 15)

   For OPEN-V:
   
   Number of cylinders = ceil ( (ceil (Number of logical blocks / 512) ) / 15)

3. 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.

   For OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, OPEN-K, and OPEN-V:
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, 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**

\[
\text{ceil } ((10,017 \times 15) / 122,752) = 2 \\
\text{ceil } ((32,760 \times 15) / 122,752) = 5 \\
\text{Total: 7}
\]

**Incorrect calculation**

\[
10,017 + 32,760 = 42,777 \text{ cylinders} \\
\text{ceil } ((42,777 \times 15) / 122,752) = 6
\]

4. 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, which is 65,536.
     Bitmap areas are also used by TrueCopy for Mainframe, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.
     Therefore, the number of bitmap areas used by these other program products (if any) must be subtracted from 65,536, with the difference used to calculate the maximum number of pairs for TrueCopy.
     If TrueCopy and Universal Replicator share the same volume, you must use the total number of bitmap areas for both pairs regardless of whether the shared volume is primary or secondary.
   - The maximum number of pairs supported per storage system, which is 32,768. If CCI is used, it is 32,767.

Use the following formula:

\[
\text{Maximum number of pairs} = \text{floor } (\text{Total number of bitmap areas in the storage system} / \text{Required number of bitmap areas})
\]

If the calculated maximum number of pairs exceeds the total number of LDEVs of the storage system, and the total number of LDEVs of the storage system is less than 32,768, then the total number of LDEVs of the storage system becomes the maximum number of pairs.
**Priority for initial copy operations and scheduling order**

Though you can set a maximum number of initial copies to be run at the same time (Maximum Initial Copy Activities in the System Option dialog box), you can perform more initial copies when creating pairs than the value specified in Maximum Initial Copy Activities. If you do this, you will set the scheduling order for the additional operations in the **Priority** field.

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 Priority field in the Paircreate(Synchronous) dialog box would be set as shown in the following table.

<table>
<thead>
<tr>
<th>P-VOL</th>
<th>Value set for Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN 00</td>
<td>2</td>
</tr>
<tr>
<td>LUN 01</td>
<td>3</td>
</tr>
<tr>
<td>LUN 02</td>
<td>1</td>
</tr>
<tr>
<td>LUN 03</td>
<td>4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Order for initial copy</th>
<th>P-VOL</th>
<th>Value set for Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LUN 02</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>LUN 00</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>LUN 01</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>LUN 03</td>
<td>4</td>
</tr>
</tbody>
</table>

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 then two new pairs are added. The P-VOLs are for the new pairs.

<table>
<thead>
<tr>
<th>P-VOL</th>
<th>Value set for Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN 10</td>
<td>2</td>
</tr>
<tr>
<td>LUN 11</td>
<td>1</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Starting order for initial copy</th>
<th>P-VOL</th>
<th>Value set for Priority</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LUN 02</td>
<td>1</td>
<td>Previously scheduled.</td>
</tr>
<tr>
<td>2</td>
<td>LUN 00</td>
<td>2</td>
<td>Previously scheduled.</td>
</tr>
<tr>
<td>3</td>
<td>LUN 01</td>
<td>3</td>
<td>Previously scheduled.</td>
</tr>
<tr>
<td>4</td>
<td>LUN 03</td>
<td>4</td>
<td>Previously scheduled.</td>
</tr>
<tr>
<td>5</td>
<td>LUN 11</td>
<td>1</td>
<td>Scheduled later.</td>
</tr>
<tr>
<td>6</td>
<td>LUN 10</td>
<td>2</td>
<td>Scheduled later.</td>
</tr>
</tbody>
</table>

Priority 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 of the 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.

You determine which pairs to include in a particular consistency group. This is based on business criteria for keeping status consistent across a group of pairs, and for performing specific operations at the same time on the group.

- A consistency group can consist of the pairs in one primary and one secondary VSP, or pairs in multiple primary and secondary VSPs.
- Both TC and TCz pairs can belong to the same consistency group.

**Consistency group for pairs in one primary and one secondary VSP**

TC and TCz pairs between one primary and secondary system can be placed in the same consistency group, as shown in the following figure.
Figure notes:
- TC pairs are assigned to a consistency group using CCI.
- TCz pairs are assigned to a consistency group using Business Continuity Manager (BCM).
- Open and mainframe volumes (P-VOLs/M-VOLs) receive I/O requests from their applications at the primary (main) site, and data in the volumes is updated.
- TC or TCz runs copy operations in the consistency group.

Consistency group for pairs in multiple primary and secondary systems

TC and TCz pairs in multiple primary and secondary systems can be placed in the same consistency group. A maximum of four storage system pairings can be placed in the same consistency group.
Figure notes:

- CCI manages the consistency group on all primary and secondary system. Business Continuity Manager cannot be used with multiple systems.
- Open and mainframe primary volumes (P-VOLs/M-VOLs) receive I/O requests from their applications at the primary (main) site, and data in the volumes is updated.
- TrueCopy or TrueCopy for Mainframe runs the copy operation in the consistency group.
- When the open or mainframe host system guarantees the update order, then data consistency in P-VOLs and S-VOLs is insured. When the host system does not guarantee update order, data consistency is not insured.

Consistency group requirements

Requirements are provided for the following consistency group configurations.

- **Consistency group between one primary and secondary system on page 3-16**
- **Consistency group between multiple primary and secondary systems on page 3-16**
**Consistency group between one primary and secondary system**

- A consistency group is configured on the primary and secondary system.
- When you have multiple pairs in the same consistency group, they must exist between the same primary and secondary system.
- A pair can be assigned to only one consistency group.
- TrueCopy pairs can be in the same consistency group as TrueCopy for Mainframe pairs. Use the same consistency group number for both types.
- A consistency group can have 8,192 pairs, maximum. (Consistency group 127 can have 4,096 pairs, maximum.)
- One primary and one secondary system can have 128 consistency groups, maximum.
- The number for a new consistency group must be an unused number.
- If you use BCM to resynchronize a TCz pair in an open/mainframe consistency group with one primary and secondary system, all pairs in the consistency group are resynchronized. Even if a TC S-VOL is being accessed by a host, the pair is nevertheless resynchronized with the others. Make sure to check the status of all pairs in the consistency group before resynchronizing.
- If you use BCM to delete a TCz pair in an open/mainframe consistency group with one primary and secondary system, only the TCz pairs are deleted. Use CCI to delete the TC pairs.

**Consistency group between multiple primary and secondary systems**

- All requirements for a consistency group between one primary and one secondary system apply to a consistency group between multiple primary and secondary systems.
- Both primary and secondary systems must be VSP G1000s, VSPs, or HUS VMs. No other model can be used.
- A maximum of four primary and four secondary (paired) systems may be assigned to a consistency group.
- The microcode for both primary and secondary systems must support consistency groups between multiple primary and secondary systems; otherwise, pair creation results in failure.
- You must install the version of CCI that supports a consistency group consisting of multiple MCUs and RCUs.
- Pair operations can be performed from CCI only. Business Continuity Manager and Storage Navigator do not support pair operations for pairs in a CG with multiple VSPs.
- Cascade configurations with Universal Replicator pairs is not supported.
Assigning pairs to a consistency group

Pairs are assigned to a consistency group (CG) during the Paircreate operation. The procedure to assign pairs depends on the number of VSPs in the CG, as follows:

- **Assigning pairs belonging to one primary and secondary system on page 3-17**
- **Assigning pairs belonging to multiple primary and secondary systems on page 3-17**

Assigning pairs belonging to one primary and secondary system

The method for assigning pairs to a consistency group differs according to the GUI used to create the pairs:

- When using Storage Navigator, one consistency group is supported, #127. See Consistency group 127 on page 3-21 for more information.
- When using CCI, see the Hitachi Command Control Interface User and Reference Guide
- When using Business Continuity Manager, see the Business Continuity Manager User Guide

Assigning pairs belonging to multiple primary and secondary systems

Assigning pairs in multiple primary and secondary systems to a consistency group depends on whether you are:

- **Using a new CG on page 3-17**
- **Using an existing CG on page 3-18**

CCI is used when creating and assigning pairs to a consistency group on multiple VSPs. Business Continuity Manager is not supported for this configuration

Using a new CG

You can assign new pairs or existing pairs to a new consistency group.

**To assign new pairs to a new consistency group**

1. Create CCI configuration definition file C for a multiple primary and secondary system configuration.
2. Perform the paircreate operation according to configuration definition file C created in Step 1.

**To assign existing pairs to a new consistency group**

1. Create CCI configuration definition file A with which to use CCI for pair operations.
2. Perform the pairsplit operation according to configuration definition file A created in Step 1.
3. Perform the pairresync operation on the TC and TCz pairs, without designating a consistency group. Do this using configuration definition file A.
4. Perform the pairsplit operation on the TC and TCz pairs again, using configuration definition file A.
5. Create CCI configuration definition file C for the multiple primary and secondary system configuration.
6. Perform the pairresync operation on the TC and TCz pairs and register them to configuration definition file C.

**Using an existing CG**

You can assign new pairs or existing pairs to an existing consistency group.

**To assign new pairs to an existing consistency group**

1. Add TC and TCz pair information to the existing configuration definition file B, which consists of pairs in multiple VSPs.
2. Copy and create CCI configuration definition file C.
3. Perform the paircreate operation for TC and TCz pairs and register them to configuration definition file C.

**To assign existing pairs to an existing consistency group**

1. Create CCI configuration definition file A with which to use CCI for pair operations.
2. Perform the pairsplit operation on the TC and TCz pairs that you want to register in the existing CG with multiple systems. Do this using configuration definition file A.
3. Perform the pairresync operation on the TC and TCz pairs, without designating a consistency group. Do this using configuration definition file A.
4. Perform the pairsplit operation on the TC and TCz pairs again, using configuration definition file A.
5. Perform the pairsplit operation to the existing configuration definition file B, which consists of the pairs in the multiple primary and secondary system configuration.
6. Add TC and TCz pair information to existing configuration definition file B.
7. Delete then re-create the TC and TCz pairs, registering them in configuration definition file C.

**Split and suspension behaviors for pairs in a CG**

When the pairs in a consistency group receive updates while in the process of being split or suspended, or when they are about to be split or suspended, S-VOL data consistency is managed as follows:

- If I/O processing is in progress on TC or TCz pairs in the same consistency group, and the split or suspend operation begins, the I/O processing completes first, then the split/suspend operation is run.

The following figure shows that I/O processing completes first; then the pair split operation for the TC pair on Volume B completes.
The following figure shows data in track 2 being copied to the R-VOL, and the data in track 3 becomes differential data. In this case, track 2 is used for I/O processing to the volume in the consistency group when the split command is issued to the pair.

- If a split or suspend operation is in progress when I/O processing on TC or TCz pairs begins, the split operation on the pairs is given priority. After the pair is split, then the I/O processing begins.
- Data consistency cannot be ensured when all of the following conditions exist:
  - A port is blocked.
  - A split command is in progress.
  - I/O processing begins.
In such a case, resynchronize the consistency group and then run the split command again.
Host access after suspension

You can specify settings for read/write access to the P-VOL/M-VOL and S-VOL/R-VOL in consistency groups after pairs are suspended. These settings are specified using CCI or Business Continuity Manager.

- The CCI settings for TC are optional.
- The Business Continuity Manager settings for TCz are required.

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

### Interface: Setting | TC P-VOL | TCz M-VOL
<table>
<thead>
<tr>
<th>Read</th>
<th>Write</th>
<th>Read</th>
<th>Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCI Write access prohibited</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>No option selected</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Business Continuity Manager Write access prohibited</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Write access permitted</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

### Interface: Setting | TC S-VOL | TCz R-VOL
<table>
<thead>
<tr>
<th>Read</th>
<th>Write</th>
<th>Read</th>
<th>Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCI Read access permitted</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Read/Write access permitted</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No option selected</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Business Continuity Manager Write access prohibited</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Write access permitted</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Pair status before and after a split operation

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

This is shown in the following table, in which background coloring indicates the following:

- **Grey background**: TC and TCz pair status before the split operation on the consistency group
- **White background**: Status after the split operation
When you create pairs using Storage Navigator, they can be assigned to only one consistency group (CG), 127. (You can also use CCI to assign pairs to CG 127.) With CG 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 CG 127 behavior and restrictions when a pair is suspended on page 3-21.

To assign pairs to CG 127

1. Turn Function Switch 30 On.
   - Turn on the switch in the primary and secondary system 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 CG 127.
   - In CCI, assign the pairs to this group number when you create the pairs.
   - In Storage Navigator, pairs are automatically assigned to CG 127 when the pairs are created and function switch 30 is On.

CG 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.

<table>
<thead>
<tr>
<th>Pair statuses</th>
<th>TCz pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All = Duplex</td>
</tr>
<tr>
<td>TC pairs</td>
<td>TC: PSUS</td>
</tr>
<tr>
<td>All = PAIR</td>
<td>TCz: Suspend</td>
</tr>
<tr>
<td>Some = PAIR, some = PSUS</td>
<td>TC: PSUS</td>
</tr>
<tr>
<td>All = PSUS</td>
<td>TC: PSUS</td>
</tr>
<tr>
<td></td>
<td>TCz: Duplex</td>
</tr>
<tr>
<td></td>
<td>- CCI: Suspend</td>
</tr>
</tbody>
</table>

Consistency group 127

Consistency group 127 behavior and restrictions when a pair is suspended on page 3-21.
When P-VOLs and S-VOLs are registered in CG 127, and both volumes are paired bi-directionally, all of the target pair volumes are registered in CG No.127 when takeover takes place.

The maximum number of pairs in CG 127 is 4,096.

For P-VOLs to be suspended, a failure must occur, 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 CG 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).

**CG 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 CG 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 CG127.

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

Host failover software transfers information between host servers at the local and remote sites. It 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:

- Bandwidth requirements
- Fibre Channel requirements
- Supported data path configurations
- Ports

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 volume. You determine required bandwidth by measuring write-workload. Workload data is collected using performance monitoring software. Consult your HDS account team for more information.

Fibre Channel requirements

The primary and secondary system must be connected using multimode or single-mode optical fibre cables.
• For distances between .5 km to 1.5 km, one switch is required, but you can use a maximum of two switches.

• For distances up to 1.5 km (4,920 feet), multimode shortwave Fibre Channel interface cables are used.

• For distances from 1.5 km to 10 km, (4,920 feet to 6.2 miles) single mode longwave optical fibre cables are required.

• For distances from 10 km to 30 km (6.2 to 18.6 miles), single-mode longwave Fibre Channel interface cables with up to two switches are required.

• For distances greater than 30 km, approved third-party channel extender products and telecommunications lines are required. TrueCopy operations typically do not extend past 30 km.

For more information about approved channel extenders, contact HDS (see Getting help on page Preface-xiii).

With Fibre Channel connections, you can use the switches as ordinary switch connections. No special settings are required for VSP.

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.

<table>
<thead>
<tr>
<th>Link speed</th>
<th>Distance maximum performance maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gbps</td>
<td>10 km</td>
</tr>
<tr>
<td>2 Gbps</td>
<td>6 km</td>
</tr>
<tr>
<td>4 Gbps</td>
<td>3 km</td>
</tr>
<tr>
<td>8 Gbps</td>
<td>3 km</td>
</tr>
</tbody>
</table>

Your HDS account team can provide the latest information about the availability of serial-channel TrueCopy connections.

**Supported data path configurations**

Three Fibre Channel configurations are supported for TrueCopy:

- **Direct connection on page 3-24**
- **Switch connection on page 3-25**
- **Extender connection on page 3-26**

LUN Manager is used to set port topology.

**Direct connection**

The following figure shows a direct connection, in which two devices are connected directly together.
Set port topology to: Fab off, FC-AL.

**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.

- Set port topology to the following:
  - NL port: Fab on, FC-AL
  - N port: Fab on, Point-to-Point
  - Some switch vendors require F port (for example, McData ED5000).
- Host I/O response time can be improved on long distance switch connections by using host mode options 49 and 50, or 51 and 65. The following table describes these options for the 8UFC or 16UFC package. A Hitachi Data Systems-approved channel extender is required.

<table>
<thead>
<tr>
<th>No</th>
<th>Host mode options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>BB Credit Set UP Option 1</td>
<td>Fixes higher values of buffer-to-buffer credits (BBCs) to increase data transfer size over long distances. This host mode option must be used in conjunction with host mode option 50.</td>
</tr>
<tr>
<td>50</td>
<td>BB Credit Set UP Option 2</td>
<td>Fixes higher values of buffer-to-buffer credits (BBCs) to increase data transfer size over long distances. This host mode option must be used in conjunction with host mode option 49.</td>
</tr>
<tr>
<td>51</td>
<td>Round Trip Set UP Option</td>
<td>Improves host I/O response time for long distance switch connections.</td>
</tr>
</tbody>
</table>
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:
  - NL/FL port: Fab on, FC-AL
  - F port: Fab on, Point-to-Point
- Best practice is to create at least two independent data paths (one per cluster) between the primary and secondary system 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 should 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 as were used for the primary-to-secondary paths.
Ports

Data is transferred along the data path from the initiator to the RCU target ports on the primary and secondary system. The amount of data each of these ports can transmit 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 as initiator and RCU target ports to handle all workload levels.

Port attributes and requirements

Plan and define the following Fibre Channel port attributes for TrueCopy:

- **Initiator ports**, which send data. One initiator port can be connected to a maximum of 64 RCU target ports. Configure initiator ports on both primary and secondary system for TrueCopy disaster recovery operations.

- **RCU target ports**, which receive data. Configure RCU target ports on both primary and secondary system for TrueCopy disaster recovery operations.
  
  One secondary system port can be connected to a maximum of 16 ports on a primary system. The number of logical paths that can be specified does not depend on the number of ports configured for TrueCopy.

- **Target port**: Connects the storage system and a host. When the host issues a write request, the request is sent to a volume on the VSP system via a target port on the storage system. Target ports must be configured on the primary system for TrueCopy operations.

- **External port**: Required for Universal Volume Manager copy operations. This port is not used for TrueCopy copy operations. This port can be changed to a target, initiator, or RCU target port.
This chapter helps you plan TrueCopy pair volumes when they are shared with non-TrueCopy volumes. All the software products that can be used with TrueCopy (TC) are discussed here.

- **Volume types that can be shared with TrueCopy**
- **Cache Residency Manager**
- **Data Retention Utility**
- **Dynamic Provisioning**
- **LUN Expansion**
- **LUN Manager**
- **Performance Monitor**
- **ShadowImage**
- **Universal Replicator**
- **Virtual LVI/LUN**
- **Volume Migration**
## 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.

<table>
<thead>
<tr>
<th>Volume type</th>
<th>Used as TC P-VOL?</th>
<th>Used as TC S-VOL?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cache Residency Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cache Residency Manager volume</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Virtual LUN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual LUN volume</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Copy-on-Write Snapshot (SS) and Thin Image (TI)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-VOL in all statuses except COPY(RS-R)/RCPY</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>P-VOL in COPY(RS-R)/RCPY status</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>TI/SS P-VOL used as UR P-VOL or S-VOL</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>V-VOL</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pool-VOL</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Cross-OS File Exchange</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume usable by both mainframe and open systems</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Data Retention Utility</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume with Read/Write attribute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume with Read Only attribute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume with Protect attribute</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume that is disabled for use as an S-VOL</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Dynamic Provisioning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-VOL</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pool vol</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Dynamic Tiering</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP-VOL</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Pool vol</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>LUN Expansion (LUSE)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LUSE Volume</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>LUN Manager</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume to which a path is defined</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Volume to which no path is defined</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Volume to which LUN security is applied</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>ShadowImage (SI)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-VOL in PSUS (Delete pair to RCU) status</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>P-VOL in COPY(RS-R)/RCPY status</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SI P-VOL is also used as a UR P-VOL or S-VOL</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>P-VOL (none of the above)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
The following topics clarify key information regarding shared volumes.

### Cache Residency Manager

Cache Residency Manager volumes that can be assigned to TC pairs, and Cache Residency Manager operations can be performed on TC P-VOLs and S-VOLs. For more information, see the *Performance Guide*.

---

**Volume type** | **Used as TC P-VOL?** | **Used as TC S-VOL?**  
--- | --- | ---  
S-VOL in PSUS (Delete pair to RCU) status | Yes | No  
S-VOL (none of the above) | No | No  
Reserved volume | No | No  

### Universal Replicator (UR)

| Volume type | Used as TC P-VOL? | Used as TC S-VOL?  
--- | --- | ---  
P-VOL in COPY status | No | No  
P-VOL in PAIR status | Yes<sup>2</sup> | No<sup>3</sup>  
P-VOL in PSUS (Delete pair to RCU) status | Yes<sup>2</sup> | No<sup>4</sup>  
P-VOL in PSUE (pair suspended-error) status | Yes<sup>2</sup> | No<sup>4</sup>  
S-VOL in COPY status | No | No  
S-VOL in PAIR status | No | No  
S-VOL in PSUS (Delete pair to RCU) status | Yes | No  
S-VOL in SSWS status | Yes | No  
S-VOL in PSUE (pair suspended-error) status | Yes | No  

### Volume Migration<sup>1</sup>

| Volume type | Used as TC P-VOL? | Used as TC S-VOL?  
--- | --- | ---  
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.)<sup>5</sup>  
Source volume (after volume migration is finished) | Yes | Yes  
Target volume | No | Yes  
Reserved volume | No | No  

1. For more information about using Volume Migration, contact the Hitachi Data Systems Support Center.
2. The volume cannot be used if the corresponding UR pair belongs to a journal that is configured for 2DC configurations.
3. The volume can be used only when you resynchronize a TC pair or perform a CCI hot takeover operation. In this case, even though the corresponding UR pair belongs to a journal that is configured for 2DC configurations.
4. The volume can be used only when you resynchronize a TC pair or perform a CCI hot takeover operation, except when the corresponding UR pair belongs to a journal that is configured for 2DC configurations.
5. 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.
**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.

<table>
<thead>
<tr>
<th>DRU access attribute</th>
<th>Availability of TC P-VOL or S-VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read/Write</td>
<td>P-VOL Yes</td>
</tr>
<tr>
<td></td>
<td>S-VOL Yes</td>
</tr>
<tr>
<td>Read Only</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Protect</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>S-VOL Disable</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Read Only and S-VOL Disable</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Protect and S-VOL Disable</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>TC Volume</th>
<th>PAIR status</th>
<th>DRU operation</th>
<th>Changing access attribute</th>
<th>Referring access attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL</td>
<td>SMPL</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>COPY</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PAIR</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PSUS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PSUE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S-VOL</td>
<td>SMPL</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>COPY</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PAIR</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PSUS</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>PSUE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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

Dynamic Provisioning virtual volumes (DP-VOLs) can be assigned to both the TC (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 ShadowImage pair, or disable the Volume Migration setting. After the pair is created, then 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.
  - 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 Hitachi Virtual Storage Platform Provisioning Guide for Open Systems.
LUN Expansion

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

- The P-VOL and S-VOL must have the same LU type and the same number of LDEVs.
- If you need to perform LUSE operations on an existing TC P-VOL or S-VOL, you must release the pair first to return the volume to SMPL status.
- If you allocate a LUSE volume that consists of LDEVs set across more than one CU to the TC pair, you must select CU Free for an RCU.

For further information about LUN Expansion (LUSE), see the *Hitachi Virtual Storage Platform Provisioning Guide for Open Systems*.

LUN Manager

- LUN Manager operations do not affect TC operations.
- Volumes that are under secure ports and/or that are assigned to host groups can also be assigned to TC pairs.
- Volumes that are assigned to TC pairs can also be assigned to secure ports and host groups 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 *Hitachi Virtual Storage Platform Provisioning Guide for Open Systems*.

Performance Monitor

Performance Monitor software provides detailed information about I/O activity and hardware performance in VSP 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.

**To lower performance impact on TrueCopy operations**

1. If Performance Monitor is collecting large amounts of LDEV data, disable this activity for one or more storage systems.
2. If Performance Monitor is collecting data for more than three storage systems on the VSP-internal LAN, disconnect Performance Monitor, if possible, from one or more storage systems before using TC.
3. When TC operations are completed, Re-enable Performance Monitor data collection.

See the *Performance Guide* for more information.
ShadowImage

ShadowImage (SI) 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.

<table>
<thead>
<tr>
<th>TC volume</th>
<th>SI P-VOL</th>
<th>SI S-VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>S-VOL</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

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 VSP. 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.

- 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 4-1 Shared TC P-VOL with SI P-VOL](image)
• 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.

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.

Status reporting and data currency

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

<table>
<thead>
<tr>
<th>Number of TC pairs</th>
<th>Number of SI S-VOLs</th>
<th>Pair status</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>SMPL</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>SI pair status</td>
</tr>
<tr>
<td>0</td>
<td>2 or more</td>
<td>SI pair status for the S-VOL with lowest LDEV ID</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>TC pair status</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>TC pair status</td>
</tr>
<tr>
<td>1</td>
<td>2 or more</td>
<td>TC pair status</td>
</tr>
</tbody>
</table>
• 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.

Storage Navigator displays the status of all S-VOLs associated with a SI P-VOL.

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

<table>
<thead>
<tr>
<th>TC pair status</th>
<th>SI pair status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COPY (PD)/COPY</td>
</tr>
<tr>
<td>COPY</td>
<td>Not Current</td>
</tr>
<tr>
<td>PAIR</td>
<td>Not Current</td>
</tr>
<tr>
<td>PSUS (Delete pair to RCU)/PSUE (pair suspended -error)</td>
<td>Not Current</td>
</tr>
</tbody>
</table>

**Universal Replicator**

TC and Universal Replicator (UR) can share the same pair volumes. Using a combined TC and os/brand_ursUnivRep_short configuration can extend disaster recovery options to a third data center.

Like TC, a os/brand_ursUnivRep_short pair maintains a copy of the production volume in a second location. However, unlike TC, the os/brand_ursUnivRep_short S-VOL is asynchronous, and the secondary system can be located much greater distances from the local and remote TC sites.

Creating both a TC and a os/brand_ursUnivRep_short backup ensures that a copy in a third location is available in the event that the primary site or one of the systems fails.

Configurations consisting of TC and os/brand_ursUnivRep_short pair volumes are covered extensively in the *Hitachi Universal Replicator User Guide*.

**Virtual LVI/LUN**

Virtual LVI/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 LVI/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 *Hitachi Virtual Storage Platform Provisioning Guide for Open Systems*.

**Volume Migration**

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

<table>
<thead>
<tr>
<th>Volume/pair status</th>
<th>Used as Volume Migration volume?</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL/S-VOL in COPY status</td>
<td>No</td>
</tr>
<tr>
<td>P-VOL/S-VOL in PAIR status</td>
<td>Yes</td>
</tr>
<tr>
<td>P-VOL/S-VOL in PSUS status</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**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 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 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.
This chapter provides instructions for configuring TrueCopy.

- Configuration workflow
- Defining port attributes
- Configuring storage systems, defining logical paths
- Configuring additional logical paths
- Setting number of vols. copied concurrently, other options
**Configuration workflow**

Configuration consists of the following tasks:

- Check prerequisites for each procedure.
- See [Planning pairs and pair volumes on page 3-6](#).
- On the primary and secondary system, install the data paths. See [Data path requirements and configurations on page 3-23](#).
- On primary and secondary system, configure the initiator and RCU target ports Fibre Channel ports that will be used for TrueCopy operations. See [Ports on page 3-27](#) and [Defining port attributes on page 5-2](#) for details.
- On the primary system, create the TrueCopy association with the secondary system. See [Configuring storage systems, defining logical paths on page 5-4](#). Logical paths between the systems are added during this procedure.

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

- Add additional logical paths. See [Configuring additional logical paths on page 5-9](#).
- Specify the number of volumes to copy at one time. See [Setting number of vols. copied concurrently, other options on page 5-10](#).

**Defining port attributes**

Initiator and RCU target ports must be set up on the primary and secondary system for TrueCopy command and data transfer.

**Prerequisite information**

Before configuring ports, make sure they are ready to have a new attribute assigned, as follows:

- If you are changing a target port to an initiator port, prepare the port for the change as follows:
  - Confirm that the port is offline.
  - Disconnect the port from the host.
  - Remove all channel paths to the port.
- If you are changing an initiator port to target or RCU target port, prepare the port for the change as follows:
  - Release all pairs using the ports.
  - Delete the paths from the initiator port to the remote storage system.
  - Delete the RCU.

The number of hosts connected to a target port must be limited to 128 or fewer to avoid disconnection. See [Ports on page 3-27](#) for information about target, initiator, and RCU target ports.
To define port attributes

1. In Storage Navigator, click Actions > Remote Copy > TrueCopy > RCU Operation.

2. Change to Modify mode by clicking the icon.

3. In the RCU Operation window Display box, select Port. The ports associated with the local storage system are listed.

4. Right-click the port that you want to configure and select the desired port type (Initiator, RCU Target, or Target).

5. When you have modified all the ports you want, review the Preview list.
   - To change the attribute that you set for a port, right-click the port in the full upper list and select the new attribute.
   - To cancel a modification, right-click the port in the Preview list and select Delete.

6. When you are satisfied, click Apply to save your modifications in the system.
**Configuring storage systems, defining logical paths**

You configure the primary and secondary system for TrueCopy by adding an RCU—a secondary storage system—to the primary storage system. This prepares both systems for TrueCopy commands and operations. During the procedure, logical paths are also defined.

**Prerequisite information**

- This procedure is performed on the primary system.
- The primary and secondary system must be ready for TrueCopy operations. See Storage system preparation on page 3-2.
- The data path must be set up. See Data path requirements and configurations on page 3-23.
- The port attributes on the primary and secondary system must be configured for TrueCopy. See Defining port attributes on page 5-2.
- The secondary system serial number, LDKC, controller ID, path group ID, and port numbers are required. The secondary SSID may also be required.
- One of the fields in the procedure, Round Trip Time, is covered more extensively in Determining Round Trip Time on page 3-5.
- Logical path settings are required in order to perform TrueCopy pair operations and check pair status in Storage Navigator. Make sure to complete the procedure. If you cancel logical path settings, you will be unable to perform operations and check status.

Also, operations involving logical paths cannot be performed when changing the microcode. Make sure the microcode change completes before performing operations involving logical paths.

**To configure the TrueCopy systems and define logical paths**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the icon.

3. In the Display box, select **MCU&RCU**. The tree displays CUs for the accessed system.
4. Click the desired CU in the tree. You must add RCUs to each CU separately.

**Note:** CU Free must be selected for the following:
- When adding a or HUS VM storage system
- When creating HAM pairs

Do not select a specific CU number in these instances.

5. Right-click the list area on the right-side. In the menu that displays, click RCU Operation/Add RCU. The Add RCU (Fibre) dialog box displays.
   - When a specific CU is selected
When CU Free is selected
6. In the RCU S/N box, enter the RCU 5- or 6-digit serial number.

**Note:** Virtual storage machine serial numbers used with VSP G1000 must be identified by physical information, not virtual, when accessing the pair from a VSP.

7. In the Controller ID box, select the remote system’s controller ID.

8. In the Logical Adr. (RCU CU) box (appears when specific CU selected - not CU Free), type the CU number of the RCU being added. The CU number differs according to the specified controller ID, as follows:
   - CU numbers from 00 to FE can be entered if the controller ID is 6 (VSP) or 5 (USP VM).
   - CU numbers from 00 to 3F can be entered if the controller ID is 4 (TagmaStore USP or TagmaStore NSC).

**Note:** VSP G1000 and HUS VM cannot be specified if you selected a specific CU in the tree (Step 4).

9. In the SSID boxes (appears when specific CU selected - not CU Free), type the SSIDs of the RCU being added. The VSP uses one SSID for each set of 256 volumes and one SSID for each set of 64 volumes or four SSIDs per CU. SSID is 4-FFFF (hexadecimal).

10. Path Gr. ID appears only when CU Free is selected. The field identifies groups of logical paths that you set up.
    To enter an ID, clear the Default checkbox and type the value, which can range from 0 (default) to 255 (0 to FF in hexadecimal).

11. In the MCU-RCU Path box, define the logical path between local and remote systems. You can define a maximum of eight logical paths to an RCU.
    a. In the MCU Port column, select a local system initiator port, which you previously set up.
    b. In the RCU Port column, select the remote system RCU target port, also previously set up. This establishes a logical path between the ports.

    You can abbreviate the number to two characters. For example, “1A” can be entered instead of “CL1-A”. Letters can be uppercase or lowercase.

12. Click Option. The RCU Option dialog box displays.
13. In the **Minimum Paths** box, type the minimum number of paths necessary for operations to continue. If the number of paths in Normal status falls below the Minimum Paths value you set, the primary system splits TrueCopy pairs. This is done to prevent a performance drop on the host because of low overall bandwidth between primary and secondary system. The default is 1.

- If your pairs contain critical data and you are using TrueCopy for disaster recovery, set the minimum number to one. This ensures that TrueCopy operations continue even when there is only one remaining data path.
- If performance is a higher priority than maintaining critical data, set the minimum number of paths to two or more (up to eight per CU).

**Note:** If the pair is split because the number of paths has dropped below the Minimum Paths setting, the P-VOL fence level determines whether write operations continue or are rejected to the P-VOL.

14. In the **RIO MIH Time (sec.)** (Remote I/O Missing Interrupt Handler Time) box, type the amount of time that can pass before the system stops the copy operation as failed. The range of time is from 10 seconds to 100 seconds. The default is 15 seconds.

15. In the **Round Trip Time (ms)** box, set a time limit in milliseconds for data to travel from the P-VOL to the S-VOL. This value is used by the system to control initial copy pace when update copying is in progress.

**Note:** The default setting of 1 on the VSP produces lower-than-expected initial copy throughput when the distances involved between the primary and secondary systems cause the RIO response time to exceed 15 milliseconds.

- To determine the appropriate value for your system, see Determining Round Trip Time on page 3-5.
- If using TagmaStore USP/TagmaStore NSC, set the following parameters using the System Option window:
  - Maximum Initial Copy Activity
Path Blockade Watch

16. Click **Set**.

17. Review the Preview list. To change a path, right-click it in the Preview list and select **Modify**. Make any changes in the Add Path(Fibre) dialog box then click **Set**. To delete the added logical paths, right-click it in the Preview list and select **Delete**.

18. When satisfied, click **Apply**. This saves the configuration.

**Configuring additional logical paths**

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

**Prerequisite information**

- Logical paths can be added from the primary or secondary system.
- Please review the path-related prerequisites in Configuring storage systems, defining logical paths on page 5-4.

**To configure additional logical paths**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the icon.

3. In the Display box, select **MCU&RCU**.

4. In the tree, open the primary system CU grouping and CU, then select the desired RCU.

5. In the list area, right-click, then select **Add Path** from the menu. The Add Path(Fibre) dialog box displays.
6. In the **MCU-RCU Path** box, define the logical path between local and remote systems:

   In the **MCU Port** column, select a local system initiator port.

   In the **RCU Port** column, select the remote system RCU target port. This establishes a logical path with the selected initiator port.

   You can abbreviate the number to two characters. For example, “1A” can be entered instead of “CL1-A”. Letters may be uppercase or lowercase.

7. When you have entered the desired logical paths, click **Set**.

8. Review changes in the Preview list. To make a change, right-click it in the Preview list and select **Modify**. Make any changes in the Add Path(Fibre) dialog box then click **Set**. To delete the added logical paths, right-click it in the Preview list and select **Delete**.

9. When satisfied, click **Apply**. This adds the logical paths to the TrueCopy system.

**Setting number of vols. copied concurrently, other options**

You can modify the number of concurrent copy operations that are run during the initial copy and resync operations. You can change this number for a specific CU or for the entire system.
For a storage system, you can copy 1-512 volumes concurrently. You also change the following options system-wide:
- The time that the system is allowed to monitor path blockades
- The time that the system is allowed to monitor path-watch related SIMs.

For instructions, see Changing options system-wide on page 5-11.

For a specific CU, you can copy 1-16 volumes concurrently.
For instructions, see Changing options for a specific CU on page 5-12

Related information
Priority for initial copy operations and scheduling order on page 3-12

Changing options system-wide

In this operation, you change concurrently copied volumes, path watch time, related SIMs (system-wide).

To change options system-wide
1. In Storage Navigator, click Actions > Remote Copy > TrueCopy > System Option.
2. Change to Modify mode by clicking the icon.
3. In the tree, click Storage System Option.
4. Right-click in the list area and select System Option from the menu. The related dialog box displays.

5. In the Maximum Initial Copy Activities box, type the number of volumes that you want to be copied concurrently during an initial copy or resync operation. The number can range from 1 to 512 volumes. The default is 64 volumes.
   - This setting may impact the performance of the primary system. This depends on this setting and the amount of I/O activity. Using the default limits the impact on performance.
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.

The number of initial copies is counted by LDEV. This is true for LUSE volumes, which are composed of LDEVs. The initial copy of each LDEV of a LUSE volume is performed separately.

6. In the **Maximum Initial Copy Activities (CU)** box, enable or disable whether to allow the number of concurrent initial copy or resync operations at the CU level (from 1 to 15). If disabled, Maximum Initial Copy Activities cannot be set at the CU level.

7. In the **Path Blockade Watch (sec.)** field, type the number of seconds that the system will monitor for path blockades. The watch time can be set from 2 to 45 seconds. The default setting is 40 seconds.

If the status of all paths becomes “Monitoring” because of a path error, MIH may occur in the host. The time of the **Path Blockade Watch** must be shorter than the setting time of MIH timer in the host.

8. In the **Path Blockade SIM Watch (sec.)**, type the number of seconds the system will monitor the SIMs that are reported when paths are blocked. The SIM watch value can be set from 2 to 100 seconds. The value you enter must be larger than the **Path Blockade Watch**.

9. You can change the value after clicking Set by right-clicking it in the Preview list and selecting **Modify**. In the dialog that appears, make any corrections and click **Set**.

To cancel the setting, right-click it in the Preview list and select **Delete**.

10. When satisfied, click **Apply**. This completes and saves the configuration.

**Changing options for a specific CU**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > System Option**.

2. Change to Modify mode by clicking the **icon**.

3. In the System Option window tree, select **CU Option(LDKC#00)**.

4. In the list, select and right-click the desired CU or CUs, then select **CU Option** from the menu. CU Option is disabled in the menu if **Maximum Initial Copy Activities (CU)** is disabled in the System Option dialog box. See previous procedure.

The CU Option dialog box displays.
5. In **Maximum Initial Copy Activities**, type the number of volumes that can be copied concurrently during an initial copy operation. The number can range from 1 to 16 volumes at the CU level.

6. Click **Set**.

7. You can change the value after clicking Set by right-clicking it in the Preview list and selecting **Modify**. In the dialog that appears, make any corrections and click **Set**.

   To cancel the setting, right-click it in the Preview list and select **Delete**.

8. When satisfied, click **Apply**. This completes and saves the configuration.
Pair operations

This chapter provides instructions for performing TrueCopy pair operations.

- Pair operations workflow
- Checking pair status
- Creating pairs
- Splitting pairs
- Resynchronizing pairs
- Releasing pairs
**Pair operations workflow**

Basic TrueCopy operations consist of the following tasks.

- 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.
- Re-synchronize a pair, in which the S-VOL again mirrors the on-going, current data in the P-VOL.
- Release a pair.

**Note:** In order 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 microcode, nor if microcode changes are cancelled. If you start a microcode change, make sure it completes before performing pair operations.

Disaster recovery procedures are discussed in *Disaster recovery on page 10-1*.

**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 on page 8-2*.

**Creating pairs**

When you create the initial copy, 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.

Information for High Availability Manager pairs also displays in the Pair Operation window.

**Prerequisite information**

- The initial copy is performed from the primary system.
- S-VOLS must be offline to all hosts.
- You will select the primary and secondary volumes to be paired by individual volume’s port, GID, LUN CU, and/or LDEV numbers. You should have this information on hand.
- Ports must be configured for TrueCopy. See Defining port attributes on page 5-2 for more information.
- The primary and secondary system must be configured for TrueCopy. See Configuring storage systems, defining logical paths on page 5-4 for more information.
- Stop Performance Monitor before performing the initial copy to avoid overloading with TCP/IP traffic.
- If you are creating High Availability Manager pairs, have the Hitachi High Availability Manager User Guide on hand for specific information.
- During this operation, you specify the fence level, which is a data protection option. For important information the options, see Fence Level options for I/O to the P-VOL after suspension on page 3-9.

To create initial copies
1. In Storage Navigator, click Actions > Remote Copy > TrueCopy > Pair Operation.

2. Change to Modify mode by clicking the icon.

3. In the tree for the Pair Operation window, select the CU grouping, CU, port, or host group in which the LU or LUs are located that you want to pair.

4. From the list, select the LU or LUs to be paired. The volumes must be in SMPL status.

5. Right-click the selections and click Paircreate > Synchronous.

   Note the following in the Paircreate(Synchronous) dialog box:
   - The P-VOL field displays the selected volume’s port number, GID, LUN, CLPR number, and CLPR name.
     - A pound symbol (#) at the end (00:00:3C #) indicates an external volume.
     - An X at the end (00:00:3C X) indicates a virtual volume.
   - If you selected more than one P-VOL, the P-VOL with the lowest LUN displays.

6. Assign an S-VOL by selecting the port, GID, and LUN from the S-VOL list, left to right. If you selected multiple volumes as P-VOLs, specify the S-VOL for the P-VOL that displays.

   Volumes for the subsequent S-VOL are automatically assigned according to LUN. If an S-VOL is not available, you will have to create the pair individually. For an in-depth explanation, see the bullet on creating multiple pairs in Planning pairs and pair volumes on page 3-6.

7. For RCU, select the secondary system in which the paired S-VOLs are located.
   - For CU Free – the serial number, LDKC number, Controller ID, model name, Path Group ID, and path type display.
   - For specific CUs – the serial number, LDKC number, CU number, SSID, and path type display for CU excepting CU Free.
8. For **P-VOL Fence Level**, select one of the following. Fence level specifies whether the primary system rejects write operations to the P-VOL.
   - **Data** – The P-VOL is fenced if an update copy operation fails.
   - **Status** – The P-VOL is fenced only if the primary system is not able to change S-VOL status to PSUS when an update copy operation fails.
   - **Never** – The P-VOL is never fenced.

9. In the **Initial Copy** list, select one of the following:
   - **Entire Volume** – To create the TrueCopy pair relationship and copy the data from primary to secondary volumes immediately. (Default)
   - **None** – To create the TrueCopy pair relationship but copy no data from primary to secondary volumes. You must ensure that data in the P-VOL and S-VOL are identical when selecting None.

10. **Copy Pace** – Type the maximum number of tracks to be copied during the initial copy. The default value is 15.
   - Between 1 and 5 is slow and is used to lower the impact to host I/O.
   - Between 5 and 10 is a medium pace.
   - Between 11 and 15 is a fast pace. Host I/O performance may be lowered.

11. From the **Priority** list, specify the scheduling order for the initial copy operation. The default value is 32, and 1 to 256 can be specified.
    Priority applies to those initial copies specified when **Apply** is clicked. Additional initial copies specified after the operation begins are not started until the original pairs are completed.
    When performing more initial copies than specified for **Maximum Initial Copy Activities** (during configuration), see **Priority for initial copy operations and scheduling order on page 3-12**.
    If a time-out error occurs during the Paircreate operation, the order specified in **Priority** may not run correctly. A time-out error may occur because of the CU configuration, or by a data path error. Review the error, release the pair with the error, and then retry the Paircreate operation.

12. From the **Difference Management** list, select the method for managing differential data. With Auto, either Cylinder or Track is used by the system, depending on the basic size of the logical unit (LU). Default is Auto. For more information, see **Differential data options on page 3-9**.
    This option cannot be changed after a pair is created.

13. Click **Set**.

14. You can review these settings in the **Preview** pane on the Pair Operation window.
   - To modify a setting, right-click the list item and select **Modify** from the menu.
   - To delete an item, right-click and click **Delete**.
   - To delete all items, click **Cancel**.
15. When satisfied, click Apply.

If the operation does not start normally, an error code displays in the Error Code column in the Preview list. To display an error message, select the LU, right-click, and select Error Detail.

**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 I/O to the S-VOL from a host. The secondary system records the updated tracks as differential data. When the pair is resynchronized, the secondary system sends the differential data to the primary system, which merges all differential data to determine which tracks are out-of-sync.

**Prerequisite information**
- The pair must be in PAIR status.

**To split one or more pairs**

1. In Storage Navigator, click Actions > Remote Copy > TrueCopy > Pair Operation.

2. Change to Modify mode by clicking the icon.

3. In the tree, select the port, host group, CU, or the CU grouping where the pair is located.

4. In the volume list, select the TrueCopy pairs that you want to split.

To split a LUSE pair with a status of PDUB, perform the pairresync operation on the LUSE pair, then split the pair. (PDUB indicates that the status of one or more individual LDEV pairs within the LUSE pair is SMPL or PSUE (due to some error condition).

5. Right-click, and select Pairsplit-r from the menu. The Pairsplit-r dialog box displays.

6. From the S-VOL Write list, select one of the following:
   - Enable, to cause host writes to be accepted by the S-VOL while the pair is split.
If using this option, you must also select S-VOL in the **Suspend Kind** option. This ensures that P-VOL and S-VOL bitmaps are merged when the pair is resynchronized.

Do not use the P-VOL failure suspend kind option if the P-VOL is required for system operation. Make sure to use the S-VOL suspend kind option, so that the P-VOL continues accepting I/Os.

This option is not available when performing the split operation from the secondary system.

- **Disable** (default), to cause host input to be rejected by the S-VOL while the pair is split.

7. From the **Suspend Kind** list, select one of the following:

- **S-VOL** (default). The P-VOL accepts host write I/O (though still adheres to the fence level in failure conditions).
  
  This setting should be used when you need to keep the P-VOL online.

- **P-VOL Failure**. The primary system will reject host write I/O to the P-VOL while the pair is split, regardless of fence level.
  
  Use this option when you need to maintain synchronization of the pair while it is split. Do not use this option if the P-VOL is required for system operation.

8. Click **Set**, and then **Apply**.

If the operation does not start normally, an error code displays in the Error Code column in the Preview list. To display an error message, select the LU, right-click, and select **Error Detail**.

**Resynchronizing pairs**

While a TrueCopy pair is split, the primary system does not perform update copy operations to the S-VOL. Re-synchronizing a 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 re-synchronizing, TrueCopy pairs can be migrated to High Availability Manager. See the *Hitachi High Availability Manager User Guide*.

**To resynchronize one or more pairs**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > Pair Operation**.

2. Change to Modify mode by clicking the icon.

3. In the tree, select the port, host group, CU, or the CU grouping where the pair is located.

4. In the list, select the pair volume that is split and that you want to resynchronize, right-click, and select **Pairresync** from the menu. The **Pairresync** dialog box displays.

5. If you are changing the **P-VOL Fence Level**, select a new fence level from the list. This is optional.
Pair operations

Data – The P-VOL is fenced if an update copy operation fails.
Status – The P-VOL is fenced only if the primary system is not able to change S-VOL status to PSUE when an update copy operation fails.
Never – The P-VOL is never fenced.
For more information, see Fence Level options for I/O to the P-VOL after suspension on page 3-9.

6. From the Copy Pace list, select the number of the tracks, 1-15, for the resync operations. The default is 15.
   - Between 1 and 5 is slow, and is used to lessen impact to host I/O.
   - Between 5 and 10 is a medium pace.
   - Between 11 and 15 is a fast pace. Host I/O performance can be lowered.

7. From the Priority list, type the desired 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 3-12.

8. Click Set, and then Apply.
   If the operation does not start normally, an error code displays in the Error Code column in the Preview list. To display an error message, select the LU, right-click, and select Error Detail.

9. Verify that the operation completed successfully and that pair status is PAIR on the Pair Operation window. You can update the progress of the operation by clicking File/Refresh.

Releasing pairs

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

- When it is no longer necessary to maintain a remote copy of the P-VOL, release 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 SMPL. When a pair is released, the primary system continues to accept write I/O to the former P-VOL but does not keep track of the updates.
- Release 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 SMPL, the primary system detects that the S-VOL status is SMPL, and then changes P-VOL status to PSUS (Delete pair to RCU).
To restart a pair that was released from the secondary system, you must release the pair from the primary system, then create the pair from the primary system.

Note: When you release a pair from the secondary system, remember that the S-VOL and P-VOL are identical (for example, same volume label). Make sure to take appropriate precautions to prevent a system problem due to duplicate volumes.
To delete a pair

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > Pair Operation**.

2. Change to Modify mode by clicking the icon.

3. In the tree, select the port, host group, CU, or the CU grouping where the pair is located.

4. In the list, select the pair volume that you want to release, right-click, and then select **Pairsplit-S** from the menu. The **Pairsplit-S** dialog box displays.

5. From the **Delete Pair by Force** list, select one of the following:
   - **Yes**, to forcibly delete the pair or pairs, even when the primary system is unable to communicate with the secondary system. Specifying Force allows host operations to continue.
   - **No**, to delete the pair or pairs only if the primary system can change the status of both P-VOL and S-VOL to SMPL.

6. Click **Set**, and then **Apply**.

   If the operation does not start normally, an error code displays in the Error Code column in the Preview list. To display an error message, select the LU, right-click, and select **Error Detail**.

7. Verify that operation completed successfully and that pair status is SMPL or **Deleting** on the Pair Operation window. You can update the progress of the operation by clicking **File/Refresh**.
Data migration

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

- Migration overview
Migration overview

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

- To load data onto new or scratch volumes (for example, to a new or upgraded storage system).
- 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.

In a data migration, the entire contents of a volume are copied to the second 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.

High-availability (HA) software can also be used to complete data migration non-disruptively. To support this, data migration must be managed through an integrated operation using CCI, TrueCopy, and HA software functions.

If you need to migrate data from other vendors’ storage systems to a VSP system, contact your HDS account team.

Migrating data

1. Make sure that the data path is installed, and TrueCopy configuration procedures are completed. See 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 Storage Navigator, connect to the storage system where the volume to be migrated is located. Create the TrueCopy pair or pairs. See Creating pairs on page 6-2 as needed.

   When pair status changes to PAIR, the operation is completed. You can monitor the progress of the operation from the Pair Operations window.

4. 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 MCU, 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, 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 MCU 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.
Monitoring and maintenance

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

- Monitoring pair status
- Monitoring copy operations, I/O statistics
- Monitoring, maintaining logical paths
- Exporting pair information to a text file
- Changing Fence Level
- RCU maintenance
- Managing power-off for systems and network devices
- Miscellaneous maintenance
Monitoring pair status

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 command, 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 the Paired status, or that differential data management is performed in the 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.

To monitor pair status
1. In Storage Navigator, click Actions > Remote Copy > TrueCopy > Pair Operation.
2. Locate the pair volume with the status you want to review. Review pair status in the Status column.

You can view more details by right-clicking and selecting Detail.

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 remote 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 P-VOL status accordingly.
- The status indicates the state of the volume or pair:
  - A volume that is not assigned to a pair is in SMPL status.
  - 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 SMPL.

When a pair is deleted from the remote system, that system changes the S-VOL status to SMPL, and the secondary system detects the pair release and changes the P-VOL status to PSUS.

**Pair status definitions**

Both Storage Navigator and CCI pair status names appear in the Pair Operation window **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 **File/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.

<table>
<thead>
<tr>
<th>SN status</th>
<th>CCI status</th>
<th>Description</th>
<th>P-VOL access</th>
<th>S-VOL access</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMPL</td>
<td>SMPL</td>
<td>This volume is not currently assigned to a TrueCopy pair.</td>
<td>Read/Write</td>
<td>Read/Write</td>
</tr>
<tr>
<td>COPY¹</td>
<td>COPY</td>
<td>The initial copy operation for this pair is in progress. This pair is not yet synchronized.</td>
<td>Read/Write</td>
<td>Read Only</td>
</tr>
</tbody>
</table>
| PAIR      | PAIR       | • The pair is synchronized  
|           |            | • Updates from the host to the P-VOL are duplicated in the S-VOL. | Read/Write   | Read Only    |
### Monitoring and maintenance

#### Split and Suspend types

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

- You can split a pair when the initial copy operation is complete.

<table>
<thead>
<tr>
<th>SN status</th>
<th>CCI status</th>
<th>Description</th>
<th>P-VOL access</th>
<th>S-VOL access</th>
</tr>
</thead>
</table>
| PSUS          | SSUS, PSUS | - The pair was split by a user. 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.  
                |             | - 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 P-VOL. While the pair is split, the storage system keeps track of updates to P-VOL. | Read/Write    | Read only if S-VOL write option is disabled. Read/Write if S-VOL write option is enabled. |
| PSUE          | 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    |
| PDUB          | (No parallel CCI status) | The status of the TrueCopy LUSE pair is COPY or PAIR, but the status of one or more individual LDEV pairs within the TrueCopy LUSE pair is SMPL or PSUS due to an error condition. | Read/Write    | Read only    |
| (No parallel SN status) | SSWS | A horctakeover and resync are in progress.                                                                                                                                                               | Read/Write    | Read/Write   |

1 When pair status is COPY, neither cache nor shared 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, then resynchronize when the cache or shared memory operation is completed.
You must split a pair to perform media maintenance on the P-VOL or 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 suspended 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.

PSUS types appear in the Detailed Information dialog box. The following table describes the PSUS types:

<table>
<thead>
<tr>
<th>PSUS type</th>
<th>Volume applies to</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL by operator</td>
<td>P-VOL</td>
<td>The user splitsuspended the pair from the primary system using the P-VOL Failure in the Suspend Type option in the Suspend Kind field. The S-VOL split type is, &quot;by MCU&quot;.</td>
</tr>
<tr>
<td>S-VOL by operator</td>
<td>P-VOL, S-VOL</td>
<td>The user splitsuspended the pair from the primary or secondary system using the S-VOL in the suspend type option in the Suspend Kind field.</td>
</tr>
<tr>
<td>by MCU</td>
<td>S-VOL</td>
<td>The secondary system received a request from the primary system to suspend the pair. The P-VOL splitsuspend type is Split-P-VOL by Operator or Split-S-VOL by Operator.</td>
</tr>
<tr>
<td>Release pair to RCU</td>
<td>P-VOL</td>
<td>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.</td>
</tr>
<tr>
<td>by RCU</td>
<td>P-VOL, S-VOL</td>
<td>The primary system detected an error condition at the secondary system (RCU), that caused the primary system to suspend the pair. The S-VOL split type is S-VOL Failure by MCU.</td>
</tr>
<tr>
<td>S-VOL failure</td>
<td>P-VOL, S-VOL</td>
<td>The primary system detected an error during communication with the secondary system, or an error during update copy. In this case, the S-VOL suspend type is usually S-VOL Failure. This suspend type is also used when the number of paths falls below the minimum number of paths setting on the RCU Option dialog box.</td>
</tr>
<tr>
<td>MCU IMPL</td>
<td>P-VOL, S-VOL</td>
<td>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).</td>
</tr>
</tbody>
</table>
**Monitoring and maintenance**

**System behavior**

Note the following behaviors for suspended 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 maintains exact synchronization by reporting a unit check and de-committing the P-VOL update. 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 suspended P-VOL, the system records the updated data in the P-VOL tracks as differential data. When a suspended pair is resynchronized, the primary system copies the out of sync P-VOL tracks to the S-VOL as differential data.

**Monitoring copy operations, I/O statistics**

You can monitor copy operations data and I/O statistics in the Usage Monitor window. This topic shows you how to do this, and also how to perform the following tasks:

- [Selecting data for the usage monitor graph on page 8-7](#)
- [Resizing the usage monitor graph, saving data on page 8-9](#)

For information on how to start and stop monitoring in Performance Monitor, see the *Performance Guide*.

**To monitor copy operations**, in the Storage Navigator, click **Actions > Remote Copy > TrueCopy > Usage Monitor**.

<table>
<thead>
<tr>
<th>PSUS type</th>
<th>Volume applies to</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial copy failed</td>
<td>P-VOL</td>
<td>The pair was suspended before the initial copy operation was complete. The data on the S-VOL is not identical to the data on the P-VOL.</td>
</tr>
<tr>
<td></td>
<td>S-VOL</td>
<td></td>
</tr>
</tbody>
</table>

---

**Initial copy failed P-VOL**

The pair was suspended before the initial copy operation was complete. The data on the S-VOL is not identical to the data on the P-VOL.
Descriptions of Usage Monitor fields are provided in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring Switch</td>
<td>• Enable: Monitoring is on. Graph displays.</td>
</tr>
<tr>
<td></td>
<td>• Disable: Monitoring is off. Graph is disabled.</td>
</tr>
<tr>
<td>Gathering Interval</td>
<td>The data collection interval.</td>
</tr>
<tr>
<td>Update</td>
<td>The most recent data sample time on the graph.</td>
</tr>
<tr>
<td>Usage Monitor Graph</td>
<td>Remote I/O statistics and status of remote copy monitor.</td>
</tr>
</tbody>
</table>

**Selecting data for the usage monitor graph**

The usage monitor graph plots I/O data that you specify. In the graph:
- The x-axis indicates time.
- The y-axis indicates the number of I/Os during the sampling period.
- The legend on the right side shows the data being displayed.

The value on the y-axis varies according to the maximum value of the statistical data appearing in the graph. If the y-axis value exceeds 10,000,000, the value is shown in exponential notation (for example, 1E7 = 1×10^7 = 10,000,000; 2E8 = 2×10^8 = 200,000,000).
**To specify I/O data to be graphed**

1. Make sure that usage monitoring is running (*Monitoring Switch = Enable*). The usage monitor graph can be viewed only when monitoring is on.

2. In the **Usage Monitor** window, right-click the graph and select **Display Item** from the menu.

3. In the **Display Item** dialog box—**Select Volume** box, select one of the following:
   - **ALL Volumes**, to view I/O statistics for all LDEVs in the system.
     When selected, the LDKC number, CU number, and LDEV number appear above the graph.
     - A device ID ending in # (such as, 00:00:3C #) indicates the LDEV is an external volume. For more information, see the *Hitachi Universal Volume Manager User Guide*.
     - A device ID ending in X (such as, 00:00:3C X) indicates the LDEV is a Dynamic Provisioning virtual volume. For more information, see the *Hitachi Virtual Storage Platform Provisioning Guide for Open Systems*. 
Volume, to view I/O statistics for a specific LU. Select the LU Port (CL1-A to CLG-M) and type the GID (00-FE) and LUN (000-7FF).

4. In Monitor Data, select the I/O statistics data that you want to appear on the graph. You must select at least one box. The following table describes the selections you can make.

<table>
<thead>
<tr>
<th>Data type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIO Count(^1)</td>
<td>All RIO Count Total number of remote I/Os.</td>
</tr>
<tr>
<td></td>
<td>All Write Count Total number of write I/Os.</td>
</tr>
<tr>
<td></td>
<td>RIO Error Count Number of errors that occur during remote I/O.</td>
</tr>
<tr>
<td>Initial Copy</td>
<td>Initial Copy RIO Count Number of initial copy remote I/Os.</td>
</tr>
<tr>
<td></td>
<td>Average Transfer Rate Average transfer rate for initial remote I/Os (kB/sec).</td>
</tr>
<tr>
<td></td>
<td>Average Response Average response time (msec) for initial copy remote I/Os.</td>
</tr>
<tr>
<td>Update Copy</td>
<td>Update Copy RIO Count Number of update copy remote I/Os.</td>
</tr>
<tr>
<td></td>
<td>Average Transfer Rate Average transfer rate (kB/sec).</td>
</tr>
<tr>
<td></td>
<td>Average Response Average response time (msec) for update copy remote I/Os.</td>
</tr>
<tr>
<td>Synchronization(^2)</td>
<td>Pair Synchronized For initial copy operations, the percentage of pairs synchronized out of the total number of pairs.</td>
</tr>
<tr>
<td></td>
<td>Out of Synchronous Tracks Number of tracks that have not yet been copied by the initial or resync copy operation.</td>
</tr>
</tbody>
</table>

(1) The RIO statistics are included for TC and TCz operations, if present.
(2) Synchronization data does not display for pairs created with the previous version of TrueCopy. In this case “0” displays.

5. Click Set to close the Display Item dialog box. The Usage Monitor window now shows a graph of the selected I/O statistics data for the selected LUs.

**Resizing the usage monitor graph, saving data**

- To enlarge the graph, right-click and select Large Size.
- To close the graph, right-click and select Close.
- To save monitoring data in text files, use the Performance Monitor Export Tool.

**Monitoring, maintaining logical paths**

Check logical path status to keep track of and maintain paths.
To monitor logical path status
1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.
2. Select **MCU&RCU** in the Display box.
3. Select the RCU you want, right-click, then click **RCU Status**. The RCU Status dialog box displays.

**Logical path status definitions**

The following table provides logical path status descriptions. To make sure your pair statuses are current, click **File/Refresh** in the Storage Navigator window.

<table>
<thead>
<tr>
<th>Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>This path has been successfully established and can be used for TrueCopy remote copy activities.</td>
</tr>
<tr>
<td>Initialization Failed</td>
<td>The link initialization procedure with the secondary system has failed, because the physical path connection between either the primary and secondary system, or between the primary system and the host, was missing.</td>
</tr>
<tr>
<td>Communication Timeout</td>
<td>A timeout error has occurred between the primary and secondary system.</td>
</tr>
<tr>
<td>Path Rejected</td>
<td>The logical path link function has been rejected by the secondary system. All logical path resources in the secondary system might be used for other connections.</td>
</tr>
<tr>
<td>Serial Number Mismatch</td>
<td>The serial number of the control unit that is connected to this logical path does not match the serial number specified by the Add RCU dialog box.</td>
</tr>
<tr>
<td>Invalid Port Mode</td>
<td>The specified port does not have the initiator attribute.</td>
</tr>
<tr>
<td>RCU Port Number Mismatch</td>
<td>There are three possible causes:</td>
</tr>
<tr>
<td></td>
<td>• The specified port in the secondary system is physically disconnected from the primary system.</td>
</tr>
<tr>
<td></td>
<td>• The port is not configured as an RCU target port.</td>
</tr>
<tr>
<td></td>
<td>• The specified port number is not available.</td>
</tr>
<tr>
<td>RCU Port Type Mismatch</td>
<td>The microcode on the secondary side does not support the fibre remote copy function; or the specified port type is not RCU target.</td>
</tr>
<tr>
<td>Communication Failed</td>
<td>A timeout error has occurred on the path between the primary and secondary system.</td>
</tr>
<tr>
<td>Logical Blockade</td>
<td>This logical path was blockaded because a path error or a link error occurred continuously.</td>
</tr>
<tr>
<td>Program Error</td>
<td>This logical path was blockaded because a program error occurred.</td>
</tr>
<tr>
<td>In Progress</td>
<td>This logical path is in progress of changing the attribute of port.</td>
</tr>
</tbody>
</table>

**Deleting logical paths**

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

**Prerequisite information**
- Delete logical 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 RCU Option dialog box, otherwise the delete path operation will fail.

**To delete a logical path**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the icon.

3. In the RCU Operation window, click **MCU&RCU**. The tree and list on the right-side display information about secondary system.

4. In the tree, select the local system, and then select the desired secondary system (RCU). Alternatively, select the RCU in the list, right click, and then click **Edit SSID(s) & Path(s)**. All paths to the selected RCU are listed.

5. Right-click the paths that you want to delete, and then click **Delete Path**. When the confirmation message appears, click **OK** to delete the paths, or click **Cancel**. The preview list displays the paths that you want to delete. **Delete** displays on the right-most column of the selected path in the SSID/Path list.

6. Verify the requested operations displayed in the preview list and the SSID/Path list.
   - To remove an operation, select the operation, right click, and then click **Delete**.
   - To cancel all operations, select all operations in the preview list, right click, and then click **Delete**.

7. When satisfied, click **Apply**. This saves the configuration to the TrueCopy system.

**Exporting pair information to a text file**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > Pair Operation**.

2. Change to Modify mode by clicking the icon.

3. In the Pair Operation window, click **Display Filter**, select the information that you want to export, and click **Set**. The Pair Operation window re-displays with the filtered columns displayed.

4. Click **Export**.

5. A message appears asking whether you want to save the information in a file. Click **Yes**.

6. A window appears prompting you to save the file. Browse to the location where you want to save the file, type the name of the file, and click **Save**.

7. A message appears when TrueCopy finishes saving the file. Click **OK**.
Example of an exported text file

The following shows an example of an exported text file. Fields above red numbers are described in the table that follows.

Example of an exported text file

<table>
<thead>
<tr>
<th>Port</th>
<th>Gr</th>
<th>LUN</th>
<th>Vol</th>
<th>Type</th>
<th>Fence</th>
<th>Diff</th>
<th>CTG</th>
<th>Pr10</th>
<th>Sync</th>
<th>QID</th>
<th>VAccess</th>
<th>CLPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL3-A</td>
<td>00 00 00:FE:01</td>
<td>Sync</td>
<td>(P)</td>
<td>Never</td>
<td>Track</td>
<td>032</td>
<td>100</td>
<td>00:CLPRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL3-A</td>
<td>00 00 00:FE:00</td>
<td>Sync</td>
<td>(S)</td>
<td>Never</td>
<td>Track</td>
<td>100</td>
<td>00:CLPRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL3-A</td>
<td>00 00 00:FE:00</td>
<td>Sync</td>
<td>(S)</td>
<td>Never</td>
<td>Track</td>
<td>100</td>
<td>00:CLPRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CL3-A</td>
<td>00 00 00:FE:00</td>
<td>Sync</td>
<td>(S)</td>
<td>Never</td>
<td>Track</td>
<td>100</td>
<td>00:CLPRO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Port number in the local storage system
(2) Group number and host group name
(3) LU number in the local storage system
(4) LDKC, CU, and LDEV numbers in the local storage system
(5) Pair status
(6) Serial number of the paired storage system
(7) CU SSID or Path Group ID of the paired system
(8) Port number of the paired volume
(9) GID of the paired volume
(10) LU number of the paired volume
(11) LDKC, CU, and LDEV numbers of the paired system
(12) Pair type
(13) Fence level
(14) Differential data setting
(15) Consistency group number
(16) Copy priority
(17) Synchronization of pair volumes
(18) Quorum disk ID
(19) Volume access status
(20) CLPR number and name

Note the following about LDEV IDs

- An ID ending in # (such as, 00:00:3C #) indicates the LDEV is an external volume. For more information, see the Hitachi Universal Volume Manager User Guide.
- An ID ending in X (such as, 00:00:3C X) indicates the LDEV is a Dynamic Provisioning virtual volume. For more information, see the Hitachi Virtual Storage Platform Provisioning Guide for Open Systems.


**Changing Fence Level**

You can change a pair’s fence level, which is an option that establishes whether or not the system rejects write operations to the P-VOL under certain failure circumstances. If you need more information on fence levels, see Fence Level options for I/O to the P-VOL after suspension on page 3-9.

Other pair options such as difference management cannot be changed unless you release and recreate the pair.

**To change the fence level**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > Pair Operation**.

2. Change to Modify mode by clicking the icon.

3. In the tree, select the port, host group, CU, or the CU grouping where the pair is located.

4. Select the P-VOL from the list pane, right click, and click **Change Pair Option**. The **Change Pair Option** dialog box displays.

5. From the **P-VOL Fence Level** box, select the fence level for the pairs.

6. Click **Set** then **Apply**.

If the operation does not start normally, an error code displays in the Error Code column in the Preview list. To display an error message, select the LU, right-click, and select Error Detail.

**RCU maintenance**

RCU maintenance consists of the following:

- Changing Minimum Paths, Round Trip Time, other RCU options
- Adding, deleting SSIDs for an RCU on page 8-14
- Deleting TrueCopy on page 8-14

**Changing Minimum Paths, Round Trip Time, Wait Time**

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

- Number of minimum paths for a pair.
- Wait time until data transfer is complete (MIH RIO).
- Round trip time, which affects update and initial copy priorities. See Determining Round Trip Time on page 3-5 for more information.

**To change RCU options**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the icon.

3. Select **MCU&RCU** in the Display box.
4. Right-click the desired RCU in the list and click **RCU Operation/ Change RCU Option**.

5. In the RCU Option dialog box, change the options as desired. Refer to steps related to the RCU Option dialog box in the procedure, Configuring storage systems, defining logical paths on page 5-4.

### Adding, deleting SSIDs for an RCU

When new LDEVs are added to the RCU, you make them available for TrueCopy operations by adding the associated SSIDs.

When an LDEV is deleted from an RCU, delete the associated SSID from the RCU in TrueCopy to avoid mis-operation.

**Prerequisite information**
- You can add three SSIDs to each TrueCopy secondary system.
- Before adding an SSID, make sure that the data path is properly installed.
- Adding SSIDs is not available for CU Free.
- Before deleting an SSID, make sure that the remaining SSIDs are still valid, otherwise the data paths will be lost.

**To add or delete SSIDs**

1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the **Modify** icon.

3. In the Display box, click the **MCU&RCU**.

4. In the tree, click the appropriate CU, then click the desired RCU. Alternatively, select the RCU in the list, right click, and then click **Edit SSID(s) & Path(s)**. All SSIDs to the selected RCU are listed.

5. **To add:**
   a. In the list area, right-click the Path and then click **Add SSID**.
   b. In the Add SSID dialog box, type the new SSIDs and then click **Set**.

6. **To delete:**
   a. In the list area, right-click the SSID and then click **Delete SSID**.
   b. Click **OK** when the confirmation message appears.

7. Click **Apply**.

### Deleting TrueCopy

You can delete the TrueCopy relationship between one or more secondary systems (RCUs) and a primary system.

**Prerequisite information**
- All TrueCopy pairs must be deleted.
- All logical paths will be deleted when the relationship is deleted.
• Deleting the TrueCopy relationship with a remote system does not affect the TrueCopy operations between other primary system CUs and that secondary system.

• After a secondary system is deleted, you can reconfigure the data path to add another secondary system (RCU) to the primary system, or you can remove the data path and reconfigure the primary system ports (initiator ports to ordinary target ports for fibre) to provide additional host channels for the primary system.

To delete the TrueCopy relationship
1. In Storage Navigator, click **Actions > Remote Copy > TrueCopy > RCU Operation**.

2. Change to Modify mode by clicking the icon.

3. Make sure **MCU&RCU** is selected in the **Display** box.

4. Click the primary system CU, then select the RCUs that you want to delete from the RCU list. Right-click and click **RCU Operation/ Delete RCU**.

5. When the confirmation message appears, click **OK**.

6. Verify the requested operations in the Preview list.

   To remove one or more operations, select the operations from the preview list, right-click, and click **Delete**.

7. When ready, 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 your HDS representative for assistance.

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

General information

Please review the following system behaviors regarding powering off:

• TrueCopy 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 remote systems to confirm S-VOL pair status(es). Make sure that TrueCopy 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 will suspend the pair and change P-VOL status to PSUE-by RCU. 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 TrueCopy operations are in progress, the primary system detects the communication failure, suspends all affected pairs, and generates SIMs reporting the failures. The primary system changes the P-VOL status to PSUE-by RCU but cannot change the status of the S-VOLs.

• If a primary or secondary system is powered off and the backup batteries are fully discharged while pairs are suspended, differential data is retained to SSD. In this unlikely case, MCU copies differential data to RCU 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 data 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 TrueCopy 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 MCU, CU, and ID (port, GID, LUN) for each of the P-VOLs.

2. Connect to each primary system that contains affected P-VOLs, and split all affected TrueCopy 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 a TrueCopy primary and one or more secondary systems at the same time, the primary system must be powered off first, and powered on last.

**To perform a planned outage of TrueCopy primary and secondary system**

1. Perform the planned outage of the primary system first. Because a planned outage does not affect TrueCopy pairs, nothing out of the ordinary must be done regarding the TrueCopy system or operations. Do not power on the primary system at this time.
2. If a secondary system to be powered off is connected to a primary system that is not powered off, split the TrueCopy 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 data path on page 8-16.

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 (pairresync) those pairs now.

**Miscellaneous maintenance**

The following topics provide miscellaneous maintenance information and procedures.

**Media maintenance**

A pair must be suspended before performing media maintenance on the P-VOL. Write operations to the P-VOL that specify normal authorization are duplicated on the S-VOL. Write operations with diagnostic or device support authorization are completed at the P-VOL only.
Troubleshooting

This chapter provides TrueCopy troubleshooting information.

- Error codes and messages
- General troubleshooting
- Secondary path status problems
- Suspended pairs problems
- Troubleshooting using CCI
- Service Information Messages (SIMs)
- Pinned track recovery
- Calling the Hitachi Data Systems Support Center
## Error codes and messages

Storage Navigator displays messages when error conditions occur during TrueCopy operations. The message describes the error and provides a part code and error code.

The error message may also include a VSP error code. You may need to contact HDS for assistance (see Getting help on page Preface-xiii); please report the error codes. See *Hitachi Storage Navigator Messages* for a list of the error codes.

## General troubleshooting

The following table provides a list of general errors.

<table>
<thead>
<tr>
<th>Error</th>
<th>Corrective action</th>
</tr>
</thead>
</table>
| The 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 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 system 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 Storage Navigator computer (for example, remote system S/N and ID, path parameters, P-VOL and S-VOL IDs). |
| An initiator channel-enabled LED indicator (on the VSP control panel) is off or flashing. | Contact HDS for assistance (see Getting help on page Preface-xiii). |
| The pairs and/or secondary 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 secondary system path status is not normal.                     | Check the path status (RCU Status dialog box), and see Secondary path status problems on page 9-3. |
| Pair status is PSUE.                                                 | See Suspended pairs problems on page 9-6.                                         |
### Secondary path status problems

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

<table>
<thead>
<tr>
<th>Path status</th>
<th>Description</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>This path has been successfully established and can be used for TrueCopy copy activities.</td>
<td>None required.</td>
</tr>
</tbody>
</table>
| Initialization Failed | The link initialization procedure to the secondary system failed because the physical path connection was missing between the primary and secondary system. | • 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. |
<table>
<thead>
<tr>
<th>Path status</th>
<th>Description</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication Time Out</td>
<td>Communication between the primary and secondary system timed out.</td>
<td>• Make sure the secondary system is powered on and that NVS and cache are fully functional.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure that network relay devices are properly configured and functional. This includes cables, connectors, switches, extender devices, communication lines, and all other devices connected to the extenders.</td>
</tr>
<tr>
<td>Path Rejected (MCU/RCU)</td>
<td>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.</td>
<td>• Delete all paths and RCUs not in use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure that all primary and secondary system ports are properly configured: ordinary RCU target ports for secondary systems, initiator ports for primary systems. If necessary, connect to the secondary system to delete paths.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reconfigure the ports, then add the paths and RCUs to the MCU again.</td>
</tr>
<tr>
<td>Serial Number Mismatch</td>
<td>The secondary system's S/N does not match the specified S/N.</td>
<td>• Make sure that you entered the correct secondary system S/N and Controller ID, and primary and secondary system port numbers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure the primary and secondary system ports are configured correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td>Invalid Port Mode</td>
<td>The specified port is not configured as an initiator port, or this path already exists.</td>
<td>• Make sure the correct port on the primary system is configured as an initiator port.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure that no two paths between primary and secondary system ports have the same settings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure that you entered the correct secondary system S/N and Controller ID, and primary and secondary system port numbers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Make sure that the primary and secondary system ports are configured correctly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 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.</td>
</tr>
<tr>
<td>Path status</td>
<td>Description</td>
<td>Corrective action</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
</tbody>
</table>
| RCU Port Number Mismatch    | The specified port in the secondary system is physically disconnected from the primary system. | - Make sure that you specified the correct secondary system port number. Correct the port number if necessary.  
- Make sure that the cables between the primary and secondary system ports and between the primary and secondary system switches are connected correctly.  
- Make sure that the topology settings of the primary and secondary system ports are correct. |
| RCU Port Type Mismatch      | The specified secondary system port is not configured as an RCU target port. | Make sure that the secondary system port is configured as an RCU target port. |
| 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. |
| In Progress                 | Paths are being created or deleted, or the port attribute is being changed. | Wait until processing is completed. |
| Logical 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*. |
| <blank>                     | This path was not established.                                              | Restore the path*. |

* 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 on page 8-14](#) or [Deleting logical paths on page 8-10](#). To re-register, see [Configuring storage systems, defining logical paths on page 5-4](#). If you cannot restore the path after performing these operations, contact HDS for assistance.
**Suspended pairs problems**

The following table provides a list of suspended pair types.

<table>
<thead>
<tr>
<th>Pair status/type</th>
<th>Applies to</th>
<th>Description</th>
<th>Corrective action</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSUE (pair suspended-error) / by RCU</td>
<td>P-VOL</td>
<td>The primary system detected an error condition at the secondary system, which caused the primary system to suspend the pair. The S-VOL suspend type is S-VOL Failure.</td>
<td>Clear the error condition at the secondary system or S-VOL, 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.</td>
</tr>
<tr>
<td>PSUE / S-VOL Failure</td>
<td>P-VOL</td>
<td>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 suspend type for the S-VOL is usually S-VOL Failure.</td>
<td>• Check the path status on the RCU Status dialog box. If errors occurred on the path, clear the error conditions. • Clear any error conditions at the remote system or S-VOL, 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.</td>
</tr>
<tr>
<td>PSUE (pair suspended-error)/MCU IMPL</td>
<td>P-VOL, S-VOL</td>
<td>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).</td>
<td>Resynchronize the pair from the primary system. An entire initial copy operation will be performed in response to the pairresync request.</td>
</tr>
<tr>
<td>PSUE / Initial Copy Failed</td>
<td>P-VOL, S-VOL</td>
<td>The primary system suspended this pair during the initial copy operation. The data on the S-VOL is not identical to the data on the P-VOL.</td>
<td>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.</td>
</tr>
</tbody>
</table>

**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:

It was rejected due to SK<KEY>=0x05, ASC=0x20, SSB=0xB901,0xB902 on Serial#(64015)

```
SSB1   SSB2
```

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 on page 9-7**
- **SSB2=B992 error codes when SSB1 = B901 or B90A on page 9-15**

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

<table>
<thead>
<tr>
<th>Error code (SSB2)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4A96</td>
<td>The pair cannot be created because the specified P-VOL belongs to a different CLPR than the registered consistency group CLPR.</td>
</tr>
<tr>
<td>4B02</td>
<td>A pair cannot be resynchronized because the specified consistency group does not have the Open/MF attribute.</td>
</tr>
<tr>
<td>9100</td>
<td>The command cannot be executed because the user authentication is not performed.</td>
</tr>
<tr>
<td>B923</td>
<td>A request for a Paircreate or Pairresync operation to the consistency group was rejected because supported and unsupported microcodes are used in the DKC.</td>
</tr>
<tr>
<td>B927</td>
<td>You cannot run the following operations to a pair in a 2DC configuration: Swap Suspend Takeover</td>
</tr>
<tr>
<td>B928</td>
<td>The pair cannot be created because the Mirror ID is invalid.</td>
</tr>
<tr>
<td>B929</td>
<td>The pair operation was rejected because the online microcode is being replaced.</td>
</tr>
<tr>
<td>B92A</td>
<td>The pair cannot be created because the specified volume is a command device.</td>
</tr>
<tr>
<td>B934</td>
<td>The pair cannot be created because TC is not installed.</td>
</tr>
<tr>
<td>B935</td>
<td>S-VOL hide mode is not supported.</td>
</tr>
<tr>
<td>B93B</td>
<td>The specified volume is a P-VOL. The pair cannot be released because the P-VOL is specified as an S-VOL.</td>
</tr>
<tr>
<td>B941</td>
<td>The specified volume is an S-VOL. The pair cannot be released because the S-VOL is specified as an P-VOL.</td>
</tr>
<tr>
<td>B945</td>
<td>The command was rejected because the volume status is SMPL.</td>
</tr>
<tr>
<td>B952</td>
<td>The specified LU is not defined. The DKC configuration might have been changed. Restart CCI.</td>
</tr>
<tr>
<td>Error code (SSB2)</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>B97B</td>
<td>The operation cannot run because pair status is PSUS, PSUE, or PDUB.</td>
</tr>
<tr>
<td>B97C</td>
<td>The command was rejected because the volume status is SMPL.</td>
</tr>
</tbody>
</table>
| B990             | The pair cannot be created because the consistency group number is greater than is allowed.  
If this error occurred when you did not specify the consistency group number, Contact HDS for assistance (see Getting help on page Preface-xiii). |
<p>| 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 remote 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 or PSUE. |
| 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. |
| C211             | The command was rejected because the specified volume is a P-VOL. If the error occurs when the volume is in SMPL status, select the volume in Storage Navigator, release the pair using the Yes option for Delete Pair by Force in the Pairsplit-S dialog box, 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 in SMPL status, select the volume in Storage Navigator, release the pair using the Yes option for Delete Pair by Force in the Pairsplit-S dialog box, 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 not PSUS, PSUE, or PDUB. |
| C21C             | The command was rejected because the secondary system is not registered, or the registered information is invalid. |
| C22A             | The command was rejected because the pair release was run on a volume other than P-VOL. |</p>
<table>
<thead>
<tr>
<th>Error code (SSB2)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C22C</td>
<td>The command was rejected because the volume status is SMPL.</td>
</tr>
<tr>
<td>C22D</td>
<td>The command was rejected because the specified volume is the volume other than the P-VOL.</td>
</tr>
<tr>
<td>C22E</td>
<td>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.</td>
</tr>
<tr>
<td>C233</td>
<td>The command was rejected because the S-VOL status is SMPL.</td>
</tr>
<tr>
<td>C234/C235/C236/C237</td>
<td>The command was rejected because an internal logical error has occurred.</td>
</tr>
<tr>
<td>C238</td>
<td>The command was rejected because the specified volume is the volume other than the P-VOL.</td>
</tr>
<tr>
<td>C239</td>
<td>The command was rejected because the pair resync was operated on a volume whose status is other than PSUS, PSUE, or PDUB.</td>
</tr>
<tr>
<td>C23A</td>
<td>The command was rejected because an internal logical error has occurred.</td>
</tr>
<tr>
<td>C23B</td>
<td>The command was rejected because the volume status is SMPL.</td>
</tr>
<tr>
<td>C23C</td>
<td>The command was rejected because the volume status is other than PAIR or COPY.</td>
</tr>
<tr>
<td>C23D</td>
<td>The command was rejected because the command for TC Asynchronous was issued to the TC Asynchronous volume.</td>
</tr>
<tr>
<td>C267</td>
<td>The pair cannot be created because the command was issued to the command device.</td>
</tr>
<tr>
<td>C271</td>
<td>The command was rejected because the specified consistency group number is invalid.</td>
</tr>
<tr>
<td>C28B</td>
<td>The command was rejected because the takeover command was issued to a volume whose status is not SSWS.</td>
</tr>
<tr>
<td>C28C</td>
<td>The command was rejected because the secondary system is not registered, or the registered information is invalid.</td>
</tr>
<tr>
<td>C28D</td>
<td>There is no volume to which the takeover command can run.</td>
</tr>
<tr>
<td>C28E</td>
<td>The command was rejected because an internal logical error has occurred.</td>
</tr>
<tr>
<td>C297</td>
<td>The command was rejected because the specified volume is used as an S-VOL.</td>
</tr>
<tr>
<td>C2A0</td>
<td>The pair cannot be created because the capacity that is used by software products other than TC exceeds license capacity.</td>
</tr>
<tr>
<td>C2A1</td>
<td>The command was rejected because an internal logical error has occurred.</td>
</tr>
<tr>
<td>C2A3</td>
<td>The pair cannot be created because the used capacity exceeds the license capacity.</td>
</tr>
<tr>
<td>C2B3</td>
<td>The command was rejected because DP-VOL capacity is changing.</td>
</tr>
<tr>
<td>C2B4</td>
<td>The command was rejected because an internal logical error has occurred.</td>
</tr>
<tr>
<td>C2B5</td>
<td>The pair cannot be created because the TC P-VOL is being initialized by ShadowImage.</td>
</tr>
<tr>
<td>C2B6</td>
<td>The command was rejected because the releasing pages in DP-VOL is in progress.</td>
</tr>
<tr>
<td>C300</td>
<td>The TC pair associated with a UR pair cannot be created because the Disaster Recovery Extended program product is not installed on the primary system.</td>
</tr>
<tr>
<td>C301</td>
<td>The TC pair associated with a UR pair cannot be created because the Disaster Recovery Extended program product is not installed on the secondary system.</td>
</tr>
<tr>
<td>C304</td>
<td>The pair cannot be created because the S-VOL is a DP-VOL.</td>
</tr>
<tr>
<td>C305</td>
<td>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.</td>
</tr>
<tr>
<td>Error code (SSB2)</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>C30D</td>
<td>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.</td>
</tr>
<tr>
<td>C312</td>
<td>The P-VOL is not in SMPL status.</td>
</tr>
<tr>
<td>C313</td>
<td>The P-VOL is not in PSUS or PSUE status.</td>
</tr>
<tr>
<td>C314</td>
<td>The P-VOL is not in SMPL status.</td>
</tr>
<tr>
<td>C315</td>
<td>The P-VOL includes PIN data.</td>
</tr>
<tr>
<td>C316</td>
<td>The P-VOL is in the process of drive copy for failure assistance.</td>
</tr>
<tr>
<td>C317</td>
<td>The P-VOL is in the process of drive copy for an SVP request.</td>
</tr>
<tr>
<td>C318</td>
<td>The P-VOL is terminating the copy task.</td>
</tr>
<tr>
<td>C319</td>
<td>The P-VOL is in the process of collection copy.</td>
</tr>
<tr>
<td>C31A</td>
<td>The P-VOL is in the process of collection access.</td>
</tr>
<tr>
<td>C31B</td>
<td>The P-VOL is blocked.</td>
</tr>
<tr>
<td>C31C</td>
<td>The P-VOL is blocked and impossible to access.</td>
</tr>
<tr>
<td>C31D</td>
<td>The P-VOL is being formatted.</td>
</tr>
<tr>
<td>C31E</td>
<td>The P-VOL is read only.</td>
</tr>
<tr>
<td>C320</td>
<td>The number of primary-secondary system logical paths is 0 (not specified).</td>
</tr>
<tr>
<td>C321</td>
<td>The number of primary-secondary system logical paths is smaller than the minimum required.</td>
</tr>
<tr>
<td>C322</td>
<td>The DKC type of the primary system does not support TC.</td>
</tr>
<tr>
<td>C324</td>
<td>The secondary system's sequence number, SSID, or CU are invalid.</td>
</tr>
<tr>
<td>C327</td>
<td>The pair cannot be created because the P-VOL is not available for remote copy.</td>
</tr>
<tr>
<td>C328</td>
<td>The track formats of the P-VOL and the S-VOL do not match.</td>
</tr>
<tr>
<td>C32A</td>
<td>The S-VOL is protected by the Data Retention Utility.</td>
</tr>
<tr>
<td>C32B</td>
<td>The P-VOL is protected by the Data Retention Utility.</td>
</tr>
<tr>
<td>C32C</td>
<td>The S-VOL is protected by the Data Retention Utility.</td>
</tr>
<tr>
<td>C32D</td>
<td>The S-VOL is protected by the Data Retention Utility.</td>
</tr>
<tr>
<td>C32E</td>
<td>A request for a Paircreate operation was rejected because the specified secondary system is an unsupported product.</td>
</tr>
<tr>
<td>C32F</td>
<td>The number of P-VOL cylinders is not the same or smaller than the number of S-VOL cylinders.</td>
</tr>
<tr>
<td>C330</td>
<td>The P-VOL's volume capacity is not equal to the S-VOL's.</td>
</tr>
<tr>
<td>C332</td>
<td>S-VOL cache is unavailable.</td>
</tr>
<tr>
<td>C333</td>
<td>S-VOL DFW is disabled.</td>
</tr>
<tr>
<td>C335</td>
<td>The S-VOL is the TC P-VOL.</td>
</tr>
<tr>
<td>C336</td>
<td>The S-VOL includes PIN data.</td>
</tr>
<tr>
<td>C337</td>
<td>The S-VOL is in reserve status.</td>
</tr>
</tbody>
</table>
| 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. |
<table>
<thead>
<tr>
<th>Error code (SSB2)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C339</td>
<td>The S-VOL is not available.</td>
</tr>
<tr>
<td>C33A</td>
<td>A request for a Paircreate operation was rejected because the secondary system is not supported by TC.</td>
</tr>
<tr>
<td>C33B</td>
<td>The corresponding volume cannot be specified as an S-VOL because the volume is used as another pair’s S-VOL.</td>
</tr>
<tr>
<td>C33C</td>
<td>A request for a Paircreate operation was rejected because the specified S-VOL was not mounted.</td>
</tr>
<tr>
<td>C33E</td>
<td>The pair cannot be created because the S-VOL is not implemented or is blocked (DEV NOT READY status).</td>
</tr>
<tr>
<td>C33F</td>
<td>The corresponding volume cannot be specified as an S-VOL because the volume is already specified as a TC pair volume.</td>
</tr>
<tr>
<td>C35C</td>
<td>The P-VOL is not accessible.</td>
</tr>
<tr>
<td>C370</td>
<td>There are fewer paths than the required minimum following a path failure or because an invalid path was specified.</td>
</tr>
<tr>
<td>C371</td>
<td>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.</td>
</tr>
<tr>
<td>C372</td>
<td>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.</td>
</tr>
<tr>
<td>C373</td>
<td>A request for a Paircreate operation was rejected because the specified S-VOL is a ShadowImage Reserved volume.</td>
</tr>
<tr>
<td>C374</td>
<td>A request for a Paircreate operation was rejected because the specified P-VOL is a ShadowImage Reserved volume.</td>
</tr>
<tr>
<td>C379</td>
<td>There are fewer paths than the required minimum following a path failure or because an invalid path was specified.</td>
</tr>
<tr>
<td>C37A</td>
<td>An internal error occurred.</td>
</tr>
<tr>
<td>C37B</td>
<td>The S-VOL is not available.</td>
</tr>
<tr>
<td>C37E</td>
<td>The S-VOL cache is unavailable.</td>
</tr>
<tr>
<td>C37F</td>
<td>The S-VOL DFW is disabled.</td>
</tr>
<tr>
<td>C380</td>
<td>The primary system cache is in transition to blockage on one side.</td>
</tr>
<tr>
<td>C381</td>
<td>The primary system cache is in the process of being restored.</td>
</tr>
<tr>
<td>C382</td>
<td>The primary system cache is either in transition to blockage on one side or in the process of being restored on one side.</td>
</tr>
<tr>
<td>C388</td>
<td>The pair cannot be created because the emulation type is not available for the specified volume.</td>
</tr>
<tr>
<td>C38B</td>
<td>The secondary system is already used by TC.</td>
</tr>
<tr>
<td>C38D</td>
<td>The S-VOL is not available.</td>
</tr>
<tr>
<td>C38E</td>
<td>The S-VOL is not supported by TC.</td>
</tr>
<tr>
<td>C390</td>
<td>The S-VOL status is not PSUS or PSUE.</td>
</tr>
<tr>
<td>C391</td>
<td>The S-VOL cannot be copied to because it is in the wrong pair status.</td>
</tr>
<tr>
<td>C392</td>
<td>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.</td>
</tr>
<tr>
<td>C393</td>
<td>The S-VOL includes PIN data.</td>
</tr>
<tr>
<td>C395</td>
<td>The S-VOL cannot be used due to LDEV blockage, collection access, or other reasons.</td>
</tr>
<tr>
<td>Error code (SSB2)</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>C398</td>
<td>The pair cannot be created because the emulation type is not available for the specified volume.</td>
</tr>
<tr>
<td>C39B</td>
<td>An internal error occurred.</td>
</tr>
<tr>
<td>C39E</td>
<td>The pair cannot be created because the capacity of the P-VOL exceeded the maximum volume capacity allowed to create a TC pair.</td>
</tr>
<tr>
<td>C39F</td>
<td>The pair cannot be created because the capacity of the S-VOL exceeded the maximum volume capacity allowed to create a TC pair.</td>
</tr>
<tr>
<td>C3A0</td>
<td>The P-VOL is a device not supported by TC.</td>
</tr>
<tr>
<td>C3A6</td>
<td>The SSID or CU number of the secondary system is invalid.</td>
</tr>
<tr>
<td>C3A8</td>
<td>The device type combination between the P-VOL and S-VOL is invalid.</td>
</tr>
<tr>
<td>C3AA</td>
<td>The secondary system’s cache is blocked on one side.</td>
</tr>
<tr>
<td>C3AB</td>
<td>The secondary system’s cache is blocked on one side.</td>
</tr>
<tr>
<td>C3AC</td>
<td>TC is not supported for this controller emulation type of the remote system.</td>
</tr>
<tr>
<td>C3AD</td>
<td>The secondary system capacity exceeds the license capacity.</td>
</tr>
<tr>
<td>C3AE</td>
<td>TC is not installed on the secondary system.</td>
</tr>
<tr>
<td>C3AF</td>
<td>The DKC type of the secondary system is not supported by TC.</td>
</tr>
<tr>
<td>C3B1</td>
<td>The number of paths is smaller than the required minimum number of paths.</td>
</tr>
<tr>
<td>C3B3</td>
<td>An internal error occurred.</td>
</tr>
<tr>
<td>C3B5</td>
<td>The configuration combination of P-VOL and S-VOL is invalid.</td>
</tr>
<tr>
<td>C3B6</td>
<td>The P-VOL is a SI volume.</td>
</tr>
<tr>
<td>C3B7</td>
<td>The S-VOL is a SI volume.</td>
</tr>
<tr>
<td>C3B8</td>
<td>An internal error occurred.</td>
</tr>
<tr>
<td>C3B9</td>
<td>The specified S-VOL LUN is not defined; or the LUN includes a CU LDEV that is not supported by the primary system.</td>
</tr>
</tbody>
</table>
| C3BA | A request for a Paircreate operation was rejected because of one of the following reasons:  
The secondary system’s SSID or CU number is not supported.  
Though the secondary system’s SSID or CU number is supported, the microcode of the main system device does not support them. |
| 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. |
<p>| 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. |</p>
<table>
<thead>
<tr>
<th>Error code (SSB2)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3D3</td>
<td>The SSID or CU number of the specified secondary system is invalid.</td>
</tr>
<tr>
<td>C3D4</td>
<td>A pair cannot be created because the P-VOL is being used by Volume Migration.</td>
</tr>
<tr>
<td>C3D6</td>
<td>The specified S-VOL is unavailable because the connecting port cannot recognize it.</td>
</tr>
<tr>
<td>C3D7</td>
<td>The pair status of the S-VOL is invalid.</td>
</tr>
<tr>
<td>C3D8</td>
<td>The pair cannot be created because the volume specified for the S-VOL is a system volume.</td>
</tr>
<tr>
<td>C3D9</td>
<td>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</td>
</tr>
<tr>
<td>C3DA</td>
<td>The TC pair cannot be created because the volume specified for the P-VOL is a system volume.</td>
</tr>
<tr>
<td>C3DB</td>
<td>S-VOL pair status is not PSUS or PSUE.</td>
</tr>
<tr>
<td>CB12</td>
<td>TC, TCz, UR, and URz cannot be mixed in the consistency group.</td>
</tr>
<tr>
<td>CB19</td>
<td>The secondary system consistency group cannot be deleted because the Takeover command reversing operations between the P-VOL and S-VOL failed.</td>
</tr>
<tr>
<td>CB1A</td>
<td>The secondary system consistency group was abnormally terminated because the Takeover command reversing operations between the P-VOL and S-VOL failed.</td>
</tr>
<tr>
<td>CB1D</td>
<td>No dummy volume can be created in the S-VOL.</td>
</tr>
<tr>
<td>CB1F</td>
<td>The secondary system does not support TC.</td>
</tr>
<tr>
<td>CB20</td>
<td>In referring to the function bit, the system information reference was abnormally terminated.</td>
</tr>
<tr>
<td>CB21</td>
<td>In a Pairresync operation, all difference setting was abnormally terminated.</td>
</tr>
<tr>
<td>CB23</td>
<td>An internal error occurred.</td>
</tr>
<tr>
<td>CB5D</td>
<td>The pair cannot be created because the specified P-VOL is in an older model storage system and unsupported.</td>
</tr>
<tr>
<td>CB5E</td>
<td>When connected to the old model, LUSE pairs with different amounts of capacity cannot be created.</td>
</tr>
<tr>
<td>CB5F</td>
<td>If the path is set between CUs, LUSE pairs with different CUs cannot be created.</td>
</tr>
<tr>
<td>CB60</td>
<td>TC is not installed in the secondary system.</td>
</tr>
<tr>
<td>CB62</td>
<td>One DKC cannot include a pair using Escon and a pair using Fibre.</td>
</tr>
<tr>
<td>CB66</td>
<td>The required differential area is not available in the secondary system.</td>
</tr>
<tr>
<td>CB67</td>
<td>An additional shared memory is not installed in the secondary system.</td>
</tr>
<tr>
<td>CB68</td>
<td>The required differential area is not available in the primary system.</td>
</tr>
<tr>
<td>CB69</td>
<td>The number of pairs exceeds the maximum number that can be created in a single consistency group.</td>
</tr>
<tr>
<td>CB6E</td>
<td>The Paircreate operation cannot run because the P-VOL is an external storage system volume.</td>
</tr>
<tr>
<td>CB6F</td>
<td>The Paircreate operation cannot run because the S-VOL is an external storage system volume.</td>
</tr>
<tr>
<td>Error code (SSB2)</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>CB71</td>
<td>The Paircreate operation cannot run because the P-VOL is an external storage system migration volume.</td>
</tr>
<tr>
<td>CB73</td>
<td>The Paircreate operation cannot run because the S-VOL is an external storage system migration volume.</td>
</tr>
<tr>
<td>CB75</td>
<td>The device is not recognized correctly.</td>
</tr>
<tr>
<td>CB76</td>
<td>The Paircreate operation cannot run because the paths are specified per storage system.</td>
</tr>
<tr>
<td>CB77</td>
<td>The used capacity of the Data Retention Utility software product on the secondary system exceeds the license capacity.</td>
</tr>
<tr>
<td>CB78</td>
<td>The Paircreate operation cannot run because the specified S-VOL is defined as the command device.</td>
</tr>
<tr>
<td>CB7E</td>
<td>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.</td>
</tr>
<tr>
<td>CB9E</td>
<td>A request for a Paircreate operation was rejected in the RCU because the configuring function for one or more of the specified OPEN or mainframe consistency groups on the MCU and/or RCU is unsupported.</td>
</tr>
<tr>
<td>CBD0</td>
<td>The Paircreate operation cannot run because the P-VOL LUN is a LUSE volume created across multiple CLPRs.</td>
</tr>
<tr>
<td>CBD1</td>
<td>The Paircreate operation cannot run because the S-VOL LUN of S-VOL is a LUSE volume created across multiple CLPRs.</td>
</tr>
<tr>
<td>CBD7</td>
<td>The storage system is in internal processing. Try the operation again.</td>
</tr>
<tr>
<td>CBD8</td>
<td>A pair cannot be created because the specified primary volume is one of the following:</td>
</tr>
<tr>
<td></td>
<td>• A journal volume used for UR.</td>
</tr>
<tr>
<td></td>
<td>• A UR secondary volume that is in a status other than Suspend.</td>
</tr>
<tr>
<td>CBDA</td>
<td>The Paircreate operation cannot run because the used capacity of the Data Retention Utility on the secondary system exceeds the license capacity.</td>
</tr>
<tr>
<td>CBDC</td>
<td>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.</td>
</tr>
<tr>
<td>CBDD</td>
<td>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.</td>
</tr>
<tr>
<td>CBDE</td>
<td>The Paircreate operation cannot run because the P-VOL is used by Thin Image or Copy-on-Write Snapshot.</td>
</tr>
<tr>
<td>CBDF</td>
<td>The Paircreate operation cannot run because the S-VOL is used by Thin Image or Copy-on-Write Snapshot.</td>
</tr>
<tr>
<td>CBE0</td>
<td>The Paircreate operation cannot run because the P-VOL is a Thin Image or Copy-on-Write Snapshot virtual volume.</td>
</tr>
<tr>
<td>CBE1</td>
<td>The Paircreate operation cannot run because the S-VOL is a Thin Image or Copy-on-Write Snapshot virtual volume.</td>
</tr>
<tr>
<td>CBE2</td>
<td>The Paircreate operation cannot run because the P-VOL is a Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot Pool-VOL.</td>
</tr>
<tr>
<td>CBE3</td>
<td>The Paircreate operation cannot run because the S-VOL is a Dynamic Provisioning, Thin Image, or Copy-on-Write Snapshot Pool-VOL.</td>
</tr>
<tr>
<td>CBE7</td>
<td>More than 32,768 pairs cannot be created in one storage system.</td>
</tr>
<tr>
<td>CBE8</td>
<td>The pair cannot be created because the specified P-VOL is being shredded by Volume Shredder.</td>
</tr>
</tbody>
</table>
SSB2=B992 error codes when SSB1 = B901 or B90A

<table>
<thead>
<tr>
<th>Error Code (SSB1)</th>
<th>Error Code (SSB2)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>B901</td>
<td>B992</td>
<td>Pair cannot be created because DKC type does not support TC Asynchronous.</td>
</tr>
<tr>
<td>B90A</td>
<td>B992</td>
<td>Consistency group information cannot be retrieved because TC or UR is not installed.</td>
</tr>
</tbody>
</table>

Service Information Messages (SIMs)

The VSP generates 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.

SIMs are classified according to the following severities: service, moderate, serious, or acute.
All SIMs are recorded on the VSP SVP and displayed in the Storage Navigator Status window.

During TrueCopy operations, the primary and secondary system 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 for the VSP, each SIM results in an SNMP trap being sent to the appropriate hosts. For further information about SNMP operations, see the Hitachi Storage Navigator User Guide, or contact your HDS account team.

For further information about the SIMs, see the Hitachi Storage Navigator User Guide, or contact HDS for assistance (see Getting help on page Preface-xiii).

**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 and select the CU where the P-VOL is located.
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 your HDS representative for assistance in recovering the pinned track.
4. Recreate the pair. Make sure to use the Entire Volume initial copy option.

**Calling the Hitachi Data Systems Support Center**

If you need to call the Hitachi Data Systems Support Center, please provide as much information about the problem as possible, including:

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

The HDS customer support staff is available 24 hours a day, seven days a week. If you need technical support, log on to the HDS Support Portal for contact information: [https://hdssupport.hds.com](https://hdssupport.hds.com)
Disaster recovery

This chapter discusses disaster recovery.

- Disaster recovery overview
- Switching operations to the secondary site
- Transferring operations back to the primary site
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 Fence Level options for I/O to the P-VOL after suspension on page 3-9).

3. Install and configure host failover software between the main 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 VSP primary system (for example, using CCI or SNMP). This should also be done at the secondary site if a host is connected to it.

Remote copy and disaster recovery procedures are inherently complex. Consult your HDS account team 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 system send sense information with unit check status to the appropriate hosts. This is used during disaster recovery to determine the currency of the S-VOL, and must be transferred to the remote 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 secondary 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 site, the first disaster recovery activity is to switch your operations to the secondary site. S-VOLs are recovered individually based on the pair status and P-VOL fence level information for each pair.

**To switch operations to the secondary site**

1. Record the pair status and fence level of each S-VOL.
2. Analyze the currency of the S-VOLs, based on pair status and P-VOL fence level setting. See Checking S-VOL currency with the P-VOL on page 10-3.
3. Perform file recovery as needed.
4. At the secondary site, connect to each remote system and release all TrueCopy pairs.
   When an S-VOL changes to simplex, you cannot distinguish it from a non-TrueCopy simplex volume. If necessary, use the volume manager to change the volume labels of the S-VOLs.
5. Complete file recovery procedures.
6. When file recovery procedures have been completed, vary the S-VOLs online.
7. At the secondary site, start critical host operations, with the previous S-VOLs now the primary volumes.

Checking S-VOL currency with the P-VOL

An S-VOL's currency 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 currency information, based on pair status and the P-VOL fence level setting.

<table>
<thead>
<tr>
<th>S-VOL status</th>
<th>Type</th>
<th>Fence level</th>
<th>Currency of S-VOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMPL</td>
<td>--</td>
<td>Data Status Never</td>
<td><strong>Not current.</strong> The S-VOL does not belong to a TrueCopy pair. Even if you have created a TrueCopy pair using this volume, if the pair status is still SMPL, you must regard its data as not current with the P-VOL.</td>
</tr>
<tr>
<td>COPY</td>
<td>--</td>
<td>Data Status Never</td>
<td><strong>Not current.</strong> 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).</td>
</tr>
<tr>
<td>PAIR</td>
<td>--</td>
<td>Data Status Never</td>
<td><strong>Not current.</strong> 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).</td>
</tr>
<tr>
<td>PSUE</td>
<td>Initial copy failed</td>
<td>Data Status Never</td>
<td><strong>Not current.</strong> 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).</td>
</tr>
</tbody>
</table>
Disaster recovery

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 TrueCopy pairs at the secondary site, with data flow moving from the secondary site to the local. After the pairs are synchronized and in PAIR status, they will be released, then new pairs will be created at the local site with data flow moving from local to remote, as originally set up.

To transfer operations to the primary site

1. At the local site, bring up the host servers. Make sure that TrueCopy components are operational.

2. At the local site, release all TrueCopy 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 local site, delete the TrueCopy association with the secondary systems (Delete RCU). In Storage Navigator, connect to each primary system and each CU to make sure that all RCUs are deleted.

4. At the local and remote sites, change path and port settings.
   - If you plan to use the same data paths:
     o At the local site, change the existing initiator ports to RCU target ports.
     o At the secondary site, change the existing RCU target ports to initiator ports.
   - To use the same switches, change the operating mode to the opposite direction.

For pairs with a P-VOL fence level setting of Never, further analysis is required to determine the S-VOL currency. 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 current (for example, database log files). The S-VOLs should be recovered using the files that are confirmed to be current.

Actual data recovery must be done using recovery point data in the database redo log.
- 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 site, perform TrueCopy configuration procedures,
setting up the TrueCopy system with the remote site as the primary
system, and the local site as the secondary system.

6. At the secondary system create the TrueCopy pairs, with the S-VOLs at
the local site. Make sure to use the Entire Volume initial copy 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 system, change the path and port
settings.
   - If you plan to use the same data paths:
     o At the local site, change the existing RCU target ports to initiator
       ports.
     o At the secondary site, change the existing initiator ports to RCU
       target ports.
   - 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 site, perform configuration tasks in preparation for
creating the pairs.

12. At the primary site, establish consistency groups and create the
    TrueCopy pairs in the original direction. You may use the “none” initial
copy option because all P-VOLs and S-VOLs are synchronized. If there is
any possibility that the volumes are not 100% synchronized, use the
Entire Volume initial copy option to be safe.

13. Vary the primary system and P-VOLs online, and start the host
operations.
This appendix describes Storage Navigator windows, dialog boxes, fields, and behaviors for TrueCopy (TC).

- Pair Operation window
- Paircreate(Synchronous) dialog box
- Pairsplit-r dialog box
- Pairresync dialog box
- Pairsplit-S dialog box
- Change Pair Option dialog box
- Display Filter dialog box
- RCU Operation window
- RCU Status dialog box
- Add RCU (Fibre) dialog box
- RCU Option dialog box
- Add Path(Fibre) dialog box
- Add SSID dialog box
- Usage Monitor window
- History window
□ System Option window
□ CU Option dialog box
Pair Operation window

Use this window to view TC and HAM pairs. From the window you begin the following procedures:

- Creating pairs on page 6-2
- Splitting pairs on page 6-5
- Resynchronizing pairs on page 6-6
- Releasing pairs on page 6-7
- Checking pair status on page 6-2
- Changing Fence Level on page 8-13

(See the Hitachi High Availability Manager User Guide for more information about HAM windows.)
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>Displays the connected storage system, LDKC, CU grouping, CUs, ports, and host groups. Select the desired CU grouping, CU ((DataType)), port (Port), or host group to display related LUs. Only one CU grouping, CU, port, or host group can be selected. <strong>Note:</strong> Though LDKC#01 displays in the Tree on some TC windows, it is not available for use in this version.</td>
</tr>
<tr>
<td>Preview List</td>
<td>Lists and allows you to review your current operations not yet applied to the storage system. You can change or delete the operations when you right-click the item in the Preview list. Clicking Apply commits them to the system.</td>
</tr>
<tr>
<td>Display Filter</td>
<td>Opens the Display Filter dialog box, which allows you to control the volumes that display in the list. See Display Filter dialog box on page A-14.</td>
</tr>
<tr>
<td>Export</td>
<td>Used to export status information for the LU to a text file.</td>
</tr>
</tbody>
</table>
| Volume list | Each row shows volume information. If it is also a pair volume (other than SMPL status), pair information also displays. The list can be sorted by column. For LUs with more than one path, each path displays in a separate row. For the selected item (storage system or CU), displays the detailed LVI information. If a CU grouping or a CU is selected from the tree, only one path displays for one LU on the list. Right-clicking a row displays a context menu with the following commands:  
  - Detailed Information. Displays information about the pair, control unit (CU), data path, pair status, and pair options.  
  - Paircreate. Used to create new pairs.  
  - Pairsplit – S. Used to release pairs.  
  - Pairsplit – r. Used to split pairs.  
  - Pairresync. Used to resynchronize pairs that are split.  
  - Change Pair Option. Used to change the pair options.  
  Fields are described in the following rows. |
### VOL
The LU path (a path from a host to a volume) information appears on the right of the icon as follows:

\[ CL1-N-00-000(00:00:00) \]
1. The port number of the local volume
2. The host group number
3. The LUN
4. The LDKC, CU, and LDEV number

The icons are:
- : SMPL
- : P-VOL
- : S-VOL

### Status
SN/CCI pair status. The CCI status name does not appear when it is the same as the SN name.
For descriptions, see [Pair status definitions on page 8-3](#).

### S/N (LDKC)
Serial number of the paired storage system.

### ID
SSID of the paired storage system, or Path group ID that you entered at RCU registration.

### Paired VOL
For the secondary volume, displays port number, the host group number, and LUN (LDKC:CU:LDEV), separated by hyphens. You cannot successfully change these values.

### Type
Pair mode: Synchronous, Synchronous-C, Multi-C, or HAM.
- Synchronous-C indicates the synchronous pair on which the consistency group (CTG) is specified.
- Multi-C indicates the synchronous pair on which the CTG is configured by RCUs.

### Fence
P-VOL fence level of the pair: data, status, or never. See [Fence Level options for I/O to the P-VOL after suspension on page 3-9](#) for more information.

### Diff
Differential data setting (bitmap table managed by cylinder or track).

### CTG
The pair’s consistency group number (00-7F). Displays only for Synchronous-C and Multi-C pairs.
Brackets around the CTG number [01] indicate that the CTG consist of multiple primary and secondary VSPs.

### Sync
Percentage of synchronization while the copy process is in progress.
During the pair split process, shows the concordance ratio of the specified volume.

### Quorum Disk ID
HAM volumes only. Shows the identification number for the assigned quorum disk.

### VOL Access
HAM volumes only. Indicates whether the volume receives host I/Os.

---

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL</td>
<td>The LU path (a path from a host to a volume) information appears on the right of the icon as follows:</td>
</tr>
<tr>
<td></td>
<td>[ CL1-N-00-000(00:00:00) ] 1. The port number of the local volume 2. The host group number 3. The LUN 4. The LDKC, CU, and LDEV number</td>
</tr>
<tr>
<td>Status</td>
<td>SN/CCI pair status. The CCI status name does not appear when it is the same as the SN name. For descriptions, see <a href="#">Pair status definitions on page 8-3</a>.</td>
</tr>
<tr>
<td>S/N (LDKC)</td>
<td>Serial number of the paired storage system.</td>
</tr>
<tr>
<td>ID</td>
<td>SSID of the paired storage system, or Path group ID that you entered at RCU registration.</td>
</tr>
<tr>
<td>Paired VOL</td>
<td>For the secondary volume, displays port number, the host group number, and LUN (LDKC:CU:LDEV), separated by hyphens. You cannot successfully change these values.</td>
</tr>
<tr>
<td>Type</td>
<td>Pair mode: Synchronous, Synchronous-C, Multi-C, or HAM.</td>
</tr>
<tr>
<td></td>
<td>- Synchronous-C indicates the synchronous pair on which the consistency group (CTG) is specified.</td>
</tr>
<tr>
<td></td>
<td>- Multi-C indicates the synchronous pair on which the CTG is configured by RCUs.</td>
</tr>
<tr>
<td>Fence</td>
<td>P-VOL fence level of the pair: data, status, or never. See <a href="#">Fence Level options for I/O to the P-VOL after suspension on page 3-9</a> for more information.</td>
</tr>
<tr>
<td>Diff</td>
<td>Differential data setting (bitmap table managed by cylinder or track).</td>
</tr>
<tr>
<td>CTG</td>
<td>The pair’s consistency group number (00-7F). Displays only for Synchronous-C and Multi-C pairs. Brackets around the CTG number [01] indicate that the CTG consist of multiple primary and secondary VSPs.</td>
</tr>
<tr>
<td>Sync</td>
<td>Percentage of synchronization while the copy process is in progress. During the pair split process, shows the concordance ratio of the specified volume.</td>
</tr>
<tr>
<td>Quorum Disk ID</td>
<td>HAM volumes only. Shows the identification number for the assigned quorum disk.</td>
</tr>
<tr>
<td>VOL Access</td>
<td>HAM volumes only. Indicates whether the volume receives host I/Os.</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CLPR</td>
<td>CLPR number and name for the pair volumes. See the <em>Hitachi Virtual Partition Manager User Guide</em> for more information about CLPR.</td>
</tr>
<tr>
<td>PM Status</td>
<td>Status of the preserve mirror when it is associated with Compatible FlashCopy® V2. If Withdraw displays, pair data does not synchronize despite the pair’s status.</td>
</tr>
<tr>
<td>Used Volume</td>
<td>Used capacity and the licensed capacity (in parenthesis) for all pairs. When the licensed capacity is unlimited, Used Volume displays nothing.</td>
</tr>
</tbody>
</table>

The S/N, SSID, and Fence columns can be blank while a pair is in transition to the SMPL status. To display the latest information in these columns, refresh the window.

**Detailed Information dialog box**

Use this dialog box to view details for a selected TrueCopy or HAM pair.
**Detailed Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL</td>
<td>The following displays in the order shown:</td>
</tr>
<tr>
<td></td>
<td>- Port - GID - LUN(LDKC number: CU number: LDEV number).</td>
</tr>
<tr>
<td></td>
<td>- Emulation type</td>
</tr>
<tr>
<td></td>
<td>- Capacity in MB (to two decimal places).</td>
</tr>
<tr>
<td></td>
<td>- The number of blocks</td>
</tr>
<tr>
<td>CLPR</td>
<td>Local volume's cache logical partition number and name.</td>
</tr>
<tr>
<td>Group Name</td>
<td>Local volume's host group name.</td>
</tr>
<tr>
<td>Pair Status</td>
<td>Status of the pair's local volume. For descriptions of pair statuses, see Pair status definitions on page 8-3.</td>
</tr>
<tr>
<td>Pair Synchronized</td>
<td>100 (%)</td>
</tr>
<tr>
<td>MCU S/N</td>
<td>64546</td>
</tr>
<tr>
<td>ID</td>
<td>01</td>
</tr>
<tr>
<td>Controller ID</td>
<td>0(VSP)</td>
</tr>
<tr>
<td>MCU-RCU Path</td>
<td>Fibre</td>
</tr>
<tr>
<td>Copy Pace</td>
<td>Initial Copy Priority:</td>
</tr>
<tr>
<td>P-VOL Fence Level</td>
<td>Never</td>
</tr>
<tr>
<td>Paired Time</td>
<td>07/26/2012 20:17:39</td>
</tr>
<tr>
<td>Last Update Time</td>
<td>07/26/2012 20:22:38</td>
</tr>
<tr>
<td>Par Copy Time</td>
<td></td>
</tr>
<tr>
<td>Difference Management</td>
<td>Track</td>
</tr>
<tr>
<td>Sync CT Group</td>
<td></td>
</tr>
</tbody>
</table>

**Refresh the Pair Operation window after this dialog box is closed**

- [Previous](#)  
- [Next](#)  
- [Refresh](#)  
- [Close](#)
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair Synchronized</td>
<td>The percentage of synchronization or consistency between the pair volumes. (Queueing) displays when the operation is waiting to start.</td>
</tr>
<tr>
<td></td>
<td>If you are accessing S-VOL information, the percentage displays for all pair statuses except COPY. When viewing P-VOL information, it displays for all statuses.</td>
</tr>
<tr>
<td>RCU (or MCU) S/N and ID</td>
<td>If you selected a P-VOL, the serial number of the RCU (secondary system) and the SSID or Path group ID display. If you selected an S-VOL, MCU (primary system) information displays.</td>
</tr>
<tr>
<td>Controller ID</td>
<td>Controller ID and model name of the secondary system.</td>
</tr>
<tr>
<td></td>
<td>• For controller ID 7, VSP G1000 is the model name.</td>
</tr>
<tr>
<td></td>
<td>• For controller ID 6, VSP is the model name.</td>
</tr>
<tr>
<td></td>
<td>• For controller ID 5, Universal Storage Platform V/VM is the model name.</td>
</tr>
<tr>
<td></td>
<td>• For controller ID 4, TagmaStore USP/TagmaStore NSC is the model name.</td>
</tr>
<tr>
<td></td>
<td>• For controller ID 19, HUS VM is the model name.</td>
</tr>
<tr>
<td>MCU-RCU Path</td>
<td>Data path channel type.</td>
</tr>
<tr>
<td>Update Type</td>
<td>Pair type: (TC) Synchronous, Synchronous-C, Multi-C, or HAM.</td>
</tr>
<tr>
<td>Copy Pace</td>
<td>Number of tracks copied per interval during the initial copy. Copy pace can be between 1-15 tracks.</td>
</tr>
<tr>
<td></td>
<td>This field displays only when the P-VOL is selected. It is disabled when the status becomes PAIR.</td>
</tr>
<tr>
<td>Initial Copy Priority</td>
<td>Order in which initial copy/resynchronizing operations are performed on multiple pairs.</td>
</tr>
<tr>
<td></td>
<td>This field displays only when the P-VOL is selected. It is disabled when the status becomes PAIR.</td>
</tr>
<tr>
<td>P-VOL Fence Level</td>
<td>The P-VOL shows Never, Data, or Status. For more information, see Fence Level options for I/O to the P-VOL after suspension on page 3-9.</td>
</tr>
<tr>
<td>S-VOL Write</td>
<td>Indicates whether write I/O to the S-VOL is enabled or disabled. When Enabled, &quot;Enabled/Received&quot; or &quot;Enabled(Not Received&quot; appears depending on whether I/O has been received by the volume.</td>
</tr>
<tr>
<td>Paired Time</td>
<td>Date and time the pair was created.</td>
</tr>
<tr>
<td>Last Update Time</td>
<td>Date and time pair status was last updated.</td>
</tr>
<tr>
<td>Pair Copy Time</td>
<td>Amount of time for the actual pair creation to complete. This differs from the time displayed in the Copy Time field on the History window, which includes the extra time used by the storage system to receive the request and start the operation.</td>
</tr>
<tr>
<td></td>
<td>This field displays only when the P-VOL is selected.</td>
</tr>
<tr>
<td>Difference Management</td>
<td>Method by which differential data is stored: by cylinder or by track.</td>
</tr>
<tr>
<td>Quorum Disk ID</td>
<td>Quorum disk ID assigned to the HAM pair.</td>
</tr>
<tr>
<td>VOL Access</td>
<td>Access status of the HAM volume.</td>
</tr>
</tbody>
</table>
### Paircreate(Synchronous) dialog box

Use this dialog box to create a pair.

See [Creating pairs on page 6-2](#) for complete information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sync CT Group</td>
<td>Consistency group number for a Synchronous-C or Multi-C pair. When the consistency group number is bracketed [1], the consistency group consists of multiple and secondary VSPs.</td>
</tr>
<tr>
<td>PM Status</td>
<td>The status of the preserve mirror when it is associated with Compatible FlashCopy® V2. If PAIR WAS THE TARGET OF A WITHDRAWN PM RELATIONS displays, the data of the pair volumes does not synchronize despite its pair status.</td>
</tr>
<tr>
<td>Refresh the Pair Operation window after this window is closed:</td>
<td>If the box is checked, the Pair Operation window updates when the Detailed Information dialog box closes.</td>
</tr>
</tbody>
</table>

#### Paircreate(Synchronous)

<table>
<thead>
<tr>
<th>Port-GID-LUN</th>
<th>CLPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL: CL1-A - 00 - 005(00:10:05)</td>
<td>00:CLPR0</td>
</tr>
<tr>
<td>S-VOL: CL1-A</td>
<td></td>
</tr>
<tr>
<td>RCU: 12345(00) 6(VSP) Default Fibre</td>
<td></td>
</tr>
</tbody>
</table>

**Initial Copy Parameters**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Copy:</td>
<td>Entire Volume</td>
</tr>
<tr>
<td>Copy Pace:</td>
<td>15 (From 1 to 15)</td>
</tr>
<tr>
<td>Priority:</td>
<td>32 (From 1 to 256)</td>
</tr>
<tr>
<td>Difference Management:</td>
<td>Auto</td>
</tr>
</tbody>
</table>
Pairsplit-r dialog box

Use this dialog box to split a pair.

See Splitting pairs on page 6-5 for complete information.
Pairresync dialog box

Use this dialog box to resynchronize a pair.

See Resynchronizing pairs on page 6-6 for complete information.
Pairsplit-S dialog box

Use this dialog box to delete a pair.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-VOL</td>
<td>Shows the selected volume's port, GID, LUN (LDKC number, CU number, LDEV number).</td>
</tr>
<tr>
<td>P-VOL Fence Level</td>
<td>Options for rejecting write operations to the P-VOL.</td>
</tr>
<tr>
<td>Copy Pace</td>
<td>Options for maximum number of tracks to be copied: 1-15.</td>
</tr>
<tr>
<td>Priority</td>
<td>Order for the current pair to be created among all pairs being created.</td>
</tr>
<tr>
<td>Change attribute to HAM</td>
<td>Whether a TC pair is resynchronized as a HAM pair.</td>
</tr>
<tr>
<td></td>
<td>This option cannot be specified in the following cases:</td>
</tr>
<tr>
<td></td>
<td>• HAM is not installed.</td>
</tr>
<tr>
<td></td>
<td>• Quorum disk ID is not registered.</td>
</tr>
<tr>
<td></td>
<td>• The option except Never is selected for P-VOL Fence Level.</td>
</tr>
<tr>
<td></td>
<td>• The option except CU Free is used for RCU of the pair.</td>
</tr>
<tr>
<td>Quorum Disk ID</td>
<td>Quorum disk ID to use for the HAM pair. Can be specified only when Yes is selected for Change attribute to HAM.</td>
</tr>
</tbody>
</table>
See *Releasing pairs on page 6-7* for complete information.

![Change Pair Option dialog box](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Selected volume’s port, GID, LUN (LDKC number, CU number, LDEV number).</td>
</tr>
<tr>
<td>Delete Pair by Force</td>
<td>Options for deleting the pair forcibly: Yes or No.</td>
</tr>
</tbody>
</table>

**Change Pair Option dialog box**

Use this dialog box to change the P-VOL Fence Level for an existing pair. See *Changing Fence Level on page 8-13* for complete information.
Display Filter dialog box

Use this dialog box to filter the information displayed on the Pair Operation window.

Filters are determined by the selection you make on the tree.

- When LDKC is selected, all settings are available.
- When a CU grouping or a CU is selected, GID and Port are disabled with All displayed. They cannot be changed.
- When a CU is selected, the CU setting is not available.
- When a port is selected, the port setting is not available.
- When GID is selected, the group and port settings are not available.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Selected volume’s port, GID, LUN (LDKC number, CU number, LDEV number).</td>
</tr>
<tr>
<td>P-VOL Fence Level</td>
<td>Options for rejecting write operations to the P-VOL: Data, Status, or Never.</td>
</tr>
</tbody>
</table>
### Display Filter

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port</td>
<td>The volume’s port</td>
</tr>
<tr>
<td>GID</td>
<td>The GID (host group identification number)</td>
</tr>
<tr>
<td>CU</td>
<td>The related CU</td>
</tr>
<tr>
<td>Type</td>
<td>Pair type: synchronous, synchronous-C, Multi-C, HAM, or all types</td>
</tr>
<tr>
<td>P-VOL/S-VOL</td>
<td>The type of pair volume to display, P-VOL or S-VOL, or all types</td>
</tr>
<tr>
<td>CT Group</td>
<td>The consistency group that a pair or volume belongs to.</td>
</tr>
<tr>
<td>MCU-RCU Path</td>
<td>Path type (disabled at this time)</td>
</tr>
<tr>
<td>CLPR</td>
<td>Cache logical partition</td>
</tr>
<tr>
<td>Internal/External VOL</td>
<td>Whether the volume is internal or external</td>
</tr>
<tr>
<td>Quorum Disk ID</td>
<td>HAM only. The quorum disk identification number specified for the HAM pair.</td>
</tr>
</tbody>
</table>

### Status

- SMPL
- COPY
- PAIR
- PSUS/PSUE
- PDUB
- SSWS
**RCU Operation window**

Use this window to view details about the local and remote storage systems, and the ports associated with them. From the window you begin the following procedures:

- Configuring storage systems, defining logical paths on page 5-4
- Configuring additional logical paths on page 5-9
- Defining port attributes on page 5-2
- Monitoring, maintaining logical paths on page 8-9

View the following:

- Information related to TC storage systems in RCU Operations list when "MCU&RCU" selected on page A-19.
- Information related to ports in RCU Operations list when "Port" selected on page A-21.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOL Access</td>
<td>HAM volumes only. Identifies the volume that receives host I/Os (Access(Lock)).</td>
</tr>
<tr>
<td>Status</td>
<td>Displays only volumes that have the selected SN pair status: SMPL, COPY, PAIR, PSUS/PSUE, PDUB (a LUSE status), and/or SSWS (HAM pair only). When PDUB is selected, simplex volumes are not displayed.</td>
</tr>
</tbody>
</table>
### Item

**Tree**

The Display area allows you to select either MCU&RCU display (default) or Port. This affects Tree selections.

- **When you click MCU&RCU**, the tree displays the LDKC#, CU groupings, CUs (CU Free and actual CU numbers) for the storage system that you accessed in Storage Navigator. The paired storage system or storage systems also display under the CU, if present. Paired storage systems are indicated with MCU or RCU at the beginning of the ID information, shown in the following figure.

- Clicking the LDKC displays related CUs, which appear both in the tree and in the list to the right.
- Clicking a CU grouping displays its CUs, which appear under the CU and in the list area. Paired CUs that exist, MCUs or RCUs, display. For the list-field definitions.
- Clicking the desired CU or the CU Free displays paired CUs, MCUs or RCUs, which appear under the CU in the tree (with serial number and Path group ID) and also in the list. You can only select one CU at a time.
- Clicking an MCU or RCU under CU Free or under a CU displays path information for the RCU in the list.
- **Selecting Port in the Display area** displays the channel adapters (CHAs) and port types for the storage system you are accessing in Storage Navigator.

- Selecting Storage System displays all port information in the list.
- Selecting a channel adapter displays related ports.
- Selecting a port type displays ports assigned that attribute type.

**Note:** Though LDKC#01 displays in the Tree on some TC windows, it is not available for use in this version.
List

The fields you see in the list depend on the Display selected.

- For MCU&RCU, the fields further depend on the tree options you select. See RCU Operations list when “MCU&RCU” selected on page A-19.
- For Port, see RCU Operations list when "Port" selected on page A-21.

Right-clicking a row displays a context menu with the following commands:

- RCU Status. Displays secondary system status and path status.
  - RCU Operation > Add RCU. Used to add a secondary system to the primary system in a TC relationship.
  - RCU Operation > Change RCU Option. Used to change secondary system options.
  - RCU Operation > Delete RCU. Used to delete a secondary system.
  - Edit SSID(s) & Path(s) > Add Path. Used to add paths to existing secondary systems.
  - Edit SSID(s) & Path(s) > Delete Path. Used to delete paths for existing secondary systems.
  - Edit SSID(s) & Path(s) > Add SSID. Used to add SSIDs to existing secondary systems.
  - Edit SSID(s) & Path(s) > Delete SSID. Used to delete SSIDs from existing secondary systems.
  - Port. Used to change the port types for the connected storage system.

Preview list

Lists and allows you to review your current operations not yet applied to the storage system. You can change or delete the operations when you right-click the item in the Preview list. Clicking Apply commits them to the system.

Operation

Displays the current operation performed on the RCU Operation window.

Preview

Displays the number of rows in the preview list.
### RCU Operations list when “MCU&RCU” selected

List field-descriptions when MCU&RCU is selected in the Display box are shown below. The fields vary according to the selections you make in the tree:

- **When LDKC, a CU group, or CU is selected in tree on page A-19**
- **When an MCU or RCU is selected in tree on page A-20**

#### When LDKC, a CU group, or CU is selected in tree

The following columns display in the list area when MCU&RCU is selected in Display, and an LDKC, CU group, or CU is selected in the tree.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CU</td>
<td>CU number selected on the tree. If you select CU Free, “Any” displays.</td>
</tr>
<tr>
<td>Type</td>
<td>Displays whether the paired storage system is the RCU or MCU. If you accessed a primary system, the MCU, then Type displays “RCU”. If you accessed a secondary system, the RCU, then Type displays “MCU”.</td>
</tr>
<tr>
<td>S/N</td>
<td>Serial number of the paired CU (five or six digits). The LDKC number (two digits) displays next to the S/N.</td>
</tr>
</tbody>
</table>
When an MCU or RCU is selected in tree

The following columns display in the list area when MCU&RCU is selected in Display, and an MCU or an RCU is selected in the tree.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
<td>SSID or path</td>
</tr>
<tr>
<td>ID</td>
<td>SSID of the paired CU or Path group ID</td>
</tr>
<tr>
<td>M-R Path</td>
<td>Path channel type (fibre) between MCU and RCU (blank when the target CU is the MCU)</td>
</tr>
<tr>
<td>Status</td>
<td>Status of the path</td>
</tr>
<tr>
<td>MCU Port</td>
<td>Port number on the MCU</td>
</tr>
<tr>
<td>RCU Port</td>
<td>Port number on the RCU</td>
</tr>
</tbody>
</table>
RCU Operations list when “Port” selected

The following columns display in the list when Port is selected in the Display box.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port</td>
<td>Cluster and port number (CL1-A-CLG-M)</td>
</tr>
<tr>
<td>Attribute</td>
<td>Port type assigned to the port: Initiator, target, RCU target, or External</td>
</tr>
</tbody>
</table>

RCU Status dialog box

Use this dialog box to view status and other information for the selected RCU. Right-click an RCU (MCU&RCU in Display), then select RCU Status.

- When specific CU is selected
When CU Free is selected
### RCU Status

<table>
<thead>
<tr>
<th>No.</th>
<th>Path Status</th>
<th>MCU Port</th>
<th>RCU Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal</td>
<td>CL2-A</td>
<td>CL8-B</td>
</tr>
</tbody>
</table>

**RCU S/N**: 64536 (00)

**Controller ID**: 6(VSP)

**Path Gr. ID**: Default

**RCU CU No.**: Any

**MCU-RCU Path**: Fibre

**Minimum Paths**: 1

**RIO MIH Time**: 15 (sec.)

**RCU Registered**: 05/08/2010 21:22:14

**Last Update Time**: 05/08/2010 21:22:14

**Round Trip Time**: 1 (ms)

- Refresh the RCU Operation window after this dialog box is closed

---

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td>Paths on this system.</td>
</tr>
<tr>
<td></td>
<td>- No. The paths are listed in numbered order.</td>
</tr>
<tr>
<td></td>
<td>- Path Status. The path’s condition. See Logical path status definitions on page B-10 for definitions.</td>
</tr>
<tr>
<td></td>
<td>- MCU Port. Port number of the MCU.</td>
</tr>
<tr>
<td></td>
<td>- RCU Port. Port number of the RCU.</td>
</tr>
<tr>
<td>RCU S/N</td>
<td>Serial number of the RCU. The LDKC number displays in parentheses to the right of the RCU S/N.</td>
</tr>
<tr>
<td>Controller ID</td>
<td>Controller ID and model name.</td>
</tr>
<tr>
<td>Path Gr. ID</td>
<td>Path group ID entered at RCU registration. Used to identify groups of logical paths.</td>
</tr>
<tr>
<td>SSID</td>
<td>SSIDs of the RCU.</td>
</tr>
<tr>
<td>RCU CU No.</td>
<td>CU number of the RCU. When you select CU Free, “Any” displays.</td>
</tr>
<tr>
<td>MCU-RCU Path</td>
<td>Type of path.</td>
</tr>
<tr>
<td>Minimum Paths</td>
<td>Minimum number of MCU-RCU paths for the selected RCU.</td>
</tr>
</tbody>
</table>
Add RCU (Fibre) dialog box

Use this dialog box to link two storage systems for TC pairs.

See Configuring storage systems, defining logical paths on page 5-4 for complete information.

- When specific CU is selected

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIO MIH Time</td>
<td>Time value for the remote I/O (RIO) missing interrupt handler (MIH), which is the wait time for data transfer from the primary to secondary storage system is complete.</td>
</tr>
<tr>
<td>RCU Registered</td>
<td>Date and time when the RCU was added.</td>
</tr>
<tr>
<td>Last Update Time</td>
<td>Date and time when the RCU was last updated.</td>
</tr>
<tr>
<td>Round Trip Time</td>
<td>Time limit for data to travel from P-VOL to S-VOL.</td>
</tr>
<tr>
<td>Check box, “Refresh the RCU Operation window after this dialog box is closed”:</td>
<td>To refresh the RCU Operation window after closing the RCU Status dialog box, click the check box. By default, the check box is not selected.</td>
</tr>
</tbody>
</table>

- When CU Free is selected
RCU Option dialog box

Use this dialog box to change data path parameters: the minimum number of paths, RIO MIH, and Round Trip Time options.

See Configuring storage systems, defining logical paths on page 5-4 for complete information.
Add Path(Fibre) dialog box

Use this dialog box to configure additional logical paths.

See Configuring additional logical paths on page 5-9 for complete information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Paths</td>
<td>Minimum number of paths for copy operations.</td>
</tr>
<tr>
<td>RIO MIH Time (sec.)</td>
<td>Time in which the copy operation must complete or the operation fails. Range is from 10 to 100 seconds.</td>
</tr>
<tr>
<td>Round Trip Time (ms)</td>
<td>Time limit for data to travel from the P-VOL to the S-VOL.</td>
</tr>
</tbody>
</table>
Add SSID dialog box

Use this dialog box to add an SSID.

See Adding, deleting SSIDs for an RCU on page 8-14 for complete information.
Usage Monitor window

Use this window to monitor and use copy-operations data and I/O statistics.

See Monitoring copy operations, I/O statistics on page 8-6 for complete information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSID (1st)</td>
<td>Existing SSID.</td>
</tr>
<tr>
<td>SSID (2nd), (3rd), (4th)</td>
<td>Additional SSIDs.</td>
</tr>
</tbody>
</table>
History window

Use this window to view the history of operations performed on pairs, and the data associated with each operation. Information about field behavior is shown in History window notes on page A-31.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
</table>
| Monitoring Switch  | • Enable: Monitoring is on. Graph displays.  
                    • Disable: Monitoring is off. Graph is disabled. |
| Gathering Interval | Data collection interval. When monitoring is stopped, the default value (1) displays. |
| Update             | Most recent data sample time on the graph. |
| Usage Monitor Graph| Remote I/O statistics and status of remote copy monitor. |
### Field Description

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>• The current status of operation history:</td>
</tr>
<tr>
<td></td>
<td>• No history file exists: Operation history does not exist.</td>
</tr>
<tr>
<td></td>
<td>• Reading a history file failed: An attempt to read operation history failed.</td>
</tr>
<tr>
<td></td>
<td>• Updating ... n (%): Updating of operation history is now in progress, where “n (%)” indicates the progress (in %).</td>
</tr>
<tr>
<td></td>
<td>• Complete: Updating of operation history has completed.</td>
</tr>
<tr>
<td>Last Update</td>
<td>Date and time when operation history was last updated.</td>
</tr>
<tr>
<td>Time</td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Number of the current page and the total number of pages. The format is: number of current page/total number of pages. If there is no history file, nothing appears.</td>
</tr>
<tr>
<td>Export</td>
<td>When clicked, saves operation history in a CSV file.</td>
</tr>
<tr>
<td>Previous/Next</td>
<td>Can display a maximum of 16,384 operations at a time. If the number of operations exceeds 16,384, click Previous or Next to show the remaining operations.</td>
</tr>
</tbody>
</table>
Related Topics

Export operations history on page A-32

History window notes

- The operation rows may not appear in chronological descending order. To sort the information in descending (or ascending) order, click a heading.
- The history file always contains the most recent operations up to a maximum of 524,288 operations. Information older than seven days is not shown.
- If a failure occurred with two or more pairs at the same time, the number of pairs showing SuspendPair(Failure) may not match the actual number of pairs in which the failure occurs.
- If a pair consists of LUSE volumes, the number of SuspendPair(Failure) rows may not correspond to the number of LDEVs in which errors occur.
- If a pair consists of LUSE volumes, the history of operation is not output when a pair operation for multiple LUSE volumes completes but when the operation for each individual pair completes. This means that operation history may not correspond to the time shown in the Last Update Time field on the detailed information dialog box.
- Information about the History window is not updated by clicking another tab and then clicking back to the History tab. To update, click File/Refresh.

### History list

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>History list</td>
<td>History of operations on pairs in the connected storage system. Consists of the following information:</td>
</tr>
<tr>
<td></td>
<td>• Operation Time: Date and time operation completed.</td>
</tr>
<tr>
<td></td>
<td>• Start Time: Date and time when the operation started.</td>
</tr>
<tr>
<td></td>
<td>• Operation:</td>
</tr>
<tr>
<td></td>
<td>- Pair Add Start: Paircreate operation started.</td>
</tr>
<tr>
<td></td>
<td>- Pair Add Complete: Paircreate operation completed.</td>
</tr>
<tr>
<td></td>
<td>- Pair Delete: The pair was released.</td>
</tr>
<tr>
<td></td>
<td>- Pair Suspend Operation: Pair split operation was performed.</td>
</tr>
<tr>
<td></td>
<td>- Pair Suspend (Failure): The pair was split because of a failure.</td>
</tr>
<tr>
<td></td>
<td>- Pair Resync. Start: Pair resync operation started.</td>
</tr>
<tr>
<td></td>
<td>- Pair Resync. Complete: Pair resync operation completed.</td>
</tr>
<tr>
<td></td>
<td>• VOL: LDKC number, CU number, and LDEV number of the local volume.</td>
</tr>
<tr>
<td></td>
<td>• Paired VOL: LDKC number, CU number, and LDEV number of the paired volume.</td>
</tr>
<tr>
<td></td>
<td>• Copy Time: Amount of time for the operation. Displayed only for Pair Add Complete and Pair Resync. Complete.</td>
</tr>
</tbody>
</table>
**Export operations history**

Use this window to save operation history to a CSV file.

The following example shows an exported text file. Explanations follow.

<table>
<thead>
<tr>
<th>Data and time when the operation finished.</th>
<th>Status</th>
<th>LDKC, CU, and LDEV numbers of the accessed volume (LDKC:CU:LDEV).</th>
<th>Not used.</th>
<th>LDKC, CU, and LDEV numbers of the paired volume (LDKC:CU:LDEV)</th>
<th>Time taken for copying. Time is provided only when the operation is Pair Add Complete or Pair Resync Complete.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010/10/25 20:26:43, Pair Add Start, 00:1a:80,-----,00:1a:85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/10/25 20:25:30, Pair Delete, 00:00:84,-----,00:00:86</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/10/25 17:01:33, Pair Suspend Operation, 00:00:85,-----,00:00:87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/10/19 20:01:58, Pair Resync. Complete, 00:1a:80,-----,00:1a:9e,000:00:02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/10/19 20:01:56, Pair Resync. Start, 00:1a:8a,-----,00:1a:a8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010/10/18 09:36:22, Pair Add Complete, 00:1a:80,-----,00:1a:85,000:00:10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Data and time when the operation finished.

(2) Status

(3) LDKC, CU, and LDEV numbers of the accessed volume (LDKC:CU:LDEV).

(4) Not used.

(5) LDKC, CU, and LDEV numbers of the paired volume (LDKC:CU:LDEV)

(6) Time taken for copying. Time is provided only when the operation is Pair Add Complete or Pair Resync Complete.

**System Option window**

Use this window to change the number of volumes on which the initial copy operation is performed concurrently.
<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree</td>
<td>Provides access to the storage system.</td>
</tr>
<tr>
<td>Option table</td>
<td>Right-clicking a row displays a context menu with the System Option command, which is used to change the storage system options.</td>
</tr>
<tr>
<td>Activities</td>
<td>The system option. See <a href="#">Setting number of vols. copied concurrently, other options on page 5-10</a></td>
</tr>
<tr>
<td>Preview list</td>
<td>Lists and allows you to review your current operations not yet applied to the storage system. You can change or delete the operations when you right-click the item in the Preview list. Clicking Apply commits them to the system.</td>
</tr>
<tr>
<td>Operation</td>
<td>Operation that occurs when you click Apply.</td>
</tr>
<tr>
<td></td>
<td>• Change System Option: Change storage system options.</td>
</tr>
<tr>
<td></td>
<td>• Change SIM Report: Change whether to report SIMs to hosts.</td>
</tr>
<tr>
<td></td>
<td>• Blank: Nothing will occur when you click Apply.</td>
</tr>
<tr>
<td>Preview</td>
<td>The number to the left of the slash (/) indicates the number of items (rows) appearing in the Preview list. The number to the right of the slash indicates the maximum number of items (rows) that can appear in the Preview list.</td>
</tr>
</tbody>
</table>
CU Option dialog box

Use this dialog box to change the CU options. See Setting number of vols. copied concurrently, other options on page 5-10 for complete information.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Initial Copy Activities</td>
<td>Number of volumes that can be copied concurrently during an initial copy operation. The number ranges from 1 to 16 volumes.</td>
</tr>
</tbody>
</table>
Glossary

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

#

2DC
two-data-center. Refers to the local and remote sites, or data centers, in which TrueCopy (TC) and Universal Replicator (UR) combine to form a remote replication configuration.

In a 2DC configuration, data is copied from a TC primary volume at the local site to the UR master journal volume at an intermediate site, then replicated to the UR secondary volume at the remote site. Since this configuration side-steps the TC secondary volume at the intermediate site, the intermediate site is not considered a data center.

3DC
three-data-center. Refers to the local, intermediate, and remote sites, or data centers, in which 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

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

at-time split
   Operation that allows multiple pairsplit operations to be performed at a pre-determined time.

audit log
   Files that store a history of the operations performed from Storage Navigator and the service processor (SVP), commands that the storage system received from hosts, and data encryption operations.

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

BCM
   Business Continuity Manager

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).

cia
   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

CFL
Configuration File Loader. A Storage Navigator function for validating
and running scripted spreadsheets.

CFW
cache fast write
CG
See consistency group (CTG).

CTG
See consistency group (CTG).

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 logical 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 and Business Continuity Manager 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 (CG, CTG)
A group of pairs on which copy operations are performed simultaneously; the pairs’ status changes at the same time. See also extended consistency group (EXCTG).
**consistency time (C/T)**

Shows a time stamp to indicate how close the target volume is to the source volume. C/T also shows the time stamp of a journal and extended consistency group.

**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-on-write**

Point-in-time snapshot copy of any data volume within a storage system. Copy-on-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.

**COW**

copy-on-write

**COW Snapshot**

Hitachi Copy-on-Write Snapshot

**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.

device emulation
Indicates the type of logical volume. Mainframe device emulation types provide logical volumes of fixed size, called logical volume images (LVIs), which contain EBCDIC data in CKD format. Typical mainframe device emulation types include 3390-9 and 3390-M. Open-systems device emulation types provide logical volumes of variable size, called logical units (LUs), that contain ASCII data in FBA format. The typical open-systems device emulation type is OPEN-V.

DEVN
device number

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 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

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

RAID storage system operates the same as the storage system being emulated.

emulation group

A set of device emulation types that can be intermixed within a RAID group and treated as a group.

env.

environment
ERC
   error reporting communications

ESCON
   Enterprise System Connection

EXCTG
   See extended consistency group (ECTG).

EXG
   external volume group

ext.
   external

extended consistency group (EXCTG)
   A set of Universal Replicator for Mainframe journals in which data consistency is guaranteed. When performing copy operations between multiple primary and secondary systems, the journals must be registered in an EXCTG.

external application
   A software module that is used by a storage system but runs on a separate platform.

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

external volume
   A logical volume whose data resides on drives that are physically located outside the Hitachi 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.
FBA
fixed-block architecture

FC
fibre channel; FlashCopy

FCA
fibre-channel adapter

FC-AL
fibre-channel arbitrated loop

FCIP
fibre-channel internet protocol

FCP
fibre-channel protocol

FCSP
fibre-channel security protocol

FIBARC
Fibre Connection Architecture

FICON
Fibre Connectivity

FIFO
first in, first out

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

FV
fixed-size volume
FWD
fast-wide differential

G

GID
group ID

GUI
graphical user interface

H

HA
high availability

HACMP
High Availability Cluster Multi-Processing

HAM
Hitachi High Availability Manager

HDLM
Hitachi Dynamic Link Manager

HDP
Hitachi Dynamic Provisioning

HDS
Hitachi Data Systems

HDT
Hitachi Dynamic Tiering

HDvM
Hitachi Device Manager

HGLAM
Hitachi Global Link Availability Manager

H-LUN
host logical unit
HOMRCF
Hitachi Open Multi-RAID Coupling Feature. Another name for Hitachi ShadowImage.

HORC
Hitachi Open Remote Copy. Another name for Hitachi TrueCopy.

HORCM
Hitachi Open Remote Copy Manager. Another name for Command Control Interface.

host failover
The process of switching operations from one host to another host when the primary host fails.

host group
A group of hosts of the same operating system platform.

host mode
Operational modes that provide enhanced compatibility with supported host platforms. Used with fibre-channel ports on RAID storage systems.

host mode option
Additional options for fibre-channel ports on RAID storage systems. Provide enhanced functionality for host software and middleware.

HRC
Hitachi Remote Copy. Another name for Hitachi TrueCopy for IBM z/OS.

HRpM
Hitachi Replication Manager

HSCS
Hitachi Storage Command Suite. This suite of products is now called the Hitachi Command Suite.

HUR
Hitachi Universal Replicator

HXRC
Hitachi Extended Remote Copy. Another name for Hitachi Compatible Replication for IBM XRC.
iFCP
internet fibre-channel protocol

IML
initial microcode load; initial microprogram load

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.

initiator port
A fibre-channel port configured to send remote I/Os to an RCU target port on another storage system. See also RCU target port and target port.

in-system replication
The original data volume and its copy are located in the same storage system. ShadowImage in-system replication provides duplication of logical volumes; Copy-on-Write Snapshot in-system replication provides “snapshots” of logical volumes that are stored and managed as virtual volumes (V-VOLs).
See also remote replication.

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

IOPS
I/Os per second
IP
internet protocol

IPL
initial program load

J

JNL
journal

JNLG
journal group

journal group (JNLG)
In a Universal Replicator system, journal groups manage data consistency between multiple primary volumes and secondary volumes. See also consistency group (CTG).

journal volume
A volume that records and stores a log of all events that take place in another volume. In the event of a system crash, the journal volume logs are used to restore lost data and maintain data integrity.

In Universal Replicator, differential data is held in journal volumes on until it is copied to the S-VOL.

JRE
Java Runtime Environment

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 site**

See *primary site*.

**logical device (LDEV)**

An individual logical data volume (on multiple drives in a RAID configuration) in the storage system. An LDEV may or may not contain
any data and may or may not be defined to any hosts. Each LDEV has a unique identifier or “address” within the storage system composed of the logical disk controller (LDKC) number, control unit (CU) number, and LDEV number. The LDEV IDs within a storage system do not change. An LDEV formatted for use by mainframe hosts is called a logical volume image (LVI). An LDEV formatted for use by open-system hosts is called a logical unit (LU).

**logical disk controller (LDKC)**

A group of 255 control unit (CU) images in the RAID storage system that is controlled by a virtual (logical) storage system within the single physical storage system.

**logical unit (LU)**

A logical volume that is configured for use by open-systems hosts (for example, OPEN-V).

**logical unit (LU) path**

The path between an open-systems host and a logical unit.

**logical volume**

See *volume*.

**logical volume image (LVI)**

A logical volume that is configured for use by mainframe hosts (for example, 3390-9).

**LU**

logical unit

**LUN**

logical unit number

**LUNM**

Hitachi LUN Manager

**LUSE**

Hitachi LUN Expansion; Hitachi LU Size Expansion

**LV**

logical volume
M

main control unit (MCU)
A storage system at a primary or main site that contains primary volumes of TrueCopy for Mainframe remote replication pairs. The MCU is configured to send remote I/Os to one or more storage systems at the secondary or remote site, called remote control units (RCUs), that contain the secondary volumes of the remote replication pairs. See also remote control unit (RCU).

main site
See primary site.

main volume (M-VOL)
A primary volume on the main storage system in a TrueCopy for Mainframe copy pair. The M-VOL contains the original data that is duplicated on the remote volume (R-VOL). See also remote volume (R-VOL).

master journal (M-JNL)
Holds differential data on the primary Universal Replicator system until it is copied to the restore journal (R-JNL) on the secondary system. See also restore journal (R-JNL).

max.
maximum

MB
megabyte

Mb/sec, Mbps
megabits per second

MB/sec, MBps
megabytes per second

MCU
See main control unit (MCU).

MF, M/F
mainframe

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
main journal

modify mode
The mode of operation of Storage Navigator that allows changes to the storage system configuration. See also view mode.

MP
microprocessor

MP blade
Blade containing an I/O processor. Performance in the storage system is tuned by allocating a specific MP blade to each I/O-related resource (LDEV, external volume, or journal). Specific blades are allocated, or the storage system can automatically select a blade.

MSCS
Microsoft Cluster Server

mto, MTO
mainframe-to-open

MU
mirror unit

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

M-VOL
main volume

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.
NUM
  number

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.

OS
  operating system

OS/390
  Operating System/390

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.

**PG**
parity group. See RAID group.

**physical device**
See device.

**PiT**
point-in-time

**point-in-time (PiT) copy**
A copy or snapshot of a volume or set of volumes at a specific point in time. A point-in-time copy can be used for backup or mirroring application to run concurrently with the system.

**pool**
A set of volumes that are reserved for storing Copy-on-Write Snapshot data or Dynamic Provisioning write data.

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

**port attribute**
Indicates the type of fibre-channel port: target, RCU target, or initiator.

**port block**
A group of four fibre-channel ports that have the same port mode.

**port mode**
The operational mode of a fibre-channel port. The three port modes for fibre-channel ports on the Hitachi RAID storage systems are standard, high-speed, and initiator/external MIX.

**PPRC**
Peer-to-Peer Remote Copy

**Preview list**
The list of requested operations on Storage Navigator.
**primary site**

The physical location of the storage system that contains the original data to be replicated and that is connected to one or more storage systems at the remote or secondary site via remote copy connections. A primary site can also be called a "main site" or "local site".

The term "primary site" is also used for host failover operations. In that case, the primary site is the host computer where the production applications are running, and the secondary site is where the backup applications run when the applications at the primary site fail, or where the primary site itself fails.

**primary volume**

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: Storage Navigator, Copy-on-Write Snapshot, ShadowImage, ShadowImage for Mainframe, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.

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.
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

**RCU**
See *remote control unit (RCU)*.

**RD**
read

**RCU target port**
A fibre-channel port that is configured to receive remote I/Os from an initiator port on another storage system.

**remote console PC**
A previous term for the personal computer (PC) system that is LAN-connected to a RAID storage system. The current term is Storage Navigator PC.

**remote control port (RCP)**
A serial-channel (ESCON) port on a TrueCopy main control unit (MCU) that is configured to send remote I/Os to a TrueCopy remote control unit (RCU).
remote control unit (RCU)
A storage system at a secondary or remote site that is configured to receive remote I/Os from one or more storage systems at the primary or main site.

remote copy
See remote replication.

remote copy connections
The physical paths that connect a storage system at the primary site to a storage system at the secondary site. Also called data path.

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

remote site
See secondary site.

remote volume (R-VOL)
In TrueCopy for Mainframe, a volume at the remote site that contains a copy of the original data on the main volume (M-VOL) at the main site.

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.

RF
record format

RIO
remote I/O

R-JNL
restore journal

RL
record length
RMI
Remote Method Invocation

rnd
random

root volume
A level-1 primary volume in a ShadowImage cascade configuration. The secondary volume of a layer-1 pair is called a node volume. See also cascade configuration.

RPO
recovery point objective

R-SIM
remote service information message

R-site
remote site (used for Universal Replicator)

RTC
real-time clock

RTO
recovery time objective

R-VOL
See remote volume (R-VOL).

R/W
read/write

S

S#
serial number

S/N
serial number

s/w
software
SAID  
    system adapter ID

SAN  
    storage-area network

SATA  
    serial Advanced Technology Attachment

SC  
    storage control

SCDS  
    source control dataset

SCI  
    state change interrupt

scripting  
    The use of command line scripts, or spreadsheets downloaded by Configuration File Loader, to automate storage management operations.

SCSI  
    small computer system interface

secondary site  
    The physical location of the storage system that contains the primary volumes of remote replication pairs at the main or primary site. The storage system at the secondary site is connected to the storage system at the main or primary site via remote copy connections. The secondary site can also be called the “remote site”. See also primary site.

secondary volume  
    The volume in a copy pair that is the copy. The following Hitachi products use the term “secondary volume”: Storage Navigator, Thin Image, Copy-on-Write Snapshot, ShadowImage, ShadowImage for Mainframe, TrueCopy, Universal Replicator, Universal Replicator for Mainframe, and High Availability Manager.
    See also primary volume.

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

service processor (SVP)
The computer inside a RAID storage system that hosts the Storage Navigator software and is used by service personnel for configuration and maintenance of the storage system.

severity level
Applies to service information messages (SIMs) and Storage Navigator error codes.

SI
Hitachi ShadowImage

SIZ
Hitachi ShadowImage for Mainframe

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

SN
serial number shown in Storage Navigator

snapshot
A point-in-time virtual copy of a Copy-on-Write Snapshot primary volume (P-VOL). The snapshot is maintained when the P-VOL is updated by storing pre-updated data (snapshot data) in a data pool.
SNMP
  simple network management protocol

SOM
  system option mode

source volume (S-VOL)
The volume in a copy pair containing the original data. The term is used only in the earlier version of the Storage Navigator GUI (still in use), for the following Hitachi products: ShadowImage for Mainframe, Dataset Replication, IBM FlashCopy.

space
  Generally refers to the data storage capacity of a disk drive or flash drive.

SRM
  Storage Replication Manager

SS
  snapshot

SSB
  sense byte

SSID
  (storage) subsystem identifier. SSIDs are used as an additional way to identify a control unit on mainframe operating systems. Each group of 64 or 256 volumes requires one SSID, therefore there can be one or four SSIDs per CU image. For VSP, one SSID is associated with 256 volumes.

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.

S-VOL
  See secondary volume or source volume (S-VOL).

SVP
  See service processor (SVP).
sync
synchronous

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

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

target volume (T-VOL)
The volume in a mainframe copy pair that is the copy. The term is used only in the earlier version of the Storage Navigator GUI (still in use), for the following Hitachi products: ShadowImage for Mainframe, Dataset Replication, Compatible FlashCopy® V2.
See also source volume (S-VOL).

TB
terabyte

TC
Hitachi TrueCopy

TCz
Hitachi TrueCopy for Mainframe

TDEVN
target device number

TGT
target; target port

THD
threshold

TID
target ID

total capacity
The aggregate amount of storage space in a data storage system.
**TSE**

track space efficient. Used in Compatible FlashCopy® V2 operations.

**T-VOL**

See target volume (T-VOL).

**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

**URz**

Hitachi Universal Replicator for Mainframe

**USP**

Hitachi TagmaStore® Universal Storage Platform

**USP V**

Hitachi Universal Storage Platform V

**USP VM**

Hitachi Universal Storage Platform VM

**UT**

Universal Time

**UTC**

Universal Time-coordinated

**V**

version; variable length and de-blocking (mainframe record format)

**VB**

variable length and blocking (mainframe record format)
view mode
The mode of operation of Storage Navigator that allows viewing only of the storage system configuration. The two Storage Navigator modes are view mode and modify mode.

virtual device (VDEV)
A group of logical devices (LDEVs) in a RAID group. A VDEV typically consists of some fixed volumes (FVs) and some free space. The number of fixed volumes is determined by the RAID level and device emulation type.

Virtual LVI/LUN volume
A custom-size volume whose size is defined by the user using Virtual LVI/Virtual LUN. Also called a custom volume (CV).

virtual volume (V-VOL)
The secondary volume in a Thin Image or Copy-on-Write Snapshot pair. When in PAIR status, the V-VOL is an up-to-date virtual copy of the primary volume (P-VOL). When in SPLIT status, the V-VOL points to data in the P-VOL and to replaced data in the pool, maintaining the point-in-time copy of the P-VOL at the time of the split operation.
When a V-VOL is used with Dynamic Provisioning, it is called a DP-VOL.

VLL
Hitachi Virtual LVI/LUN

VLVI
Hitachi Virtual LVI

VM
volume migration; volume manager

VOL, vol
volume

VOLID
volume ID

volser
volume serial number

volume
A logical device (LDEV), or a set of concatenated LDEVs in the case of LUSE, that has been defined to one or more hosts as a single data
storage unit. A mainframe volume is called a logical volume image (LVI), and an open-systems volume is called a logical unit. (LU).

**volume pair**

*See copy pair.*

**V-VOL**

virtual volume

**V-VOL management area**

Contains the pool management block and pool association information for Copy-on-Write Snapshot operations. The V-VOL management area is created automatically when additional shared memory is installed and is required for Copy-on-Write Snapshot operations.
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