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Hitachi TagmaStore®
Adaptable Modular Storage
and Workgroup Modular Storage

TrueCopy™ Synchronous Remote Replication
Software User's Guide

MK-95DF710-09

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Source Document(s) for this Revision

The following source document was used to produce this TagmaStore® subsystem user guide:

- *Hitachi TagmaStore® Adaptable Modular Storage TrueCopy™ Synchronous Remote Replication Software User's Guide*, RSD-95DF710-06_1

Changes in this Revision

- Changed Hitachi TagmaStore Adaptable Modular Storage products version to version 7.0 and higher.
- Added information on assigning LUs (configured from SATA drives) to P-VOL and S-VOL in Table 2.1 TrueCopy Requirements.
- Revised captions for Figure 2.12 and Figure 2.14 in section 2.8.1 Cascading TrueCopy with ShadowImage.
- Added Figure 2.13 and Figure 2.15 in section 2.8.1 Cascading TrueCopy with ShadowImage.
- Revised caption for Figure 2.16 in section 2.8.1.1 Cascading with a ShadowImage P-VOL.
- Added Figure 2.15 in section 2.8.1.1 Cascading with a ShadowImage P-VOL.
- Changed column heading in Table 2.8 and Table 2.9.
- Added notes on Cascade restrictions for ShadowImage P-VOL in section 2.9.2.1.
- Changed information on number of SnapShot V-VOLs in section 2.9.3.1.

- Changed Figure 3.1, Figure 3.2, Figure 3.3, Figure 3.4 and Figure 3.5 in section 3.1.1. Added separate Navigator GUI screens for versions 5.00 or later and versions less than 5.00.
- Changed step 5 of TrueCopy installation procedure in section 3.1.1.
- Added illustration to step 8 of TrueCopy installation procedure in section 3.1.1.
- Added step 9 for TrueCopy installation procedure in section 3.1.1.
- Revised step 5 of TrueCopy uninstallation procedure in section 3.1.2.
- Changed Figure 3.6 and Figure 3.7 in section 3.1.2 Uninstalling TrueCopy. Added separate Navigator GUI screens for versions 5.00 or later and versions less than 5.00.
- Changed captions for Figure 3.12 and Figure 3.14 in section 3.3 Setting the Differential Management LU.
- Changed platform support information in Table 5.1 Supported Platform List.
- Added information on assigning LUs (configured from SATA drives) to P-VOL and S-VOL in Table 5.2 Basic and External Specifications.
- Added TrueCopy on NAS Modular information (section 10.3)
- Changed step 2 in section A.1 of Appendix A. Added examples in procedure for installing TrueCopy using Navigator versions less than 5.00 and versions 5.00 or later.
- Changed step 2 in section A.2 of Appendix A. Added examples in procedure for uninstalling TrueCopy using Navigator versions less than 5.00 and versions 5.00 or later.
- Deleted section A.8 Setting the ShadowImage I/O Switching Mode and section A.9 Confirming the Status of ShadowImage Pairs.
- Added Appendix B TrueCopy on NAS Modular.
- Added Appendix C Command Operations on NAS Modular.
- Added Appendix D Failure Operations on NAS Modular.
- Added a new list of acronyms.
- Added index entries

Preface

This document describes and provides instructions for performing TrueCopy™ Synchronous Remote Replication operations on the Hitachi TagmaStore® Adaptable Modular and Workgroup Modular Storage array subsystem.

This user's guide assumes the following:

- The user has a background in data processing and understands RAID storage subsystems and their basic functions.
- The user is familiar with the Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage array subsystem.
- The user has read and understands the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
- The user is familiar with the Windows® 98, Windows NT®, and/or the Windows 2000 operating system.

Notes:

- The use of TrueCopy Synchronous Remote Replication Software, and all other Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.
- Throughout this manual, the term **"TrueCopy"** refers to the TrueCopy Synchronous Remote Replication Software program.
- Throughout this manual, the term **"TCE"** refers to the TrueCopy Extended Distance Remote Replication Software program.
- Throughout this manual, the term **"Navigator"** refers to the Storage Navigator Modular program.
- Throughout this manual, the term **"ShadowImage"** refers to the ShadowImage™ In-System Replication Software program.
- Throughout this manual, the term **"SnapShot"** refers to the Copy-on-Write SnapShot Software program.
- Throughout this manual, the term **"Volume Migration"** refers to the Modular Volume Migration.
- For further information, please contact your Hitachi Data Systems account team, or visit the Hitachi Data Systems worldwide web site at http://www.hds.com.
- The use of TrueCopy Synchronous Remote Replication and all other Hitachi Data Systems products is governed by the terms of your agreement(s) with Hitachi Data Systems.

Software Version

This document revision applies to Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage products version 7.0 and higher.

Convention for Storage Capacity Values

Storage capacity values for logical units (LUs) on the TagmaStore AMS/WMS products are calculated based on the following values:

1 KB (kilobyte) = 1,024 bytes
1 MB (megabyte) = $1,024^2$ bytes
1 GB (gigabyte) = $1,024^3$ bytes
1 TB (terabyte) = $1,024^4$ bytes

Storage capacity values for hard disk drives (HDDs) on the TagmaStore AMS/WMS products are calculated based on the following values:

1 KB (kilobyte) = 1,000 bytes
1 MB (megabyte) = $1,000^2$ bytes
1 GB (gigabyte) = $1,000^3$ bytes
1 TB (terabyte) = $1,000^4$ bytes

Referenced Documents

- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Storage Navigator Modular Graphical User Interface (GUI) User's Guide*, MK-95DF711
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Storage Navigator Modular Command Line Interface (CLI).* MK-95DF712
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide,* MK-95DF701
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Copy-on-Write SnapShot Software User's Guide,* MK-95DF708
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage ShadowImage™ In-System Replication Software User's Guide,* MK-95DF709

Comments

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Thank you! (All comments become the property of Hitachi Data Systems Corporation.)

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1.1 TrueCopy™

The Hitachi Data Systems TrueCopy feature enables you to maintain remote copies of all user data on the TagmaStore® storage subsystem for data backup or duplication. The duplicated volumes are created between subsystems that are connected with a fibre channel interface. TrueCopy is used for UNIX®-based and PC server data, and can provide one duplicate for each primary volume.

TrueCopy operations are non-disruptive and allow the primary (main) volume of each volume pair to remain online to all hosts for both read and write I/O operations. Once established, TrueCopy operations continue unattended to provide synchronous remote data backup. Usability is further enhanced through a resynchronization capability that reduces data duplication requirements and backup time, thereby increasing user productivity.

Notes:

- If a TrueCopy pair suspended-error (PSUE) occurs, the cause is usually due to a failure in the hardware (or when the user forcibly suspends the pair). To recover from a suspended status, the hardware error and designated data must be recovered. To accomplish this task, contact Hitachi Data Systems Customer Support.

  To prepare for resolving a PSUE error, ensure that the user (system engineer) monitors the CCI system log. Verify that the PSUE error is not caused by user operation before contacting Hitachi Customer Support.

- TrueCopy operations are performed from the UNIX® and/or PC-server host using the Hitachi Data Systems Command Control Interface (CCI) software. For information and instructions on using CCI to perform TrueCopy operations, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

- Many references to the TrueCopy Extended Distance feature appear in this document. TrueCopy Extended Distance is a long distance remote replication business continuity application that will be available during the next release. Please contact your HDS representative for more information. We apologize for any inconvenience.

Chapter 2 Overview of Operations

This chapter includes the following:

- Overview of TrueCopy Operations (see section 2.1)
- TrueCopy Components (see section 2.2)
- TrueCopy Requirements (see section 2.3)
- Command Operations (see section 2.4)
- Pair Status (see section 2.5)
- TrueCopy Operations (see section 2.6)
- Concurrent Use of LUN Size Expansion (see section 2.7)
- TrueCopy Cascade Connections with ShadowImage™ (see section 2.8)
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- TrueCopy Operation (see section 2.10)
- Operation When the Fence Level is “never” (see section 2.11)
- Concurrent Use of TrueCopy and ShadowImage/SnapShot (see section 2.12)
- Cautions and Restrictions (see section 2.13)

2.1 Overview of TrueCopy Operations

The TrueCopy feature synchronizes the data of LUs in subsystems that are connected by a Fibre Channel interface. Using TrueCopy, the data received from the server is written into subsystems on local and remote sides simultaneously. The data of subsystems on local and remote sides are always synchronized. When the resynchronization is executed, you can save time by transferring the differential data only to the subsystem on the remote side. Since TrueCopy also has a fail-over function (for example, a failure occurs on the local side), you can immediately switch the server that is in the normal condition.

To use TrueCopy, the Hitachi Command Control Interface (CCI) and the Storage Navigator Modular (Navigator) are required. The Hitachi Command Control Interface (CCI) enables you to execute and control operations (for example, a copy operation). The Navigator enables you to set the path. Additionally, a Web browser is required for maintenance of the path.

The LED device traces, and the analyzing tool enable you to reference the path, the LU status, and the failure information of the subsystem. You can also reference this information easily by concurrently using the Web browser.

Note: To avoid a path failure:

- When you turn on the subsystem where a path has already been set, turn on the remote subsystem first. Turn on the local subsystem after the remote subsystem is READY.

  When you turn off the subsystem where a path has already been set, turn off the local subsystem first, and then turn off the remote subsystem.
- When you restart the subsystem, verify that the subsystem is on the remote side of TrueCopy. When the subsystem on the remote side is restarted, both paths are blocked.
- When the subsystem on the remote side is powered off or restarted when the TrueCopy pair status is PAIR or COPY, it is changed to PSUE. If you power off or restart the subsystem, do so after changing the TrueCopy pair status to PSUS.
- You will receive an error/blockage if the remote subsystem is not available. A notice regarding SNMP Agent Support Function and TRAP occurs in path blockade mode. Perform the functions in the notice and the check the Failure Monitoring Department in advance. Path blockade automatically recovers after restarting. If the path blockage is not recovered when the subsystem is READY, contact Hitachi Customer Support.
- Do not change the microprogram when the subsystem power is on during the execution of a TrueCopy copy operation.
- When the local subsystem is directly connected with the remote subsystem paired with the local subsystem, the setting of the fibre transfer rate must not be modified while the subsystem power is on. If the setting of the fibre transfer rate is modified, a path blockage will occur.

2.2 TrueCopy Components

To operate TrueCopy in primary and secondary volumes in the TagmaStore subsystem, the Navigator and the Command Control Interface (CCI) are used. For TrueCopy on NAS Modular, see Appendix B. Figure 2.1 shows a typical TrueCopy configuration. TrueCopy system components include the following:

- TrueCopy volume pairs (P-VOLs and S-VOLs) (see section 2.2.1)
- Navigator (see section 2.2.2)
- Hitachi Command Control Interface (CCI) on the UNIX® and/or PC-server host (refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

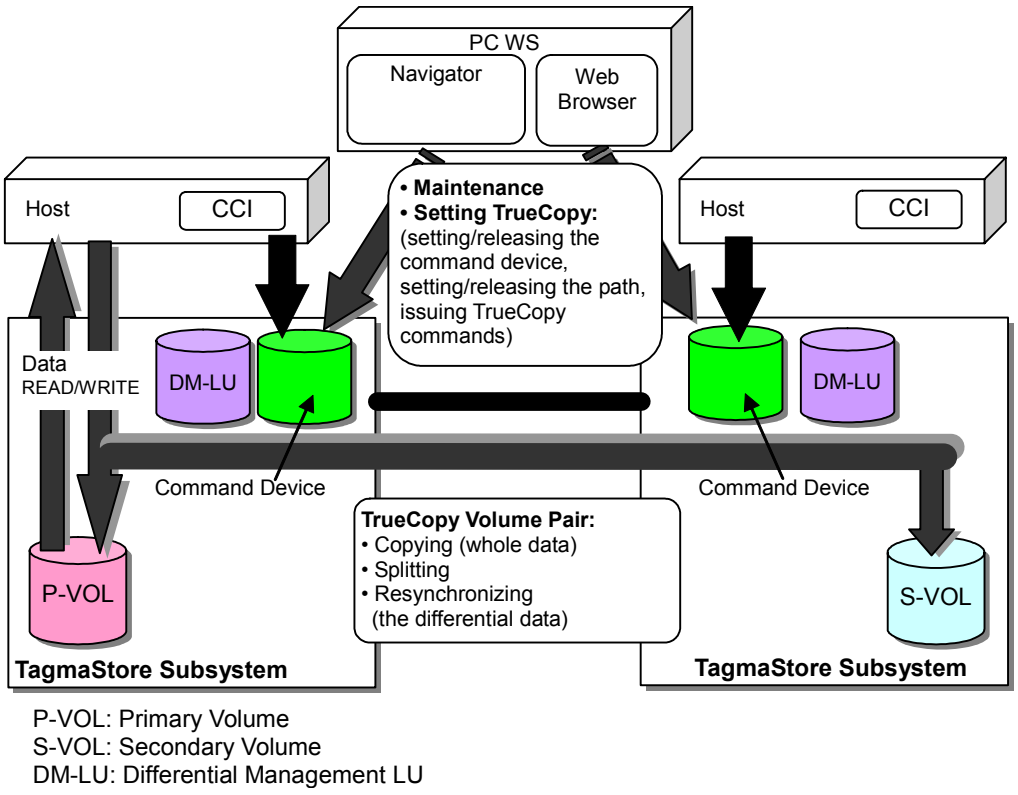


Figure 2.1 TrueCopy Components

2.2.1 TrueCopy Volume Pairs (P-VOLs and S-VOLs)

TrueCopy performs remote copy operations for logical volume pairs established by the user. Each TrueCopy pair consists of one primary volume (P-VOL) and one secondary volume (S-VOLs), which are located in the TagmaStore subsystems that are connected by a Fibre Channel interface. The TrueCopy P-VOLs are primary volumes that contain original data. The TrueCopy S-VOLs are secondary or mirrored volumes that contain backup data. TrueCopy supports a maximum of 510 pairs for AMS200/WMS100, 2,046 pairs for AMS500, and 4,094 pairs for AMS1000. For TrueCopy on NAS Modular, see Appendix B.

During TrueCopy operations, the P-VOLs remain available to all hosts for read and write I/O operations. An exception to this includes when “data” is specified in the fence level and the LU is impossible to access (for example, an LU blockage). The S-VOLs become available for write operations from the hosts only after the pair has been split.

Depending on how the pair is split, the S-VOL is available for both read and write I/O.

When a TrueCopy volume pair is created, the data on the P-VOL is copied to the S-VOL to synchronize the volumes. During this initial copy operation and after the pair is synchronized, all write operations to the S-VOL are prohibited. If you need to access an S-VOL, you can “split” the pair to make the S-VOL accessible. The P-VOL is accessible except when “data” is specified in the fence level and the LU is impossible to access (for example, an LU blockage). While a TrueCopy pair is split, the TagmaStore subsystem keeps track of all changes to the P-VOL and S-VOL. When you “resync” the pair, the differential data in the P-VOL (due to P-VOL and S-VOL updates) is copied to the S-VOL so that the S-VOL is again identical to the P-VOL. For reverse resync, the differential data in the S-VOL (due to P-VOL and S-VOL updates) is copied to the P-VOL; the P-VOL is now identical to the S-VOL.

2.2.2 Navigator

The Navigator displays path information. Setting the path, a route for copying, enables you to perform TrueCopy operations.

The Navigator can set a TrueCopy environment by connecting the PC, which is installed with the subsystem, through a LAN. This operation enables the command device to be specified or released.

2.3 TrueCopy Requirements

TrueCopy operations provide remote copies of UNIX®/PC server volumes (LUs) on the TagmaStore subsystem. Table 2.1 lists and describes the operational requirements for TrueCopy. For TrueCopy on NAS Modular, see Appendix B.

Table 2.1 TrueCopy Requirements

Parameter	TrueCopy Requirement
User interface	The following software products are necessary: CCI: used for issuing commands to create and split TrueCopy pairs. Navigator: used for specifying and releasing command devices. Also used for specifying the path and referencing the status of the path on TrueCopy.
Controller configuration	Configuration of dual controller is required.
Max number of differential management LU	2 The Differential Management LU size must be greater than or equal to 5 GB. The Differential Management LUs must be set on both the local and remote subsystems. It is recommended that two Differential Management LUs are set according to the following conditions. ▪ To be created in a different RAID group ▪ To be allocated in different controllers
Max number of command devices	Two command devices per TagmaStore subsystem. The command devices must be set on both the local and remote subsystems.
Unit of pair management	LUs are the target of TrueCopy pairs, and are managed per logical unit.
Max number of pairs	WMS100: 510 AMS200: 510 AMS500: 2,046 AMS1000: 4,094 The maximum number of pairs when different types of TagmaStores are combined is that of a TagmaStore whose maximum number of pairs is smaller. When the micro program version is less than 0760/A in the case of the WMS100/AMS200, TrueCopy is not supported.
Pair structure	One copy (S-VOL) per P-VOL.
Supported RAID level	RAID 1 (1D+1D), RAID 5 (2D+1P to 15D+1P), RAID 1+0 (2D+2D to 8D+8D), RAID 6 (2D+2P to 28D+2P)
Combination of RAID levels	All combinations supported. The number of data disks does not need to be the same.
Number of paths (for 1 pair)	Two paths per 1 pair must be set. (One path is specified per 1 controller. Since it requires a dual controller configuration, total of 2 paths are specified.) In the case of the WMS100/AMS200, the optional FC Interface Board is required.
Size of LU	The LU size must always be P-VOL = S-VOL. Please set the value larger than or equal to 65,538 blocks (1 block = 512 bytes) (33 MB) for the LU size of the command device.
Server access restrictions while copying	Read-only while copying (S-VOL)
P-VOL/S-VOL drive types	Both LUs with FC drives and SATA drives can be assigned to any P-VOL and an S-VOL. However, in the case where a local side subsystem is the AMS1000/AMS500/AMS200, it is recommended to specify an LU configured in the FC drives for a P-VOL. When integrating the LUs configured in the SATA drive, the use conditions of the SATA drive may be different (see Table 2.2).

Parameter	TrueCopy Requirement
Allocation of P-VOL and S-VOL	S-VOL is allocated in the remote subsystem which is connected to the local subsystem in which a P-VOL is included with Fibre Channel Interface.
Initial copy	When receiving the paircreate command, the entire copy is executed in the direction of P-VOL to S-VOL.
Split	When receiving the pairsplit command, splitting P-VOL and S-VOL is executed. Splitting is completed immediately (few ms to 10ms).
Differential management	When the P-VOL and S-VOL is in split status (PSUS), write operations received individually will be managed as differential data of P-VOL and S-VOL.
Resynchronization	When receiving the pairresync command, the differential copy is executed in the direction of P-VOL to S-VOL or S-VOL to P-VOL.
S-VOL data creation	The S-VOL data on cache is created during the write operation. 1. Receiving the write command from the host. 2. Creates the P-VOL data. 3. Creates the S-VOL data. 4. Reports “GOOD” to host.
Management of LUs while using TrueCopy	Formatting, extending, and deleting LUs are not available. When formatting, extending, and deleting LUs, split TrueCopy/ShadowImage pair(s) using the pairsplit command.
Concurrent use of LUN Size Expansion	Available. For details, see section 2.7.
Concurrent use of Data Retention Utility	When the S-VOL Disable is set for an LU, a pair creation using the LU as an S-VOL is suppressed. An S-VOL Disable setting of a volume that has already become an S-VOL is not suppressed only when the pair status is PSUS.
Concurrent use of LU Cache Residency Manager	The LU specified for Cache Residency Manager (LU cache residence) cannot be set to S-VOL or P-VOL.
Concurrent use of SNMP Agent	Available
Concurrent use of Password Protection	Available
Concurrent use of LUN Manager	Available
Concurrent use of ShadowImage	TrueCopy and ShadowImage can be used concurrently. For details, see section 2.12.
Concurrent use of SnapShot	TrueCopy can be cascaded with SnapShot. For details, see section 2.8.2.
Concurrent use of Cache Partition Manager	Available
Concurrent use of TCE	Not available.

Parameter	TrueCopy Requirement
Concurrent use of Volume Migration	Available. However, a P-VOL, an S-VOL, and Reserved LU of Volume Migration cannot be specified as a P-VOL or an S-VOL of TrueCopy.
Concurrent use of Power Saving	Available. However, when a P-VOL or an S-VOL is included in a RAID group, for which the Power Saving has been specified, no pair operation can be performed except the pair split and the pair release.
Concurrent use of iSCSI	The configuration in which the connection between the host and the subsystem is made via iSCSI is allowed but iSCSI cannot be used for the connection between the subsystems.
Key	TrueCopy becomes usable by entering the key code.
Failures	When a failure of the copy operation from P-VOL to S-VOL occurs, TrueCopy will suspend the pair (PSUE). If a LU failure occurs, TrueCopy suspend the pair. If a drive failure occurs, the TrueCopy pair status is not affected because of the RAID architecture.
RAID group deleting, LU deleting, and formatting for a paired P-VOL or S-VOL	RAID group deleting, LU deleting, and formatting for a paired P-VOL or S-VOL cannot be performed.
Restriction for formatting the volumes	Do not execute TrueCopy operations while formatting the volume. Formatting takes priority and the TrueCopy operations will be suspended. The pair operation of TrueCopy can be performed unless the volume to be targeted is being formatted.
Limitation of a device type	Only configuration between the same device types is supported.
The maximum supported capacity value of P-VOL and S-VOL (TB)	***Notes***
Reduction of memory	The memory cannot be reduced when the ShadowImage, SnapShot, TrueCopy, or TCE function is validated. Make the reduction after invalidating the function.

Table 2.2 Characteristics of FC Drive and SATA Drive

Items	SATA Drive		FC Drive
	ATE250R/ATE400R	Others	
Drives presumed operation environment	The Read/Write access takes 330 hours/month or less on the average.	The Read/Write access takes 720 hours/month.	The Read/Write access takes 720 hours/month.
Drive warranty period	3 years	5 years	5 years

Table 2.3 Combination of Equipment Types that Support TrueCopy (When the Micro Program Version is More Than 0760/A)

Local side equipment type	Remote side equipment type			
	WMS100	AMS200	AMS500	AMS1000
WMS100	Available	Available	Available	Available
AMS200	Available	Available	Available	Available
AMS500	Available	Available	Available	Available
AMS1000	Available	Available	Available	Available

Table 2.4 Combination of Equipment Types that Support TrueCopy (When the Micro Program Version is Less Than 0760/A))

Local side equipment type	Remote side equipment type			
	WMS100	AMS200	AMS500	AMS1000
WMS100				
AMS200				
AMS500			Available	Available
AMS1000			Available	Available

Notes:

- The combination of the 9500V series and the WMS/AMS is not supported.
- For AMS200/WMS100 in the remote side, the micro program version of a local side subsystem must be 0760/A or later.
- The maximum capacity supported by TrueCopy can be calculated from the following formula. The single maximum capacity of TrueCopy is shown in

Table 2.5.

ShadowImage: Maximum supported capacity value of P-VOL and S-VOL (TB)

= Maximum TrueCopy single capacity
- (2 x Total S-VOL capacity of ShadowImage)
- 17 x (Total P-VOL capacity of SnapShot)

Table 2.5 Single Maximum Supported Capacity of TrueCopy (TB)

Equipment type	Mounted memory capacity	Single maximum supported capacity (TB)
WMS100	512 MB/CTL	39
	1 GB/CTL	180
AMS200	1 GB/CTL	110
	2 GB/CTL	350
AMS500	1 GB/CTL	110
	2 GB/CTL	430
	3 GB/CTL	530
	4 GB/CTL	770
AMS1000	2 GB/CTL	750
	4 GB/CTL	1,100
	6 GB/CTL	1,340
	8 GB/CTL	1,610

2.4 Command Operations

Command operations can be performed from the UNIX/PC server host using CCI software. For further information on using the Hitachi Command Control Interface, please refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

2.4.1 Paircreate Operation for TrueCopy

The paircreate operation establishes the new specified pair(s). The volumes, which will be the P-VOL and S-VOL, must be in the SMPL (simplex) state before being added to a pair.

2.4.1.1 Initial Copy Operation

The initial copy operation takes place when you create a new pair (see Figure 2.2). The initial copy operation copies all data on the P-VOL to the associated S-VOL. The P-VOL remains available to all hosts for read and write I/Os throughout the initial copy operation. Write operations performed on the P-VOL during the initial copy operation will always be duplicated to the S-VOL. The pair status changes to PAIR when the initial copy is complete.

When creating pairs, you can select the pace for the initial copy operation(s): slower, medium, and faster. The pace is divided on a scale of 1 to 15. The default value is 3. However, for optimum results, set the maximum value of 15. For details, see section 4.1.

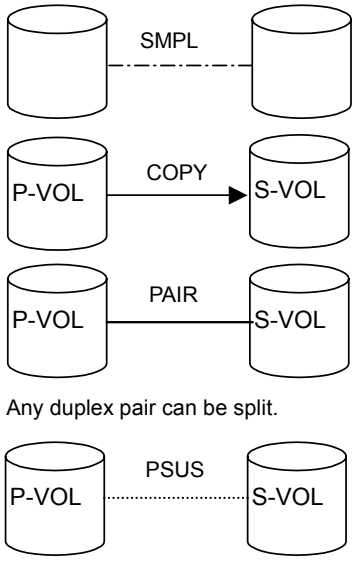


Figure 2.2 Adding a TrueCopy Pair

2.4.2 Pairsplit Operation for TrueCopy

The pairsplit operation suspends all pending S-VOL updates (those issued prior to the split command and recorded in the P-VOL track map) to make the S-VOL identical to the state of the P-VOL when the split command was issued; it then provides full read/write access to the split S-VOL. You can split existing pairs as needed; you can also use the pairsplit operation to create and split pairs in one step.

When the split operation is complete, the pair status changes to PSUS, and you have full read/write access to the split S-VOL. While the pair is split, the TagmaStore establishes a track map for the split P-VOL and S-VOL and records all updates to both volumes. The P-VOL remains fully accessible during the pairsplit operation. For details on the pairsplit operation, see section 4.2.

2.4.3 Pairresync Operations for TrueCopy (Normal, Swap)

The pairresync operation resynchronizes the split pairs (PSUS) or the suspended pairs (PSUE). When the pairresync operation starts, the pair status changes to COPY. The pair status changes to PAIR when the pairresync operation completes.

TrueCopy allows you to perform two types of pairresync operations:

- **Normal.** The normal pairresync operation (see Figure 2.3) resynchronizes the S-VOL with the P-VOL. The copy direction for a normal pairresync operation is P-VOL to S-VOL. The pair status during a normal resync operation is COPY. The S-VOL becomes inaccessible to all hosts for write operation, and the P-VOL remains accessible to all hosts for both read and write operations during a normal pairresync. The normal pairresync operation can be executed for pairs with PSUS and PSUE status.
- **Swap.** The pairresync (-swaps/-swapp) operation (see Figure 2.4) swaps the P-VOL for the S-VOL. The copy direction for a pairresync operation is S-VOL to P-VOL. The pair status during a pairresync (-swaps/-swapp) operation is COPY, and the S-VOL becomes inaccessible to all hosts for write operations during a pairresync (-swaps/-swapp) operation. The P-VOL remains accessible for both read and write operations, and the write operation on P-VOL will always be reflected to S-VOL.

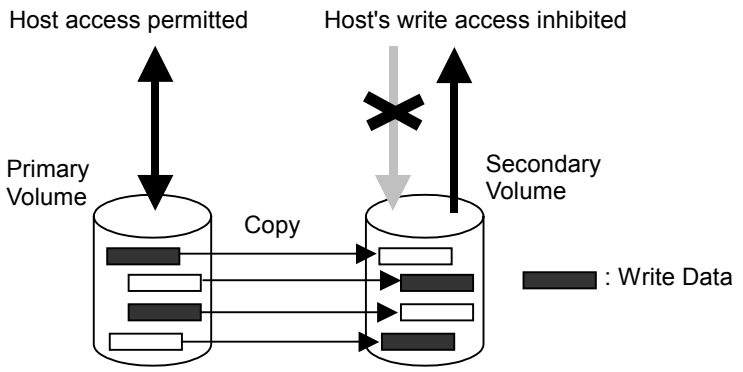


Figure 2.3 Normal Pairresync Operation

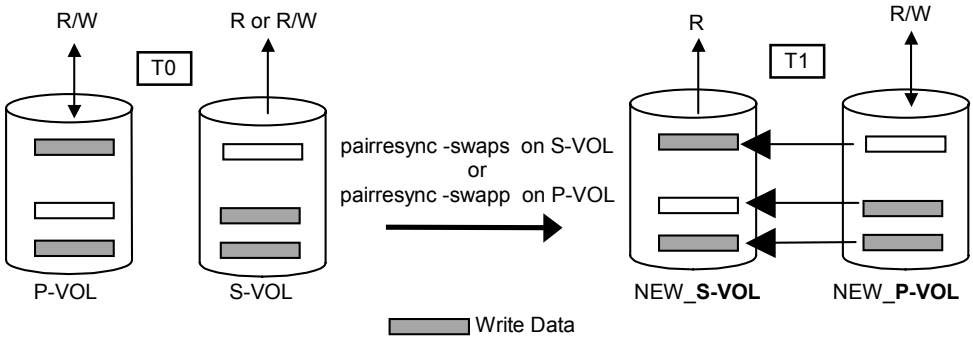


Figure 2.4 Swap Operation

TrueCopy allows you to perform pairresync operations on split and suspended pairs.

- **Pairresync for split pair.** When pairresync operation is performed on a split pair (status = PSUS), the subsystem merges the S-VOL track map into the P-VOL track map and then copies all flagged data from the P-VOL to the S-VOL.
- **Pairresync for suspended pair.** When a pairresync operation is performed on a suspended pair (status = PSUE), the subsystem copies all data on the P-VOL to the S-VOL, since all P-VOL data were flagged as differential data when the pair was suspended. The pairresync operation takes as long as the TrueCopy initial copy operation. For details on the pairresync operation, see section 4.3.

2.4.4 Pairsplit –R Operation for TrueCopy

The TrueCopy pairsplit –R operation suspends the TrueCopy copy operations to the S-VOL of the pair. A TrueCopy pair can be suspended by the user at any time.

The TagmaStore subsystem will automatically suspend a TrueCopy pair when it cannot keep the pair mirrored for any reason. When the TagmaStore subsystem suspends a pair, a file is output to system log or event log to notify the host. The TagmaStore subsystem will automatically suspend a pair under the following conditions:

- When the TrueCopy volume pair has been suspended or deleted from the UNIX/PC server host using the Hitachi Command Control Interface (CCI),
- When the TagmaStore subsystem detects an error condition related to a copy operation. When a volume pair with COPY status is suspended, the TagmaStore subsystem aborts the copy operation, changes the status of the P-VOL and S-VOL to PSUE, and accepts all subsequent Read/Write I/Os to the P-VOL. An exception to this includes when "data" is specified in the fence level and the LU is impossible to access (for example, an LU blockage).

2.4.5 PairSplit –S Operation for TrueCopy

The **pairsplit -S** operation stops the copy operations to the S-VOL of the pair and releases the volume in paired status. A pair can be released by the user at any time except during the pairsplit operation (i.e., any status except SMPL). TrueCopy volume status changes to SMPL for both.

2.5 Pair Status

2.5.1 TrueCopy Pair Status

TrueCopy displays the pair status of all TrueCopy volumes (LUs). Figure 2.5 illustrates the TrueCopy pair status transitions and the relationship between the pair status and the TrueCopy operations.

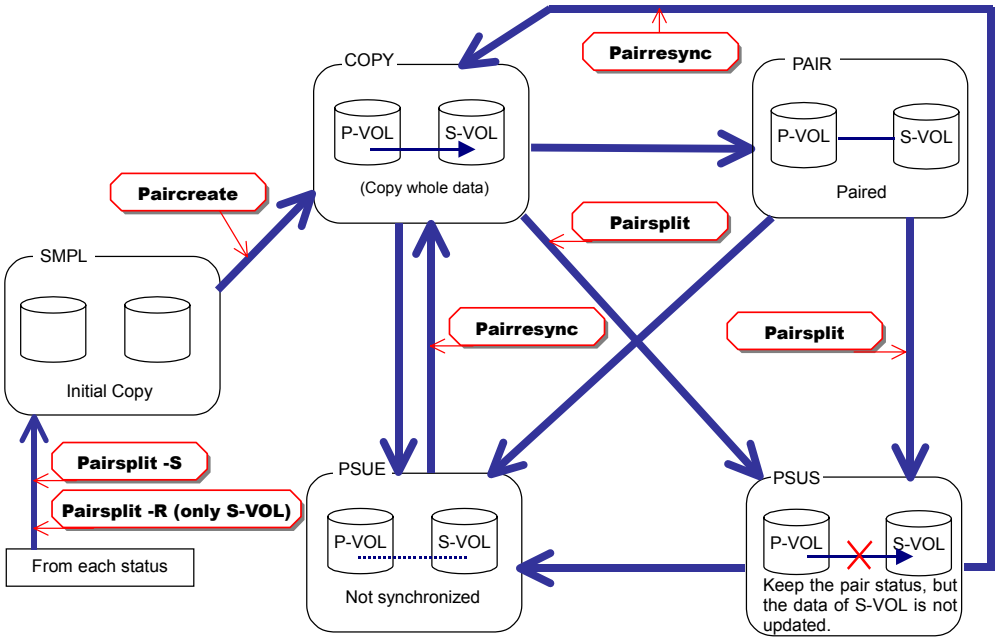


Figure 2.5 TrueCopy Pair Status Transitions

Table 2.6 lists and describes the TrueCopy pair status conditions. If a volume is not assigned to a TrueCopy pair, its status is SMPL. When you create a TrueCopy pair, the status of the P-VOL and S-VOL changes to COPY. When the copy operation is complete, the pair status becomes PAIR. If the TagmaStore cannot maintain PAIR status for any reason, or if you suspend the pair (pairsplit -E), the pair status changes to PSUE. When the pairsplit operation is complete, the pair status changes to PSUS to enable you to access the split S-VOL. When you start a pairresync operation, the pair status changes to COPY. When the pairresync operation is complete, the pair status changes to PAIR. When you release a pair (pairsplit -S or -R), the pair status changes to SMPL.

Table 2.6 TrueCopy Pair Status Conditions

Pair Status	Description	P-VOL Access	S-VOL Access
SMPL	The volume is not assigned to the pair. The subsystem accepts read and write operations for all SMPL volumes.	Read: Available Write: Available	Read: Available Write: Available
COPY	The copy operation is in progress. The subsystem continues to accept read and write operations for P-VOL and the read operation for S-VOL. The subsystem, however, rejects the write operation for S-VOL.	Read: Available Write: Available	Read: Available Mount operation is disabled Write: Not available
PAIR	The copy operation is complete. P-VOL and S-VOL are still paired. The subsystem accepts the read and write operation for P-VOL and the operation for S-VOL. The subsystem, however, rejects the write operation for S-VOL.	Read: Available Write: Available	Read: Available Mount operation is disabled Write: Not available
PSUS (SSUS)	The copy operation is suspended. The subsystem starts accepting write operations for P-VOL and S-VOL. When the pair is resynchronized, the subsystem executes the differential data copying from P-VOL to S-VOL.	Read: Available Write: Available	Read: Available Write: Available
PSUE	A failure occurred and the copy operation is suspended forcibly. The subsystem rejects the acceptance of write operation for a PSUE (suspended) P-VOL when the fence level is “data” (however, it also rejects the acceptance of read operation when the PSUE Read Reject Mode is valid). The subsystem continues accepting read and write I/Os, except when “never” is specified in the fence level* and the LU is impossible to access (for example, the LU blockage). The subsystem accepts the read operation for S-VOL, but rejects the write operation. When the pair is resynchronized, the subsystem executes copying whole data of LU or the differential data from P-VOL to S-VOL.	Read: Available/ Not available Write: Available/ Not Available	Read: Available Write: Not available

2.6 TrueCopy Operations

TrueCopy operations for setting the path can be performed from the host with the Navigator. For more detailed information on the Navigator, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Storage Navigator Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711).

Paircreate can be performed from the host using RAID Manager (CCI). For further information on using the Hitachi Command Control Interface, please refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

2.6.1 Setting the Path

2.6.1.1 Path

TrueCopy operations can be performed between the subsystems that are connected by a Fibre Channel Interface. A route called a "path" connects the port from the local subsystem that executes the volume replication to the port on the remote subsystem.

The local and remote ports of the subsystem are specified using the Navigator. Only one path can be specified per controller. Since the subsystem requires a dual controller, two paths must be set.

2.6.1.2 Alternative Path

Two paths must be set to avoid stopping (suspending) the copy operation due to a single point malfunction in the path. A single path for each controller on the local and remote subsystem must be set and a duplex path for each pair is allocated.

To avoid malfunction, the path can be automatically switched from the main path to the alternative path from the local subsystem.

In Figure 2.6, if the path-1 is blocked while copying with path-1, the path can be automatically switched from path-1 to path-2.

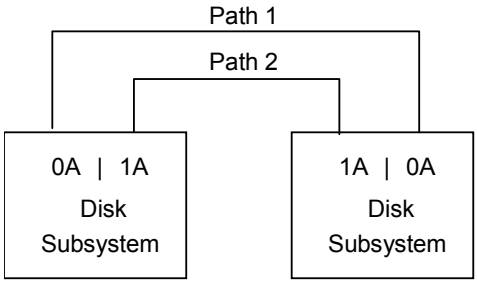


Figure 2.6 Switching the Paths

2.6.1.3 Confirming the Path Condition

TrueCopy supports a function that periodically issues commands between the subsystems and monitors the path status. When a path status is blocked due to path malfunction, its status will be reported from the LED or from the Web interface (no status is reported for temporary command error). The user can also confirm the path status any time by using the Web interface.

2.6.2 Port Connection and Topology

The subsystem supports direct or switch connection only. Hub connection is not supported. Like the Switch-Hub subsystem, a connection via Hub is not supported even if the connection is FL-Port of Fabric (switch).

For topology, please refer to Table 2.7.

Table 2.7 Supported Topology

#	Port Connection	Topology		Local	Remote
1	Direct	Point to Point		Not available	Not available
2		Loop		Available	Available
3	HUB	Loop		Not available	Not available
4	Switch	Point to Point	F-Port	Available	Available
5		Loop	FL-Port	Available	Available

2.7 Concurrent Use of LUN Size Expansion

2.7.1 Concurrent Use with TrueCopy and LUN Size Expansion

In TrueCopy, a unified LU can be used as a P-VOL or an S-VOL.

Preconditions and restrictions of concurrent use with TrueCopy and LUN Expansion are as follows:

- Capacities of the P-VOL and the S-VOL
  - Capacities of the P-VOL and S-VOL must be the same. The P-VOL and S-VOL can be paired as long as their capacities are the same even if numbers of LUs composing them (unified LUs) are different from each other.

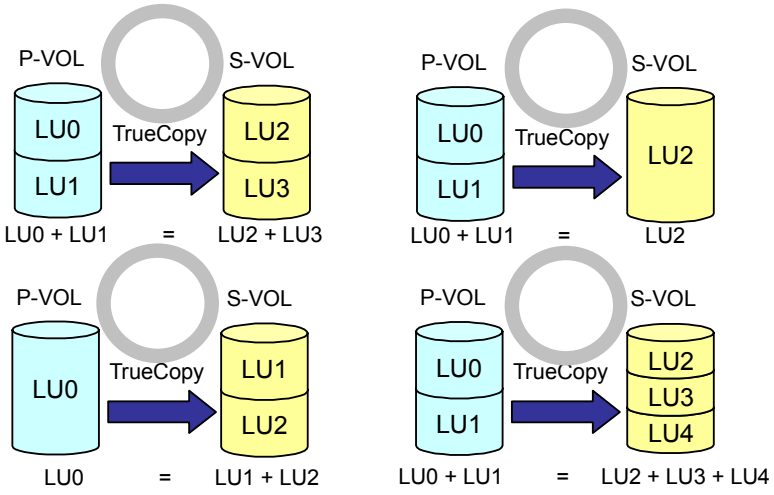


Figure 2.7 Example: Unified LU Assigned to P-VOL or S-VOL

  - A unified LU composed of 17 or more LUs cannot be assigned to the P-VOL or S-VOL.

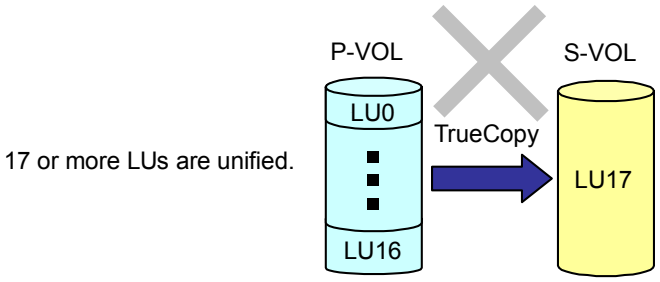


Figure 2.8 Example: A Restriction Placed on LUs Composing a Unified LU

- RAID levels of the P-VOL and the S-VOL
  - All the LUs including the unified LU(s) assigned to the P-VOL and S-VOL do not have to be on the same RAID level and have the same number of data disks.

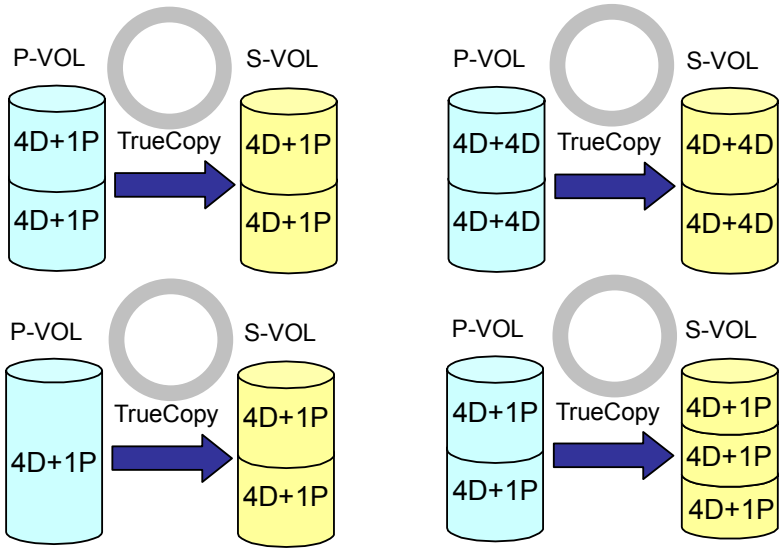


Figure 2.9 Example: Combination of RAID Levels (TrueCopy)

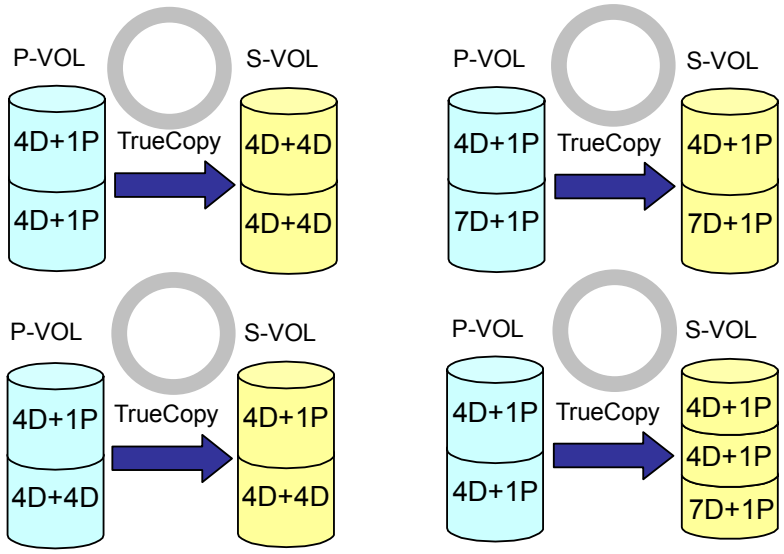


Figure 2.10 Example: Combination of RAID Levels (TrueCopy)

- Others
  - A P-VOL or an S-VOL belonging to a TrueCopy pair cannot be used to compose a unified LU. Unify it after splitting the pair once.
  - An LU with an FC drive and an LU with a SATA drive cannot be unified. Unify LUs that contain drives of the same type.

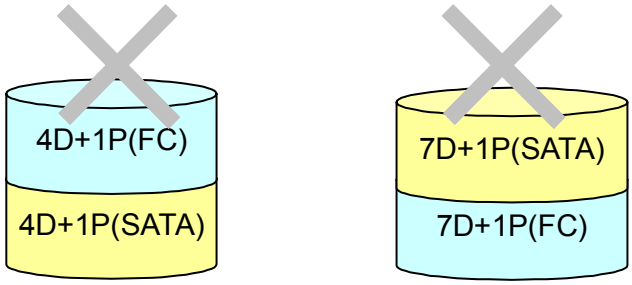


Figure 2.11 Example: Restriction on Unification of LUs with Mixed Drives (TrueCopy)

2.8 Cascade Configurations

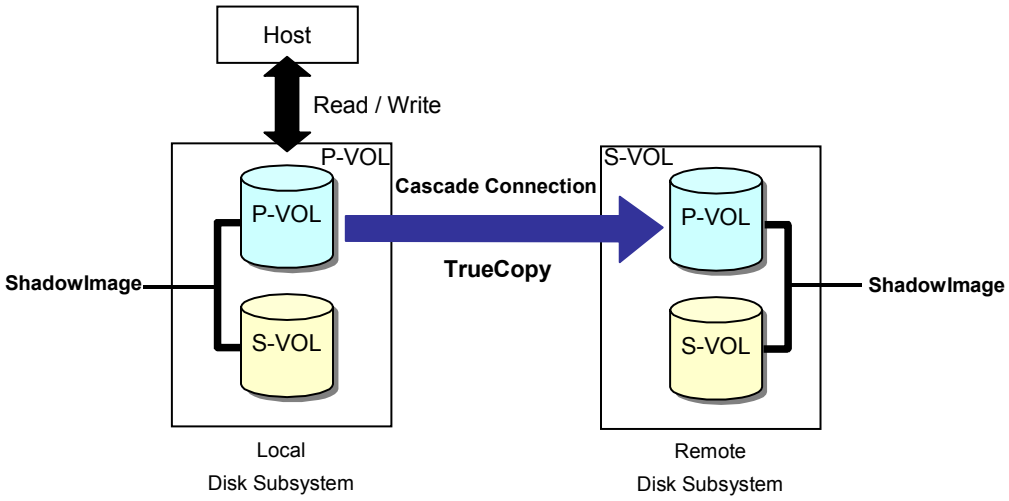
The following cascade configurations are discussed in this section:

- Cascading TrueCopy with ShadowImage
- Cascading TrueCopy with SnapShot

2.8.1 Cascading TrueCopy with ShadowImage

TrueCopy volumes can be cascaded with those of ShadowImage, as shown in Figure 2.12. TrueCopy does not always need ShadowImage.

- Cascade with a P-VOL of ShadowImage



- Cascade with a S-VOL of ShadowImage

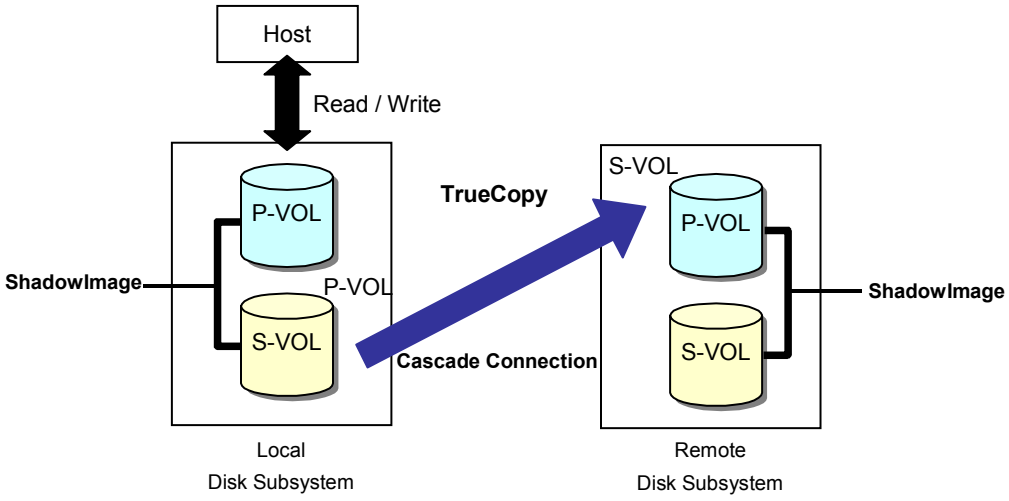
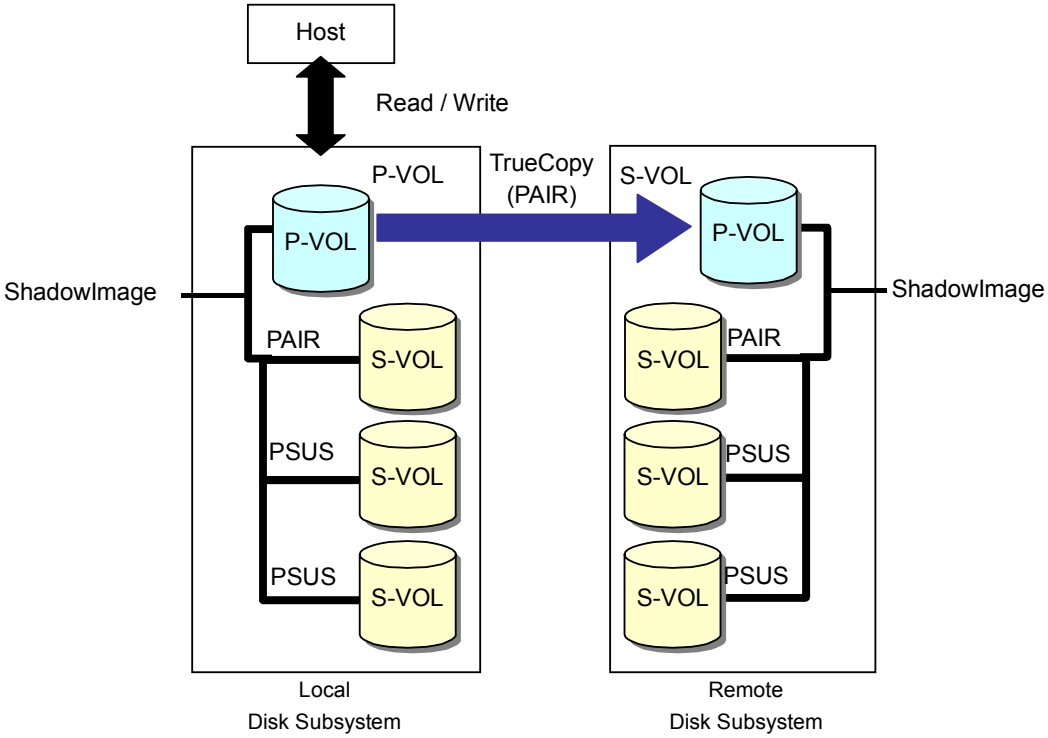


Figure 2.12 Cascade Connection of TrueCopy with ShadowImage (P-VOL: S-VOL=1: 1)

■ Cascade with a P-VOL of ShadowImage



■ Cascade with an S-VOL of ShadowImage

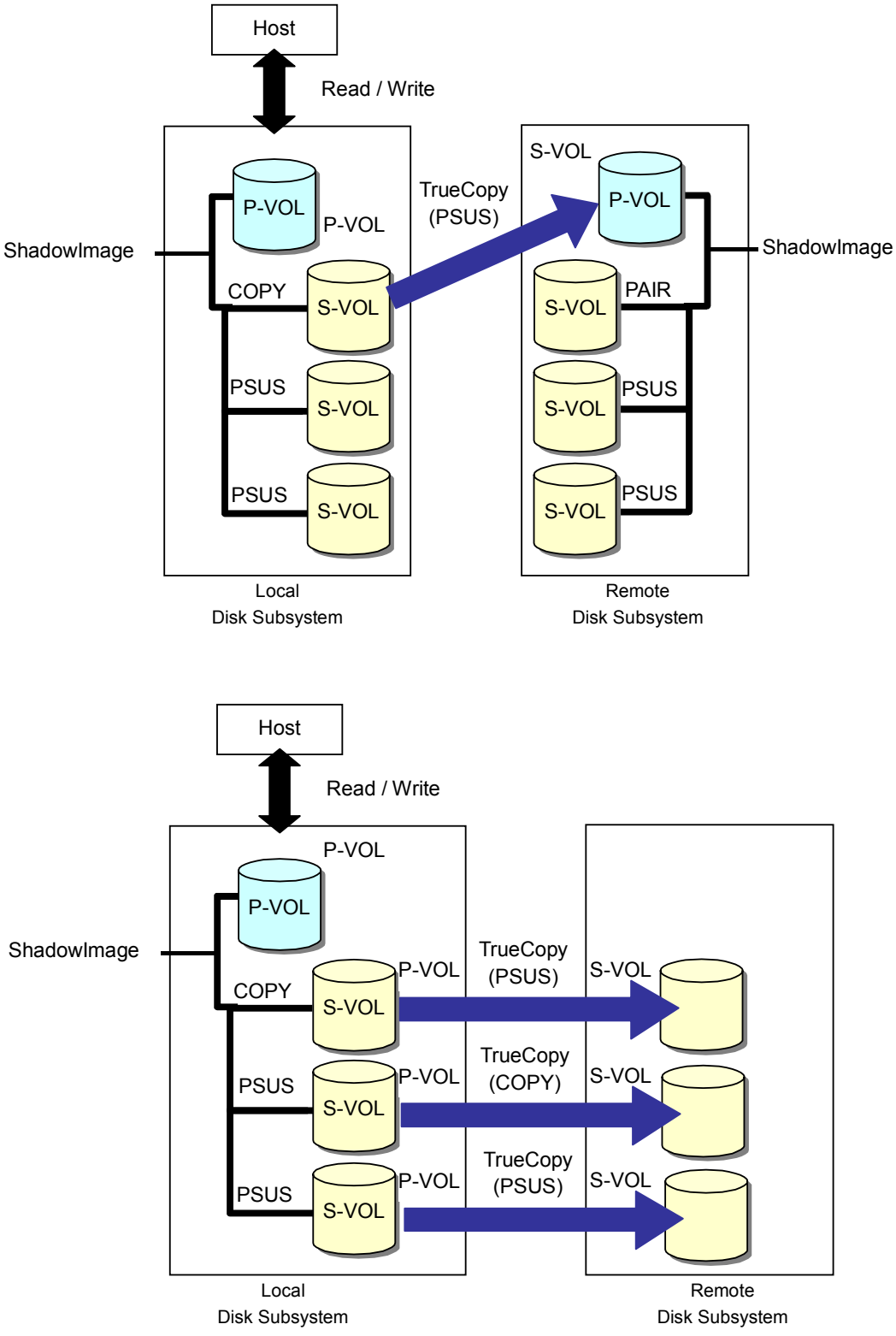


Figure 2.13 Cascade Connection of TrueCopy with ShadowImage (P-VOL: S-VOL=1: 3)

2.8.1.1 Cascading with a ShadowImage P-VOL

When both TrueCopy and ShadowImage pairs are placed in the PAIR status, performance of the host on the local side is lowered. It is best to assign a PSUS status to the TrueCopy and ShadowImage pairs at a time period in which host I/Os are frequently instructed (see Figure 2.14).

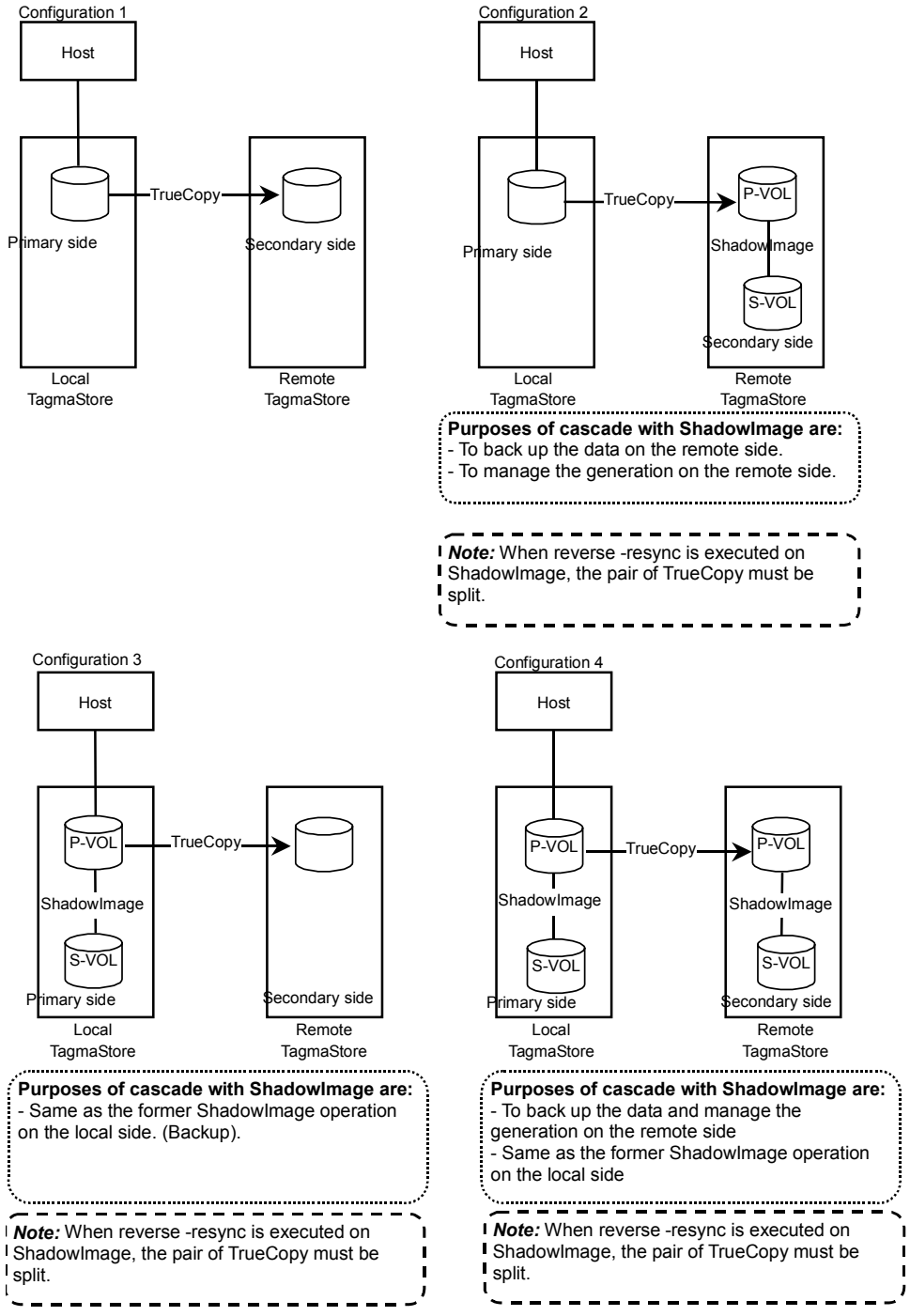


Figure 2.14 Cascading with a ShadowImage P-VOL (P-VOL: S-VOL=1: 1)

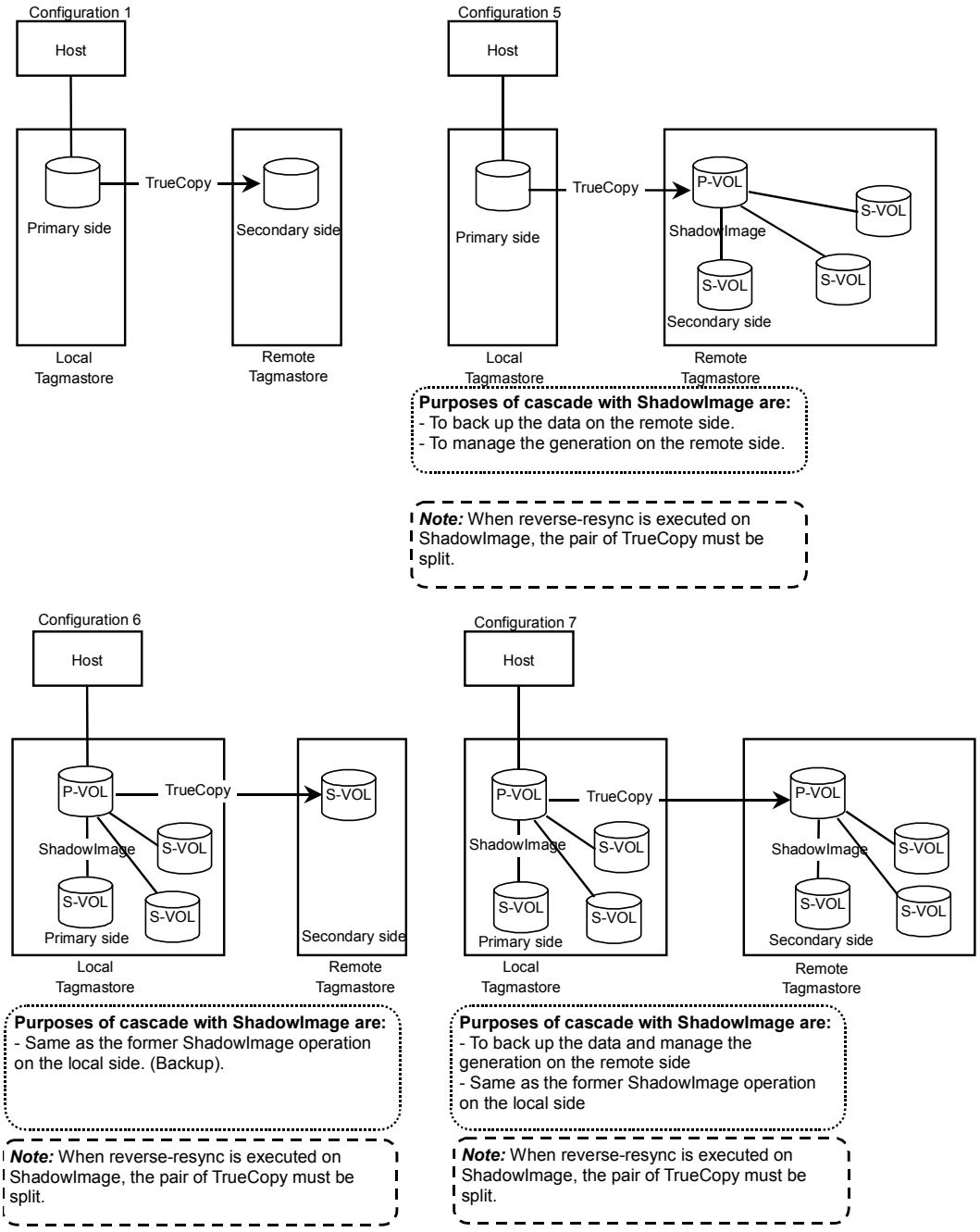


Figure 2.15 Cascading with a ShadowImage P-VOL (P-VOL: S-VOL=1: 3)

2.8.1.2 Cascading with a ShadowImage S-VOL

A cascade of a ShadowImage S-VOL is used when asynchronously performing a backup on the remote side. Because the backup is done from an S-VOL of ShadowImage to the remote side in this configuration, the lowering of performance on the local side (a P-VOL of ShadowImage) during the backup can be minimized. Note that a TrueCopy pair must be placed in the PSUS status when resynchronizing a volume of ShadowImage on the local side (see Figure 2.16).

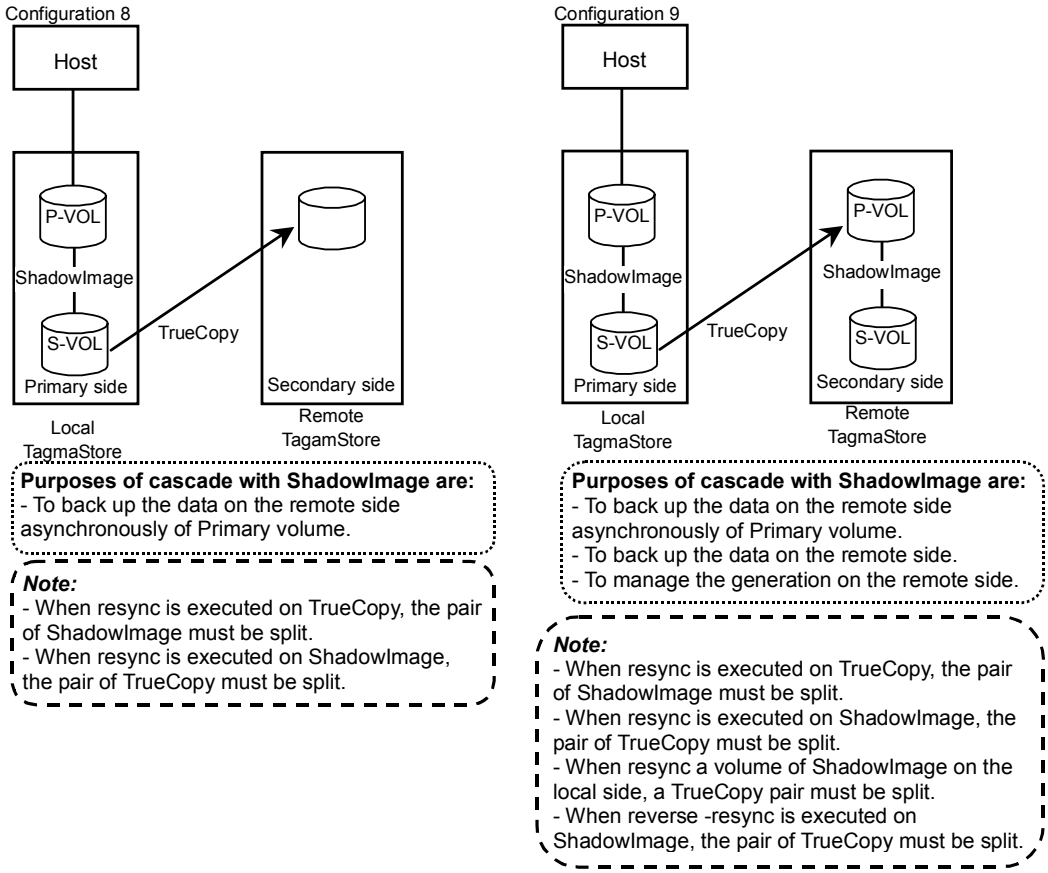


Figure 2.16 Cascading with a ShadowImage S-VOL (P-VOL: S-VOL=1: 1)

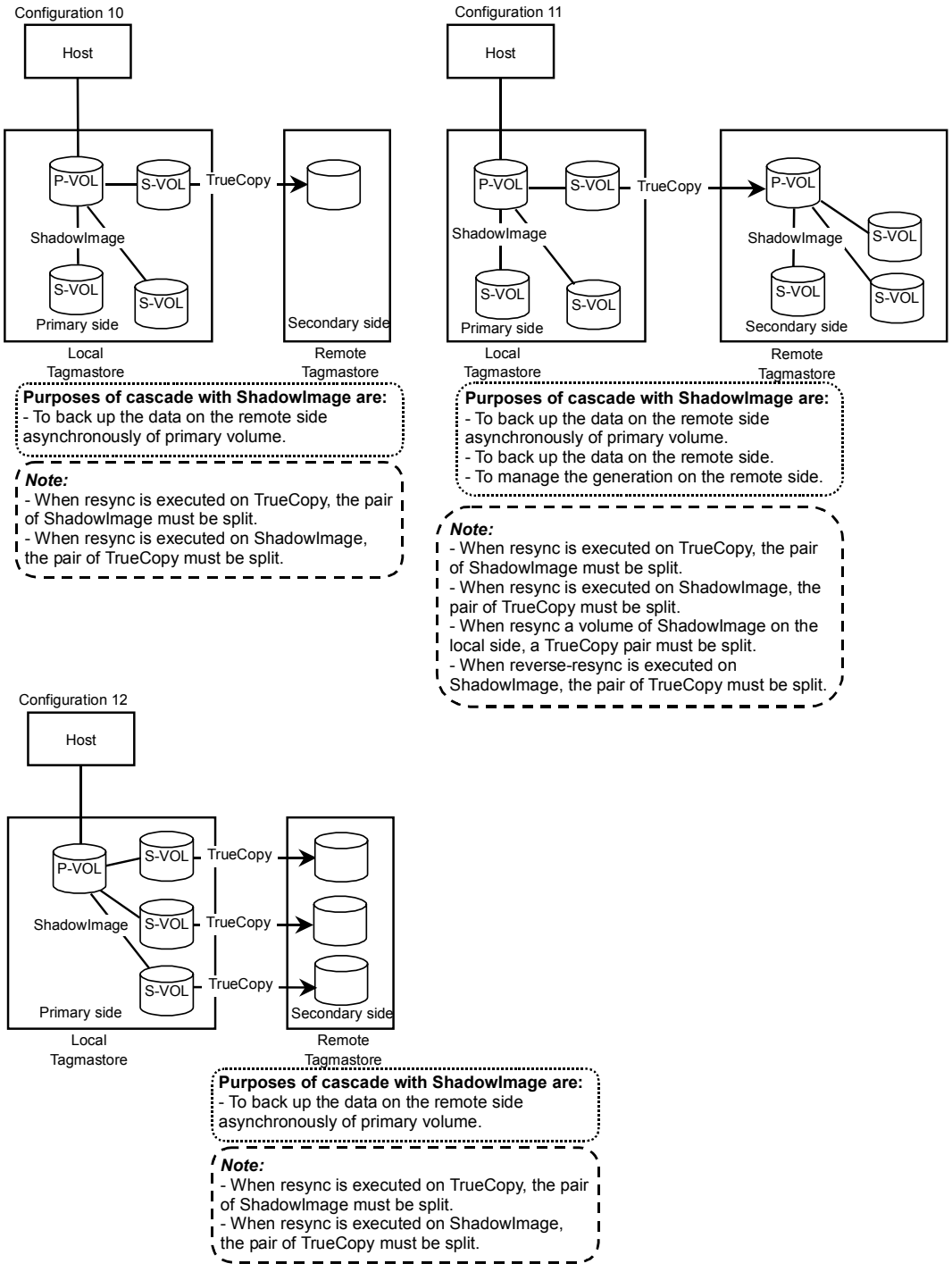


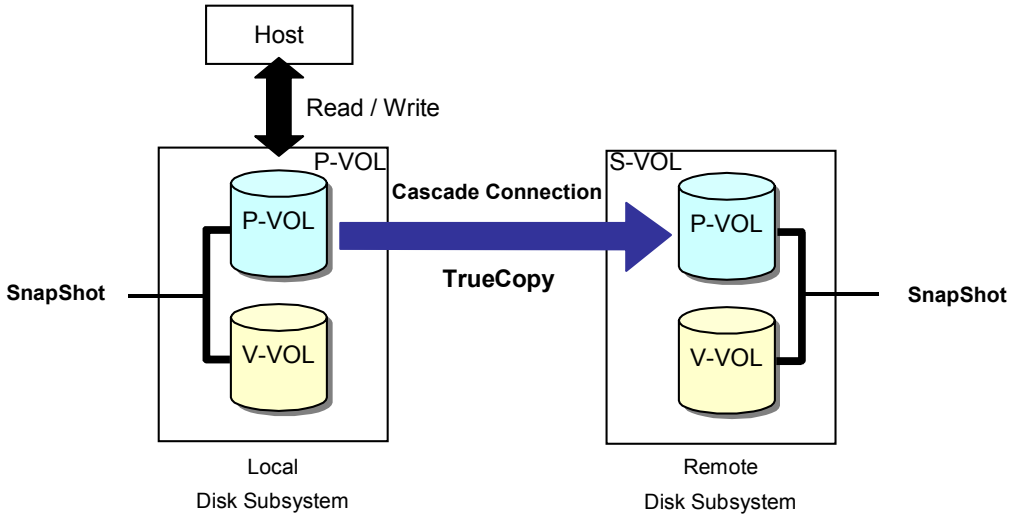
Figure 2.17 Cascading with a ShadowImage S-VOL (P-VOL: S-VOL=1: 3)

2.8.2 Cascading TrueCopy with SnapShot

Because TrueCopy volumes can be cascaded with those of SnapShot as shown in the following figure. Because cascading SnapShot with TrueCopy lowers performance, use it only when it is necessary (see Figure 2.18).

Note: SnapShot cannot be cascaded with ShadowImage.

- Cascade with a P-VOL of SnapShot



- Cascade with a V-VOL of SnapShot

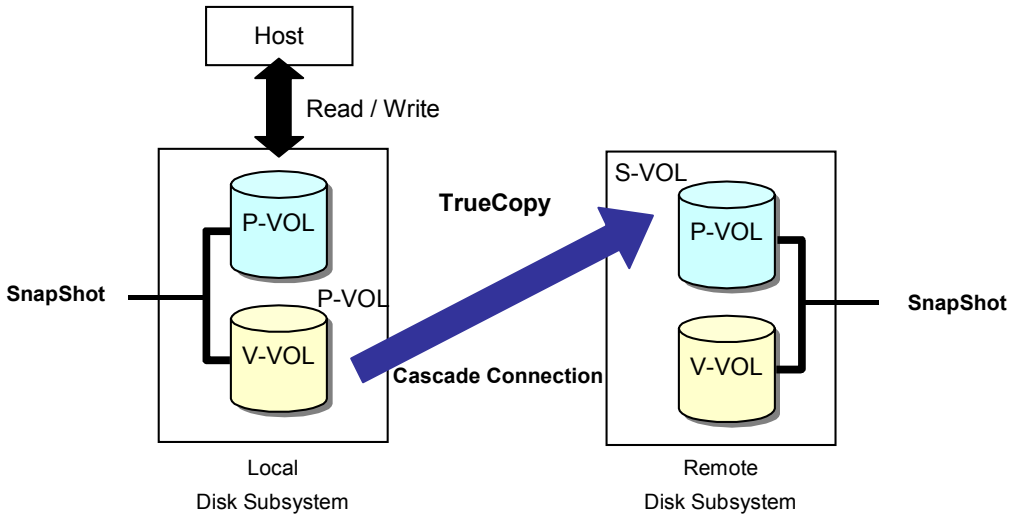


Figure 2.18 Cascade Connection of TrueCopy with SnapShot

2.8.2.1 Cascading with a SnapShot P-VOL

If a TrueCopy pair is placed in the PAIR status when a SnapShot pair is in the PSUS status, the performance of a host on the local side is lowered. It is best to assign a PSUS status to a TrueCopy pair in a period of time when host I/Os are frequently instructed (see Figure 2.19).

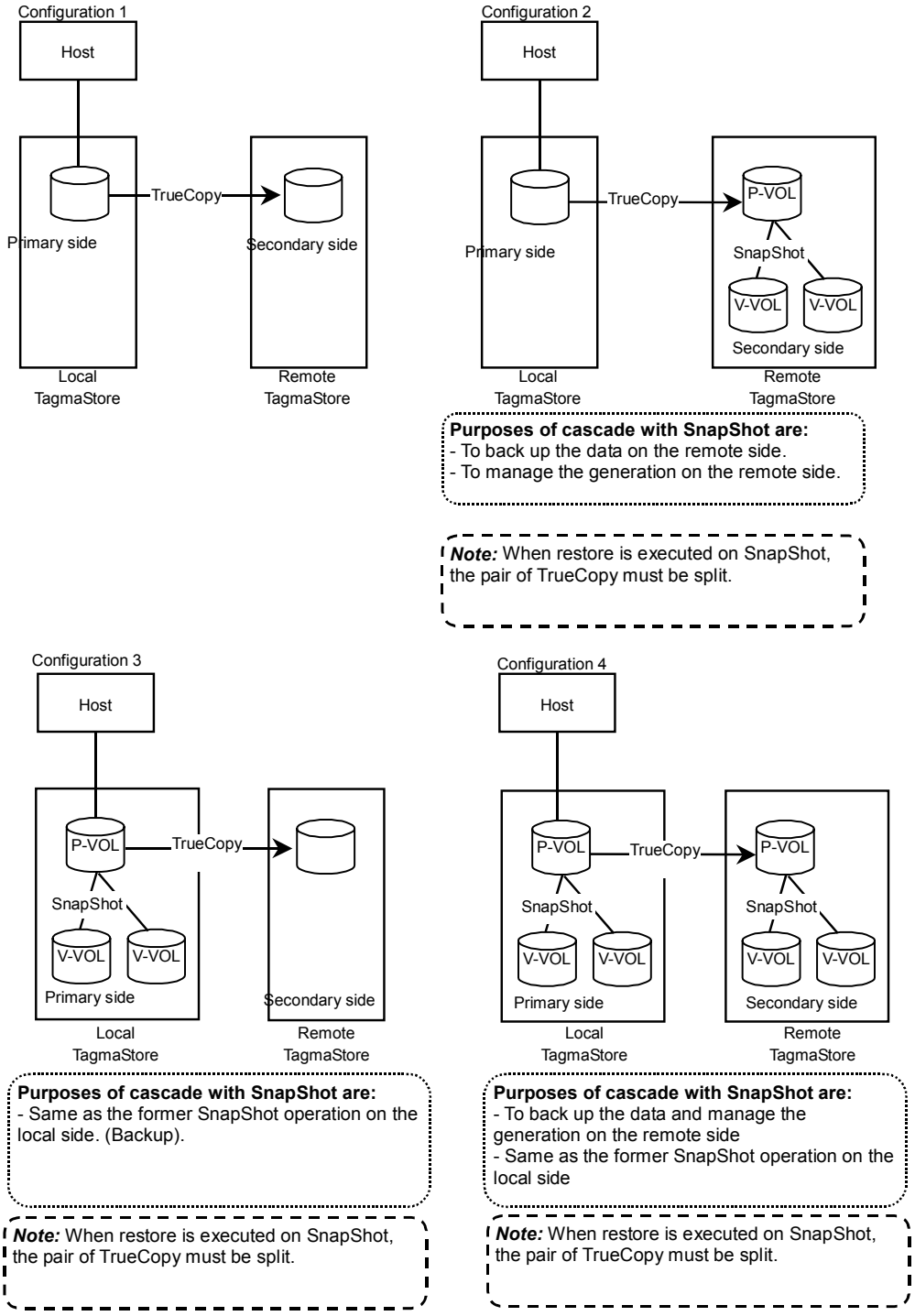


Figure 2.19 Cascading with a SnapShot P-VOL

2.8.2.2 Cascading with a SnapShot V-VOL

A cascade of a SnapShot V-VOL is used when asynchronously performing a backup on the remote side. Though the cascade of SnapShot can decrease an S-VOL (V-VOL) capacity differently from a cascade of ShadowImage, the performance on the local side (a P-VOL of SnapShot) is affected by the backup. SnapShot can make two or more V-VOLs for a P-VOL, however, what can be cascaded with TrueCopy is a single V-VOL only. Note that a TrueCopy pair must be placed in the PSUS status when resynching (giving the Snapshot instruction) a volume of SnapShot on the local side (see Figure 2.20).

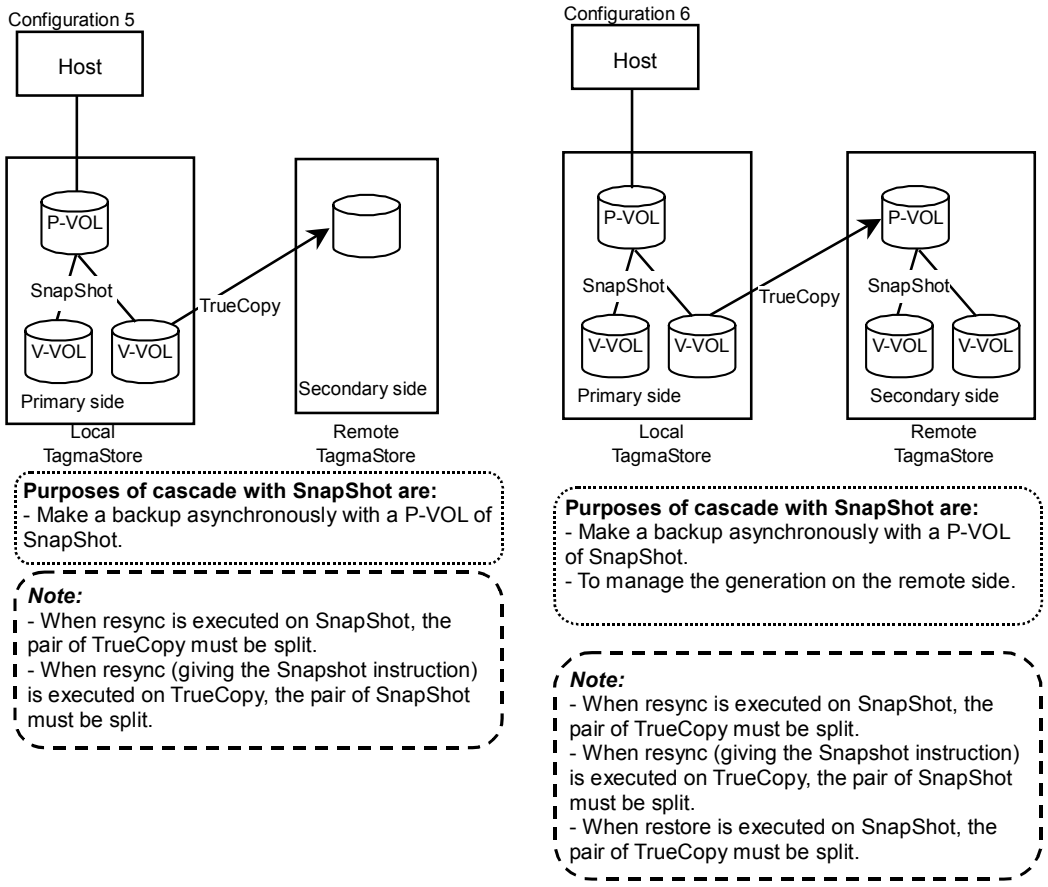


Figure 2.20 Cascading with a SnapShot V-VOL

2.9 Cascade Restrictions

The following cascade restrictions are discussed in this section:

- Cascade Restrictions between TrueCopy instances
- Cascade Restrictions of TrueCopy with ShadowImage
- Cascade Restrictions of TrueCopy with SnapShot
- Cascade Restrictions for POOL of SnapShot

2.9.1 Cascade Restrictions between TrueCopy Instances

Cascade procedures cannot be performed between TrueCopy instances (see Figure 2.21).

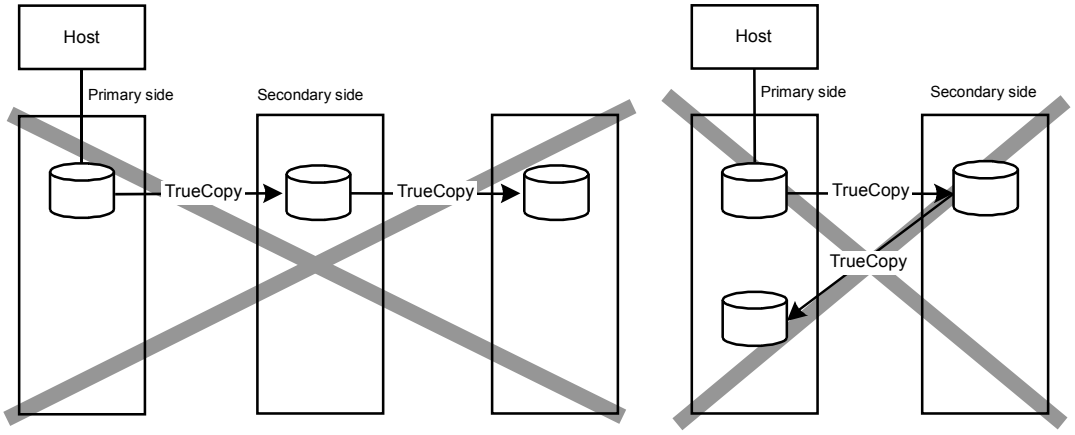


Figure 2.21 Cascade Restrictions between TrueCopy Instances

2.9.2 Cascade Restrictions of TrueCopy with ShadowImage

The following is an example of a configuration in which restrictions are placed on cascading TrueCopy with ShadowImage (see Figure 2.22).

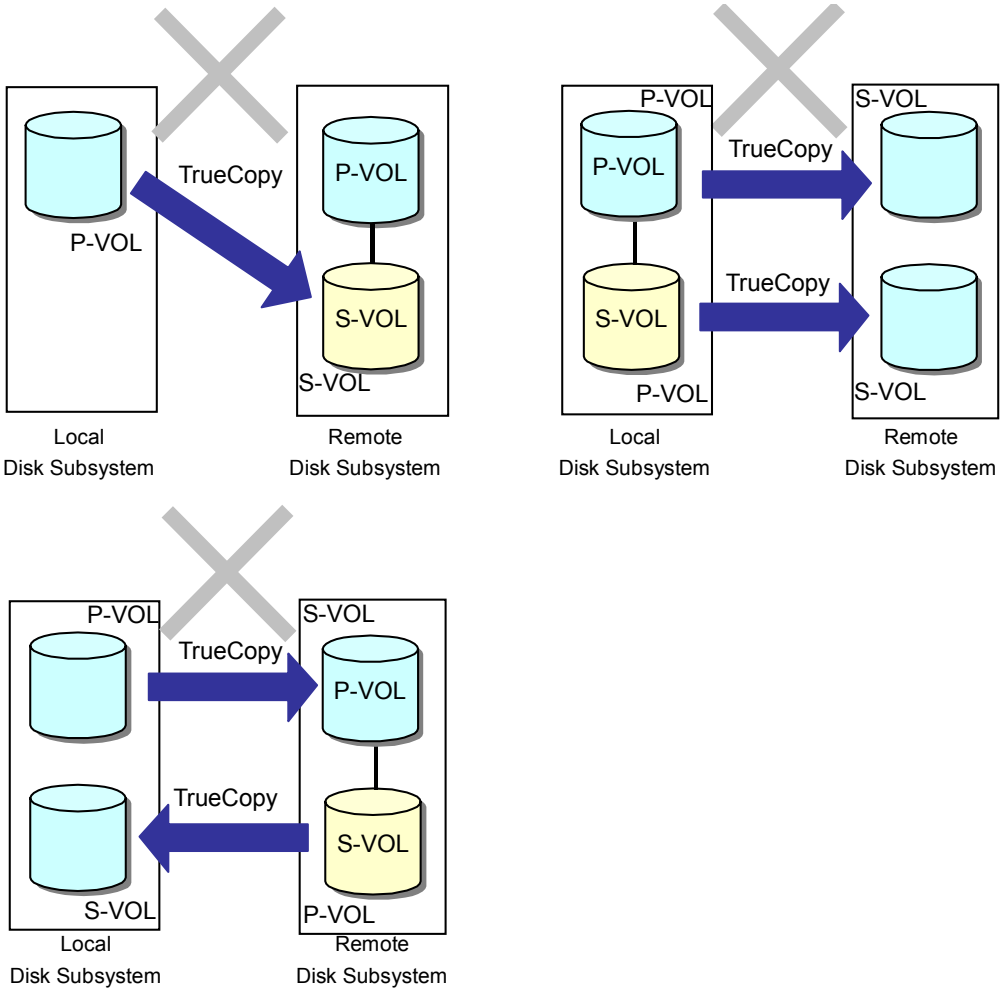


Figure 2.22 Restrictions: Cascading TrueCopy with ShadowImage

2.9.2.1 Cascade Restrictions for a ShadowImage P-VOL

When using TrueCopy, if the P-VOL on ShadowImage is cascaded, due to reverse-resync being executed by ShadowImage, the data of the P-VOL on the local side might not equal the data of P-VOL on the remote side. To avoid this, a restriction is provided on TrueCopy that enables reverse-resync using ShadowImage to only be executed in PSUS status.

When reverse-resync using ShadowImage is executed, TrueCopy must have a PSUS status. If reverse-resync using ShadowImage is executed in COPY status or PAIR status of TrueCopy, the data in the LUs for P-VOL that are cascaded using TrueCopy on the local side and the remote side cannot be assured of equality.

- LU Shared with P-VOL on ShadowImage and P-VOL on TrueCopy

  Table 2.8 displays whether or not a read/write from/to a P-VOL of ShadowImage on the local side is possible when a P-VOL of ShadowImage and a P-VOL of TrueCopy are the same LU.

Table 2.8 A Read/Write Instruction to a P-VOL of ShadowImage on the Local Side

		ShadowImage P-VOL						
		PAIR	COPY	RCPY		PSUS	PSUE	PSUE (Reverse resync)
				R/W	W			
TrueCopy P-VOL	PAIR	○ R/W	○ R/W	x	x	○ R/W	○ R/W	x
	COPY	○ R/W	○ R/W	x	x	○ R/W	○ R/W	x
	PSUS R/W	○ R/W	○ R/W	○ R/W	○ W	○ R/W	○ R/W	Δ ~~R/W~~
	PSUS R	○ R	○ R	x	x	○ R	○ R	x
	PSUE R/W	○ R/W	○ R/W	Δ R/W	Δ W	○ R/W	Δ R/W	Δ ~~R/W~~
	PSUE R	○ R	○ R	x	x	○ R	Δ R	x
	PSUE ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	x	x	○ ~~R/W~~	Δ ~~R/W~~	x

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note 1: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

Note 2: When one P-VOL configures a pair with one or more S-VOLs, decide which item is applied as the pair status of the P-VOL of the above-mentioned ShadowImage with the following procedure. ① If all the pairs that the P-VOL concerned configures are in the PSUS status, the item of PSUS is applied. ② If all the pairs that the P-VOL concerned configures are in the PSUS status or the PSUE status, the item of PSUS is applied. However, when including the pair that became PSUE during the reverse resynchronization, the items of PSUE(R) are applied. ③ If a pair in the PAIR status, the COPY status, or the RCPY status is included in the pair that the P-VOL concerned configures, the item of PAIR, COPY, and RCPY is applied, respectively. (Two or more pairs in the PAIR status, the COPY status, and the RCPY status are never included in the pair that the P-VOL concerned configures.)

- One LU is used for P-VOL on ShadowImage and S-VOL on TrueCopy

  Table 2.9 displays whether or not a read/write from/to a P-VOL of ShadowImage on the remote side is possible when a P-VOL of ShadowImage and an S-VOL of TrueCopy are the same LU.

Table 2.9 A Read/Write Instruction to a P-VOL of ShadowImage on the Remote Side

		ShadowImage P-VOL						
		PAIR	COPY	RCPY		PSUS	PSUE	PSUE (Reverse resync)
				R/W	W			
TrueCopy S-VOL	PAIR	○ R	○ R	x	x	○ R	○ R	x
	COPY	○ R	○ R	x	x	○ R	○ R	x
	PSUS R/W	○ R/W	○ R/W	○ R/W	○ W	○ R/W	○ R/W	Δ ~~R/W~~
	PSUS R	○ R	○ R	x	x	○ R	○ R	x
	PSUE	○ R	○ R	x	x	○ R	Δ R	x

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note 1: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

Note 2: When one P-VOL configures a pair with one or more S-VOLs, decide which item is applied as the pair status of the P-VOL of the above-mentioned ShadowImage with the following procedure. ① If all the pairs that the P-VOL concerned configures are in the PSUS status, the item of PSUS is applied. ② If all the pairs that the P-VOL concerned configures are in the PSUS status or the PSUE status, the item of PSUS is applied. However, when including the pair that became PSUE during the reverse resynchronization, the items of PSUE(R) are applied. ③ If a pair in the PAIR status, the COPY status, or the RCPY status is included in the pair that the P-VOL concerned configures, the item of PAIR, COPY, and RCPY is applied, respectively. (Two or more pairs in the PAIR status, the COPY status, and the RCPY status are never included in the pair that the P-VOL concerned configures.)

2.9.2.2 Cascade Restrictions for a ShadowImage S-VOL

Cascading for an LU of TrueCopy with an S-VOL of ShadowImage is supported only when the S-VOL of ShadowImage and a P-VOL of TrueCopy are the same LU. Operations of ShadowImage and TrueCopy pairs are restricted, depending on statuses of the pairs.

When cascading volumes of TrueCopy with an S-VOL of ShadowImage, a ShadowImage pair is created first. When a TrueCopy pair is created earlier, split the TrueCopy pair once and create a pair using ShadowImage.

When changing the status of a ShadowImage pair, the status of a TrueCopy pair must be PSUS or PSUE. When changing the status of a TrueCopy pair, the status of a ShadowImage pair must be PSUS.

Table 2.10 displays whether or not a read/write from/to an S-VOL of ShadowImage on the local side is possible when an S-VOL of ShadowImage and a P-VOL of TrueCopy are the same LU.

Table 2.10 A Read/Write Instruction to an S-VOL of ShadowImage on the Local Side

		ShadowImage S-VOL					
		PAIR	**COPY**	**RCPY**	**PSUS**	**PSUE**	**PSUE (Reverse resync)**
TrueCopy P-VOL	**PAIR**	x	x	x	○ R/W	x	x
	COPY	x	x	x	○ R/W	x	x
	PSUS R/W	○ R	○ R	○ R	○ R/W	Δ R	Δ ~~R/W~~
	PSUS R	○ R	○ R	○ R	○ R	Δ R	Δ ~~R/W~~
	PSUE R/W	○ R	○ R	○ R	○ R/W	Δ R	Δ ~~R/W~~
	PSUE R	○ R	○ R	○ R	○ R	Δ R	Δ ~~R/W~~
	PSUE ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	Δ ~~R/W~~	Δ ~~R/W~~

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

2.9.3 Cascade Restrictions for TrueCopy with SnapShot

The following is an example of a configuration in which restrictions are placed on cascading TrueCopy with SnapShot.

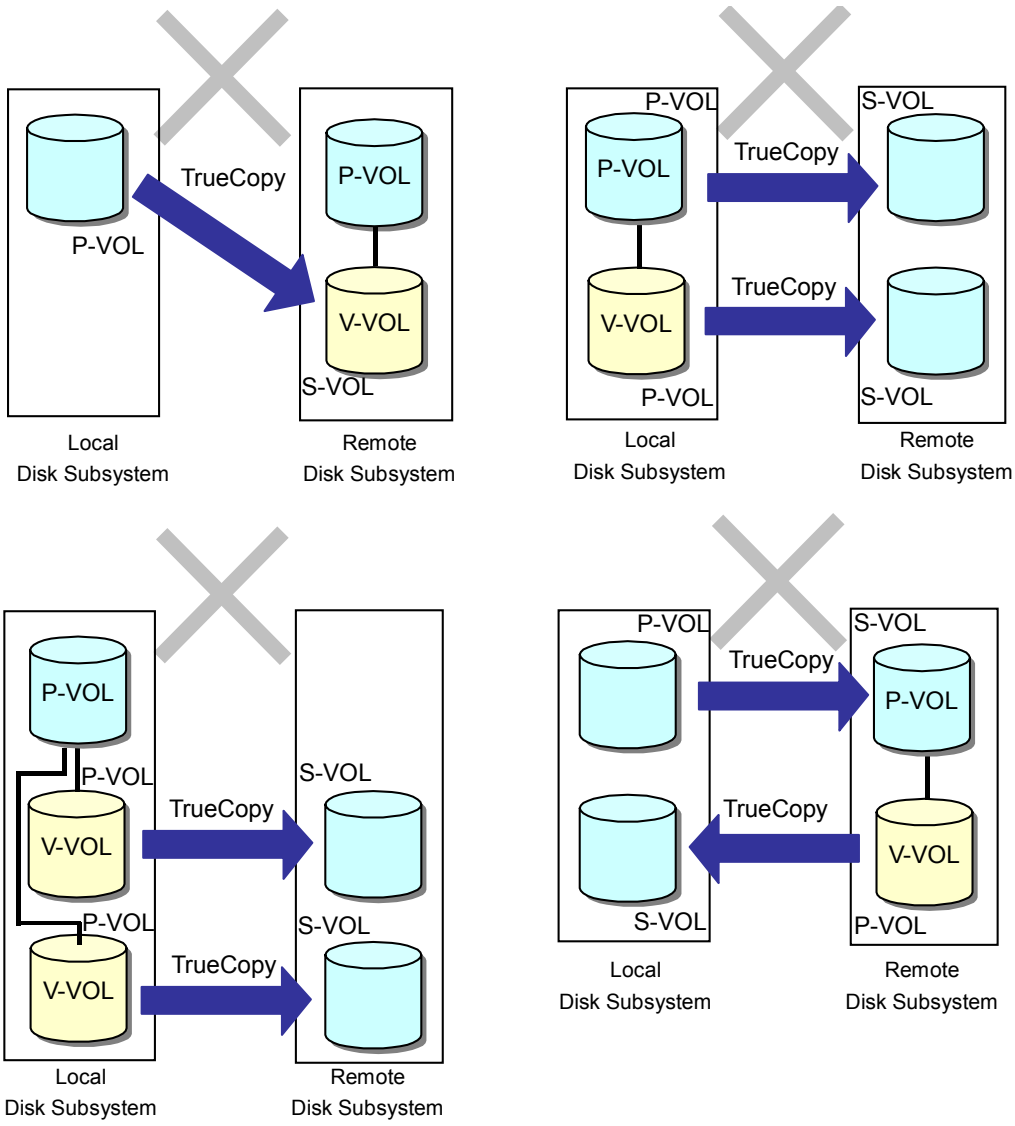


Figure 2.23 Restrictions for the Cascade Configuration of TrueCopy with SnapShot

2.9.3.1 Cascade Restrictions for a SnapShot P-VOL

When -restore is executed while using SnapShot, the status of TrueCopy must be PSUS. If –restore is executed while using SnapShot and the status of TrueCopy is COPY or PAIR, the data in the LUs for P-VOL that are cascaded using TrueCopy on the local side and the remote side cannot be assured of equality.

- LU Shared with P-VOL on SnapShot and P-VOL on TrueCopy

  Table 2.11 displays whether or not a read/write from/to a P-VOL of SnapShot on the local side is possible when a P-VOL of SnapShot and a P-VOL of TrueCopy are the same LU.

Table 2.11 A Read/Write Instruction to a P-VOL of SnapShot on the Local Side

		SnapShot P-VOL				
		PAIR	**RCPY**	**PSUS**	**PSUE**	**PSUE (Restore)**
TrueCopy P-VOL	**PAIR**	○ R/W	x	○ R/W	○ R/W	x
	COPY	○ R/W	x	○ R/W	○ R/W	x
	PSUS R/W	○ R/W	○ R/W	○ R/W	○ R/W	Δ ~~R/W~~
	PSUS R	○ R	x	○ R	○ R	x
	PSUE R/W	○ R/W	Δ R/W	○ R/W	Δ R/W	Δ ~~R/W~~
	PSUE R	○ R	x	○ R	Δ R	x
	PSUE ~~R/W~~	○ ~~R/W~~	x	○ ~~R/W~~	Δ ~~R/W~~	x

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

- One LU is used for P-VOL on SnapShot and S-VOL on TrueCopy

  Table 2.12 displays whether or not a read/write from/to a P-VOL of SnapShot on the remote side is possible when a P-VOL of SnapShot and an S-VOL of TrueCopy are the same LU.

Table 2.12 A Read/Write Instruction to a P-VOL of SnapShot on the Remote Side

		SnapShot P-VOL				
		PAIR	**RCPY**	**PSUS**	**PSUE**	**PSUE (Restore)**
TrueCopy S-VOL	**PAIR**	○ R	x	○ R	○ R	x
	COPY	○ R	x	○ R	○ R	x
	PSUS R/W	○ R/W	○ R/W	○ R/W	○ R/W	Δ ~~R/W~~
	PSUS R	○ R	x	○ R	○ R	x
	PSUE R	○ R	x	○ R	Δ R	x

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

- Number of SnapShot V-VOLs

  V-VOLs of up to 15 (14: less than 0750/A the micro program version) generations can be made even when the P-VOL of SnapShot is cascaded with the P-VOL and S-VOL of TrueCopy in the same way as when no cascade connection is made.

2.9.3.2 Cascade Restrictions for a SnapShot V-VOL

- Status Transitions of TrueCopy and SnapShot Pairs

  Cascading a TrueCopy LU with a SnapShot V-VOL is supported only when the SnapShot V-VOL and a TrueCopy P-VOL are the same LU. Operations including SnapShot and TrueCopy pairs are restricted, depending on the pair status.

  When cascading TrueCopy volumes with a SnapShot V-VOL, create a SnapShot pair first. If a TrueCopy pair is created earlier, split the TrueCopy pair once and create a pair using SnapShot.

  When changing the status of a SnapShot pair, the status of a TrueCopy pair must be PSUS or PSUE. When changing the status of a TrueCopy pair, the status of a SnapShot pair must be PSUS.

  Table 2.13 displays whether or not a read/write from/to a V-VOL of SnapShot on the local side is possible when a V-VOL of SnapShot and a P-VOL of TrueCopy are the same LU.

Table 2.13 A Read/Write Instruction to a V-VOL of SnapShot on the Local Side

		SnapShot V-VOL				
		PAIR	**RCPY**	**PSUS**	**PSUE**	**PSUE (Restore)**
TrueCopy P-VOL	**PAIR**	x	x	○ R/W	x	x
	COPY	x	x	○ R/W	x	x
	PSUS R/W	○ ~~R/W~~	○ ~~R/W~~	○ R/W	Δ ~~R/W~~	Δ ~~R/W~~
	PSUS R	○ ~~R/W~~	○ ~~R/W~~	○ R	Δ ~~R/W~~	Δ ~~R/W~~
	PSUE R/W	○ ~~R/W~~	○ ~~R/W~~	○ R/W	Δ ~~R/W~~	Δ ~~R/W~~
	PSUE R	○ ~~R/W~~	○ ~~R/W~~	○ R	Δ ~~R/W~~	Δ ~~R/W~~
	PSUE ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	○ ~~R/W~~	Δ ~~R/W~~	Δ ~~R/W~~

○: Possible, ×: Not Possible
Δ: When a pair operation causes an error (can occur as a result of a change of the pair status to PSUE)
R/W: Read/Write by a host is possible.
R: Read by a host is possible but write is not possible.
W: Write by a host is possible but read is not possible.
~~R/W~~: Read/Write by a host is not possible.

Note: PSUE in this table excludes a condition in which access of an LU is not possible (for example, LU blockage).

- RAID Level Restrictions

  For a SnapShot V-VOL cascade connection with a TrueCopy volume, a P-VOL of SnapShot and an S-VOL (including all LUs unified) of TrueCopy must be on the same RAID level and have the same number of data disks. However, for a POOL, a pair can be created even if the RAID levels and/or the numbers of data disks are not the same.

2.9.4 Cascade Restrictions for POOL of SnapShot

Neither TrueCopy pairs nor ShadowImage pairs can be created using a POOL.

2.10 TrueCopy Operations

2.10.1 Failover and Fence Level

When an application is used, such as a database, which has a data and writing log, and it is able to execute the I/O operation using the alternative host although a failure occurs during the writing operation, it is possible to perform the failover from the local side to the remote side.

Refer to the following configuration (see Figure 2.24).

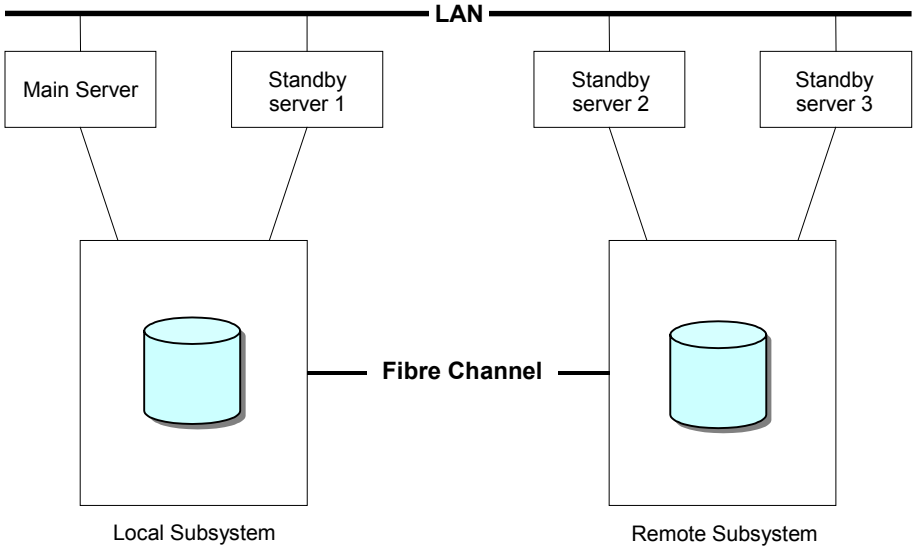


Figure 2.24 Configuration for Performing Failover

In this example, “data” is selected for the fence level, and “PAIR” is selected for the pair status. If the write operation into the S-VOL cannot be executed, an error occurs during the write operation into the P-VOL. Therefore the mirror-consistency between the P-VOL and the S-VOL is kept. The fence level is a feature that controls the host command (write) response after the status of the P-VOL changes into PSUE.

The responses to the host, after the status transitions to PSUE, are shown in Table 2.14.

Table 2.14 Response to the Host after the Status Transitions to PSUE

Fence Level	Write to P-VOL
data	Check Response
never	Good Response

2.10.2 Swapping From the Local Main Server to the Local Standby Server

If the status changes to PSUE because a blockage occurs in both paths between the local side and the remote side, or the subsystem on the remote side is down, a read/write I/O from the main server error occurs. In this case, the main server on the local side is changed over to the standby server, and the takeover operation (horctakeover) is performed in accordance with the Hitachi Command Control Interface (CCI) command.

On the local side, P-VOL-Takeover is performed, and the subsystem cuts off the P-VOL. Subsequently, P-VOL can read and write the data and the standby server 1 on the local side can be used as a main server (see Figure 2.25).

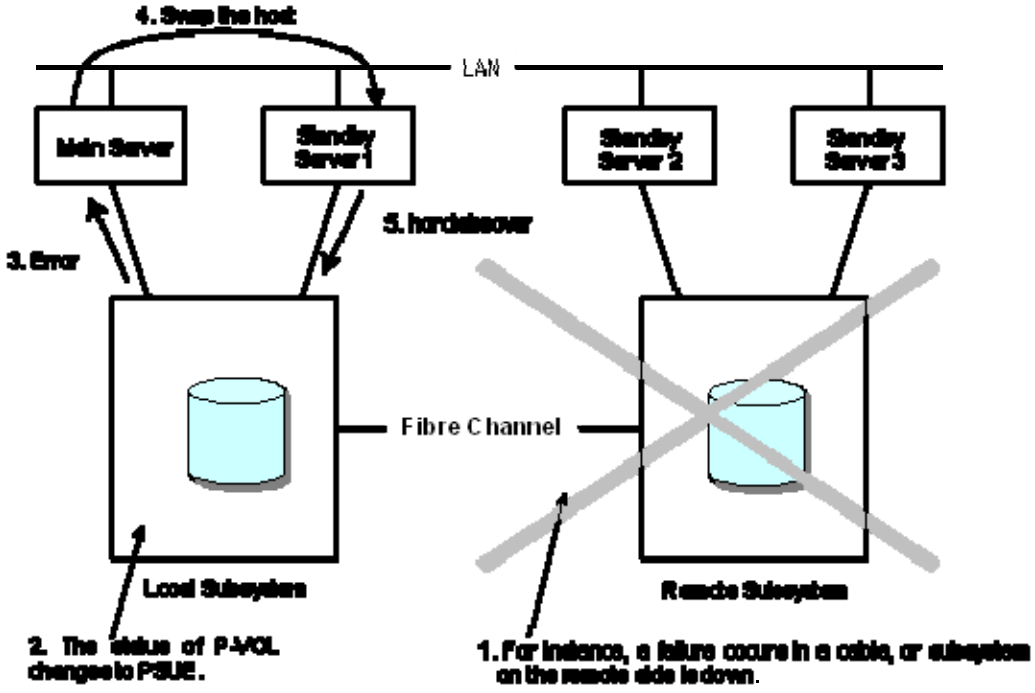


Figure 2.25 Movement When Main Server is Changed for Standby Server on Local Side

2.10.3 Swapping the Local Server for the Remote Server

Notes:

- When the disk system is changed to a remote one by the horctakeover command, the local disk system is placed in the PSUE status, depending on the time that the change is made due to a collision with an I/O instruction issued by a host to the local disk system. This status transition occurs because the change is untimely. However, even if this occurs, reading/writing from/to an S-VOL of the remote disk system can be done because the horctakeover command keeps the S-VOL in the PSUS status (SSWS).
- When the horctakeover command is issued to the remote disk system, in rare circumstances the SWAP-Takeover may fail and terminate the SVOL-Takeover status due to a load of the other CCI command on the local disk system added to a load of the horctakeover command. However, the S-VOL stays in the PSUS status (SSWS) and reading/writing from/to it is possible. A swap between a primary and secondary volume can be done when it is possible after statuses of the local and remote disk systems are checked and the pairresync -swaps command is executed for the remote disk system.

  If both the main server and the standby server on the local side break down, or the subsystem on the local side goes down, the server on the remote side is used as the host (instead of the server on the local side).

  The standby server 2 on the remote side performs the takeover operation (horctakeover) in accordance with the Hitachi Command Control Interface (CCI) command. If the subsystem on the local side can be used, SWAP-Takeover is performed, and the role of the subsystem is changed over between the primary side and the secondary side. (The local side is assigned to the secondary side, and the remote side is assigned to the primary side.)

  - Split a pair of P-VOL and S-VOL
  - Execute SWAP resynchronization (pairresync-swaps)

  If the subsystem on the local side cannot be used, S-VOL-Takeover is performed, the status of S-VOL changes to PSUS (SSWS), and S-VOL can read and write.

Figure 2.26 shows movement when the host is changed from local side to remote side.

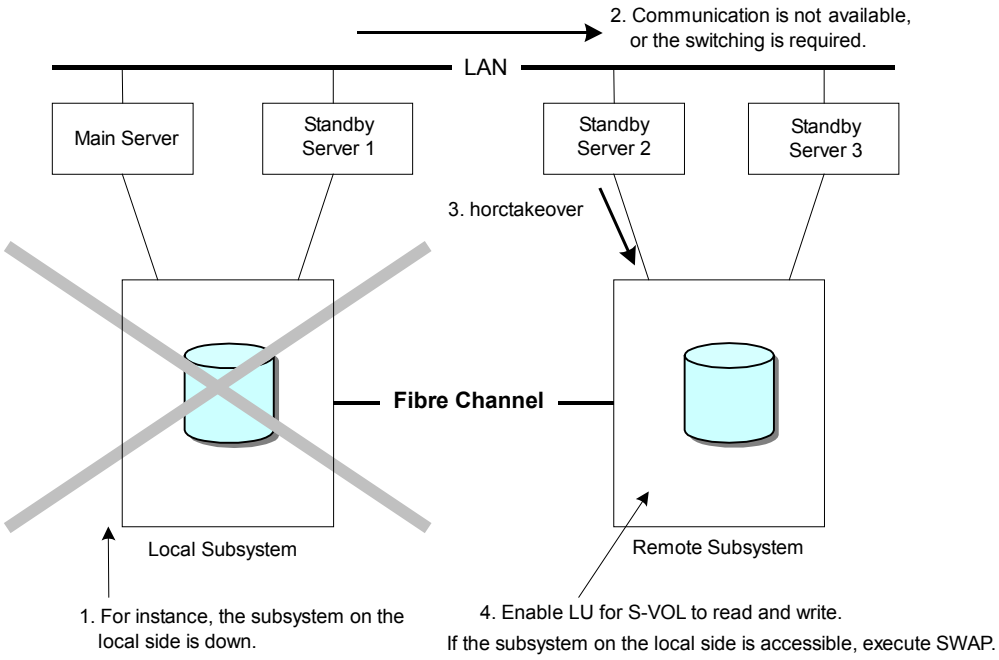


Figure 2.26 Movement When Host is Changed from Local Side to Remote Side

2.11 Operation When the Fence Level is “never”

The file systems for UNIX and Windows NT®/2000/Windows Server™2003 do not have the writing log (or the journal file). Even though “data” is set for the fence level, the file sometimes does not correspond to the directory. Therefore, “never” is set for the fence level.

In this case, the data of S-VOL is used after “fsck” and “chkdsk” are executed. The data, however, is not guaranteed completely. Therefore, we recommend a configuration which saves the complete data in the P-VOL or the S-VOL that is cascaded by using ShadowImage on the remote side.

2.12 Concurrent Use of TrueCopy and ShadowImage/SnapShot

By using TrueCopy and ShadowImage concurrently, the LU in the subsystem that the TrueCopy function used is duplicated. Even when the TrueCopy function is in progress, the host I/O operation to the volume is guaranteed. Additionally, it is possible to replace ShadowImage with SnapShot. When ShadowImage is replaced with SnapShot, the S-VOL capacity can be decreased but performance decreases. Make a selection according to your requirements.

2.12.1 System Configuration for Backup Use

By using TrueCopy, you can back up the LU in the subsystem (see Figure 2.27). To save data when a failure occurs during a copy operation, it is recommended that you connect the primary LU and the secondary LU by using ShadowImage on the remote side (Ordinary Split).

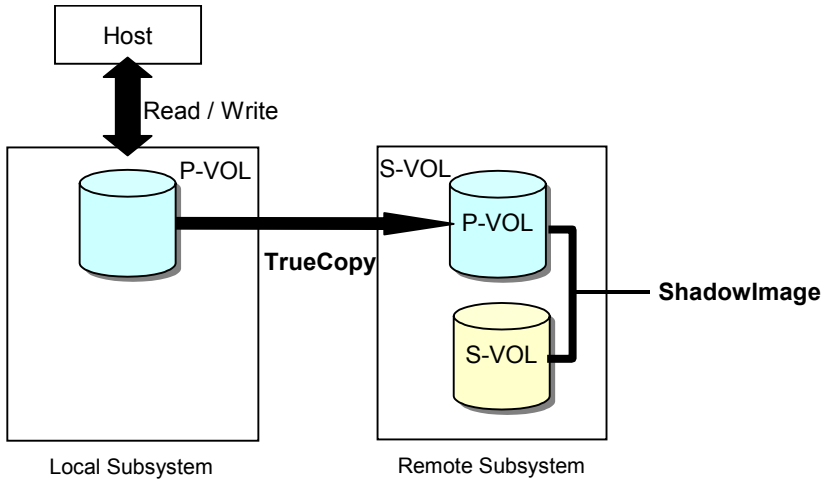


Figure 2.27 System Configuration for Backup Use

The following two operations are available:

- **Completely Full-time Pair** (Attaching importance to the recovery time)
- **Ordinary Split** (Attaching importance to the performance)

2.12.1.1 Completely Full-time Pair (Attaching importance to the recovery time)

This can be used for the failover and the backup operation. “Completely Full-time Pair” also can be used for the data move, but it is recommended that you use “Ordinary Split” for the data move.

Characteristics of the system include:

- When the primary LU and the secondary LU are cascaded by using ShadowImage, split a pair of ShadowImages. When splitting this pair, the data is saved in the secondary LU on ShadowImage.
- Although the subsystem on the local side is in the hang-up condition, because “data” is being set for the fence level and the application (for example, the database that has logs) is being used, the data can be completely recovered. (Merit)
- When data is written from the host to the subsystem on the local side, the performance deteriorates because the data is simultaneously written from the host to the LUs on the local side and the remote side. (Demerit)

Status restrictions include:

- Completely Full-time Pair: TrueCopy is used under the Full-time PAIR condition.

2.12.1.2 Ordinary Split (Attaching importance to the performance)

This can be used for the backup and the data move operation. “Ordinary Split” cannot be used for failover.

Characteristics of the system include:

- Execute resynchronization when the host I/O is performed infrequently. When the resynchronization is complete, stop the processing for the application temporarily and split a pair. The data is saved when a pair is split.
- If the primary LU is cascaded with the secondary LU using ShadowImage on the remote side, the data is saved in the secondary LU on ShadowImage by resynchronization using TrueCopy after splitting a pair of ShadowImage.
- When TrueCopy is in the PSUS status, the host accesses the subsystem on the local side only. Therefore, the host I/O is quicker than a “Completely Full-time Pair”. (Merit)
- When splitting a pair after resynchronization, data is saved on the remote side; therefore, the data that is changed during the period from when a TrueCopy pair is split until a failure occurs is not saved. (Demerit)

Status restrictions include:

- Completely Full-time Pair: TrueCopy is used under the Full-time PAIR condition.

2.12.2 System Configuration for Data Move

To configure the system for Data Move, set the LU on the local side to TrueCopy P-VOL and set the remote LU to TrueCopy S-VOL as shown in Figure 2.28.

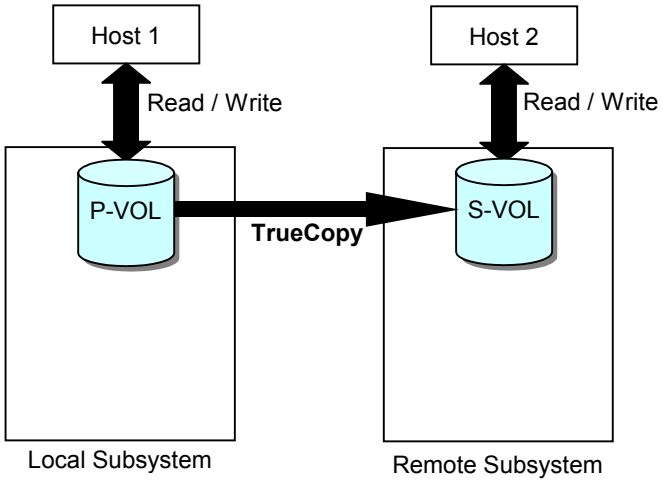


Figure 2.28 System Configuration for Data Use

The operation for the "Ordinary Split" condition is described as follows.

2.12.2.1 Ordinary Split

By using TrueCopy, you can transfer the data of the LU in the subsystem on the local side to the remote side, then use the data on the remote side.

Characteristics of the system include:

- Execute resynchronization when the host I/O is performed infrequently. When the resynchronization is complete, stop the processing for the application temporarily and split a pair.
- On the remote side, process the data by using the host on the remote side.
- When TrueCopy is in the PSUS status, each host on the local side and the remote side can access the subsystem on their side only.

Status restrictions include:

- TrueCopy is used under the ordinary PSUS condition.

2.13 Cautions and Restrictions

- Cautions for the SYNCHRONIZE CACHE command:
  - When a SYNCHRONIZE CACHE command is received from a host, it usually writes the entire write pending data stored in the cache memory to drives. However, when TrueCopy is installed, the write pending data is not written to drives on the SYNCHRONIZE CACHE command.
  - When you need to write the entire write pending data stored in the cache memory to drives on the SYNCHRONIZE CACHE command when TrueCopy is installed, you must turn on the Synchronize Cache All Execution Mode through Navigator.

Note: Turn off the Synchronize Cache Execution Mode in the remote site, otherwise a TrueCopy path failure may occur.

- Cautions on using the function together with the other copying function:
  - TrueCopy cannot be used together with TCE. A ShadowImage or SnapShot volume can be cascaded with a TrueCopy volume.

Chapter 3 Preparing for TrueCopy Operations

The following preparations are required for TrueCopy operations:

- Installing and Uninstalling TrueCopy (see section 3.1)
- Setting the Command Device (see section 3.2)
- Setting the Differential Management LU (see section 3.3)
- Setting the Target ID (see section 3.4)
- Setting the Host Group Option (see section 3.5)
- Setting the Path (see section 3.6)
- Defining the Configuration Definition File (see section 3.7)
- Setting the Environment Variable (see section 3.8)

3.1 Installing and Uninstalling TrueCopy

Since TrueCopy is an extra-cost option, TrueCopy cannot usually be selected (locked) when first using the TagmaStore® subsystem. To make TrueCopy available, you must install the TrueCopy and make its function selectable (unlock).

TrueCopy can be installed from the Navigator. This section describes the installation/uninstallation procedures using the Navigator via the Graphical User Interface (GUI).

For procedures performed by using the Command Line Interface (CLI) of Navigator, see Appendix B.

Notes:

- The installing, uninstalling, enabling, and disabling functions of the TrueCopy feature are set for each disk array subsystem.
- Before installing/uninstalling TrueCopy, verify that the array unit to be operated is in normal state. If a failure such as a controller blockage has occurred, installation/uninstallation cannot be performed.

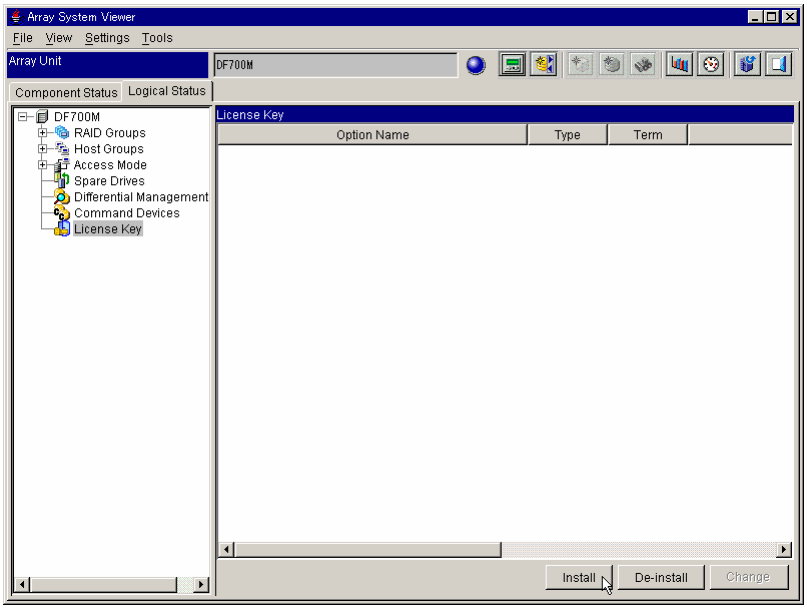
3.1.1 Installing TrueCopy

To install TrueCopy, the key code or key file is provided with the optional feature is supplied. The following describes the installation procedure.

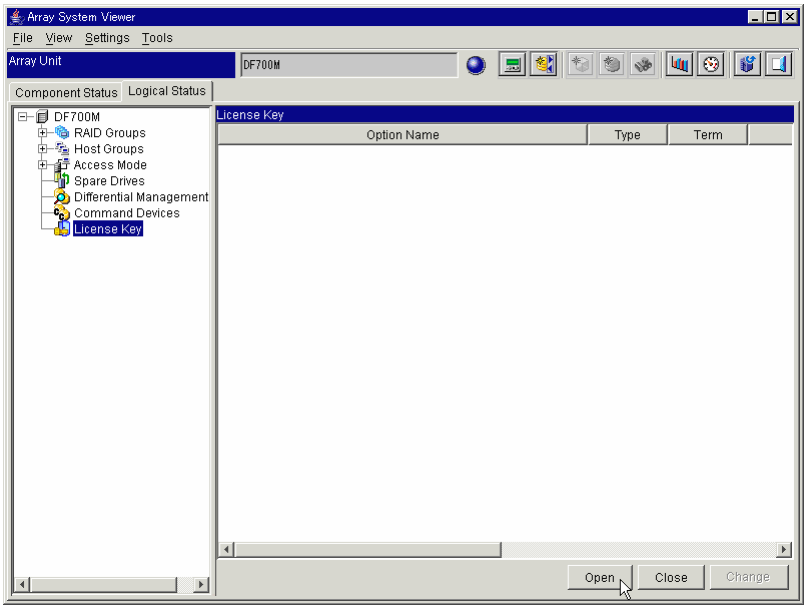
To install TrueCopy:

1. Start the Navigator, and change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem (array unit) in which TrueCopy is to be installed, then connect to the subsystem.

   The Array System Viewer window showing the connected subsystem displays.
3. Select the **Logical Status** tab.
4. Click the **License Key** icon.



Navigator: Version 5.00 or later

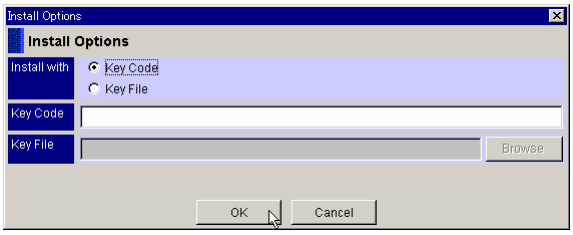


Navigator: Less than 5.00 version

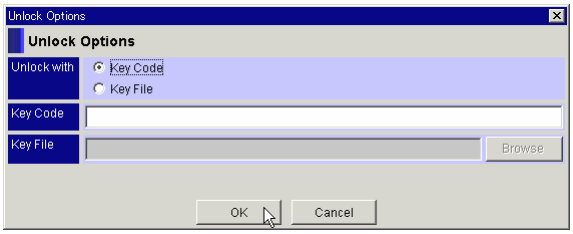
Figure 3.1 Array System Viewer Window (Logical Status Page)

5. Select **Install**. The **Install Options** dialog box displays. (Navigator: Version 5.00 or later)

   Select **Open**. The **Unlock Options** dialog box displays. (Navigator: Less than 5.00 version)



Navigator: Version 5.00 or later



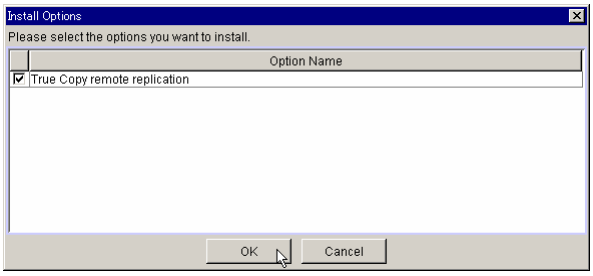
Navigator: Less than 5.00 version

Figure 3.2 Install/Unlock Options Dialog Box

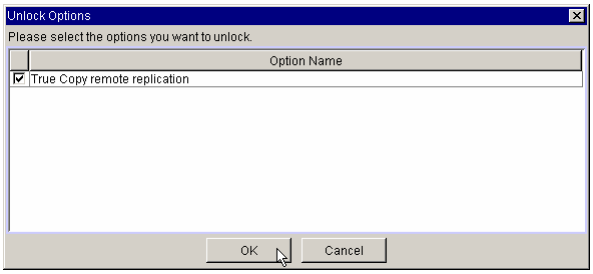
6. When you install the option using the key code, select **Key Code** radio button, and then set up the key code. When you install the options using the key file, select the **Key File** radio button, set up the path for the key file, and then click **OK**.

   Note: To set the path to a key file, use the Browse button.

7. When you install the options using the key file, the options selection dialog box displays. Verify the **Option Name** and click **OK**.



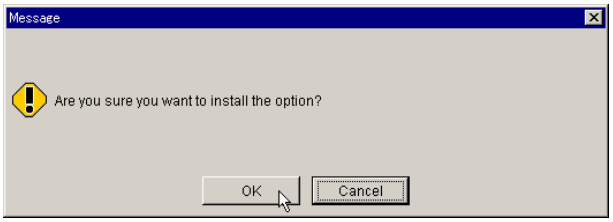
Navigator: Version 5.00 or later



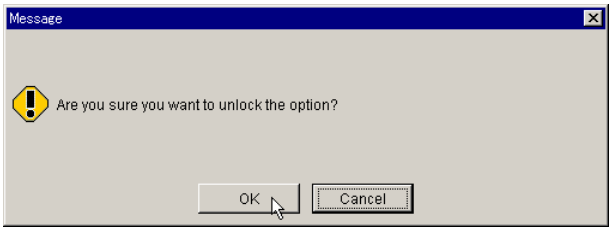
Navigator: Less than 5.00 version

Figure 3.3 Options Selection Dialog Box

8. A confirmation message displays. Click **OK**.

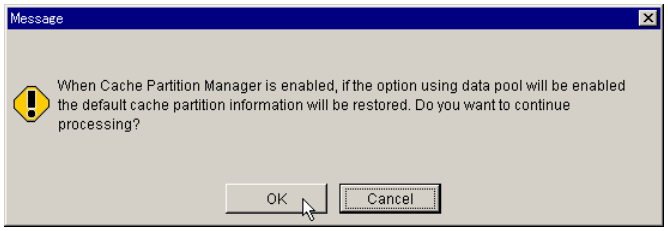


Navigator: Version 5.00 or later

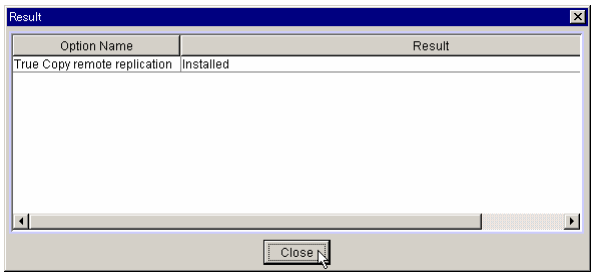


Navigator: Less than 5.00 version

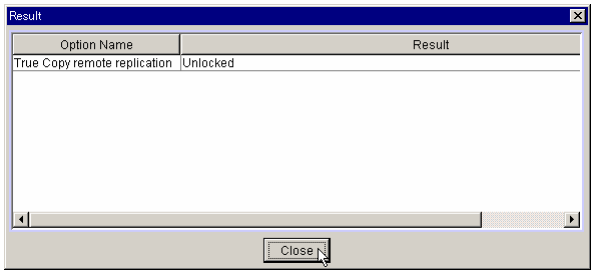
9. When Navigator version is 3.00 or later and Cache Partition Manager is enabled, the following message is displayed. Since TrueCopy does not use the data pool, click the **OK** button at this point without doing anything else.



10. When you install the options using the key file, a result dialog box displays. Click **Close**.



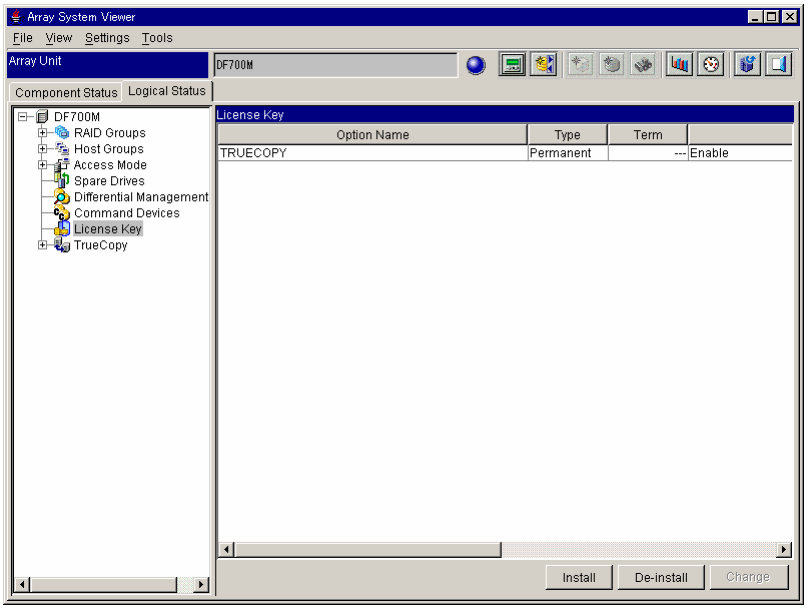
Navigator: Version 5.00 or later



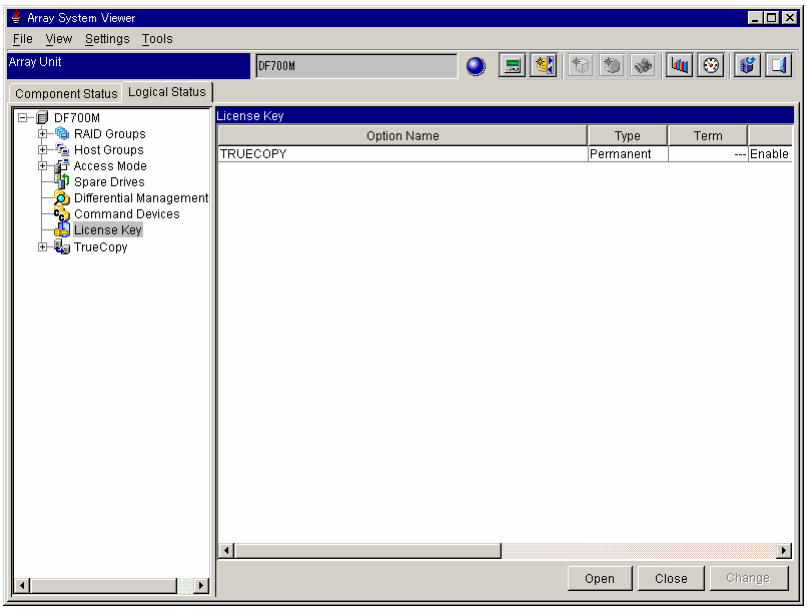
Navigator: Less than 5.00 version

Figure 3.4 Result Dialog Box

The Array System Viewer window displays.



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 3.5 Array System Viewer Window (Logical Status Page Option: Enable)

The TrueCopy installation is now complete.

3.1.2 Uninstalling TrueCopy

To uninstall TrueCopy, the key code provided with the optional feature is required. Once uninstalled, TrueCopy cannot be used (locked) until it is again installed using the key code or key file.

Note: The following conditions must be satisfied in order to uninstall TrueCopy.

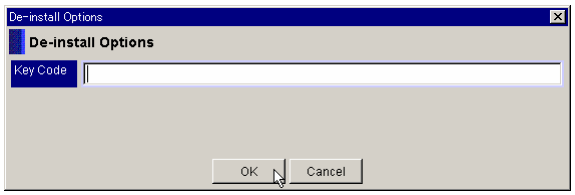
- All TrueCopy pairs must be released (that is, the status of all LUs are SMPL).
- The path settings must be released.

To uninstall TrueCopy:

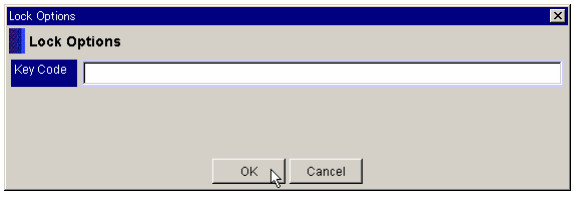
1. Start the Navigator, and change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem (array unit) in which the TrueCopy is to be uninstalled, and then connect to the subsystem.

   The Array System Viewer window (see Figure 3.1 opens displaying the connected subsystem.
3. Select the **Logical Status** tab.
4. Select the **License Key** icon (see Figure 3.8).
5. Click **De-install**. The **De-install Options** dialog box displays. (Navigator: Version 5.00 or later)

   Click **Close**. The **Lock Options** dialog box displays. (Navigator: Less than 5.00 version)



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 3.6 De-install/Lock Options Dialog Box

6. Enter a **key code** in the text box and click **OK**.
7. A confirmation message displays. Click **OK**.

   TrueCopy is now uninstalled.

3.1.3 Enabling or Disabling TrueCopy

TrueCopy can be set to “enable” or “disable” when it is installed.

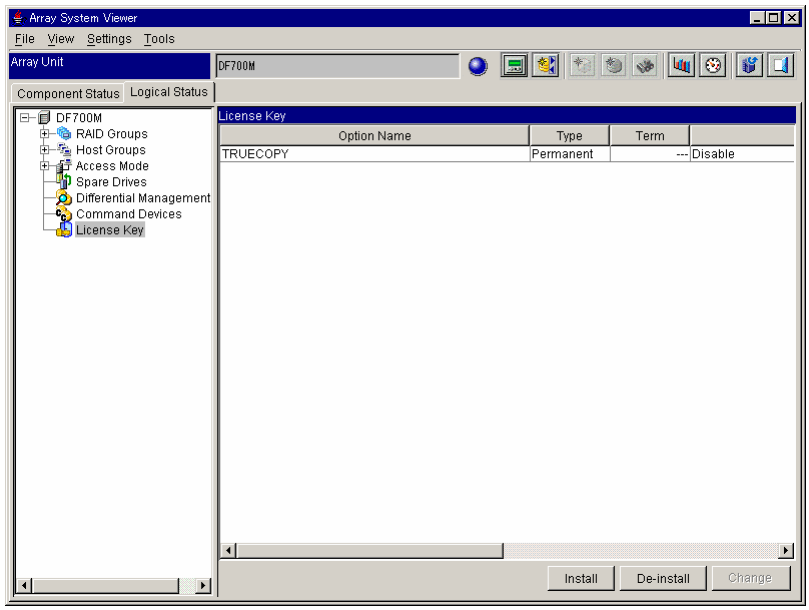
Note: The following conditions must be satisfied in order to disable TrueCopy:

- All TrueCopy pairs must be released (that is, the status of all LUs are SMPL).
- The path settings must be released.

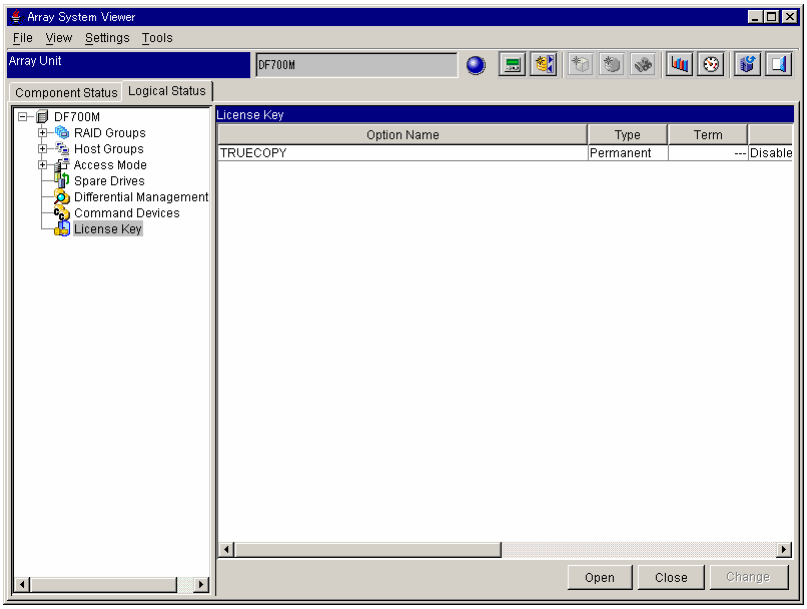
To enable or disable TrueCopy:

1. Start Navigator, then change the operation mode to **Management Mode** (administrator mode).
2. Register the subsystem in which the TrueCopy is to be changed, and then connect to the subsystem.

   The Array System Viewer window (see Figure 3.1) displays the connected subsystem.
3. Select the **Logical Status** tab.
4. Select the **License Key** icon (see Figure 3.8).
5. From **Option Name**, select **TRUECOPY**, then select **Change**.
6. A confirmation message displays. Click **OK**.



Navigator: Version 5.00 or later



Navigator: Less than 5.00 version

Figure 3.7 Array System Viewer Window (Logical Status Page Option: Disable)

Enabling or disabling TrueCopy is now complete.

3.2 Setting the Command Device

The command device is a user-selected, dedicated logical volume on the TagmaStore subsystem which functions as the interface to the CCI software. The TrueCopy commands are issued by the CCI (HORCM) to the TagmaStore subsystem through command device.

In order to accept read and write commands that are executed by the TagmaStore subsystem and return read requests to the UNIX®/PC host, the command device must be designated. The command device must be defined in the HORCM_CMD section of the configuration definition file for the CCI instance on the attached host. Two command devices can be designated for the TagmaStore subsystem. You can designate command devices using Navigator.

Notes:

- LUs set for command devices must be recognized by the host.
- The Command Device LU size must be greater than or equal to 33 MB.
- For TrueCopy, the command devices must be designated on both the remote and local subsystems.
- There are the following restrictions when either pair of ShadowImage™, SnapShot, TrueCopy, or TCE exists or the path of True Copy or TCE is defined.
  - When two command devices are set, only one command device can be released.
  - When only one command device is set, the command device cannot be released.

To designate command device(s):

1. Start the Navigator, and change the operation mode to **Management Mode** (administrator mode).
2. Connect to the subsystem. The Array System Viewer window (Figure 3.1) opens displaying the connected subsystem.
3. Select the **Logical Status** tab.
4. Select the **Command Devices** icon.

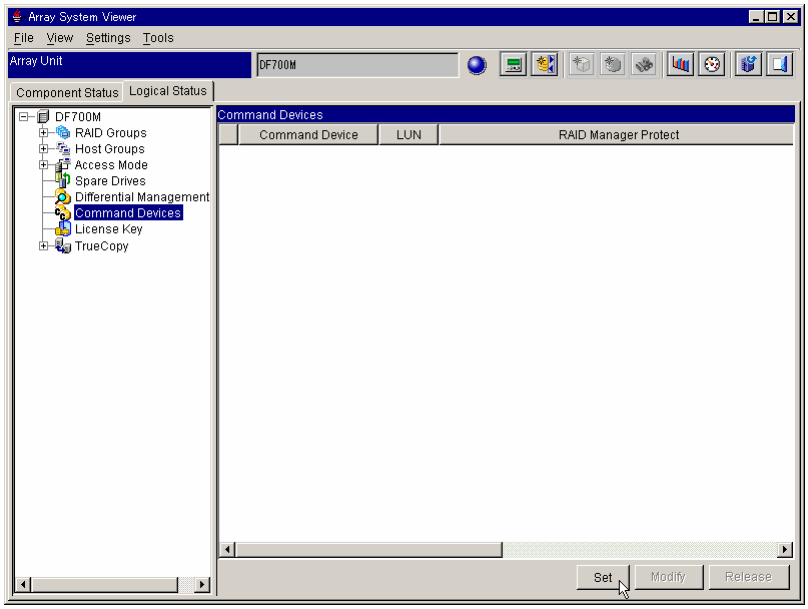


Figure 3.8 Array System Viewer Window (Command Device Page: Before Setting)

5. Click **Set**.

   The **Command Devices Settings** dialog box displays.

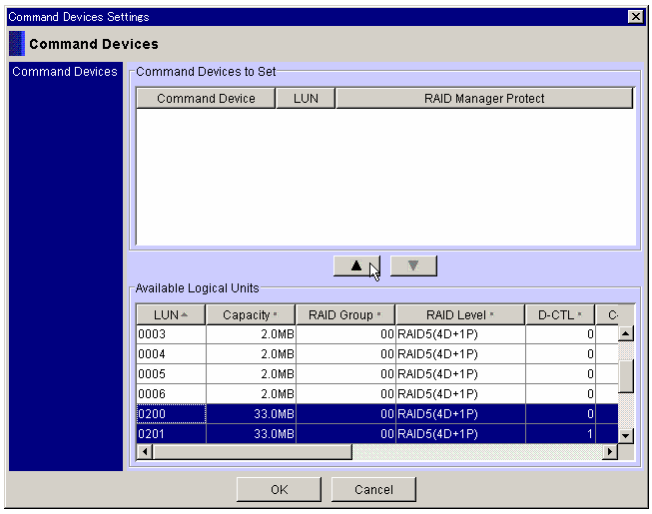


Figure 3.9 Command Devices Settings Dialog Box (Before Setting)

6. In **Available Logical Units** list, select **LUN**, and click ▲.

   The selected **LUN** moves to the **Command Devices to Set** list.

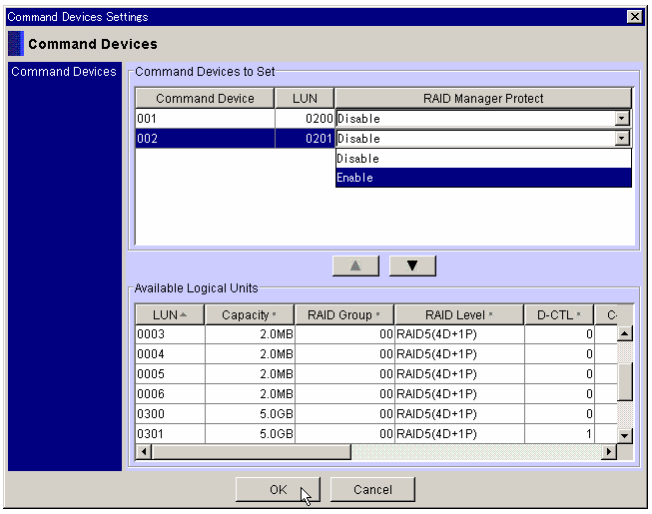


Figure 3.10 Command Devices Settings Dialog Box (Before Setting)

7. When you want to use the protection function of CCI, in the **RAID Manager Protect** drop-down list, select **Disable** or **Enable**.

   When you want to change the already set command devices, select the **LUN** on the **Command Devices to Set** list, and click ▼.

   The selected **LUN** moves to the **Available Logical Units** list.

8. Click **OK**.

   The setting information displays.

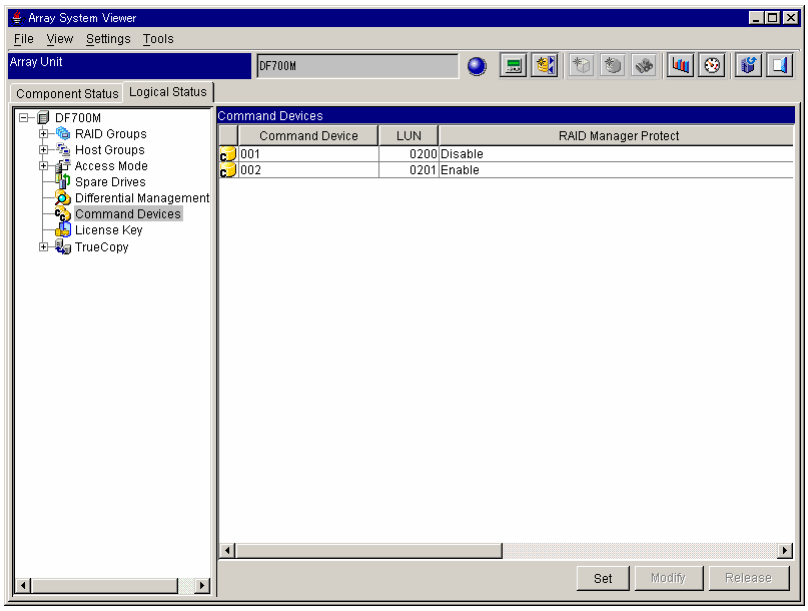


Figure 3.11 Array System Viewer Window (Command Device Page: After Setting)

Note: To use the alternate command device function, or to avoid data loss and subsystem downtime, designate two command devices. When two command devices are set within the one disk subsystem, assign them to the respective RAID groups; if they are assigned to the same RAID group, both command devices become unavailable due to a malfunction such as a drive failure. For details on the alternate command device function, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

9. **To release an already set command device**, select the LUN of the command device you want to release, and click **Release**.
10. A message displays. Click **OK**.

The command device is now designated. Leave the Array System Viewer window open, and go on to the next section (Setting the Differential Management LU).

3.3 Setting the Differential Management LU

When the Differential Management LU is not set, create it. The Differential Management LU is an exclusive logical unit for storing the differential data at the time when the volume is copied. The Differential Management LU in the disk subsystem is treated in the same way as the other logical units. However, a logical unit that is set as the Differential Management LU is not recognized by a host (it is hidden).

Set a logical unit with a size of 5 GB minimum as the Differential Management LU. Up to two Differential Management LUs can be set. The second one is used for the mirroring. It is recommended that two Differential Management LUs are set.

The Differential Management LUs must be set on both the local and remote subsystems.

To designate Differential Management LUs:

1. On the Array System Viewer window, select the **Logical Status** tab.
2. Select the **Differential Management LU** icon.

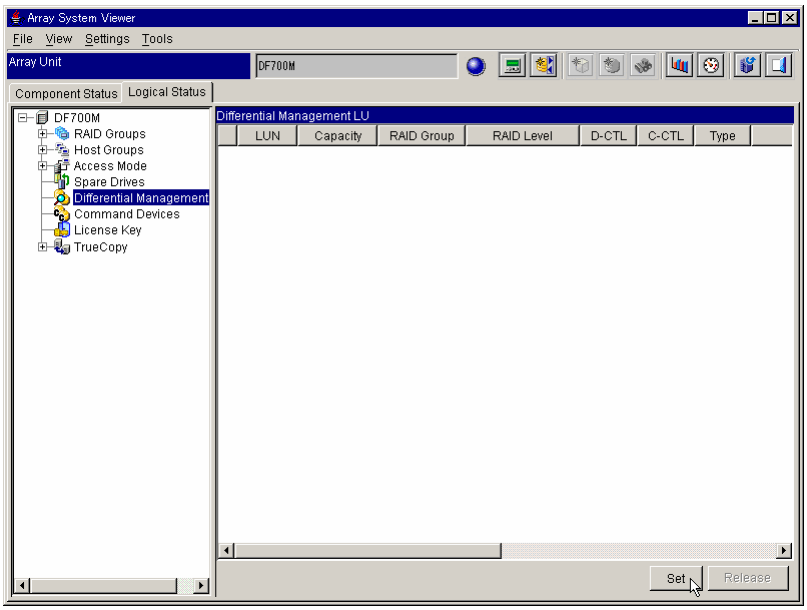


Figure 3.12 Array System Viewer Window (Differential Management LU Page: Before Setting)

3. Click **Set**.

   The **Select Logical Unit** dialog box displays.

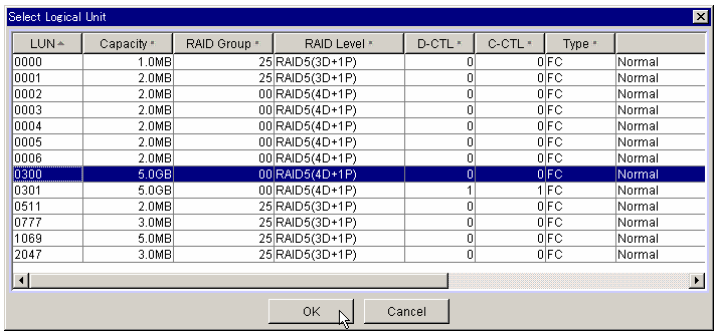


Figure 3.13 Select Logical Unit Dialog Box

4. Select the **LUN** you want to set the differential management LU, and click **OK**.
5. A message displays. Click **OK**.

   The setting information displays.

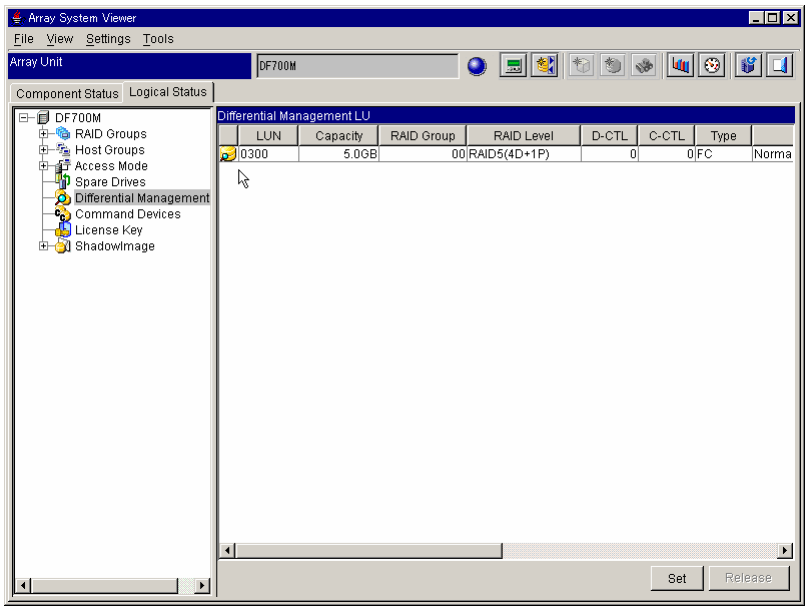


Figure 3.14 Array System Viewer Window (Differential Management LU Page: After Setting)

Note: There are the following restrictions when either pair of ShadowImage, SnapShot, TrueCopy, or TCE exists, the path of True Copy or TCE is defined, or POOL of SnapShot or TCE is defined.

- When two differential management LUs are set, only one differential management LU can be released.
- When only one differential management LU is set, the differential management LU cannot be released.

3.4 Setting the Target ID (LU Mapping)

The following is the procedure for specifying the target ID. The target ID is specified using Navigator.

3.4.1 Specifying Mapping Mode

To specify the Mapping Mode:

1. On the Array System Viewer window, select the **Logical Status** tab.
2. Select the **Access Mode** plus signs next to the **Mapping Mode**.

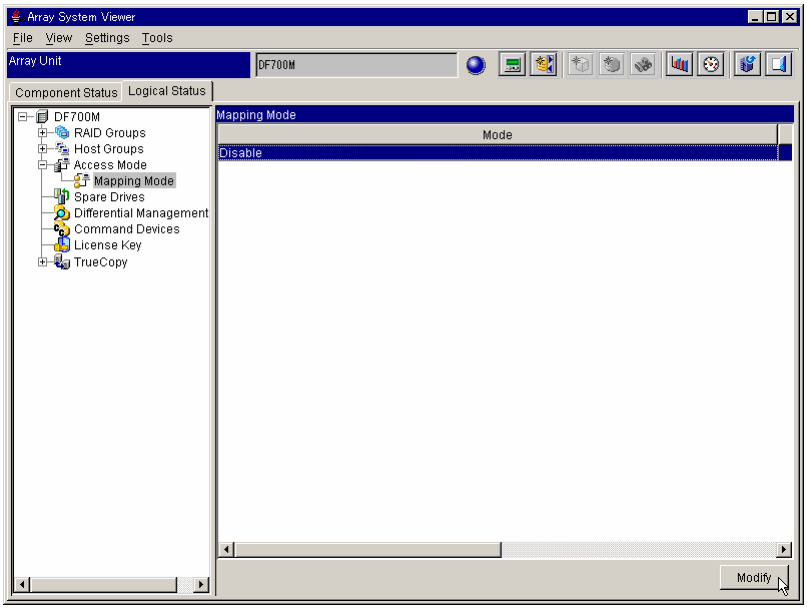


Figure 3.15 Array System Viewer Window (Specifying Mapping Mode)

3. Select the **Disable** in the **Mapping Mode** list, and click **Modify**.

   The **Mapping Mode** dialog box displays.

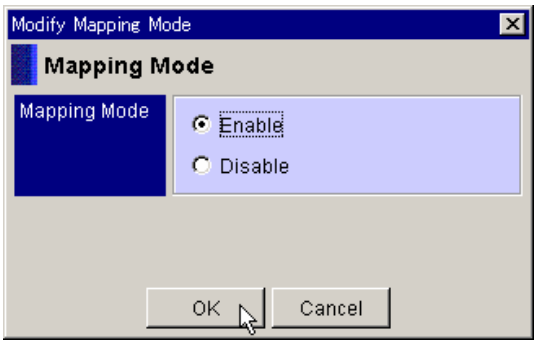


Figure 3.16 Mapping Mode Dialog Box

4. Select the **Enable** radio button, and click **OK**.
5. A confirmation message displays. Click **OK** (three times).

3.4.2 Setting Mapping Information

1. Click the **Port** plus signs next to the **000:G000** and select **000:G000**.
2. Select the **Logical Unit** icon, select the **Modify Mapping** button.
   The **Mapping Property** window displays.

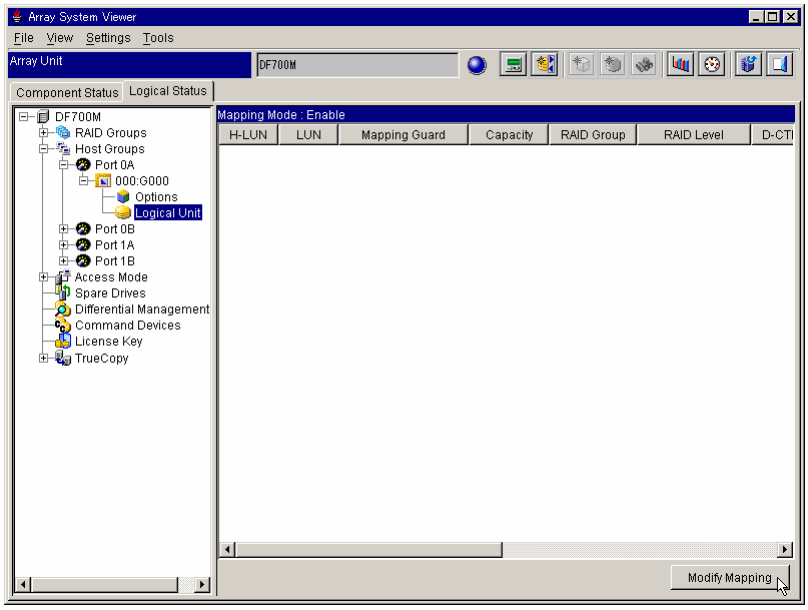


Figure 3.17 Array System Viewer Window (Setting Mapping Information)

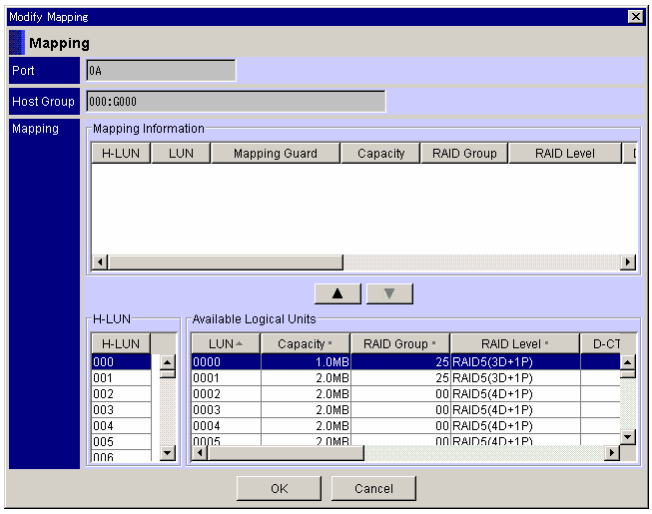


Figure 3.18 Mapping Property Window (Before Setting)

3. Select one **H-LUN** to be added. Select **LUN**, and click the ▲ button. The added contents are displayed in **Mapping Information** list.

   Select the following items:

   – For **H-LUN**, select the LU number that the host can recognize.

   – For **LUN**, select the LU number of the subsystem.

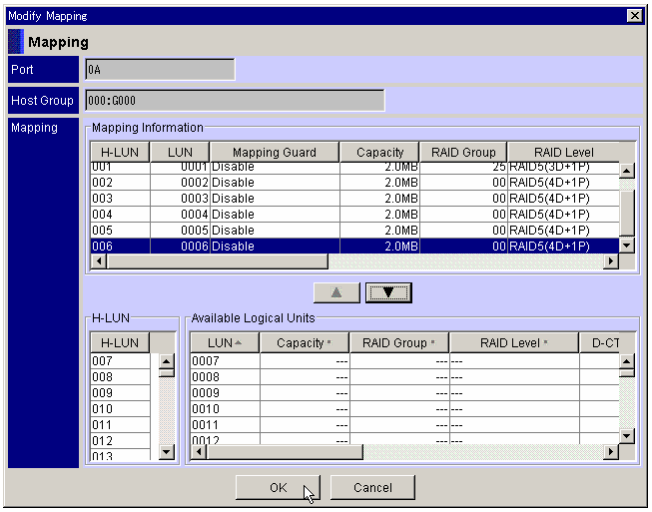


Figure 3.19 Mapping Property Window (After Setting)

4. Click **OK**.

5. A confirmation message displays. Click the **OK** button (two times).

The set mapping information is updated and the following window displays.

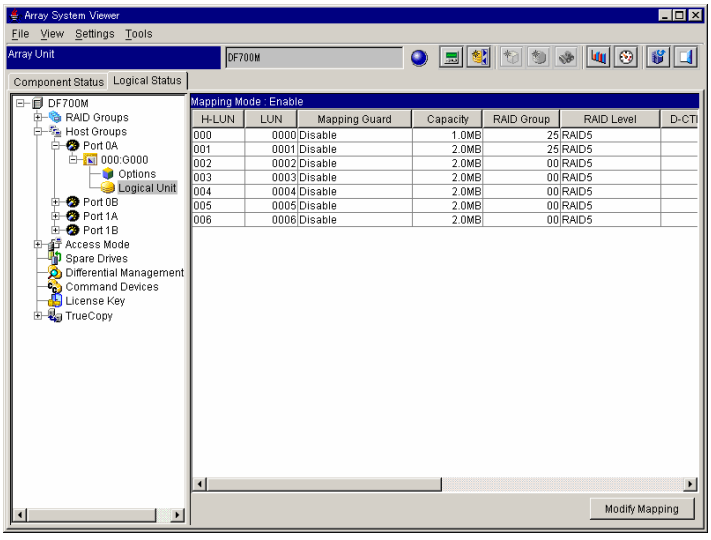


Figure 3.20 Updated Mapping Information

Setting the target ID is now complete.

3.5 Setting the Host Group Option

When MC/Serviceguard™ is used on HP server, set the host group option.

1. On the Array System Viewer window, select the **Logical Status** tab.
2. Click the **Port** plus signs next to the **000:G000** and select **000:G000**.
3. Select **Options** on **000:G000**.
4. Select the **Detail Setting** button.

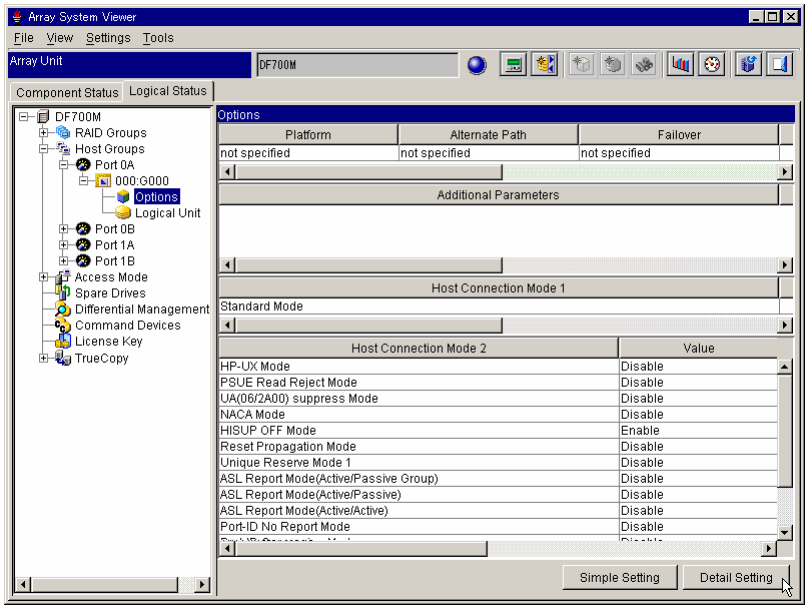


Figure 3.21 Array System Viewer Window (Setting the Host Group Option)

5. Click the check box of the **PSUE Read Reject Mode** enable option for the **Host Connection Mode 2** setting item. Then click the **OK** button.

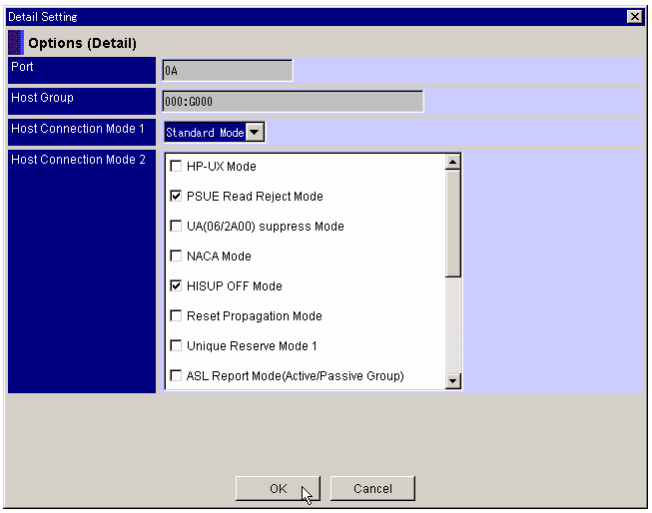


Figure 3.22 Selecting the Host Connection Mode

6. A message displays; click the **OK** button (three times).

The setting contents are displayed.

3.6 Setting the Path

It is necessary to designate Command Device(s) before a path setting.

If a failure such as a controller blockage has occurred, a path setting cannot be performed.

The path on TrueCopy is specified using Navigator.

Only single path for each controller-0 and controller-1 must be specified, so a total of two paths should be specified. Path-0 is connected to the port of the controller-0 on the local subsystem, then Path-1 is connected to the port of the controller-1 on the local subsystem.

If you want to change the already set path information, specify new path information again after releasing the previously set path information. Once path information is set, the previously set path information cannot be changed.

Note: Release all the pairs of TrueCopy before path releasing.

The following is the procedure for specifying the path on TrueCopy.

1. Navigator and change the operation mode to **Management Mode** (administrator mode).
2. Connect to the subsystem. The Array System Viewer window (Figure 3.1) opens displaying the connected subsystem.
3. Select the **Logical Status** tab.
4. Select the **Remote Path** icon in the **TrueCopy** icon.

   Note: The **TrueCopy** icon displays only when the TrueCopy option is enabled.

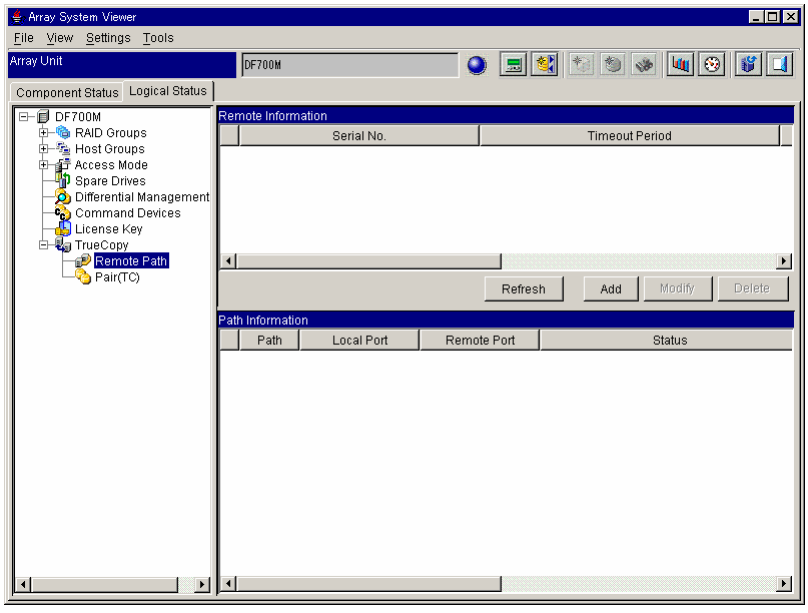


Figure 3.23 Array System Viewer Window (Remote Path Page: Before Setting)

5. Click **Add**.

   The **Remote Path** setting window displays.

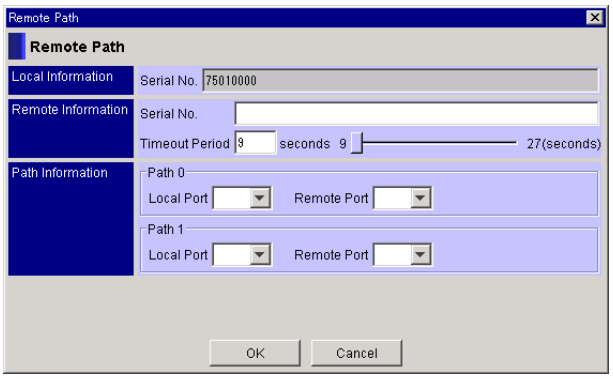


Figure 3.24 Remote Path Setting Window

6. On the Remote Path page, select the following items:

- **Local information:**
- **Remote information:**
  - For **Serial No.**: Specify the eight digits numbers in decimal notation.
  - For the **Timeout Period**: The default value is 9 seconds. When remote subsystem is in a long distance using Extender, the timeout value may be changed. Set the time limit to the double writing to be done to the remote subsystem in the PAIR status. It is required to make the time limit shorter than that, which is checked by a host. Specify the time limit to be checked by a host as six times as long as the time limit that is set now. For instance, when the time limit is set as 27 seconds, which is the longest allowable value, the time to be checked by a host must be longer than 162 (27×6) seconds.

    In the case of a cascade configuration in which an S-VOL of ShadowImage or a V-VOL of SnapShot is a P-VOL of TrueCopy, specify the time limit as the standard value shown below according to a frequency band of the line. However, in some cases, it is better to specify a larger value based on a rate of errors such as a packet loss of the line.

Table 3.1 Time Limit

Frequency band of a line	Time limit (seconds)
200 Mbps or more	9
40 to 200 Mbps	18
20 to 40 Mbps	27

The time limit must be specified shorter than the time for monitoring by CCI. When you specify the time limit as ten seconds or longer, specify the time-out threshold value of the HORCM_MON of the configuration definition file of CCI for the TrueCopy pare as a value six times as large as the value that has been set here. For example, when you specify the time limit as 27 seconds, which is the allowable longest value, the time-out threshold value must be 27×6 = 162 seconds or longer.

Note: When the equipment is AMS200/WMS100, the time limit until the time-out occurs must be 18 seconds or more. Therefore, the time limit is set for 18 seconds automatically even when a time limit of 18 seconds or less is entered. It is also impossible to change the time limit, which has already been set, to 18 seconds or less.

- **Path Information:** For **Path 0 information** and **Path 1 information**, select the port in the pull-down menu referred to Table 3.2. The port to be selected differs according to Equipment Type.

Table 3.2 Selection Items by Equipment Type

	Equipment Type of Local Device		Equipment Type of Remote Device	
	AMS500/AMS200/ WMS100	**AMS1000**	**AMS500/AMS200/ WMS100**	**AMS1000**
Path 0 Port	0A or 0B	0A, 0B, 0C, 0D	0A, 0B, 1A, 1B	0A, 0B, 0C, 0D, 1A, 1B, 1C, 1D
Path 1 Port	1A or 1B	1A, 1B, 1C, 1D	0A, 0B, 1A, 1B	0A, 0B, 0C, 0D, 1A, 1B, 1C, 1D

7. Click **OK**.
8. When the Setting ended normally, a window displays. Click **OK**. The Remote Path page on which path is specified displays.

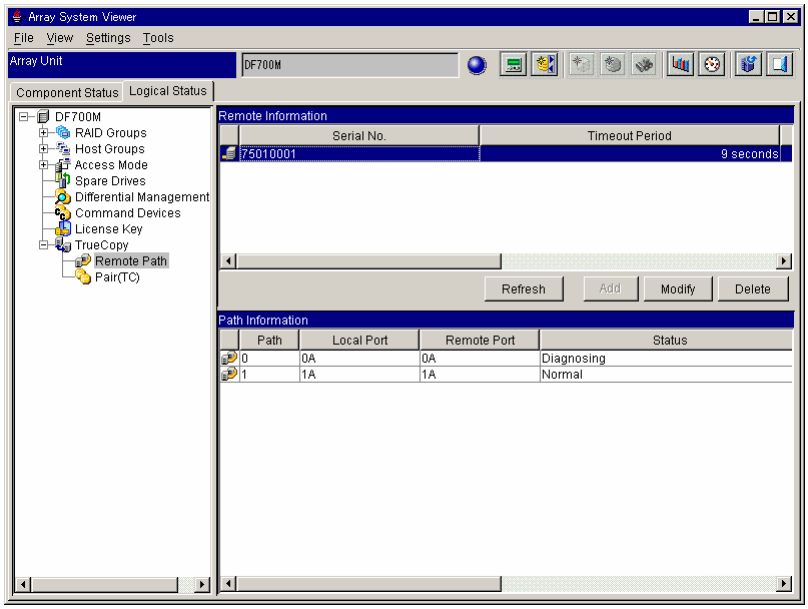


Figure 3.25 Array System Viewer Window (Remote Path Page: After Setting)

The functions of the buttons displayed on this page are as follows:

- **Refresh** button gets the latest information in that time, and displays its condition again.
- **Add** button is not selectable in this condition.
- **Modify** button modifies the specified path information.
- **Delete** button deletes the specified path information.

Table 3.3 lists the status strings displayed on the **Path Status** field in each status.

Table 3.3 Status Strings Displayed on the Path Status Field

No.	Status	Status string
1	Undefined	Undefined
2	Normal	Normal
3	Detached	Detached
4	Diagnosing	Diagnosing

3.7 Defining the Configuration Definition File

The configuration definition file describes the system configuration in order to make CCI operational. The configuration definition file is a text file created and/or edited using any standard text editor, and can be defined from the PC where the CCI software is installed. This sample configuration definition file (HORCM_CONF), is included with the CCI software, and this file should be used as the basis for creating your configuration definition file(s). The system administrator should copy the sample file, set the necessary parameters in the copied file, and place the copied file in the proper directory. For details on configuration definition file, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

The configuration definition file can be automatically created using the mkconf command tool. However, the parameters, such as poll(10ms) must be set manually (see step 4 below). For details on the mkconf command tool, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

The following describes an example for manually defining the configuration definition file, when the system configuration with two instances within the same server (Windows® NT®/2000).

1. On the host where CCI is installed, verify that the CCI is not running. If the CCI software is still running, shut down the CCI software using the horcmshutdown command. For details on horcmshutdown, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
2. In the command prompt, make two copies of the sample file (horcm.conf).

   Example:

   ```
   c:\HORCM\etc> copy \HORCM\etc\horcm.conf \WINNT\horcm0.conf
   c:\HORCM\etc> copy \HORCM\etc\horcm.conf \WINNT\horcm1.conf
   ```

3. Open horcm0.conf using the text editor.
4. In the **HORCM_MON** section, set the necessary parameters.

   Important: A value more than or equal to 6000 must be set for poll(10ms). Please refer to *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701) for details on calculating the poll(10ms) value. Specifying the value incorrectly may cause a conflict in the internal process, which suspends the process temporary and stops the internal process of the subsystem. For more details on configuration parameters, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

5. In the **HORCM_CMD** section, specify the physical drive (command device) on the subsystem.

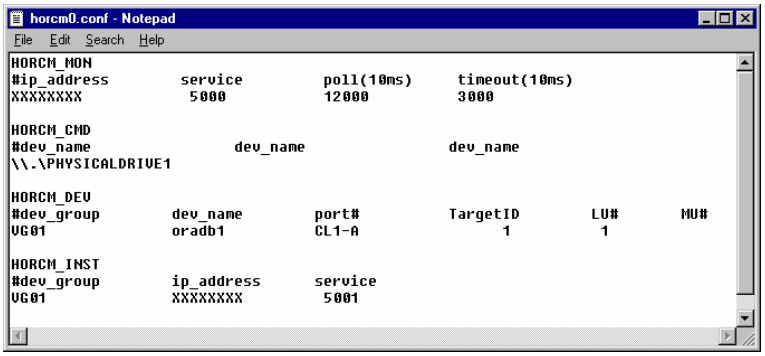


Figure 3.26 Horcm0.conf Example

6. Save the configuration definition file and use the horcmstart command to start the CCI software. For details on horcmstart, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
7. Execute the raidscan command and make sure you write down the target ID displayed in the execution result. For details on the raidscan command, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
8. Shut down the CCI software and then open the configuration definition file again.
9. In the **HORCM_DEV** section, set the necessary parameters. For the target ID, set the ID of the raidscan result you wrote down.

   Note: For the MU#, don't set the parameter.
10. In the **HORCM_INST** section, set the necessary parameters, and then save (overwrite) the file.
11. Repeat step 3 to 10 for the horcm1.conf file (Figure 3.27).

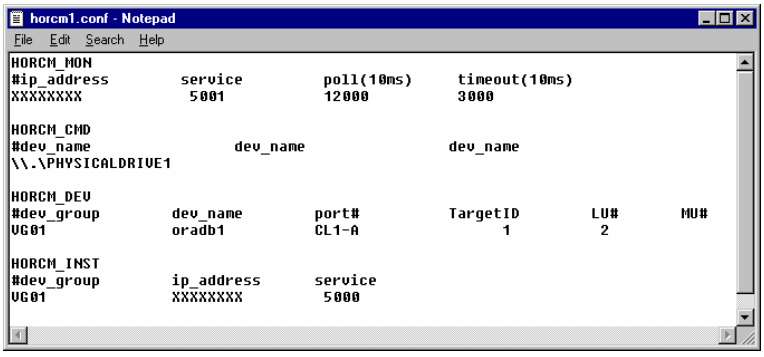


Figure 3.27 Horcm1.conf Example

12. Enter the following in the command prompt to verify the connection between CCI and the subsystem.

    Example:

```
C:\>cd horcm\etc

C:\horcm\etc>echo hd1-3 | .\inqraid
Harddisk 1 -> [ST] CL1-A Ser =75000174 LDEV=   0 [HITACHI  ]  [DF600F-CM     ]
Harddisk 2 -> [ST] CL1-A Ser =75000174 LDEV=   1 [HITACHI  ]  [DF600F        ]
              HORC = SMPL  HOMRCF[MU#0 = NONE  MU#1 = NONE  MU#2 = NONE]
              RAID5[Group 1-0] SSID = 0x0000
Harddisk 3 -> [ST] CL1-A Ser =75000174 LDEV=   2 [HITACHI  ]  [DF600F        ]
              HORC = SMPL  HOMRCF[MU#0 = NONE  MU#1 = NONE  MU#2 = NONE]
              RAID5[Group 2-0] SSID = 0x0000

C:\horcm\etc>
```

For details on configuration definition file, refer to the Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage *Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

3.8 Setting the Environment Variable

3.8.1 Setting the Environment Variable (TrueCopy)

To perform TrueCopy operations, you must set the environment variable for the execution environment. The following describes an example supposing the system configuration with two instances within the same server (Windows NT®/2000).

1. Set the environment variable for each instance. Enter the following from the command prompt.

   Example:

```
C:\HORCM\etc>set HORCMINST=0
```

2. Execute the horcmstart script, and then execute the pairdisplay command to verify the configuration.

   Example:

```
C:\HORCM\etc>horcmstart 0 1
starting HORCM inst 0
HORCM inst 0 starts successfully.
starting HORCM inst 1
HORCM inst 1 starts successfully.

C:\HORCM\etc>pairdisplay -g VG01
group   PairVOL(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status, Fence, Seq#,P-LDEV# M
VG01    oradb1(L)    (CL1-A , 1,  1)75000174     1.SMPL ----- ------,-----   ----  -
VG01    oradb1(R)    (CL1-B , 1,  2)75000175     2.SMPL ----- ------,-----   ----  -
```

Preparing for TrueCopy operation is now complete.

Chapter 4 Performing Command Operations

This chapter provides examples of commands using the Windows NT®/2000 systems and shows icons of the pairs displayed in the Navigator.

To execute commands from the host where CCI is installed, display the command prompt.

This chapter includes the following:

- Creating TrueCopy Pairs (`paircreate`, see section 4.1)
- Splitting TrueCopy Pairs (`pairsplit`, see section 4.2)
- Resynchronizing TrueCopy Pairs (`pairresync`, see section 4.3)
- Suspending TrueCopy Pairs (`pairsplit -R`, see section 4.4)
- Releasing TrueCopy Pairs (`pairsplit -S`, see section 4.5)
- Confirming the Status of TrueCopy Pairs (see section 4.6)
- Confirming the Status of Paths (see section 4.7)
- Troubleshooting (see section 4.8)

4.1 Creating TrueCopy Pairs (paircreate)

To create TrueCopy pairs:

1. In this example, the group name in the configuration definition file is vg01. Execute the `pairdisplay` command to verify that the status of the TrueCopy volume is SMPL.

   Example:

```
c:\horcm\etc>pairdisplay -g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)    (CL1-A , 1,  1 )75000174     1.SMPL ----- ------,-----  ----  -
vg01    oradb1(R)    (CL1-B , 1,  2 )75000175     2.SMPL ----- ------,-----  ----  -
```

2. Execute the `paircreate` commandSelect “fast” (11 to 15) for the -c option, which indicates the copying pace when copying pace is preceded. Select “fast” (11 to 15) when copying pace is preceded. However, when “fast” (11 to 15) is selected, the host I/O performance may be lowered. Therefore, when you need to prevent lowering of performance for the host I/O, select “medium” or “slow” (1 to 10). Then, execute the `pairevtwait` command to verify that the status of each volume is PAIR.

```
c:\horcm\etc>paircreate -g vg01 -vl -c 15
c:\horcm\etc>pairevtwait -g vg01 -s pair -t 300 10
pairevtwait : Wait status done.
```

Figure 4.1 Paircreate Command Example

3. Execute the `pairdisplay` command to verify the pair status and the configuration.

   Example:

```
c:\horcm\etc>pairdisplay -g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)    (CL1-A , 1,  1 )75000174   1.P-VOL COPY Never ,75000175    2  -
vg01    oradb1(R)    (CL1-B , 1,  2 )75000175   2.S-VOL COPY Never ,-----       1  -
```

The TrueCopy pair is created. For details on the `paircreate` command and its options, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

4.2 Splitting TrueCopy Pairs (pairsplit)

To split TrueCopy pairs:

1. In this example, the group name in the configuration definition file is vg01. Execute the `pairsplit` command to split the TrueCopy pair in the PAIR status.

```
c:\horcm\etc>pairsplit -g vg01
```

Figure 4.2 Pairsplit Command Example

2. Execute the `pairdisplay` command to verify the pair status and the configuration.

   Example:

```
c:\horcm\etc>pairdisplay -g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)   (CL1-A , 1,  1 )75000174   1.P-VOL PSUS Never ,75000175    2  -
vg01    oradb1(R)   (CL1-B , 1,  2 )75000175   2.S-VOL PSUS Never ,-----       1  -
```

The TrueCopy pair is split. For details on the `pairsplit` command and its options, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

4.3 Resynchronizing TrueCopy Pairs (pairresync)

To resynchronize TrueCopy pairs:

1. In this example, the group name in the configuration definition file is vg01. Execute the `pairresync` command to resynchronize the TrueCopy pair. Select “fast” (11 to 15) for the -c option, which indicates the copying pace when copying pace is preceded. Select “fast” (11 to 15) when copying pace is preceded. However, when “fast” (11 to 15) is selected, the host I/O performance may be lowered. Therefore, when you need to prevent lowering of performance for the host I/O, select “medium” or “slow” (1 to 10). Execute the `pairevtwait` command to verify that the status of each volume is PAIR.

```
c:\horcm\etc>pairresync -g vg01 -c 15
c:\horcm\etc>pairevtwait -g vg01 -s pair -t 300 10
pairevtwait : Wait status done.
```

Figure 4.3 Pairresync Command Example

2. Execute the `pairdisplay` command to verify the pair status and the configuration.

   Example:

```
c:\horcm\etc>pairdisplay -g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)   (CL1-A , 1,  1 )75000174   1.P-VOL PAIR NEVER ,75000174    2  -
vg01    oradb1(R)   (CL1-B , 2,  2 )75000175   2.S-VOL PAIR NEVER ,-----       1  -
```

The TrueCopy pair is resynchronized. For details on `pairresync` command and its options, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

4.4 Suspending TrueCopy Pairs (pairsplit –R)

To suspend TrueCopy pairs:

1. In this example, the group name in the configuration definition file is vg01. Execute the `pairdisplay` command to verify that the pair to be suspended is in PAIR status.

   Example:

```
c:\horcm\etc>pairdisplay –g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)    (CL1-A , 1,  1 )75000174   1.P-VOL PAIR NEVER ,75000175    2  -
vg01    oradb1(R)    (CL1-B , 1,  2 )75000175   2.S-VOL PAIR NEVER ,-----       1  -
```

2. Execute the `pairsplit` (pairsplit –R) command to split the TrueCopy pair.

```
c:\horcm\etc>pairsplit –g vg01 –R
```

Figure 4.4 Pairsplit –R Command Example

3. Execute the `pairdisplay` command to verify that the pair status changed to SMPL.

```
c:\horcm\etc>pairdisplay –g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)    (CL1-A , 1,  1 )75000174   1.P-VOL PSUE NEVER ,75000175    2  -
vg01    oradb1(R)    (CL1-B , 1,  2 )75000175   2.SMPL ----- ----- ,------ ----   -
```

The TrueCopy pair is split. For details on the `pairsplit` command and the –R option, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

4.5 Releasing TrueCopy Pairs (pairsplit –S)

To split TrueCopy pairs:

1. Execute the `pairsplit` (pairsplit -S) command to release the TrueCopy pair.

```
c:\horcm\etc>pairsplit -g vg01 -S
```

Figure 4.5 Pairsplit –S Command Example

2. Execute the `pairdisplay` command to verify that the pair status changed to SMPL.

   Example:

```
c:\horcm\etc>pairdisplay -g vg01
Group   PairVol(L/R) (Port#,TID, LU) ,Seq#,LDEV#.P/S,Status,Fence, Seq#,P-LDEV# M
vg01    oradb1(L)   (CL1-A , 1,  1 )75000174     1.SMPL ----- ------,-----  ---- -
vg01    oradb1(R)   (CL1-B , 1,  2 )75000175     2.SMPL ----- ------,-----  ---- -
```

The TrueCopy pair is released. For details on the `pairsplit` command and the -S option, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

4.6 Confirming the Status of TrueCopy Pairs

The pair status can be verified in the Navigator. Pair status is displayed in the **Logical Status** page of the Array System Viewer window. P is used to designate a primary volume and S is used to designate secondary volume.

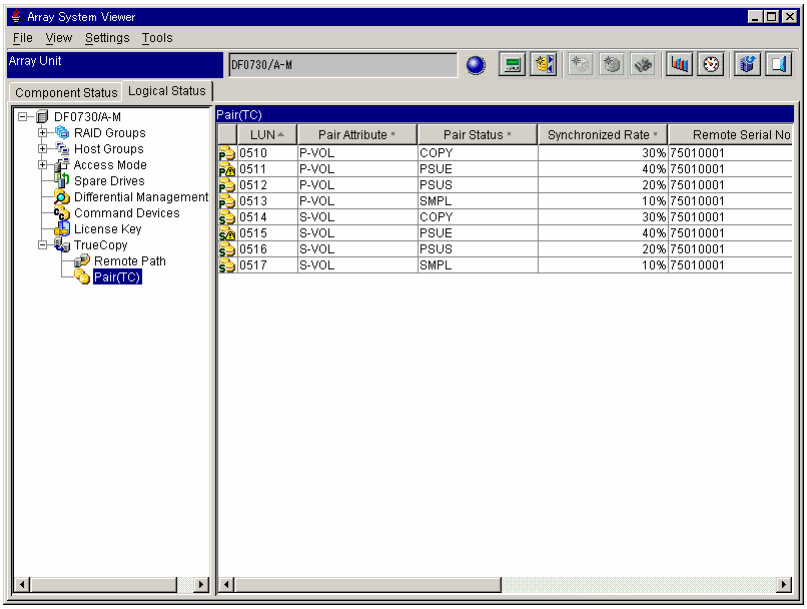


Figure 4.6 Array System Viewer Window (Logical Status Page: TrueCopy Pairs)

Table 4.1 Icons for Pair Status

Volume Status				Paired Status	Meaning
Formatted Yellow	Un formatted Gray	Regressed Pink	Blockaded Red		
				PAIR	Indicates the paired volume.
				COPY	Indicates a paired status, but initial copy or resync operation is not complete.
				PSUS	In paired status, but updates to the S-VOL data are suspended due to user-requested pairsplit.
				PSUE	In paired status, but updates to the S-VOL data are suspended forcibly or due to an error condition.

4.7 Confirming the Status of Paths

The status of paths can be verified in the Navigator.

Path status displays in the **Component Status** page of the Array System Viewer window.

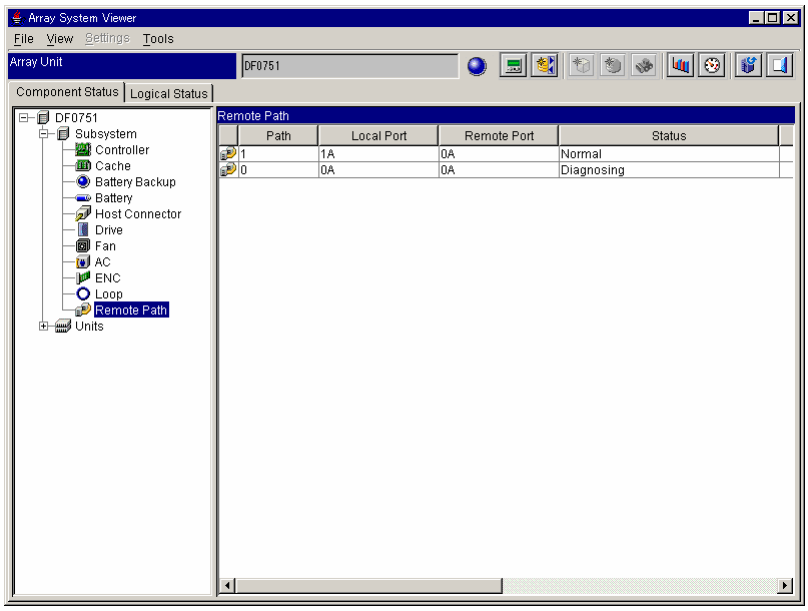


Figure 4.7 Array System Viewer Window (Component Status Page)

4.8 Troubleshooting

If a hardware error occurs while you are operating TrueCopy, both of the following are necessary:

- A CCI user intervention
- Assistance from a Hitachi Customer Service representative

For example, when formatting is needed to resolve an LU error and that LU is used for TrueCopy, the pair must be released by the user (CCI operation by the user) before the LU can be formatted. Therefore, contact Hitachi personnel because maintenance requires the user to issue CCI commands. Note that the Hitachi personnel can only remove errors which result from hardware. An operation such as recovering a TrueCopy pair status (for example, resynchronizing) must be done by the user.

If you have a problem with TrueCopy or ShadowImage™ operation, refer to the Troubleshooting section in the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701). TrueCopy and/or ShadowImage error messages and procedures for recovering the PSUE errors are described in detail.

Chapter 5 Basic Specification and Function Comparison

This chapter includes the following:

- Supported Platforms (see section 5.1)
- Basic and External Specifications (see section 5.2)
- Overview of Command Control Interface (CCI, see section 5.3)
- Host Connection (see section 5.4)

5.1 Supported Platforms

The supported platforms are shown in Table 5.1.

Table 5.1 Supported Platform List

No.	Platform	OS REV	Disaster Recovery		Backup Use	Data Migration Use
			High Availability Configuration (Automatically Switching)	Manual Switching		
1	SUN™	Solaris™ 8 (SPARC)	Supported: VERITAS® Cluster Server™ Not supported: Sun Cluster	Supported	Supported	Supported
		Solaris™ 9 (SPARC)				
		Solaris™ 10 (SPARC)				
		Solaris™ 10 (x86)				
		Solaris™ 10 (x64)				
2	PC Server (Microsoft®)	Windows Server™ 2000	Not supported: MSCS	Supported	Supported	Supported
		Windows Server™ 2003 (IA32)				
		Windows Server™ 2003 (X64)				
		Windows Server™ 2003 (IA64)				
3	HP	HP-UX® 11i V1.0 (PA-RISC)	Case-by-case: MC/Serviceguard™ (See ***Note***)	Supported	Supported	Supported
		HP-UX® 11i V2.0 U2 (PA-RISC)				
		HP-UX® 11i V2.0 U2 (IPF)				
		Tru64 UNIX® 5.1	Not supported: Truecluster	Supported	Supported	Supported
4	IBM®	AIX® 5.1	Supported: HACMP™	Supported	Supported	Supported
		AIX® 5.2				
		AIX® 5.3				
5	Red Hat®	Red Hat Linux® AS2.1 (IA32)	—	Supported	Supported	Supported
		Red Hat Linux® AS3. 0 (IA32)				
		Red Hat Linux® AS4. 0 (IA32)				
		Red Hat Linux® AS3. 0 (EM64T)				
		Red Hat Linux® AS4. 0 (EM64T)				
		Red Hat Linux® AS3. 0 (IA64)				
		Red Hat Linux® AS4. 0 (IA64)				
6	SGI®	IRIX® 6.5.x	—	Supported	Supported	Supported

Note: MC/Serviceguard™ needs to evaluate with "5-node configuration". We will treat as individual if required.

5.2 Basic and External Specifications

The following table lists and describes the basic and the external specifications (restrictions) of TrueCopy.

Table 5.2 Basic and External Specifications

Item	TagmaStore® Specifications (TrueCopy)
User Interface and Basic Specifications	
User Interface	Navigator, Web, CCI
Basic Specification	**CCI (host):** ▪ Takeover function (switching P-VOL and S-VOL) ▪ Pair create (new copy) ▪ Pair splitting and deleting (releasing the pair, suspending copy) ▪ Pair resynchronization (copy) ▪ Event wait (serial automatic execution control for multiple copy) ▪ Pair status display, configuration confirmation ▪ Referencing failure information (log, error messages) ▪ Copy progress display **Navigator:** ▪ Setting the path and the command device ▪ Referencing path status ▪ Setting the differential management LU **Web:** ▪ Referencing path status ▪ Referencing pair status ▪ Referencing the failure information of the subsystem **Disk Subsystem:** ▪ Confirming the failure position using LED ▪ Confirming the failure position using traces (analyzing tool required) ▪ Path check function (function for detecting the path malfunction)
External Specifications	
Copy movement	Copies the whole LU, and the differential data
Dual writing during PAIR status	Only synchronization is supported.
Restrictions for copy destination	WMS100, AMS200, AMS500, or AMS1000 (Installation of TrueCopy is necessary.)
Number of subsystems	Local subsystem and remote subsystem
Maximum number of LUs for creating pairs	WMS100/AMS200: 510 pairs (maximum) AMS500: 2,046 pairs (maximum) AMS1000: 4,094 pairs (maximum)
Number of command device	2LUs *1 Device is used in common with ShadowImage™.
Maximum number of pairs for 1 LU	Supports only 1:1
Size for management of difference data	Fixed at 1 MB.
Location for storing a bit map	1 GB area at the top of the Differential Management LU.

Item	TagmaStore® Specifications (TrueCopy)
Number of Differential Management LUs	One or two (One of them is for mirroring) The Differential Management LUs must be set on both the local and remote subsystems. The Differential Management LU size must be greater than or equal to 5 GB. It is recommended that two Differential Management LUs are set according to the following conditions. ▪ To be created in a different RAID group ▪ To be allocated in different controllers.
Target LU	RAID 1 (1D+1D), RAID 5 (2D+1P to 15D+1P), RAID 1+0 (2D+2D to 8D+8D), RAID 6 (2D+2P to 28D+2P) P-VOL and S-VOL can be paired between different RAIDs. The number of data disks must not be the same.
Number of paths (for 1 pair)	2 paths (1 path/controller, 2 paths for the dual- controller configuration) are required.
LU size	P-VOL = S-VOL
Host access restrictions while copying	The read and write operations for S-VOL are not available under the PAIR status and the COPY status. (Volume cannot be mounted.) The read and write operations for P-VOL are always available.
Types of the drive for a P-VOL/S-VOL	Both LUs consisting of the FC drives and the SATA drives can be assigned to any one of a P-VOL and a S-VOL. However, it is recommended to assign an LU consisting of the FC drives to a P-VOL. When integrating the LUs configured in the SATA drive, the use conditions of the SATA drive may be different (see Table 2.2).
Movement mode of the port	Fibre only. Mixing initiator and target mode.
Path switching when the path failure occurred	Available. Path switching is executed by the subsystem.
Path switching when the controller blockage occurred.	Available. Path switching is executed by the subsystem.
Method for specifying the path	Specified by the remote subsystem serial number, the remote and local port number.
Concurrent use of other copy functions	ShadowImage and SnapShot: available TCE: not available
Cascade connection with ShadowImage	With P-VOL and S-VOL LUs of ShadowImage are possible.
Cascade connection with SnapShot	With P-VOL and V-VOL LUs of SnapShot are possible.
Concurrent use of LUN Expansion	Available.
Concurrent use of Cache Residency Manager	Available. However, the LU specified for Cache Residency (LU cache residence) cannot be set to S-VOL or P-VOL.
Concurrent use of SNMP Agent	Available.
Concurrent use of Password Protection	Available.
Concurrent use of LUN Manager	Available.
Concurrent use of Data Retention	When the S-VOL Disable is set for an LU, a pair creation using the LU as an S-VOL is suppressed. An S-VOL Disable setting of a volume that has already become an S-VOL is not suppressed only when the pair status is PSUS.
Concurrent use of Cache Partition Manager	Available.

Item	TagmaStore® Specifications (TrueCopy)
Concurrent use of Volume Migration	Available. However, a P-VOL, an S-VOL, and Reserved LU of Volume Migration cannot be specified as a P-VOL or an S-VOL of TrueCopy.
Concurrent use of Power Saving	Available. However, when a P-VOL or an S-VOL is included in a RAID group, for which the Power Saving has been specified, no pair operation can be performed except the pair split and the pair release.
Setting copy priority function	Available (e.g. specifying priority with host I/O).
Copy progress display function	Available.
Controller configuration	Since the path is dual, Dual-controller configuration is required.
LU format	Cannot format the LU of the pair of TrueCopy.
LUN Expansion	Cannot expand the LU of the pair of TrueCopy. Cannot specify an expanded LU as a TrueCopy pair.
Deleting RG/LU RG means the RAID groups.	Cannot delete the RG/LU that are the target pair of TrueCopy.
License	TrueCopy becomes usable by entering the key code.
The maximum supported capacity value of P-VOL and S-VOL (TB)	See Table 2.7

Notes:

- For details on command devices, see the Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage *Command Control Interface (CCI) User and Reference Guide* (MK-95DF701). Command device is shared between several hosts. However, this does not mean the data is shared. Command devices must not be used by ordinary applications. Set the command device with caution. For details on setting the command device, see the Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage *Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
- RG means the RAID groups.

5.3 Overview of Command Control Interface (CCI)

Like ShadowImage™, TrueCopy uses commands and options of CCI in order to create pairs, obtain information, and execute copy operation. For more information, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

Table 5.3 shows the supported commands. (Commands are same as HORC.)

Table 5.3 Overview of CCI Commands

#	Item	Commands	Meaning
1	Starting CCI	horcmstart	Starts CCI
2	Terminating CCI	horcmshutdown	Terminates CCI
3	Create pairs	paircreate	Creates a new pair and the P-VOL and S-VOL is specified. Copying is executed in the direction of P-VOL to S-VOL.
4	Split or delete pair	pairsplit	Splits or deletes the pair. For TrueCopy, the pair becomes in a split status during the copy operation. Pair splitting and pair releasing are performed for both P-VOL and S-VOL.
5	Resynchronize pair	pairresync	Resynchronizes the pair. The differential data copying is performed between an already created pairs.
6	Event wait (status wait)	pairevtwait	Checks the status of creating a pair and waits the completion of resynchronization. This command can also be used for specifying logical pairs per group. ***Example***: Copy process (2) is executed after the copy process (1) (pairresync(1)) completes. : pairresync(1) pairevtwait pairresync(2) :
7	Confirming the pair status and the configuration	pairmon	Displays the status transition
8	Reporting the volume attribute	pairvolchk	Reports the volume attribute
9	Displaying the connection configuration	raidscan	Displays the connection configuration
10	Monitoring the statistical information	raidar	Monitors the statistical information
11	Confirming the connection between the host and the subsystem	raidqry	Confirms the connection between the host and the subsystem
12	Changing and displaying the CCI and the command trace control parameter	horcctl	Changes and displays the CCI and the command trace control parameter
13	Confirming the connection of the device file	inqraid	Confirms the connection of the device file
14	Switching P-VOL and S-VOL	horctakeover	HA linkage function

5.4 Host Connection

Access to a Command Device

When a pair is created, the following conditions are necessary:

- It is possible to access from one host to both command devices of TagmaStore® subsystem on the local side and the remote side.
- It is possible to access from two hosts to each TagmaStore subsystem on the local side and the remote side, and two hosts are connected with the LAN.

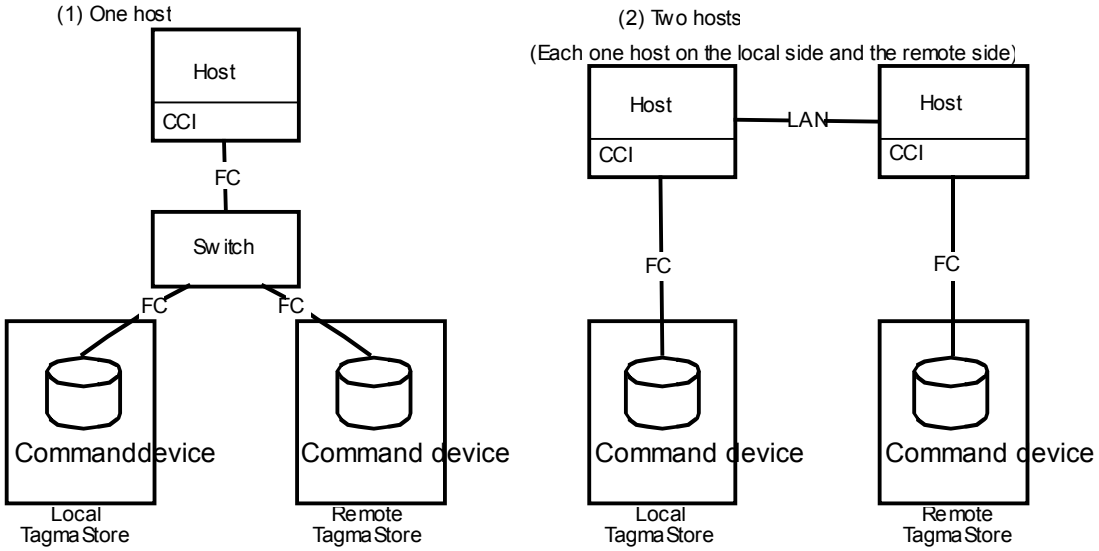


Figure 5.1 Examples of the Host Connection

Note: When a pair is created on TrueCopy, it is necessary to connect two hosts with a LAN for communicating between CCIs on the host associated with the local TagmaStore subsystem and on the host associated with the remote TagmaStore subsystem. When there are two hosts, one host activates both CCIs on the local side and on the remote side; it is not necessary to connect two hosts to the LAN.

Chapter 6 TrueCopy System Configuration

This section contains the following:

- Connection Between TagmaStore® Subsystems (see section6.1)
- Restrictions of Path Setting (see section6.2)
- Combination (see section6.3)
- Recommendations (see section6.4)

Notes:

- Connections between a TagmaStore subsystem and additional TagmaStore subsystems are available.
- For the connection between TagmaStore subsystems, only a direct connection and the Fibre connection via a switch are allowed. A connection via Hub is not available. The connection via a switch supports both F-Port (Point-to-Point) and FL-Port (Loop).
- The setting of two paths for entire TagmaStore subsystem, i.e. one path per one controller, is necessary. For restrictions of path settings, see section 6.2.

6.1 Connection between TagmaStore Subsystems

Some examples of the structure are shown in this section.

6.1.1 Direct Connection

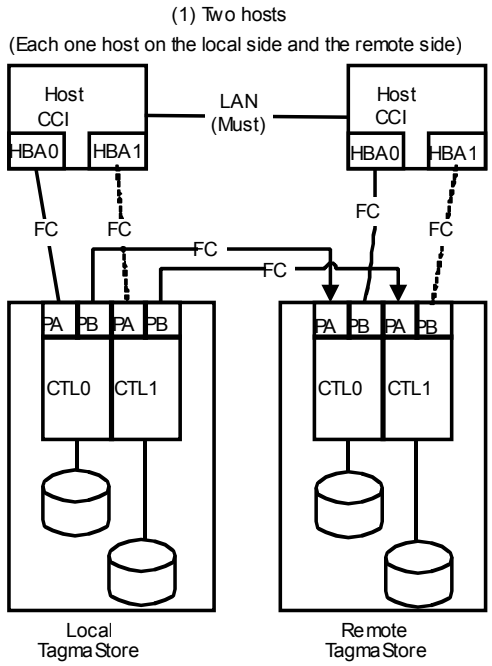


Figure 6.1 Examples of a Direct Connection

Between a host and TagmaStore subsystem, only one path is acceptable. If a configuration has two paths as illustrated in Figure 6.1, a path can be switched when a failure in a path or the controller blockage occurs.

6.1.2 Switch Connection

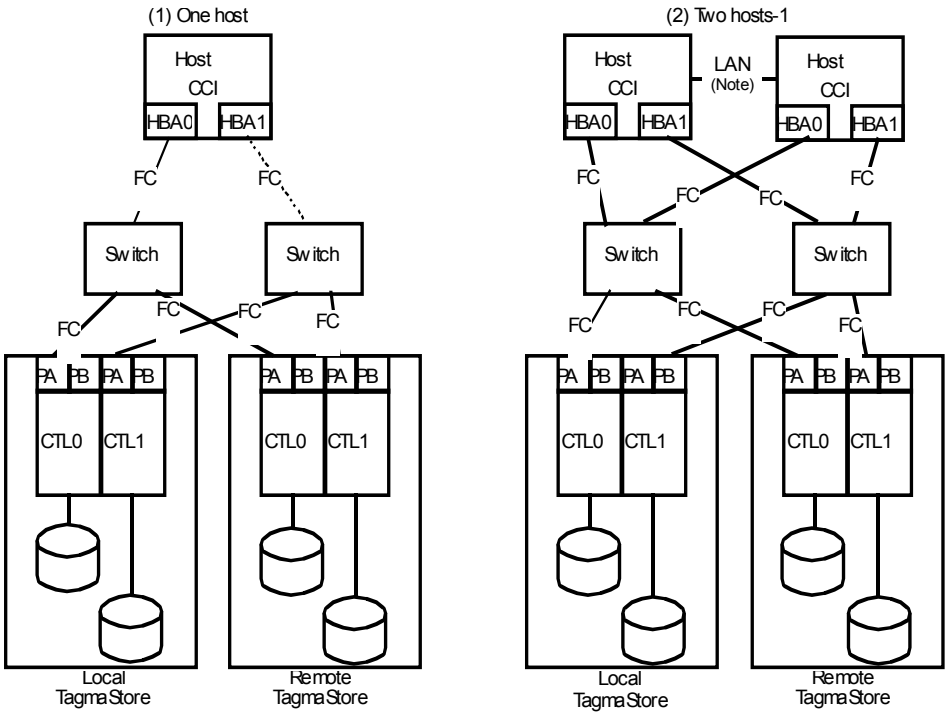


Figure 6.2 Example of Switch Connection-1

Note: When a pair is created on TrueCopy, it is necessary to connect two hosts with the LAN for communicating between CCIs on the host associated with the local TagmaStore subsystem and on the host associated with the remote TagmaStore subsystem. If there are two hosts, one host activates both CCIs on the local side and on the remote side; it is not necessary to connect two hosts with the LAN.

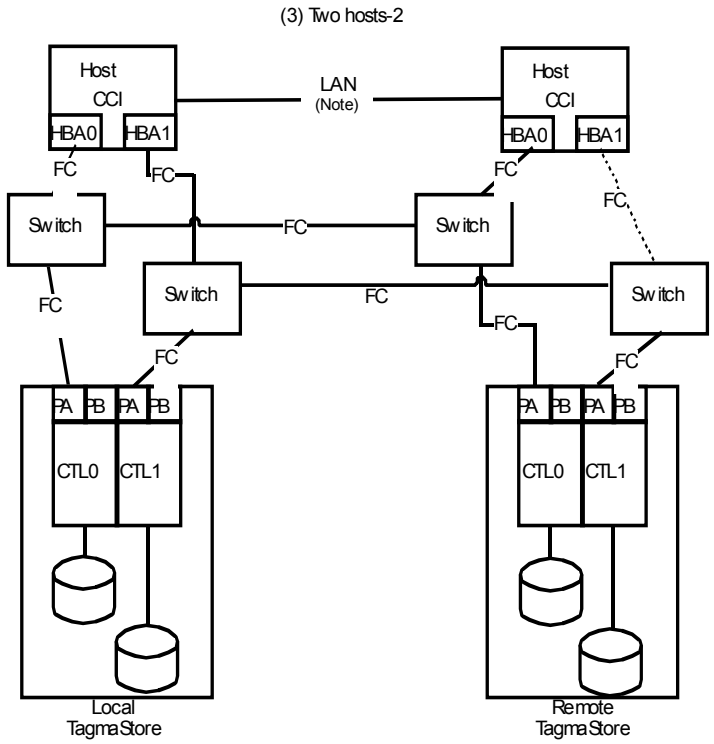


Figure 6.3 Example of Switch Connection-2

Note: When a pair is created on TrueCopy, it is necessary to connect two hosts with the LAN for communicating between CCIs on the host associated with the local TagmaStore subsystem and on the host associated with the remote TagmaStore subsystem. If there are two hosts, one host activates both CCIs on the local side and on the remote side; it is not necessary to connect two hosts with the LAN.

Between a host and TagmaStore subsystem, only one path is acceptable. If a configuration has two paths as illustrated in Figure 6.3, a path can be switched when a failure in a path or the controller blockage occurs.

The TagmaStore subsystem must be connected with a switch as follows (see Table 6.1):

Table 6.1 Connections between TagmaStore Subsystem and a Switch

TagmaStore Mode	Switch		
	For 4 G bps	For 2 G bps	Only for 1 G bps
Auto Mode	From the viewpoint of the performance, one path/controller between the TagmaStore subsystem and a switch is acceptable, as illustrated in Figure 6.2. The same port is available for the host I/O and for copying data of TrueCopy.	See the left column.	From the viewpoint of the performance, a port between the TagmaStore subsystem and a switch has to be provided for the host I/O and for a copying respectively. If the ports are not provided respectively, the performance deteriorates. For Figure 6.2, two paths/controller between the TagmaStore subsystem and a switch, or a switch per a port for the host I/O and for copying TrueCopy respectively have to be provided.
4 G bps Mode		Not available	Not available
2 G bps Mode		See the left column.	Not available
1 G bps Mode	From the viewpoint of the performance, a port between a TagmaStore subsystem and a switch has to be provided for the host I/O and for a copying respectively. If the ports are not provided respectively, the performance deteriorates. For Figure 6.2, two paths/controller between TagmaStore and a switch, or a switch per a port for the host I/O and for copying TrueCopy respectively have to be provided.	See the left column.	See the left column.

6.1.3 One-Path-Connection between TagmaStore Subsystems

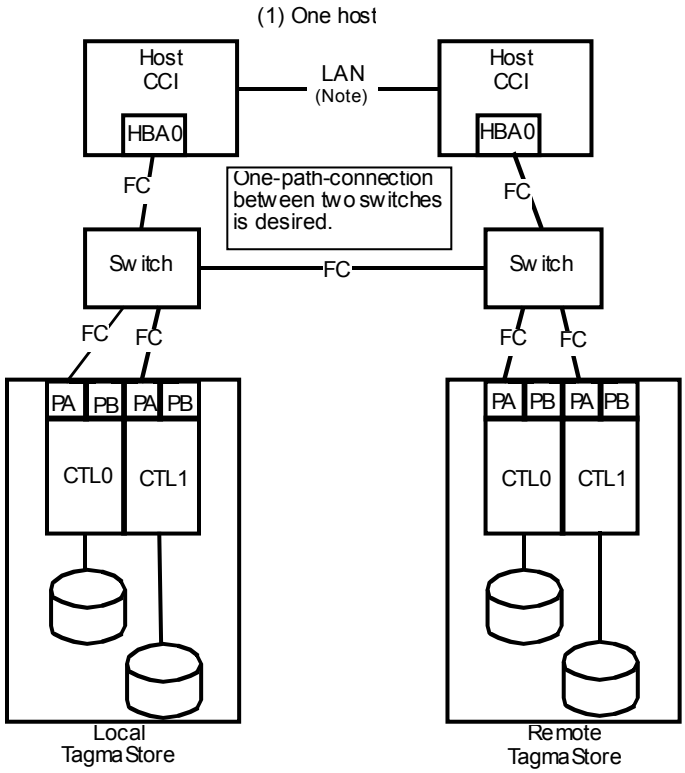


Figure 6.4 Example of a One-Path-Connection

Note: When a pair is created on TrueCopy, it is necessary to connect two hosts with the LAN for communicating between CCIs on the host associated with the local TagmaStore subsystem and on the host associated with the remote TagmaStore subsystem. If there are two hosts, one host activates both CCIs on the local side and on the remote side; it is not necessary to connect two hosts with LAN.

However, if a failure occurs in a switch or a path, a path cannot be switched. Therefore, this configuration is not recommended.

6.2 Restriction of Path Setting

Set one path for one controller, two paths total.

Figure 6.5 shows the combinations of a controller and a port. As illustrated in the following figure, the combination of two CTL0s, or two CTL1s on the local and the remote side (Combination 1) and the combination of CTL0 and CTL1 on both sides (Combination 2) are available.

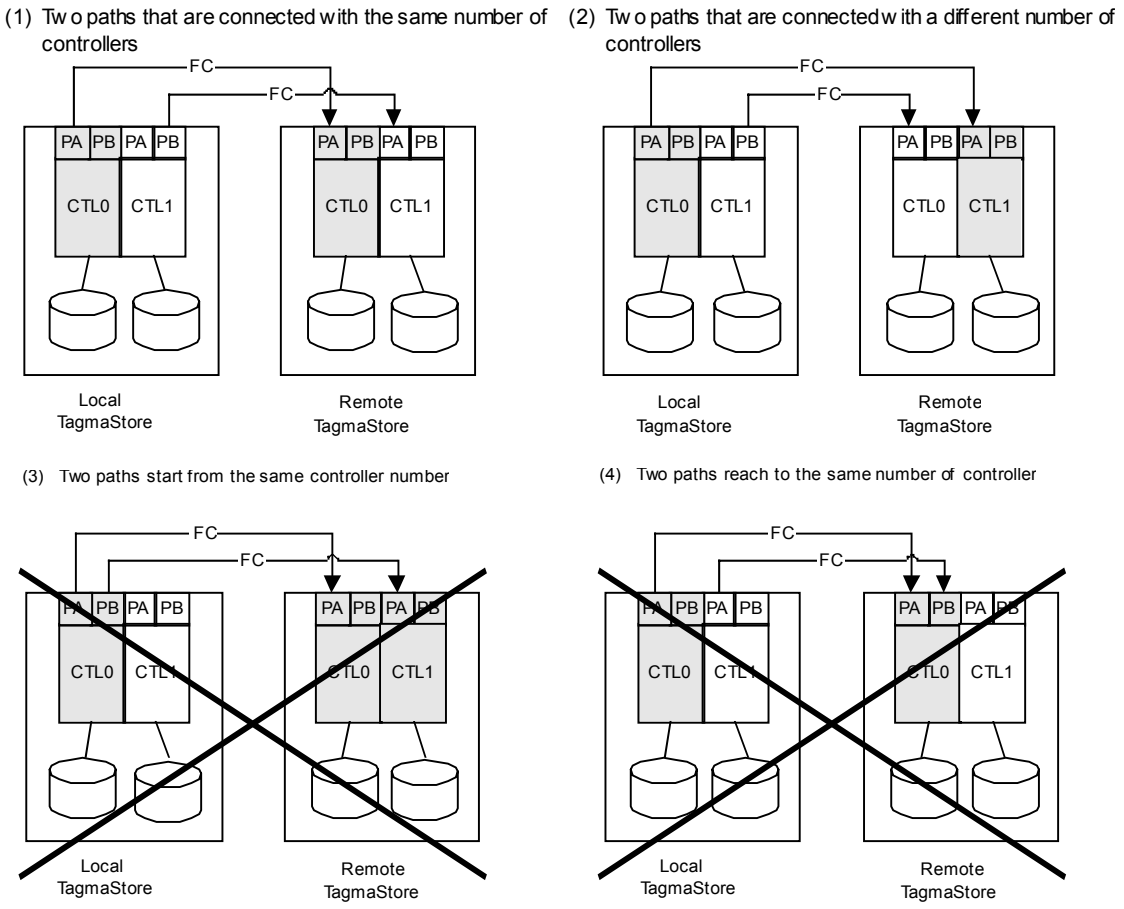


Figure 6.5 Combinations of a Controller and a Port

6.3 Combination

Details of restrictions are included in this section.

6.3.1 Restrictions for the Controller Associated with the LU on Each Path

When the LUs on the local side and the remote side are paired, it is necessary to connect the same number of the controllers on the local side and the remote side. Therefore, (1) in Figure 6.6 is recommended.

In (2) in Figure 6.6, because the copy I/O of TrueCopy between CTL0 and CTL1 on the remote side has to be executed, the performance deteriorates.

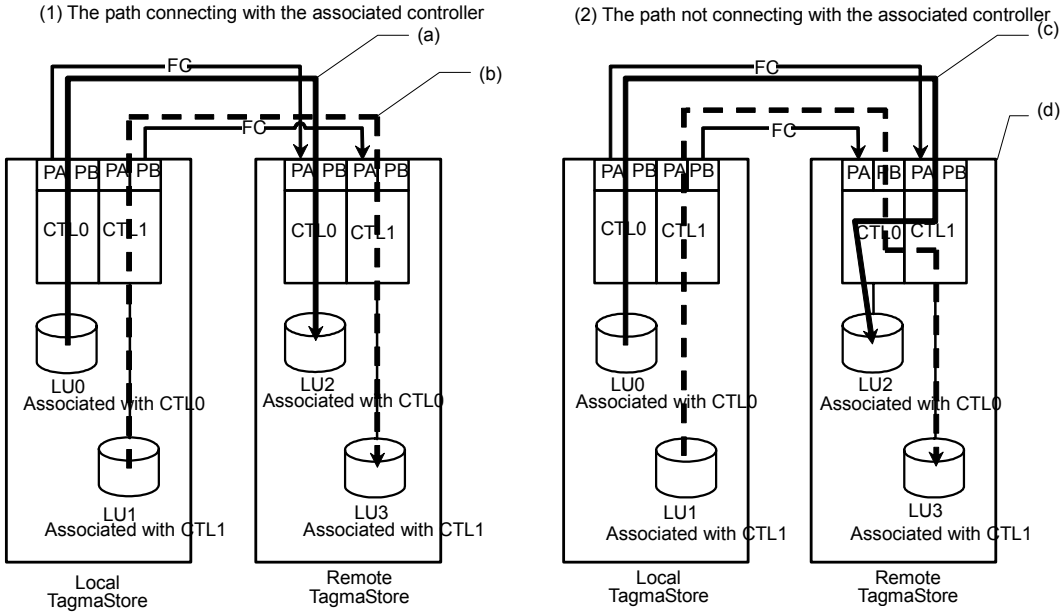


Figure 6.6 Examples of Path Connection

6.4 Recommendations

Consider the following information when you construct a system. If these items are not included, lower performance and/or a path detachment may occur.

6.4.1 Pair Configuration

- Do not assign an LU (required for a quick response to a host) to a pair.

  For a TrueCopy pair, data written to a primary volume is also written to a secondary volume at a remote site synchronously. Therefore, performance of a write operation instructed by a host is lowered according to the distance to the remote site. Select the TrueCopy pair carefully. Observe the matter described above, particularly when an LU required for a high-performance response is required.

- Assign a small number of volumes within the same RAID group.

  When volumes are assigned to the same RAID group and used as pair volumes, pair creation or resynchronization of one volume affects the performance of a host I/O, pair creation, and/or resynchronization of the other pair, so that the performance may be restricted due to drive contention. Therefore, it is best to assign a small number (one or two) of volumes to be paired to the same RAID group. When creating two or more pairs within the same RAID group, standardize the controllers that control LUs in the same RAID group and make the pair creation or resynchronization timely. In the case of the AMS200/WMS100, refrain from issuing a host I/Os to a RAID group that is the same as an S-VOL.

- For a primary volume, use FC drives. (For AMS1000/AMS500/AMS200)

  When a P-VOL is located in a RAID group containing SATA drives, I/O host performance, pair formation, and pair resynchronization, etc. decrease due to the lower performance of the SATA drive. Therefore, it is best to assign a primary volume to a RAID group that consists of FC drives.

- Assign four or more disks to the data disks.

  When the data disks that compose a RAID group are not sufficient, host performance and/or copying performance decreases because reading/writing from/to the drives is restricted. Therefore, when operating pairs with TrueCopy, it is best to use an LU consisting of the four or more data disks.

- When using the SATA drives, make the data disks between 4D and 6D.

  When the number of data disks, which configures a RAID group, is large in the case where the SATA drives are used, the copying performance is affected. Therefore, it is recommended to use an LU with the number of data disks between 4D and 6D for the TrueCopy LU in the case where the SATA drives are used.

- Make the stripe size 64 kB and the segment size 16 kB or less.

  AMS200/WMS100, it is recommended to use an LU, whose stripe size is 64 kB and segment size is 16 kB or less for a TrueCopy LU.

- When cascading TrueCopy and SnapShot pairs, assign a volume of the FC drives to a POOL.

When TrueCopy and SnapShot are cascaded, performance of the drives composing a POOL influences the performance of the host operation and copying. Therefore, it is best to assign a volume of FC drives (which have higher performance) than SATA drives, to a POOL. Since WMS100 cannot use the FC drive, it is not recommended to make an LU that uses WMS100 cascaded with a SnapShot LU.

6.4.2 Pair Creation and Resynchronization

- Create/resynchronize a pair when the I/O load is light.

  Pair creation/synchronization initiates data copying (initial copying) from a primary volume to a secondary volume and therefore affects the performance of the host I/O. It affects the same parity group to which the paired LUs belong. Therefore, it is best to create/resynchronize a pair when the I/O load is light. Perform an operation (such as a batch processing) at a different time from that when a pair is created/resynchronized.

- Restrict the creation/resynchronization of multiple pairs simultaneously.

  If many pairs are created/resynchronized at the same time, pair creation/resynchronization not only affects the performance of the other processes but it also takes longer to create/resynchronize the pair. Therefore, restrict creating/resynchronizing multiple pairs simultaneously. Create/resynchronize pairs in order of necessity. In the case of AMS200/WMS100, it is recommended to make the copying multiplicity two or less.

- When TrueCopy and ShadowImage™ pairs are cascaded and one of them is placed in the PAIR/COPY status, place the other in PSUS status.

  When TrueCopy and ShadowImage are cascaded, if both of TrueCopy and ShadowImage pairs are in the PAIR or COPY status, operating performance decreases because data copying or writing for synchronization of TrueCopy and ShadowImage are performed at the same time. Therefore, when cascading TrueCopy and ShadowImage, it is best to operate pairs as described below.

  - When a TrueCopy pair is in the PAIR status or when you are creating and resynchronizing it, set the ShadowImage pair in the PSUS status.
  - When a ShadowImage pair is in the PAIR status or when you are creating and resynchronizing it, set the TrueCopy pair in the PSUS status. When creating and resynchronizing the ShadowImage pair, leaving the TrueCopy pair in the PAIR status, perform the operations at a time when the host I/O load is not heavy.

- For a bi-directional TrueCopy pair, perform a pair creation/resynchronization in each direction, one-by-one.

In a configuration in which each site serves as both local and remote sites, as shown in Figure 6.7, if creation and resynchronization of a pair are performed from the both sites at the same time, the time from pair creation until completion of the resynchronization becomes longer. Additionally, the influence on the performance of the other operation becomes greater because reading and writing of data are done at the both sites, parallel with each other. Therefore, is best to perform pair creation and resynchronization in one direction at a time and one-by-one. In the case of AMS200/WMS100, an operation with the bidirectional configuration is not recommended. When the configuration is temporarily made bidirectional because of the resynchronization (swapping), place all of the pairs to be resynchronized (swapped) and the pairs processed in the reverse direction in the PSUS status.

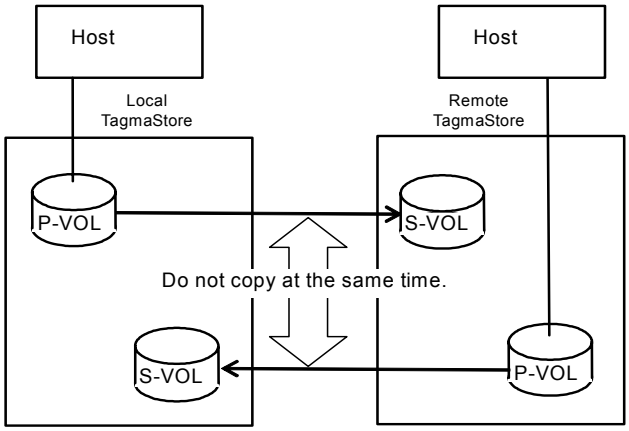


Figure 6.7 Bi-directional Operation-1

- For a bi-directional TrueCopy pair in the PAIR or Copy status in one of two directions, a pair operation in the other direction is suppressed or restricted.

  When a TrueCopy pair is in a PAIR or COPY status in one of two directions and the write data sent from a host is overwritten to the remote side in a configuration in which both sites are local and remote at the same time, a pair operation (creation, resynchronization, or releasing) performed on the TrueCopy pair in the other direction affects execution of a host I/O (See Figure 6.8). This occurs because the pair operation is performed preferentially. Especially, when pair operations are performed continuously, the host I/O execution is greatly affected. Therefore, a TrueCopy pair in a PAIR or COPY status in one of two directions, suppress a pair operation in the other direction. When TrueCopy pairs are in the PAIR or COPY status in one of the two directions, it is impossible to suppress operations on them in the other direction. Limit the number to be operated to a few at a time and insert the wait times of approximately several tens of seconds between the adjacent pair operations.

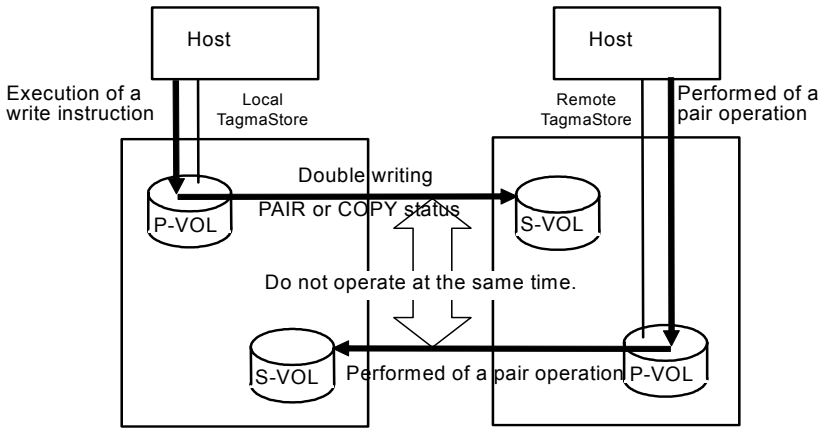


Figure 6.8 Bi-directional Operation-2

6.4.3 Remote Processing

- Considerations for remote processing:

  When a write I/O instruction received at a local site is executed at a remote site synchronously, performance attained at the remote site directly affects performance which is attained at the local site. The performance attained at the local site or the system is lowered when the remote site is overloaded, due to a large number of updates, etc.

  Therefore, carefully monitor the load on the remote site as well as the local site.

6.4.4 Command Devices

- Locating command devices:

  When two command devices are set within the one disk subsystem, assign them to the respective RAID groups; if they are assigned to the same RAID group, both command devices become unavailable due to difficulties such as a drive failure.

Chapter 7 Extender

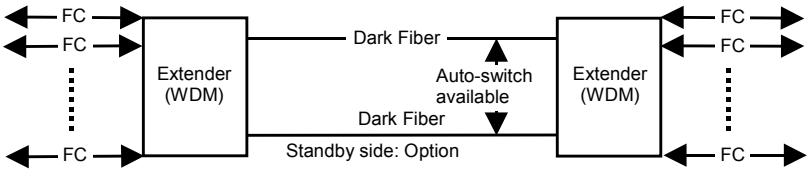
7.1 Extender for Wavelength Division Multiplexing (WDM)

7.1.1 Overview

This section explains an extender to support Wavelength Division Multiplexing (WDM).

The different wavelength lights do not interfere with each other. By using this characteristic, WDM is the optical communications technology for increasing information transmission amounts dramatically. The number of the wavelength is in accordance with multiplexing several different wavelength optical signals on a dark fiber. Multiplexing several channels of the optical signal is called WDM; multiplexing several dozen channels of the optical signal is called Dense WDM (DWDM).

The overview of WDM is illustrated in Figure 7.1.



- By converting several wavelengths of the optical signal, such as Fibre Channel, it is possible to transmit the data via one dark fiber.
- By duplicating the dark fiber using the function of an extender for WDM, it is possible to automatically switch to dark fiber on the stand-by side when a failure occurs.

Figure 7.1 Overview of WDM

An example of the configuration (HA configuration) is shown below (see Figure 7.2).

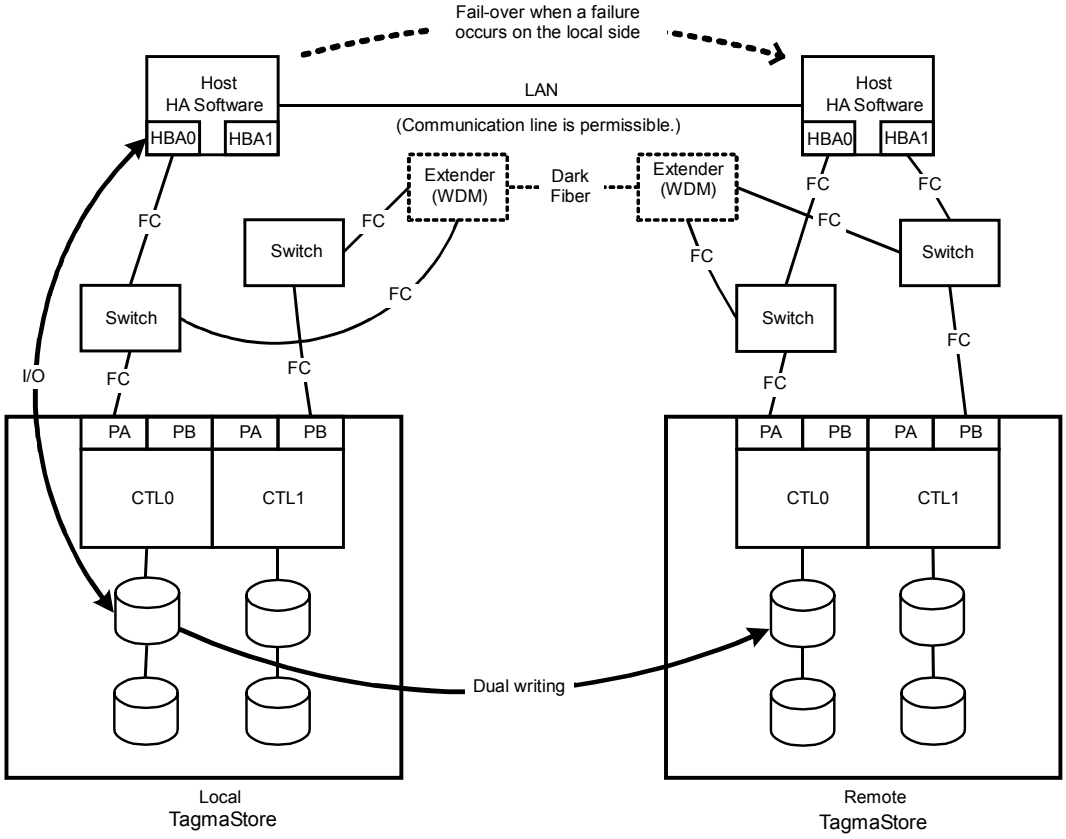


Figure 7.2 Example of HA Configuration

Presently, the communication enterprises offer the dark fiber. Therefore, the combination of the dark fiber and an extender for WDM makes the long-distance transmission possible at 1 Gbps, which is the same speed of the fibre channel. (There are small numbers of dark fibers for 2 Gbps fibre channel.)

If the distance will extend, the response time will increase. (The measure of the response time is approximately 5 ms for 100 km.) For more detail, contact a carrier.

Dark fiber is optical fiber that does not work but it is laid. Optical fibers are generally laid from several dozen fibers to several hundred. Only needed fibers are activated; others are left as dark fiber.

7.1.2 Communication Line (Dark Fiber) when using WDM

When WDM is used, the response time will extend. This deterioration of response time has to be covered with increasing BB-Credit (the number of buffer) of fibre channel and the transmission volume, without waiting for the response. Therefore, a switch is required.

If the TagmaStore® subsystem is connected directly to an extender for WDM without a switch, BB-Credit is 4 or 8. If they are connected with a switch (Brocade), BB-Credits are 16. It can hold up to 10 km, on the standard scale. BB-Credit can be increased up to 60; it can hold up to 100 km by adding Extended Fabrics to a switch.

For short distances (within several dozen kilometers), both signals of IN and OUT can be transmitted via one dark fiber.

For long distances (more than several dozen kilometers), an optical amplifier is required to amplify the wavelength between two extenders to prevent the attenuation through a fiber. Therefore, dark fibers are required to prepare for IN and OUT respectively (see Figure 7.3).

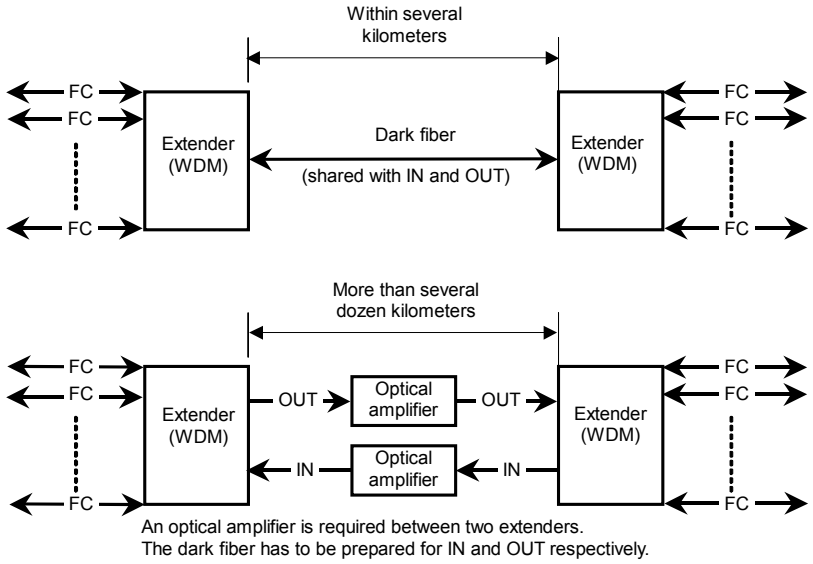


Figure 7.3 Dark Fiber with WDM

If switching is executed when a failure in the dark fiber occurs, the dark fiber in other path has to be selected. If the fiber in the same path is selected, several failures may occur in several dark fibers simultaneously because optical fibers are laid from several dozen fibers to several hundred, as mentioned previously (see Figure 7.4).

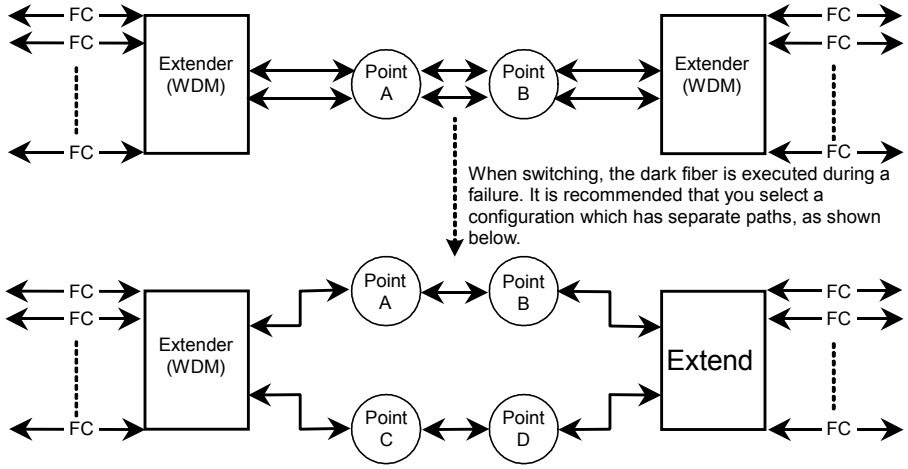


Figure 7.4 A Failure in the Dark Fiber

WDM function can be multiplexed not only in Fibre Channel but also in Gbps Ethernet in one dark fiber. While monitoring an extender for WDM or TagmaStore subsystem by using LAN, if a failure occurs in the dark fiber, you cannot confirm the condition of each device. We recommend that you secure another line for monitoring in addition to the line for the data transmission (see Figure 7.5).

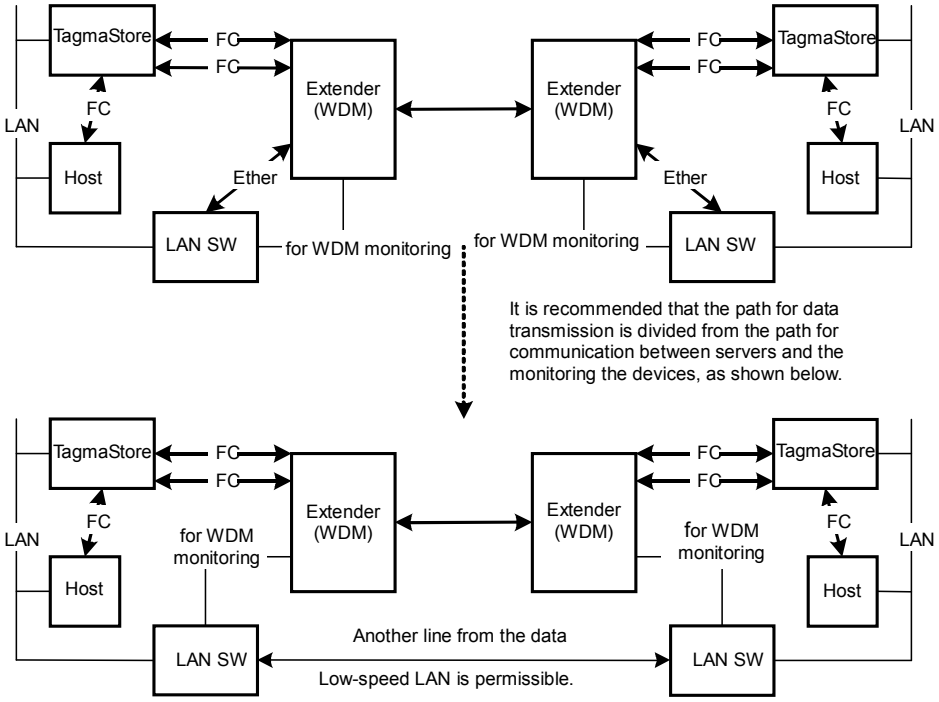


Figure 7.5 Line for Monitoring

7.1.3 Maintenance and Operation

If the connection with WDM is used in the customer's environment, a test period is required before the actual operation. A sufficient investigation for the connection to meet the customer's environment is necessary.

TagmaStore subsystem and a switch that is the product of Hitachi OEM are maintained with Hitachi's responsibility. Because an extender for WDM and the communication line of the dark fiber between two WDMs are not the Hitachi's product, the maintenance is up to a user. If the switch is not a product of Hitachi OEM, the user is responsible for maintenance. A consensus about a partial charge for the maintenance and operation is negotiated between the user and Hitachi Customer Service.

Chapter 8 Example of System Operation

This section includes the following:

- Disaster Recovery (see section 8.1)
- Backup Use (see section 8.2)
- Data Migration Use (see section 8.3)

8.1 Disaster Recovery

If both the host and the disks (TagmaStore® subsystem) on the local side are destroyed by a disaster condition (for example, an earthquake), data recovery and continuing operation are executed by the stand-by host and the disks on the remote side.

8.1.1 Automatic Switching by High Availability (HA) Software

By installing the High Availability (HA) Software on both the local side and the remote side, when a failure occurs in the host or in the subsystem, although the input and output operation from the host on the local side cannot be executed, operation will continue by automatically switching over to the stand-by host on the remote side. A configuration is shown below (see Figure 8.1).

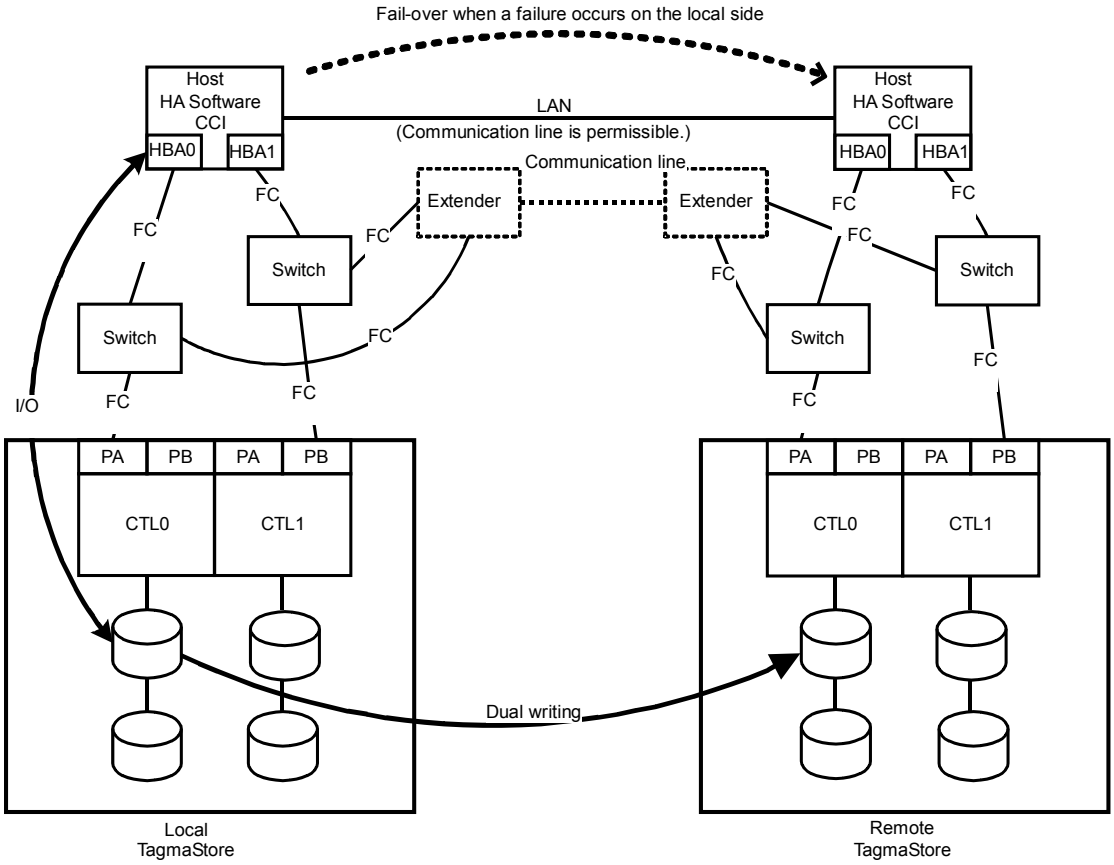


Figure 8.1 Configuration for Failover

When a failure occurs on the local side, a host is switched into the stand-by host on the remote side (failover) by HA software. Automatically executing the script of the recovery process in the stand-by host on the remote side enables the host on the remote side to continue the operation.

Note: Several minutes are needed for the switching process.

Recovery processes for the database and file system are as follows:

1. Database
   - Issuing the `takeover` command of CCI from the stand-by host makes the stand-by host possible to access the disk on the remote side.
   - By using RED0 log, the data of the database is recovered.
2. File system
   - Issuing the `takeover` command of CCI from the stand-by host on the remote side makes the stand-by host possible to access the disk on the remote side.
   - For UNIX®, the file of fsck and Windows® is recovered by executing 'chkdsk'.

For details of the system recovery by takeover, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

8.1.2 Manual Switching

As mentioned in this section, if the host on the local side can access TagmaStore subsystems on both the local side and the remote side via the Fibre Channel, the stand-by host on the remote side can be OFF. If the host on the local side can access the disks on both the local side and the remote side, it is not necessary to connect with the host on the local side and the stand-by host on the remote side with LAN (see Figure 8.2).

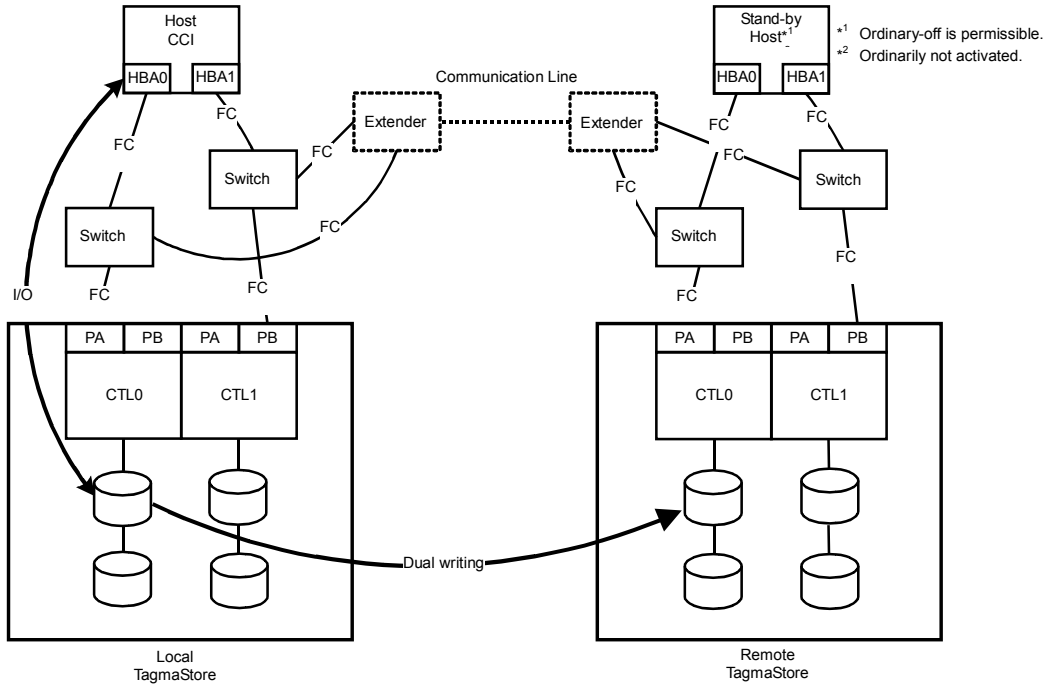


Figure 8.2 Disaster Recovery

The process of manual switching:

When a failure occurs on the local side, executing the script for the recovery process enables continuous operation by the stand-by host.

The recovery processes for the database and the file system are as follows:

1. Database
   - Issuing the take-over command of CCI from the stand-by host on the remote side makes the stand-by host possible to access the disk on the remote side.
   - By using RED0 log, the data of the database is recovered.
2. File system
   - Issuing the `takeover` command of CCI from the stand-by host on the remote side makes the stand-by host possible to access the disk on the remote side.
   - For UNIX, the file of fsck and Windows is recovered by executing 'chkdsk'.

For details of the system recovery by takeover, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

8.2 Backup Use

8.2.1 TrueCopy Ordinary Split Operation

When the host I/O is lightly executed (for example, at night) resync is executed. After resync, I/O operation of the database on the local side is stopped and the pair is split (see Figure 8.3).

Note: When a copy operation on ShadowImage™ and TrueCopy is performed, the copy prior mode is recommended.

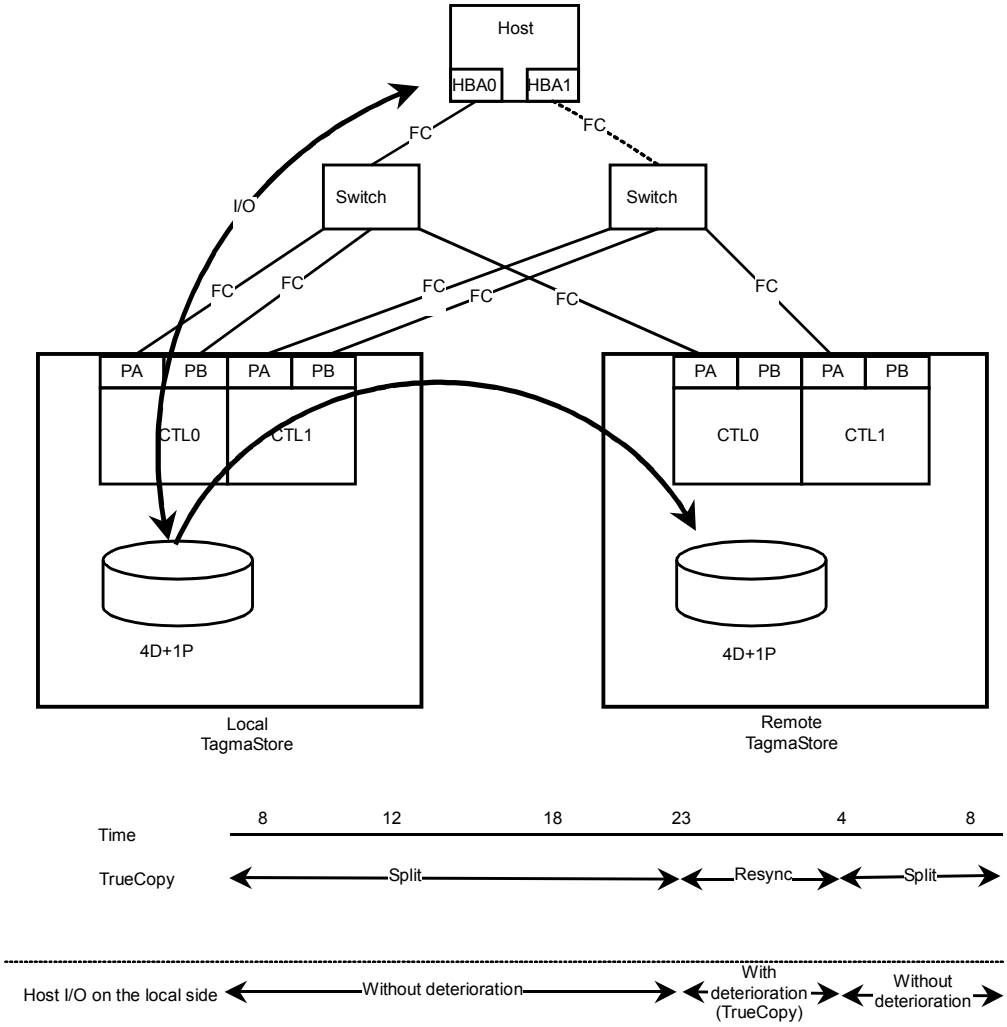


Figure 8.3 TrueCopy Ordinary Split Operation-1

If the LUs are cascaded via ShadowImage on the remote side and resync of TrueCopy is executed after LUs on ShadowImage split, the data is saved in the secondary side of ShadowImage even though a failure occurs during the resync of TrueCopy (see Figure 8.4).

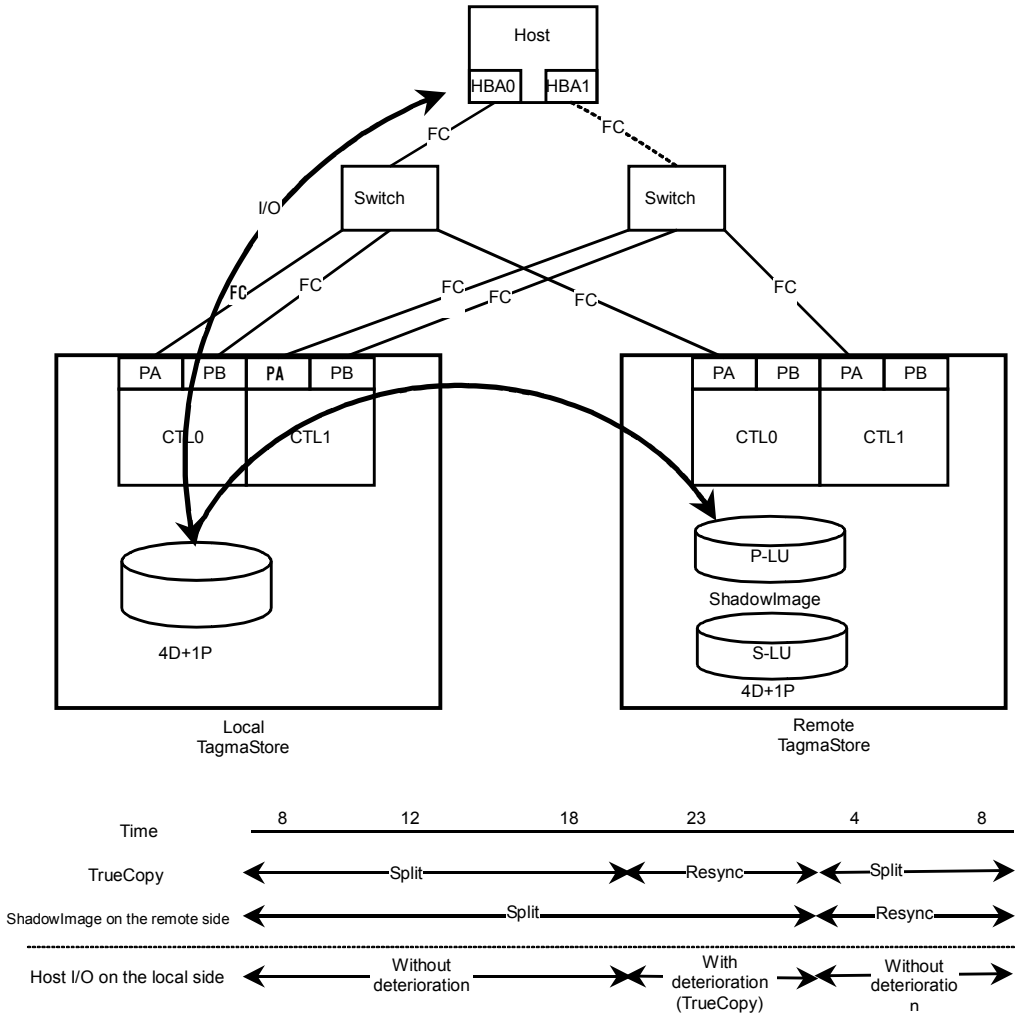


Figure 8.4 TrueCopy Ordinary Split Operation-2

During the split status of TrueCopy, the host I/O performance does not deteriorate because the host does not write to the remote side. Since the data when TrueCopy is split after resync is not saved, the data from when a pair of TrueCopy is split to when a failure occurs is not saved. Therefore, we recommended this operation to the user who attaches importance to the host I/O performance.

8.2.2 TrueCopy Ordinary Pair Operation

If you want to backup the data and a pair of TrueCopys is split, the backup data at the time remains on the remote side. By cascading LUs with ShadowImage on the remote side, the data when a pair of ShadowImages are split is saved on the secondary side of ShadowImage (see Figure 8.5).

Note: When a copy operation on ShadowImage and TrueCopy is performed, the copy prior mode is recommended.

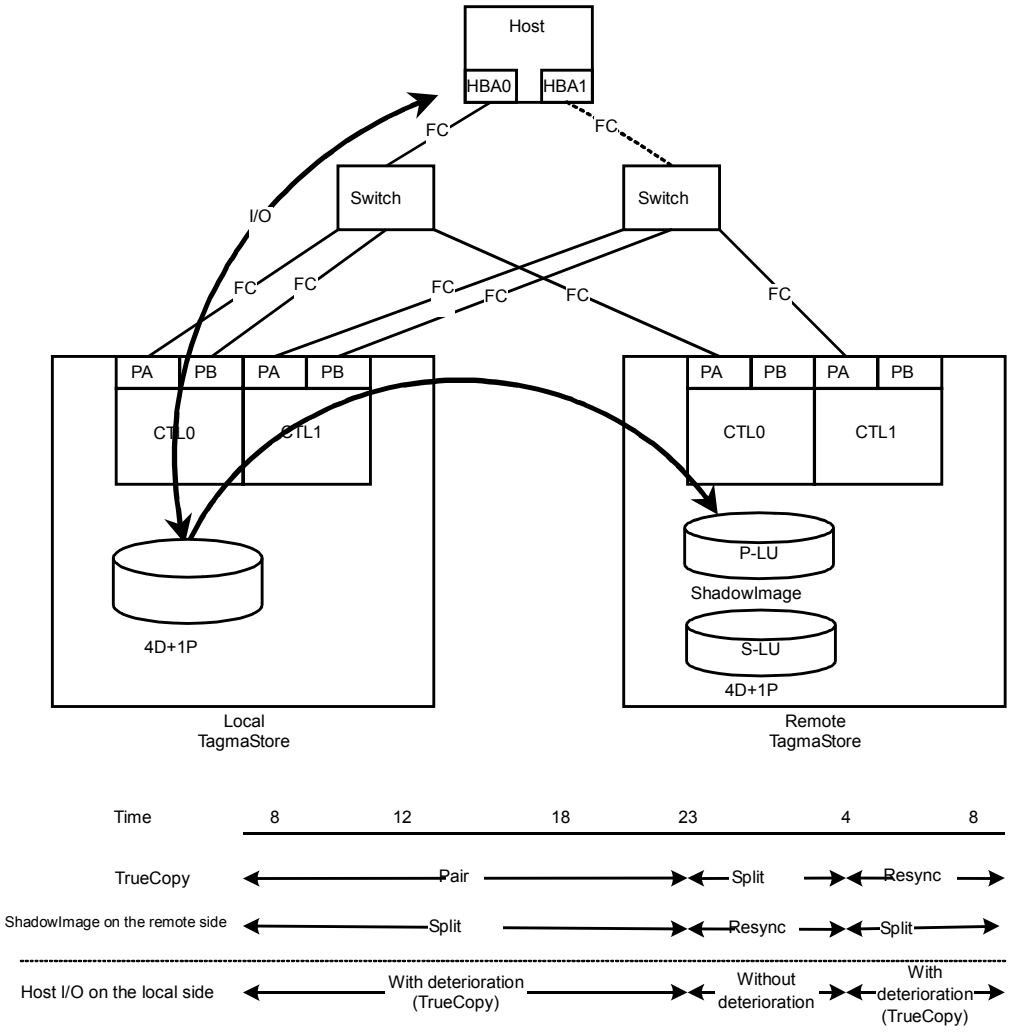


Figure 8.5 TrueCopy Ordinary Pair Operation

The performance of the write operation from the host during the pair status deteriorates because the subsystem gives a “finish” response to the host after writing to the subsystem on the remote side. Therefore, we recommend this operation to the user who attaches importance to data recovery when failure occurs.

8.3 Data Migration Use

8.3.1 TrueCopy Ordinarily Split Operation

If you want to use the data on the local side from the remote side and the pair of TrueCopys is split directly after the resync operation is performed, the data of the local side at this point in time remains on the remote side (see Figure 8.6).

Note: The copy operations are performed in the copy prior mode.

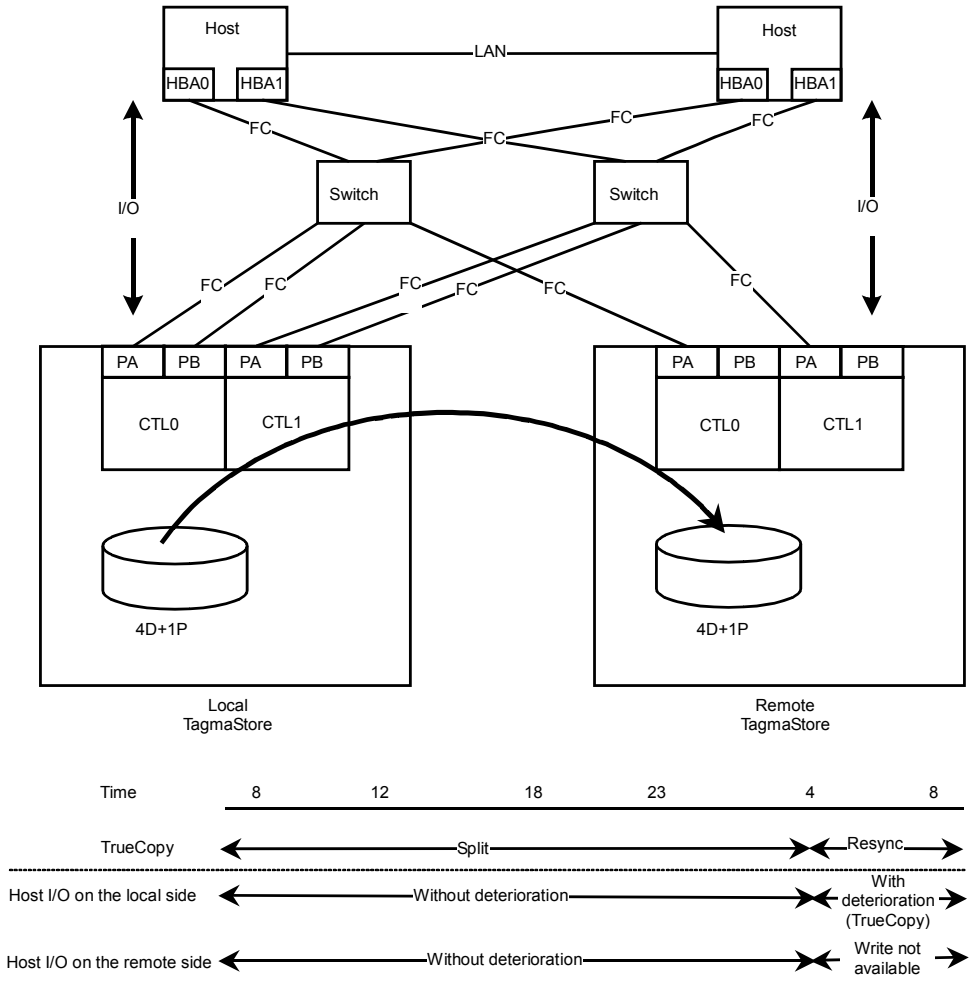


Figure 8.6 Data Migration Use

Chapter 9 Restrictions

This section includes the following:

- Host Timeout (see section 9.1)
- For VxVM and TrueCopy Configuration (see section 9.2)
- For AIX® and TrueCopy Configuration (see section 9.3)
- Windows Server™ 2003 and TrueCopy Configuration (see section 9.4)
- Linux® and LVM Configuration (see section 9.5)
- Windows® 2000/Windows Server 2003 and Dynamic Disk (see section 9.6)
- Restrictions using One Host (see section 9.7)
- Conflict with Command for Format, Synchronize Cache, and Verify (see section 9.8)
- Changing Order of Copy Execution when Receiving Multiple Requests from CCI (see section 9.9)

9.1 Host Timeout

It is recommended that you set more than 60 seconds for the I/O timeout from the host to the TagmaStore subsystem.

9.2 VxVM and TrueCopy Configuration

- **Volumes to be recognized by the same host**

  If you have set the P-VOL and the S-VOL to be recognized by the same host, the VxVM will not operate properly. Set only the P-VOL of TrueCopy to be recognized by the host.

9.3 AIX® and TrueCopy Configuration

- **Volumes to be recognized by the same host:**

  If you have set both the P-VOL and the S-VOL to be recognized by the same host, AIX® will not operate properly. Set only the P-VOL to be recognized by the host.

9.4 Windows Server™ 2003 and TrueCopy Configuration

- Volume mount:

  When mounting a volume, use Volume{GUID} as an argument of the mount command of CCI. The Volume{GUID} can be used by CCI 01-13-03/00 or later. (For more detail, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

- Command devices:
  - When describing a command device in the configuration definition file, specify it as Volume{GUID}. For more detail, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).
  - When a path detachment, which is caused by a controller detachment or fibre channel failure, continues for longer than one minute, the command device may be unable to be recognized when recovery from the path detachment is made. To make the recovery, execute the "re-scanning of the disks" of Windows. When Windows cannot access the command device, although CCI becomes able to recognize the command device, restart CCI.

9.5 Linux® and LVM Configuration

- **Volumes to be recognized by the same host:**

  If you have set both the P-VOL and the S-VOL to be recognized by the same host, LVM will not operate properly. Set only the P-VOL to be recognized by the host.

9.6 Windows® 2000/Windows Server 2003 and Dynamic

9.6.1 Environments

In an environment of the Windows Server 2000, you cannot make a P-VOL and an S-VOL (V-VOL) into a dynamic disk. In an environment of the Windows Server 2003, you can use a P-VOL and an S-VOL (V-VOL) as a dynamic disk.

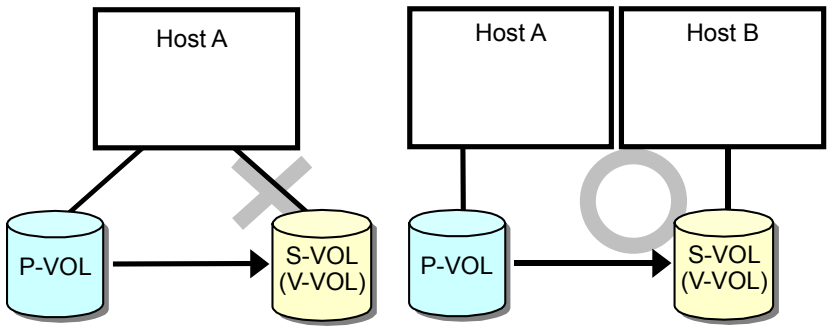
Note: A dynamic disk is a function of Windows 2000/Windows Server 2003.

9.6.2 Restrictions

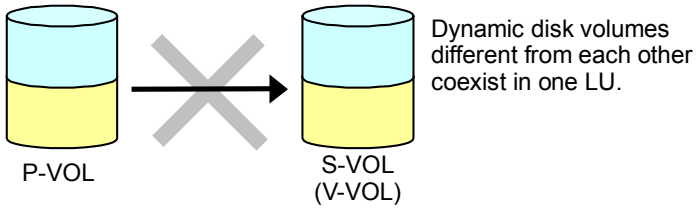
Observe the following when you use a dynamic disk with Windows Server 2003.

Follow the restrictions of the copy functions (ShadowImage, SnapShot, TrueCopy, and TCE) in addition to the following restrictions. For the restrictions of the each copying function, refer to the corresponding manual.

- When a secondary host uses an S-VOL (V-VOL), verify that the host recognizes it after making sure that the pair status is PSUS after the pair is created.
- One host cannot recognize both a P-VOL and an S-VOL (V-VOL).



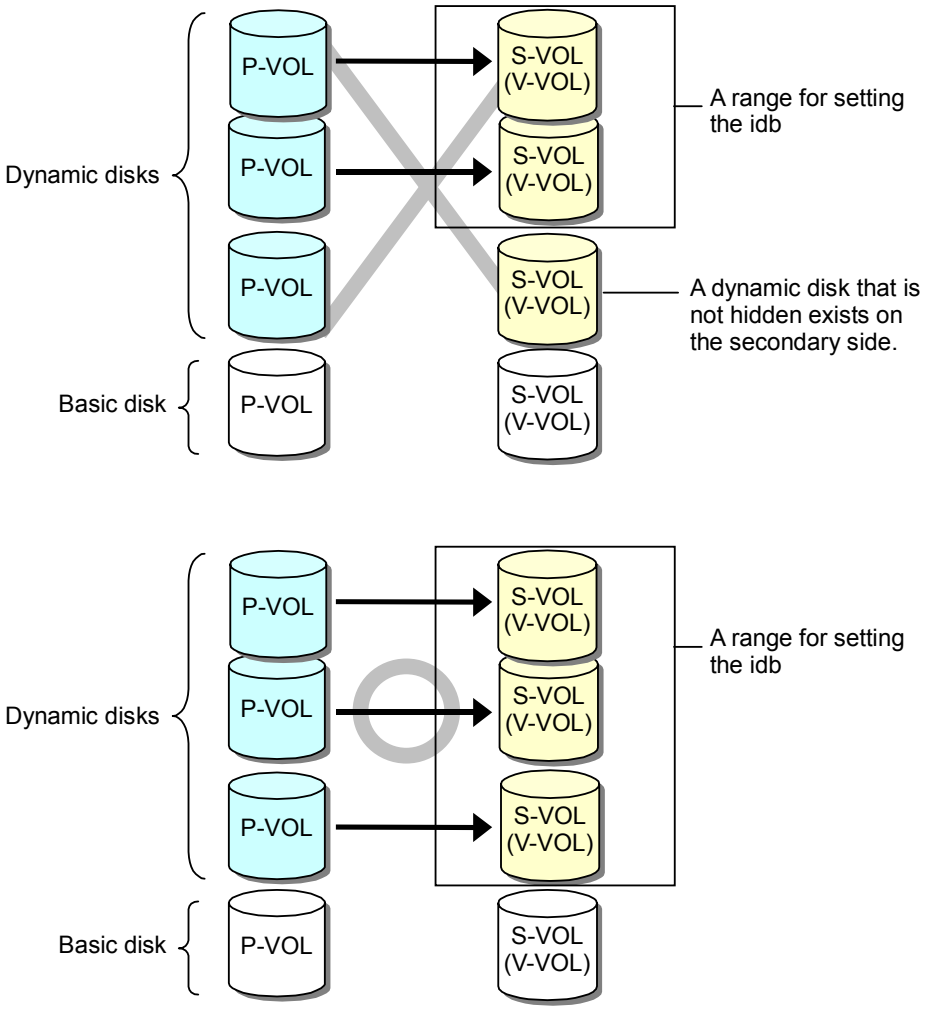
- An LU, in which two or more dynamic disk volumes coexist, cannot be copied.



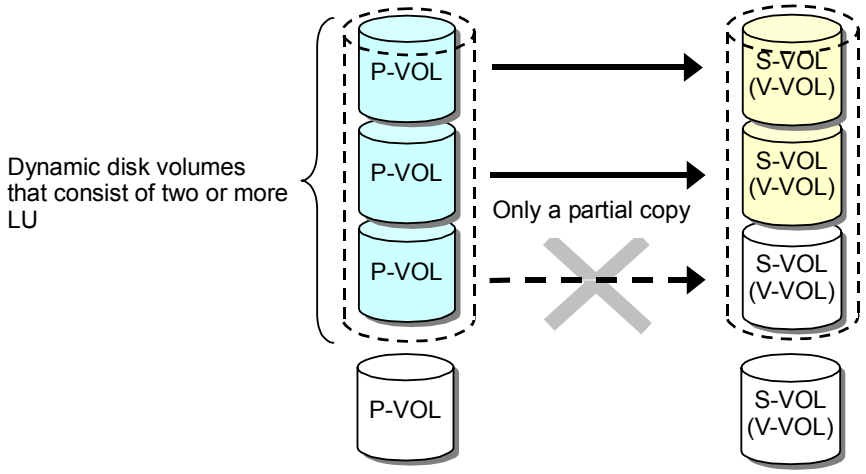
- Do not use a dynamic disk function for volumes other than an S-VOL (V-VOL) on the secondary host side.

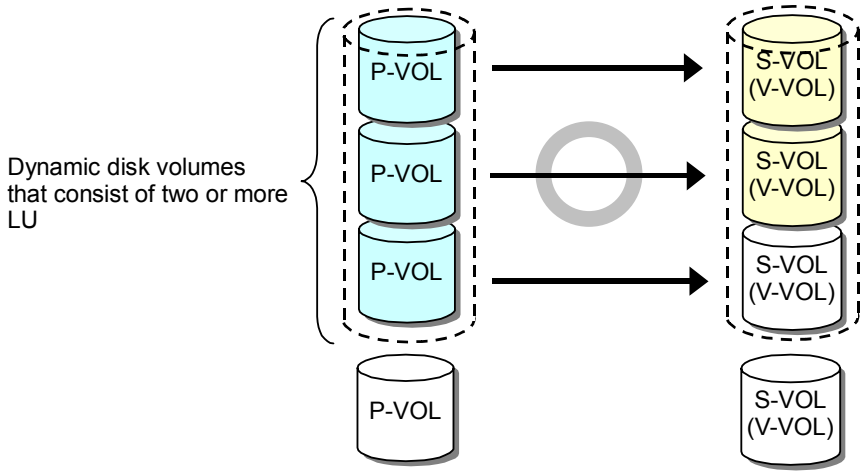
  When copying, hide all the dynamic disks exist on the primary side using `raidvchkset -vg idb`. No restriction is placed on the primary side. (Hide all the dynamic disk volumes to be restored on the primary side at the time of restoration.)

  If any one of the dynamic disks is left unhidden, a **Missing** drive occurs. When this occurs, delete it manually using the `diskpart delete` command.



- When copying dynamic disk volumes that consist of two or more LUs, do this after hiding all LUs composing the dynamic disk at the same time. After the copy is completed, release LUs from being hidden and have them recognized by a host.





- A dynamic disk cannot be used with a cluster (MSCS, VCS, and etc).
- A dynamic disk cannot be used with VxVM and HDLM.

9.7 Restrictions for Using One Host

Table 9.1 describes the restrictions for each OS.

Table 9.1 The Restrictions for Each OS

No.	OS	Restrictions
1	Windows NT®, 2000/Windows Server 2003	The target LU for TrueCopy has to recognize and release a drive with “mount” and “unmount” command of CCI instead of your specifying the drive letter. Cannot use “mountvol” command of Windows 2000/Windows Server 2003 because the data is not output when releasing. (For more detail, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701). Cannot combine with a path switching software.
2	HP-UX	Available. Cannot mount at the same time. Can combine with a path switching software (PV-Link).
3	Sun™	Available. Cannot mount at the same time. Cannot combine with a path switching software because of the restrictions of section 9.2.
4	AIX®	Not available because of the restrictions of section 9.3.

9.8 Conflict With Command for Format, Synchronize Cache, and Verify

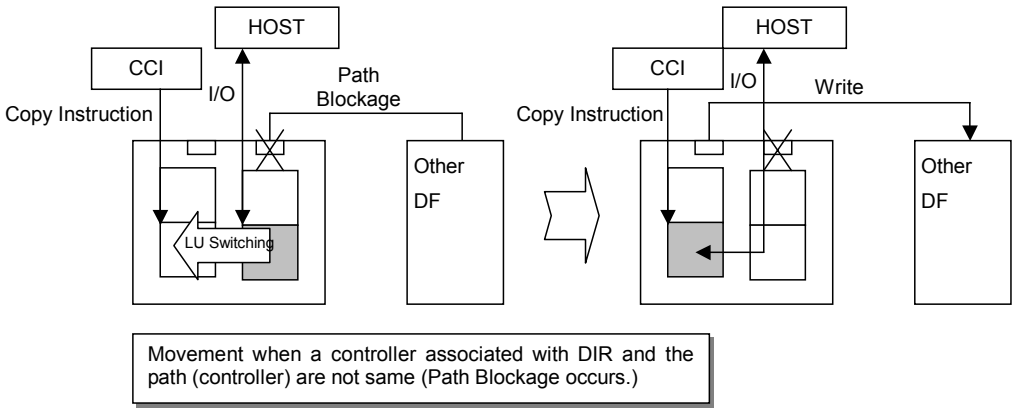


Figure 9.1 Movement when the Controller to be Associated with DIR and the Path are not the Same

When both paths are operating under normal conditions, there is no problem. If a path blockage occurs in one path, however, TrueCopy is restricted as follows:

- While `Format` or `Synchronize Cache` command is executed for the LU that does not work under TrueCopy, the copy operation of TrueCopy sometimes stops. The copy operation restarts when the Format or Synchronize Cache operation is completed. It sometimes takes considerable time to execute the `Format` and `Synchronize Cache` command.
- While the `Verify` command is executed for an LU that does not work under TrueCopy, the copy operation of TrueCopy sometimes stops. The copy operation restarts when the Verify operation is completed. Since the `Verify` command is issued continuously to check a disk when you execute the logical format for the disk by using Windows NT/2000/2003, the TrueCopy copy operation suspends until the logical format is completed.

  For example, `Format, Synchronize Cache`, and `Verify` commands are issued when the following operations are executed:

- Formatting LU by using the Navigator program (Format command issue)
- The logical format of a disk from Windows® NT®/2000/2003 (`Verify` command continuous issue)

Note: During the copy operation of TrueCopy, issuing the *`Format`*, `Synchronize Cache`, and `Verify` commands is not permitted.

9.9 Changing Order of Copy Execution when Receiving Multiple Requests from CCI

The commands issued from CCI are generally executed in the order they were received in LUs. However, when receiving more than five commands per controller, the order of execution changes.

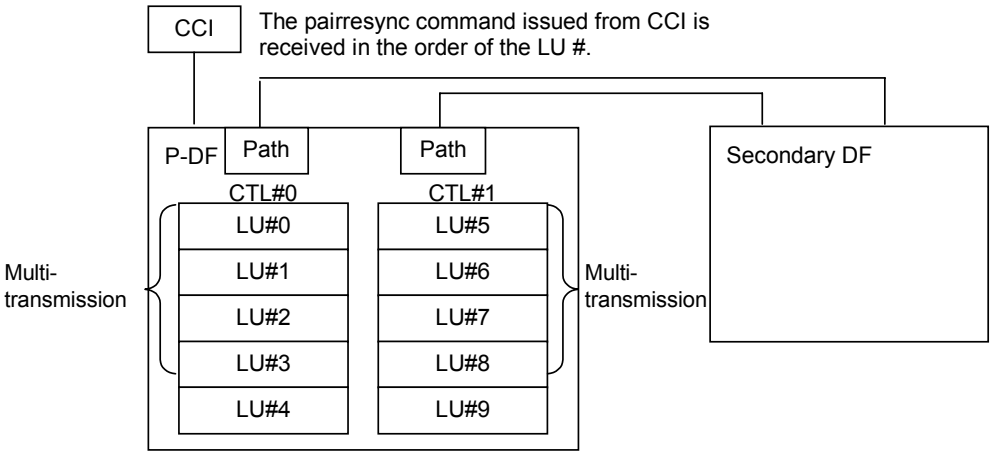


Figure 9.2 Order of Copy

The LUs numbers 0, 1, 2, 3, 5, 6, 7, 8 begin multi-transmission and start the copy operation almost at the same time. LU #4 starts copying when one of the LUs (0 to 3) completes the operation. LU #9 starts copying when one of the LUs (5 to 8) completes the operation.

A single controller provides a data-transmission-area-resource for four pairs multi-transmission. If the controller receives more than that of a command request, the recent request will be processed later.

Chapter 10 Notes on System Configuration

10.1 Pre-designing a procedure for recovering data in the event of malfunction

To cascade in TrueCopy and ShadowImage™, the P-VOL and S-VOL synchronization may become corrupt due to a hardware malfunction. Even when the user has a hardware maintenance contract (including free warranty period) with Hitachi, recovering TrueCopy and ShadowImage status (such as resynchronization) is beyond the maintenance personnel's task. The maintenance personnel's tasks include removing the cause of malfunction and recovering the hardware only. Therefore, the procedure for recovering TrueCopy and ShadowImage status must be specified by the user when designing the system.

10.2 Applying TrueCopy and ShadowImage to an existing system

When newly applying TrueCopy and ShadowImage to an existing system, follow the description described in Chapter 6 and design the configuration.

10.3 TrueCopy on NAS Modular

When TrueCopy is used in the NAS system, do not execute the pair creation or resynchronization during operations such as installation, boot, shutdown, node stop, and cluster stop of the NAS OS. Conversely, do not perform the operations such as installation, boot, shutdown, node stop, and cluster stop of the NAS OS during the execution of the pair creation or resynchronization of TrueCopy.

There is a high probability of failure due to operating system overload, if resynchronization or creation of a TrueCopy pair is performed simultaneously with the above NAS OS tasks.

Appendix A Operations Using CLI

This appendix describes the following operation procedure for TrueCopy using the CLI of the Navigator program. The following sections are included:

- Installing TrueCopy (see section B.1)
- Uninstalling TrueCopy (see section B.2)
- Enabling or Disabling TrueCopy (see section B.3)
- Setting the Command Device (see section B.4)
- Setting the Differential Management LU (see section B.5)
- Setting the Target ID (see section B.6)
- Setting the Path (see section B.7)

For details on the Navigator program, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Storage Navigator Modular Command Line Interface (CLI)* (MK-95DF712).

A.1 Installing TrueCopy

Since TrueCopy is an extra-cost option, TrueCopy cannot usually be selected (locked) before it can be used. To make TrueCopy available, you must install TrueCopy and set its function selectable (unlock).

Note: Before installing/uninstalling TrueCopy, verify that the array unit to be operated is in normal state. If a failure such as a controller blockage has occurred, installation/uninstallation cannot be performed.

To install TrueCopy, the key code or key file provided with the optional feature is required. The following describes the installation procedure.

To install TrueCopy:

1. From the command prompt, register the subsystem (array unit) in which TrueCopy is to be installed, and then connect to the subsystem.
2. Execute the `auopt` command to install TrueCopy. An example is shown below.

   Example:

   Navigator version is 5.00 or later and Cache Partition Manager is enabled

```
% auopt -unit subsystem-name -lock off -keycode manual-attached-keycode
Password: manager-password
Are you sure you want to install the option? (y/n [n]): y
When Cache Partition Manager is enabled, if the option using data pool will be e
nabled the default cache partition information will be restored.
Do you want to continue processing? (y/n [n]): y
The option is installed successfully.
%
```

   Navigator version is less than 5.00 and Cache Partition Manager is enabled

```
% auopt -unit subsystem-name -lock off -keycode manual-attached-keycode
Password: manager-password
Are you sure you want to unlock the option? (y/n [n]): y
When Cache Partition Manager is enabled, if the option using data pool will be e
nabled the default cache partition information will be restored.
Do you want to continue processing? (y/n [n]): y
The option is unlocked.
%
```

   Navigator version is less than 3.00 and Cache Partition Manager is enabled

```
% auopt -unit subsystem-name -lock off -keycode manual-attached-keycode
Password: manager-password
Are you sure you want to unlock the option? (y/n [n]): y
The option is unlocked.
%
```

3. Execute the `auopt` command to confirm that TrueCopy has been installed. An example is shown below.

   Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
Option Name      Type      Term     Status
TRUECOPY Permanent ---      Enable
%
```

TrueCopy is installed and the status is “Enable”. Installation of TrueCopy is now complete.

A.2 Uninstalling TrueCopy

To uninstall TrueCopy, the key code provided with the optional feature is required. Once uninstalled, TrueCopy cannot be used (locked) until it is again installed using the key code or key file.

Note: The following conditions must be satisfied in order to uninstall TrueCopy:

- All TrueCopy pairs must be released (the status of all LUs are SMPL).
- The path settings must be released.

To uninstall TrueCopy:

1. From the command prompt, register the subsystem (array unit) in which the TrueCopy is to be uninstalled, and then connect to the subsystem.
2. Execute the `auopt` command to uninstall TrueCopy. An example is shown below.

   Example:

   Navigator: Version 5.00 or later

```
% auopt -unit subsystem-name -lock on -keycode manual-attached-keycode
Password: manager-password
Are you sure you want to de-install the option? (y/n [n]): y
The option is de-installed successfully.
%
```

   Navigator: Less than 5.00 version

```
% auopt -unit subsystem-name -lock on -keycode manual-attached-keycode
Password: manager-password
Are you sure you want to lock the option? (y/n [n]): y
The option is locked.
%
```

3. Execute the `auopt` command to confirm that TrueCopy has been locked. An example is shown below.

   Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
DMEC002015: No information displayed.
%
```

Uninstalling TrueCopy is now complete.

A.3 Enabling or Disabling TrueCopy

TrueCopy can be set to enable or disable the usage when it is installed.

Note: The following conditions must be satisfied in order to disable TrueCopy:

- All TrueCopy pairs must be released (the status of all LUs are SMPL).
- The path settings must be released.

To enable/disable TrueCopy:

1. From the command prompt, register the subsystem (array unit) in which the status of the feature is to be changed, and then connect to the subsystem.
2. Execute the `auopt` command to change the status (enable or disable).

   The following is an example of changing the status from enable to disable. If you want to change the status from disable to **enable**, enter enable after the **-st** option.

   Example:

```
% auopt –unit subsystem-name –option TRUECOPY –st disable
Password: manager-password
Are you sure you want to disable the option? (y/n [n]): y
The option has been set successfully.
%
```

3. Execute the `auopt` command to confirm whether the status has been changed. An example is shown below.

   Example:

```
% auopt -unit subsystem-name -refer
Password: manager-password
Option Name      Type      Term     Status
TRUECOPY Permanent ---      Disable
%
```

Enabling or disabling TrueCopy is now complete.

A.4 Setting the Command Device

The command device is a user-selected, dedicated logical volume on the TagmaStore subsystem that functions as the interface to the CCI software. The TrueCopy commands are issued by the CCI (HORCM) to the TagmaStore subsystem command device.

In order to accept read and write commands that are executed by the TagmaStore subsystem and return read requests to the UNIX/PC host, the command device must be designated. The command device must be defined in the HORCM_CMD section of the configuration definition file for the CCI instance on the attached host. Two command devices can be designated for the TagmaStore subsystem. You can designate command devices using the Navigator program.

Notes:

- LUs set for command devices must be recognized by the host.
- The Command Device LU size must be greater than or equal to 33 MB.
- For TrueCopy, the command devices must be designated on both the remote and local subsystems.
- There are the following restrictions when either pair of ShadowImage, SnapShot or TrueCopy exists or the path of True Copy is defined.
  - When two command devices are set, only one command device can be released.
  - When only one command device is set, the command device cannot be released.

To designate command device(s):

1. From the command prompt, register the subsystem (array unit) to which you want to create the command device. Connect to the subsystem.
2. Execute the `aucmddev` command to create a command device.

   First, display the LUs to be assignable to a command device. Later, create a command device.

   The following is an example of specifying LU 2 for command device 1.

   Example:

```
% aucmddev -unit subsystem-name -availablelist
Password: manager-password
Available Logical Units
  LUN  Capacity    RAID Group RAID Level  D-CTL C-CTL Type Status
    2   35.0 Mbyte          0  5( 4D+1P)      0     0 FC   Normal
    3   35.0 Mbyte          0  5( 4D+1P)      1     1 FC   Normal
%
% aucmddev -unit subsystem-name -set -dev 1 2
Password: manager-password
Are you sure you want to set the command devices? (y/n [n]): y
The command devices have been set successfully.
%
```

3. Execute the `aucmddev` command to verify that the command device has been created. The following shows an example.

   Note: To set the alternate command device function or to avoid data loss and subsystem downtime, designate two command devices. For details on alternate command device function, refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

   Example:

```
% aucmddev -unit subsystem-name -refer
Password: manager-password
Command Device    LUN  RAID Manager Protect
1                   2  Disable
%
```

1. To release an already set command device, specify as follows. The following is an example of releasing command device 1.

   Example:

```
% aucmddev -unit subsystem-name -rm -dev 1
Password: manager-password
Are you sure you want to release the command devices? (y/n [n]): y
The command devices have been released successfully.
%
```

4. To change an already set command device, release the already set command device first, then change the LU number. The following is an example of specifying LU 3 for command device 1.

Example:

```
% aucmddev -unit subsystem-name -set -dev 1 3
Password: manager-password
Are you sure you want to set the command devices? (y/n [n]): y
The command devices have been set successfully.
%
```

A.5 Setting the Differential Management LU

When the Differential Management LU is not set, create it. The Differential Management LU is an exclusive logical unit for storing the differential data at the time when the volume is copied. The Differential Management LU in the disk subsystem is treated in the same way as the other logical units. However, a logical unit that is set as the Differential Management LU is not recognized by a host (it is hidden).

Set a logical unit with a size of 5 GB minimum as the Differential Management LU. Up to two Differential Management LUs can be set. The second one is used for the mirroring. It is recommended that two Differential Management LUs are set.

The Differential Management LUs must be set on both the local and remote subsystems.

To designate Differential Management LUs:

1. From the command prompt, register the subsystem to which you want to create the differential management LU. Connect to the subsystem.
2. Execute the `audmlu` command to create a differential management LU.

   First, display the LUs to be assignable to the differential management LU. Later, create a differential management LU.

   Example:

```
% audmlu  -unit subsystem-name -availablelist
Password: manager-password
Available Logical Units
  LUN Capacity     RAID Group  RAID Level  D-CTL  C-CTL Type Status
    0  5.0 GByte            0   5( 4D+1P)      0      0 FC   Normal
%
% audmlu  -unit subsystem-name -set -lu 0
Password: manager-password
Are you sure you want to set the DM-LU? (y/n [n]): y
The DM-LU has been set successfully.
%
```

3. To release a previously set differential management LU, specify as follows:

   Example:

```
% audmlu  -unit subsystem-name -rm -lu 0
Password: manager-password
Are you sure you want to release the DM-LU? (y/n [n]): y
The DM-LU has been released successfully.
%
```

   Note: There are the following restrictions when either a pair of ShadowImage, SnapShot or TrueCopy exists, the path of True Copy is defined, or POOL of SnapShot is defined.

- When two differential management LUs are set, only one differential management LU can be released.
- When only one differential management LU is set, the differential management LU cannot be released.

A.6 Setting the Target ID

The following is the procedure for specifying the target ID. The target ID is specified using the Navigator program.

1. From the command prompt, register the subsystem to which you want to set the target ID, and then connect to the subsystem.
2. Execute the `auhgmap` command to set the target ID. The following is an example of setting LU 0 in the subsystem to be recognized as 6 by the host. The port is connected via host group 0 of port 0A on controller 0.

   Example:

```
% auhgmap -unit subsystem-name -MappingMode on
Password: manager-password
Are you sure you want to set the mapping mode? (y/n [n]): y
when setting starts, the subsystem stops accepting access to the controller from the
host.
Before setting, stop access to the controller from the host.
Do you want to continue processing? (y/n [n]): y
The mapping mode has been set successfully.
%

% auhgmap -unit subsystem-name -add 0 A 0 6 0
Password: manager-password
Are you sure you want to add the mapping information? (y/n [n]): y
The mapping information has been set successfully.
%
```

3. Execute the `auhgmap` command to verify that the target ID has been set.

   Example:

```
% auhgmap -unit subsystem-name -refer
Mapping mode = ON
Port  Group  H-LUN    LUN
  0A      0      6      0
%
```

A.7 Setting the Path

It is necessary to designate Command Device(s) before a path setting. However, if a failure such as a controller blockage has occurred, path setting cannot be performed.

To specify, release, and reference path status, use the CLI as follows:

1. From the command prompt, register the subsystem (array unit) in which you want to set the system parameter, then connect to the subsystem.
2. Reference the path status. The following is an example of referencing the path status where path information is not yet specified.

   Example:

```
% aurmtpath –unit subsystem-name –refer
Password: manager-password
Timeout Period   : 9 sec

Local Information
    Serial Number : 75010012
    Equipment ID  : 0012

Remote Information
    Serial Number :
    Equipment ID  :

Path  Local  Remote  Status
   0     --      --  undefined
   1     --      --  undefined
%
```

3. Execute the `aurmtpath` command to set the path as in the following example:
   - **path-0** for 0A and **path-1** for 1A port on the local subsystem
   - **path-0** for 0A port
   - **path-1** for 1B port on the remote subsystem with serial Number **75012326**, equipment ID **2326**

   Example:

```
% aurmtpath –unit subsystem-name –set –remote 75012326 –path0 0A 0A –path1 1A 1B
Password: manager-password
%
```

4. Execute the `aurmtpath` command to confirm whether the path has been set.

   Example:

```
% aurmtpath –unit subsystem-name –refer
Password: manager-password
Timeout Period   : 9 sec

Local Information
    Serial Number : 75010012

Remote Information
    Serial Number : 75012326

Path  Local  Remote  Status
   0     0A      0A  normal
   1     1A      1B  normal
%
```

It is necessary to release all the pairs of TrueCopy before path releasing.

5. To release a previously set command device, specify as follows.

   The following is an example of releasing the previously set path information.

   Example:

```
% aurmtpath –unit subsystem-name –rm
Password: manager-password
%
```

6. The default value is 9 seconds. When remote subsystem is in a long distance using Extender, the timeout value may be changed.

   Set the time limit to double writing to be done to the remote subsystem in the PAIR status. It is necessary to make the time limit shorter than that checked by a host. Specify the time limit checked by a host to be six times longer than the time limit that is now set. For example, when the time limit is set as 27 seconds, the longest allowable value, the time to be checked by a host must be longer than 162 (27×6) seconds.

   When a cascade configuration in which an S-VOL of ShadowImage or a V-VOL of SnapShot is a P-VOL of TrueCopy, specify the time limit as the standard value shown below according to a frequency band of the line. However, in some cases, it is better to specify a larger value based on a rate of errors such as a packet loss of the line.

Frequency band of a line	Time limit (seconds)
200 Mbps or more	9
40 to 200 Mbps	18
20 to 40 Mbps	27

The time limit must be specified as shorter than the time for monitoring by CCI. When you specify the time limit as ten seconds or longer, specify the time-out threshold value of the HORCM_MON of the configuration definition file of CCI for the TrueCopy pare as a value six times as large as the value that has been set here. For example, when you specify the time limit as 27 seconds, which is the allowable longest value, the time-out threshold value must be 27×6 = 162 seconds or longer.

Note: When the other equipment is AMS200/WMS100, the time limit until the time-out occurs must be 18 seconds or more. Therefore, the time limit is set for 18 seconds automatically even when a time limit of 18 seconds or less is entered. It is also impossible to change the time limit, which has already been set, to 18 seconds or less.

Example:

```
% aurmtpath –unit subsystem-name –set –remote 75012326 -timeout 27
Password: manager-password
%
```

Appendix B TrueCopy on NAS Modular

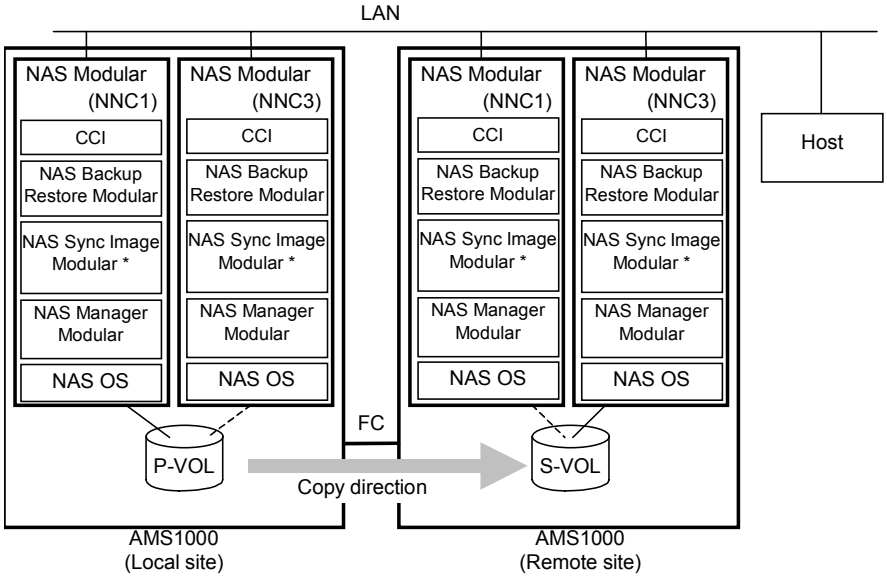
This appendix describes operating procedures for using TrueCopy on NAS Modular. Table B.1 lists and describes the operational requirements for TrueCopy on NAS Modular.

This section is based on the following assumptions:

- The reader has familiarity with Linux® computers or UNIX® computers.
- The reader understands basic operation, requirements and limitations of TrueCopy (Read chapters 1 through 10 of this document).
- The reader understands the operation of CCI (Read the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide*, MK-95DF701), for using NAS Backup Restore Modular remote copy function.
- The reader understands the operation of the NAS Modular system (Read the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759).

Table B.1 TrueCopy Requirements (Difference of FC and NAS)

Parameters	FC	NAS
User interface	CCI is used for issuing commands to create and split TrueCopy pairs. Navigator is used for specifying and releasing command devices.	CCI is used for issuing commands to create and split TrueCopy pairs. The following interfaces can be used to operate CCI: ▪ Operation of CCI commands with SSH Navigator is used for specifying and releasing command devices.
Max number of command devices	AMS1000: 2	AMS1000: 1 (NAS) AMS1000: 2* (FC) * One command device shares with NAS
Max number of pairs	AMS1000: 4,094	AMS1000: Up to 256 pairs for NAS AMS1000: Up to 4,086 pairs for FC (Fibre Channel) including the 256 pairs for NAS
Target LUs	All LUs	NAS: NAS user LUs only. The NAS system LUs are unusable. The LU, for which a file system has been created, cannot be assigned to an S-VOL
Concurrent use of Data Retention Utility	Can be used together at the same time.	Can be used together at the same time. NAS user LUs and NAS system LUs are unusable. When a file system is created, an S-VOL Disable attribute is added automatically.
Concurrent use of SnapShot	Can be used together at the same time.	Can be used together at the same time. NAS user LUs and NAS system LUs are unusable.
CCI protection function	Supported	Not supported



* Required when copying a file system managed by NAS Sync Image Modular.

Figure B.1 TrueCopy Operation in a NAS Modular System

B.1 Overview of TrueCopy Operation in NAS Modular

NAS Modular system enables integrated management of data in AMS1000 subsystems using TrueCopy. NAS Modular utilizes the LAN environment already in place and enables the data within a disk subsystem to be shared across heterogeneous platforms. Using TrueCopy, you can copy data utilizing the NAS server (even in the remote center), backup data to guard against a main volume failure, and perform disaster recovery at the local site.

TrueCopy operations are performed in the NAS Modular system, using CCI for Linux in AMS1000. CCI for Linux gets installed on the NAS Modular system, if NAS Backup Restore Modular is installed.

B.2 Scope of TrueCopy Function

This section describes the applicable scope and specific procedures for using the TrueCopy function.

B.2.1 Scope Related to TrueCopy

- Volume type

  Only the user LUs may be used as TrueCopy P-VOLs and S-VOLs in a NAS Modular system. The NAS system LUs (NAS OS LU, Cluster Management LU, and dump LU) cannot be used as TrueCopy P-VOLs or S-VOLs.

- Platforms which can access the TrueCopy P-VOLs or S-VOLs

  Only clients that are connected to a network via Hitachi Network Attached Storage products or a NAS Modular, can access the TrueCopy P-VOLs and S-VOLs created in a NAS Modular system. Hosts connected through a Fibre-channel port cannot access them.

- File systems which can be allocated in the TrueCopy P-VOL

  You cannot allocate a file system that consists of 257 or more LUs and that uses Logical Volume Manager (LVM) on the NAS OS. You cannot allocate a volume group that consists of 257 or more LUs if it contains a file system managed by NAS Sync Image Modular.

- Writing data to a S-VOL after a volume pair is split

  When you split a TrueCopy volume pair in a NAS Modular system, you must change the S-VOL to write-enable. It is also necessary to always specify the **-rw** option instead of the **-r** option when issuing the CCI pairsplit command.

  To protect the data in the split S-VOL from being overwritten by the client, use the **enas_fsmount** command with **-r** option from NAS Manager Modular, when mounting the file system in S-VOL.

B.2.2 Scope Related to CCI

- Relationships of failover and fail-back on CCI and NAS Modular system

  CCI is not subject to failover or failback by the NAS Modular system. Therefore it is required to prepare the same configuration definition file on the failover destination node and the failover orientation node. The only difference is in the ip_address in the **HORCM_MON** section. If a failure occurs in the NAS unit , causing a failover while CCI is operating, start CCI on failover destination node and continue operating TrueCopy.

- Protect feature

  When you use TrueCopy in the NAS Modular system, you create or resynchronize pairs using CCI while the NAS Modular system does not recognize the S-VOL. You therefore cannot use the protect facility in CCI since this facility prohibits volume pair operations that the system does not recognize.

- Executing the CCI commands

  To execute the CCI commands using CCH while using the **nasroot** account for logging in to NAS unit, you should use the **sudo** command as shown below:

```
$ sudo pairdisplay -g VG01
```

Figure B.2 Sample CCI pairdisplay Command using sudo Command

```
$ ssh -2 nasroot@123.456.78.51 sudo pairdisplay -g VG01
```

Figure B.3 Sample pairdisplay Command using SSH Client Shell Script (SSH Protocol Version 2)

Note: You should create a shell script on OS used by the system administrator. For details about creating a shell script, see the appropriate OS documentation.

- Special file names given from standard input device to the command in CCI

  When giving special file names from the standard input to the **raidscan**, **inqraid**, or **mkconf.sh** commands, specify **cat /home/nasroot/horc_devfile** instead of **ls/dev/sd***.

```
$ cat /home/nasroot/horc_devfile | sudo inqraid -CLI
```

Figure B.4 Sample 'inqraid' Command using 'sudo' Command

```
$ ssh -2 nasroot@123.456.78.51 "cat /home/nasroot/horc_devfile | sudo inqraid -CLI"
```

Figure B.5 Sample 'inqraid' Command using Shell Script created on SSH client (SSH protocol version 2)

- Scanning on NAS Modular ports using **raidscan** command

  When scanning on NAS Modular ports using the **raidscan** command, there may be cases when some entries such as **/dev/sda ~ sdi** which stand for NAS system LU (NAS OS LU, NAS Cluster Management LU, Backup of NAS Cluster Management LU, Dump LU, Error Information LU, or Command device) are displayed. These devices must not be defined in the **HORCM_DEV** section of configuration definition file, since these devices cannot be defined as P-VOL or S-VOL for TrueCopy.

B.2.3 Scope Related to NAS Backup Restore Modular

- Limitations on functionality of backup management software

  If you resynchronize a TrueCopy pair defined by the remote copy function after performing an S-VOL backup using the backup management software, a full backup also occurs the next time.

B.2.4 Scope Related to Other Products of Hitachi Network Attached Storage Series

- NAS Sync Image Modular

  When you copy a file system managed by NAS Sync Image Modular using TrueCopy or ShadowImage, you must copy both the LUs that constitute the file system and the LUs which constitute the differential-data storage devices. If you copy only the LUs which constitute a file system, you cannot connect them to the NAS Modular system on the remote site.

  The automatic creation schedule setting for NAS Sync Image Modular is not copied. The differential-data snapshot that is mounted by the automatic creation schedule is not mounted at the copy destination.

B.3 Requirements

B.3.1 Hardware Requirements

You need a workstation or PC to log in to the NAS Modular system using secure shell (SSH) in addition to the prerequisite hardware for TrueCopy, CCI, and the NAS Modular system described in the following guides:

- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage* TrueCopy™ Synchronous Remote Replication Software User's Guide, MK-95DF710 (this document)
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701)
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759)

B.3.2 Software Requirements

All of the following AMS1000 storage subsystem program products (PP) must be installed in the NAS Modular, and their licenses must be valid.

- TrueCopy
- NAS Data Control Modular
- NAS File Sharing Modular
- NAS Manager Modular
- NAS Backup Restore Modular

- NAS Sync Image Modular (required when TrueCopy is applied to the file system operated by NAS Sync Image Modular)

B.4 Other Requirements and Restrictions

- **UID for user registration and GID for group registration in** P**primary and/**S**secondary sites**

  With TrueCopy,the file owner information (UID and GID in the primary site), quota information and ACL information for each user and group (UID and GID in the primary site) that are included in the source file system, are copied to the secondary site. When sharing the NFS/CIFS, you should note the UID for user registration and the GID for group registration in the primary and secondary sites before setting the quota or the ACL in the target file system. The following paragraphs describe some user name and group name registration scenarios:

  - Register the same user name (or group name) in both sites. (The quota settings and ACL settings the same).

    For local authentication, assign the same UID (or GID) to the same user name (or group name) in both sites. For NIS, share the NIS server in both sites. For domain authentication, share the domain controller.

  - Register the same user name (or group name) in both sites. (The quota settings or the ACL settings are different for each site.)

    Set the quotas or the ACLs again in the secondary site each time the TrueCopy volume pair is split.

  - Register the user (or group) in only one site.

    For local authentication, do not assign the target UID (GID) in another site. This ensures that the UID is not overlapped with the UID (or GID) of the another user in the another site. For NIS, share the NIS server in both sites. For domain authentication, share the domain controller.

- **Mounting the NFS client for a file system whose data is backed up online**

  If you perform online backup for a file system accessed by the NFS client using remote copy, you must specify NFS Version 3 before mounting a NAS Modular file system on the NFS client. If you specify the NFS Version 2, you must specify the hard option before mounting a NAS Modular file system on the NFS client.

- **Limitations on TrueCopy operations due to the status of cluster, nodes, and resource groups**

  Connecting the device file or creating and mounting a file system is restricted, when a cluster is not configured, the cluster is stopped, the nodes are stopped, or when the resource groups are offline. Due to these restrictions, the operations performed by the target TrueCopy operation will also end in error. You should not therefore operate the cluster, nodes, and resource groups during the TrueCopy operation. Problems arising within clusters, nodes or resource groups should be fixed immediately. The following is a list of prohibited operations when TrueCopy operations are being performed:

  - Un-mount and mount the source file system during the splitting of a TrueCopy pair volume.

- Connect the target file system to the NAS unit.
- Un-mount and delete the target file system before the TrueCopy pair is resynchronized.

- **Changing system configuration during the TrueCopy operations**

  When performing the following system configurations tasks during TrueCopy operations, you must change the CCI configuration definition files in the NNC1 and NNC3 NAS units to which the TrueCopy P-VOL is connected, and in the NNC1 and NNC3 NAS units where the S-VOL is used:

  - Changing a fixed IP address
  - Expanding or deleting a source file system
  - Setting up, expanding, or releasing a differential-data storage device for NAS Sync Image Modular

  When the host name is specified in the CCI configuration definition file and you change the following system configurations, you must change the configuration definition file:

  - Editing the /etc/hosts file (when resolving the host name using the /etc/hosts file)
  - Changing registration information on NIS server, or changing a setting for NIS server (when resolving the host name using NIS)
  - Changing registration information on DNS server, or changing a setting for DNS server (when resolving the host name using DNS)
  - Changing the CHA (host name)

- **Splitting a TrueCopy volume pair using the online backup method**

  When there is a long time interval between the execution of the **horc_pvol_freeze** command and the execution of the **horc_pvol_unfreeze** command, an access time-out may occur depending on the client. When NAS Sync Image Modular is operated in the copy source file system, the time-out tends to occur easily because the execution of the **horc_pvol_freeze** command may take a long time.

- **Restrictions on TrueCopy at the time of the NAS OS boot**

  When TrueCopy is used in the NAS system, you should not execute pair creation or resynchronization during the operations such as installation, boot, shutdown, node stop, and cluster stop of the NAS OS. Conversely, you should not perform operations such as installation, boot, shutdown, node stop, and cluster stop of the NAS OS during TrueCopy pair creation or resynchronization.

  If the creation or resynchronization of a TrueCopy pair and NAS OS operations (such as installation, boot, shutdown, node stop, and cluster stop) are performed at the same time, a failure may occur because the NAS OS is overloaded.

B.5 Preparing for TrueCopy Operations

B.5.1 Preparing for TrueCopy Volume Pair Operation

Preparation procedures for creating TrueCopy volume pairs are described in Chapter 3 .

B.5.2 Registering the Public Key used for SSH

Before issuing the commands described in this document, the public key used for SSH needs to be registered in the NAS unit to which the TrueCopy P-VOL is connected and also in the NAS unit which will use the S-VOL. For more information on registering the public key, see the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757).

B.5.3 Configuration Settings of CCI

- **Logging in to the target NAS unit using SSH**

  You can log into both the NAS unit in which the TrueCopy P-VOL is connected and the NAS unit which will use the S-VOL, using the **nasroot** account via SSH. (For information about logging in to the NAS unit, see the appropriate documentation for each tool in the platform.)

- **Configuring the CCI configuration definition files**

  To control a TrueCopy pair using CCI, you should first define the TrueCopy pair using the CCI configuration definition file. The installation of NAS Backup Restore Modular creates the templates of the CCI configuration definition file. Only the **HORCM_MON** section and the **HORCM_CMD** section are described in this template.

  – The template of the CCI configuration definition file for instance number 16 is:

    `/home/nasroot/horcm16.conf`

  – The template of the CCI configuration definition file for instance number 17 is:

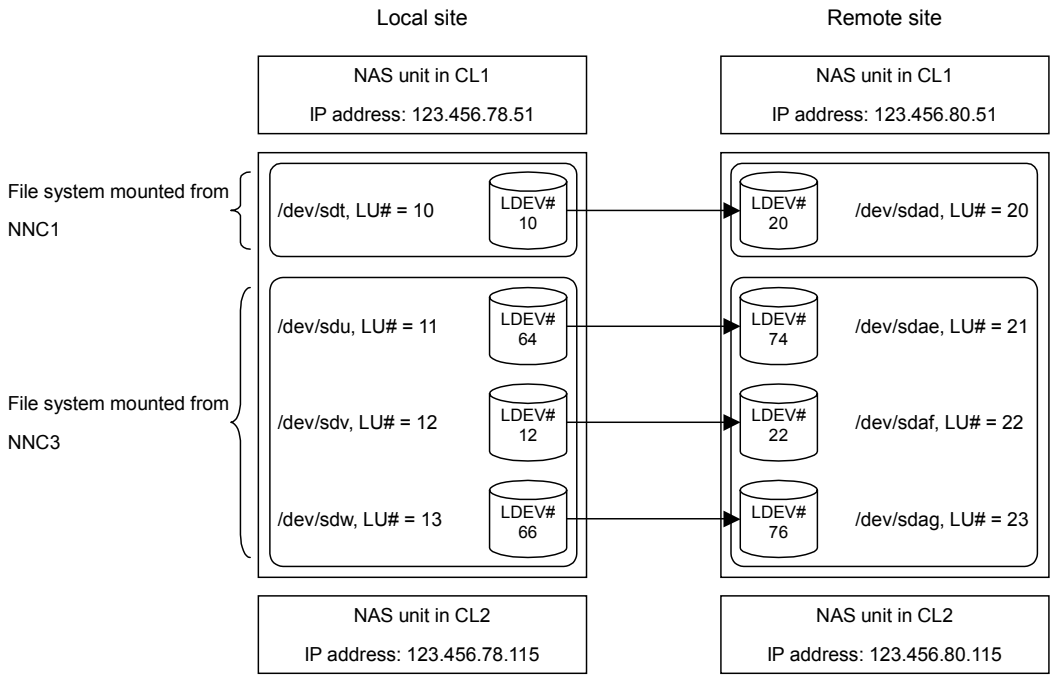
    `/home/nasroot/horcm17.conf`

  Next, you should add the **HORCM_DEV** section and the **HORCM_INST** section to the CCI configuration definition file template using the **mkconf.sh** command in CCI. Then you should edit the file and create the CCI configuration definition file.

  These operations should be performed in each NAS unit in NNC1 and NNC3 where the TrueCopy P-VOL is connected and in each NAS unit in NNC1 and NNC3 that will use the S-VOL. You should prepare a total of four CCI configuration files assuming one instance per NAS unit. For two instances, you need a total of eight configuration files.

  In NAS Modular, you can define one or two CCI instances per NAS unit. You need one instance to operate only the TrueCopy pairs in CCI. To operate cascaded TrueCopy and ShadowImage pairs, you will need two instances.

The following section explains how to create a CCI configuration definition file using the NAS Modular system with LUs using an example (see Figure B.6).



Note: To enable two NAS units to communicate over a LAN, define the network configuration. Use fixed IP addresses of all eth1 of each unit. Do not mix eth1 addresses.

Figure B.6 Example of the Configuration of Pair LU

- Add the **HORCM_DEV** section and the **HORCM_INST** section using the **mkconf.sh** command of CCI.
- Add **HORCM_DEV** section and the **HORCM_INST** section to the template of the CCI configuration definition file using the **mkconf.sh** command in CCI.

```
$ cat /home/nasroot/horc_devfile | sudo mkconf.sh -gg <device group name> -i 16 -a
```

Figure B.7 Adding HORCM_DEV, HORCM_INST Sections (for instance number 16)

Note: Specify the **-gg** option for the **mkconf.sh** command. When the **-gg** option is specified, a pair is defined with an LU number allocated to the host group. When the **-gg** option is not specified, an LU other than the required LU, is used for copying since a pair cannot be defined with the LU number allocated to the host group. When the **-gg** option is specified for the **mkconf.sh** command, one of the CL1-C-1 and CL2-C-1 are set as the port. When the **-gg** option is not specified, CL1-C or CL2-C are set as the port (-1 is omitted). Therefore, you should niether perform the pair operation nor create the configuration definition file over again, specifying the **-gg** option.

Note: If the mkconf.sh command is executed without specifying the -a option, the HORCM_MON section and the HORCM_CMD section in the CCI configuration definition file automatically created when NAS Backup Restore Modular is installed will be overwritten. Delete all the lines above the HORCM_MON section and change the entry service in the HORCM_MON section to an appropriate value based on Table B.2.

To execute the mkconf.sh command, the LU that constitutes the file system to be paired must be created. The LU configuration (number and size) in the file system to be paired needs to be to be exactly the same in both which the TrueCopy P-VOL is connected and which the TrueCopy S-VOL is connected.

To create the correct CCI configuration definition file, create a file system to be temporarily paired before executing the mkconf.sh command. After creating the CCI configuration definition file using the mkconf.sh command, continue using the file system to which the TrueCopy P-VOL is connected. Alternatively, you can delete it and create a file system with the same configuration using the same LU according to the procedure described in section B.5.4. However, you must delete the temporarily created file system to which the TrueCopy P-VOL is connected before creating a file system pair.

The sample in the following configuration explains how to create a CCI configuration definition file in the NAS unit in NNC1 to which the TrueCopy P-VOL is connected. Create CCI configuration definition files for the other NAS units using the same procedure.

```
$ cat /home/nasroot/horc_devfile | sudo mkconf.sh -gg VG -i 16 -a
starting HORCM inst 16
HORCM inst 16 starts successfully.
HORCM Shutdown inst 16 !!!
A CONFIG file was successfully completed.
starting HORCM inst 16
HORCM inst 16 starts successfully.
DEVICE_FILE             Group    PairVol     PORT   TARG  LUN M   SERIAL  LDEV
/dev/sdj               VG       VG_000      CL1-C-1   0   17 -  77062486    70
/dev/sdk               VG       VG_001      CL1-C-1   1   18 -  77062486    18
        :
        :
/dev/sdt                VG       VG_010      CL1-C-1   0   10 -  77062486    10
/dev/sdu                VG       VG_011      CL1-C-1   0   11 -  77062486    64
/dev/sdv                VG       VG_012      CL1-C-1   0   12 -  77062486    12
/dev/sdw                VG       VG_013      CL1-C-1   0   13 -  77062486    66
/dev/sdx                VG       VG_014      CL1-C-1   0   14 -  77062486    14
/dev/sdy                VG       VG_015      CL1-C-1   0   15 -  77062486    68
/dev/sdz                VG       VG_016      CL1-C-1   0   16 -  77062486    16
HORCM Shutdown inst 16 !!!
Please check '/home/nasroot/horcm16.conf','/home/nasroot/log16/curlog/horcm_*.log', and
modify 'ip_address & service'.
#
```

Figure B.8 Example of mkconf.sh Execution Result (for instance number 16)

- Editing the template for the CCI configuration definition file

  Table B.2 lists the values that are specified for the items included in the CCI configuration definition file in the NAS Modular system.

Table B.2 Configuration Definition File Settings (HORCM_MON, HORCM_CMD) and Specified Values in NAS Modular System

Section Name	Item	Specified Values in NAS Modular System
HORCM_MON	ip_address	Unique IP address for eth1 in the local NAS unit
	service	20331 (Instance number 16) or 20332 (Instance number 17)
HORCM_CMD	dev_name	/dev/sdf

Note: The host name can be specified instead of the fixed IP address if the fixed IP address and the corresponding host name are registered into **/etc/hosts**, an NIS server or a DNS server. Refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757) for information on how to register the fixed IP address and the corresponding host name into **/etc/hosts**, and for information on how the NAS Modular system can search the host name using NIS or DNS.

Based on Table B.2, change each entry of ip_address in **HORCM_MON** to an appropriate value. For the entry service in **HORCM_MON** and the entry in **HORCM_CMD**, appropriate values are specified when NAS Backup Restore Modular is installed.

If you have created the configuration definition file using the **mkconf** command tool, remember to change the value of the poll(10ms) manually. Always set a value more than or equal to 6000.

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.78.51      20331                6000             3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 77062486)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdj            SER =  77062486  LDEV =   70 [ FIBRE FCTBL = 3 ]
VG                 VG_000          CL1-C-1          0      0
# /dev/sdk            SER =  77062486  LDEV =   18 [ FIBRE FCTBL = 3 ]
VG                 VG_001          CL1-C-1          0      1
        :
        :
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG                 VG_013          CL1-C-1          0      13
# /dev/sdx             SER =  77062486  LDEV =   14 [ FIBRE FCTBL = 3 ]
VG                 VG_014          CL1-C-1          0      14
# /dev/sdy             SER =  77062486  LDEV =   68 [ FIBRE FCTBL = 3 ]
VG                 VG_015          CL1-C-1          0      15
# /dev/sdz             SER =  77062486  LDEV =   16 [ FIBRE FCTBL = 3 ]
VG                 VG_016          CL1-C-1          0      16

HORCM_INST
#dev_group        ip_address      service
VG                127.0.0.1       20332
```

Figure B.9 Example of CCI Configuration Definition File - 1 (for instance number 16)

Next, at **HORCM_DEV** section, remove all unnecessary LU entry (line) other than those to be managed by CCI.

LU which makes up a file system and its LDEV ID can be obtained by using the following command.

```
$ sudo horc_devlist | grep ':filesystem name'
```

For Figure B.10, LU 11, 12, 13 shown on left make up a file system **sample** and their LDEV ID are 64, 12, 66 shown on the third column from the left.

```
$ sudo horc_devlist | grep ':sample$'
  11(  17)  64 FC   3.906GB   -- 0  Normal Own   File:sample
  12(  18)  12 FC   3.906GB   -- 0  Normal Own   File:sample
  13(  19)  66 FC   3.906GB   -- 0  Normal Own   File:sample
```

Figure B.10 Example of an Explorer Command of LU which Makes up a File System Sample

Next, modify the device file name and the device name, which are to be handled by CCI. There are some restrictions on modifying the device file name or device name.

- Volumes on both P-VOL side and S-VOL side must be assigned the same device group name and same device name.
- Volumes making up one file system must be assigned the same device group name.
- When NAS Sync Image Modular is used, volumes for file system and differential-data storage device must be assigned the same device group name.

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.78.51      20331                6000             3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 77062486)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG                 VG_010          CL1-C-1          0      10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG                 VG_011          CL1-C-1          0      11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG                 VG_012          CL1-C-1          0      12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG                 VG_013          CL1-C-1          0      13

HORCM_INST
#dev_group        ip_address      service
VG                127.0.0.1       20332
```

Figure B.11 Example of CCI Configuration Definition File - 2 (for instance number 16)

Next, specify the IP address of the instance to be paired in the secondary site for the **HORCM_INST** section (see Table B.3 and Figure B.12). Specify the IP addresses of the instances in both NNC1 and NNC3 for a failover between NAS unit in the secondary site.

Table B.3 Configuration Definition File Settings (HORCM_INST) and Specified Values in NAS Modular System

Section	Item	Values for NAS Modular System
HORCM_INST	ip_address	Fixed IP address of eth1 or eth2 in the NAS unit in the secondary site of TrueCopy (But if you specify eth1 in HORCM_MON ip_address, specify eth1. If you specify eth2 in HORCM_MON ip_address, specify eth2).
	service	20331 (for instance number 16) or 20332 (for instance number 17)

Note: The host name can be specified instead of the fixed IP address if the fixed IP address and the corresponding host name are registered into **/etc/hosts**, an NIS server or a DNS server. Refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757) for information on how to register the fixed IP address and the corresponding host name into **/etc/hosts**, and for information on how the NAS Modular system can search the host name using NIS or DNS.

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.78.51      20331                6000             3000

HORCM_CMD
#dev_name                dev_name                dev_name
#UnitID 0 (Serial# 77062486)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG                 VG_010          CL1-C-1          0      10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG                 VG_011          CL1-C-1          0      11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG                 VG_012          CL1-C-1          0      12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG                 VG_013          CL1-C-1          0      13

HORCM_INST
#dev_group        ip_address      service
VG                123.456.80.51    20332
VG                123.456.80.115   20332
```

Figure B.12 Example of CCI Configuration Definition File - 3 (for instance number 16)

- Checking the contents of the CCI configuration definition file

  By combining the following commands, you can check whether an appropriate LU is specified in the **HORCM_DEV** section in the CCI configuration definition file.

  First, start CCI in both the NAS unit in which the TrueCopy P-VOL is connected and in the NAS unit which will use the S-VOL (see Figure B.13).

```
$ sudo horc_setenv HORCMINST 16      (For instance number 16)
  or sudo horc_setenv HORCMINST 17   (For instance number 17)
$ sudo horc_unsetenv HORCC_MRCF
When you logged in to the target NAS unit using SSH and performed the above setup, confirm
the setup by once logging out of the NAS unit and relogging in.
$ sudo horcmstart.sh
```

Figure B.13 Procedure for Starting CCI

By issuing the **pairdisplay** command in the NAS unit in which TrueCopy P-VOL is connected or in which S-VOL is used, you can see the LDEV numbers of LUs specified in the **HORCM_DEV** section (see Figure B.14).

```
$ sudo pairdisplay –g device group name
```

Figure B.14Checking LDEV Number of LUs Specified in the HORCM_DEV Section

You can check the device file numbers, and the LDEV numbers for the device files that constitute a file system, by issuing the **horc_devlist** command in the NAS unit in which P-VOL is connected (see Figure B.15). Compare this with Figure B.14. For information about the **horc_devlist** command, please refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759).

```
$ sudo horc_devlist | grep ':sample$'
  0A(  10)   120 FC   20.000GB     -- 0  Normal Own   File:sample
  0B(  11)   121 FC   20.000GB     -- 0  Normal Own   File:sample
  0C(  12)   122 FC   20.000GB     -- 0  Normal Own   File:sample
```

Figure B.15 How to Check Device File Numbers and LDEV Numbers of P-VOL

You can also check the device file numbers and the LDEV numbers for the unused device files which can be S-VOL by issuing the **horc_devlist** command in the NAS unit in which S-VOL is used. Compare this with Figure B.14.

```
$ sudo horc_devlist | grep ' Free$'
  01(   1)    21 FC   20.000GB     -- 0  Normal --    Free
  02(   2)    22 FC   20.000GB     -- 0  Normal --    Free
  03(   3)    23 FC   20.000GB     -- 0  Normal --    Free
```

Figure B.16 How to Check Device File Numbers and LDEV Numbers for Unused Device Files Which Can be S-VOLs

Table B.4 lists the port names described in the **HORCM_DEV** section in the CCI configuration definition file and the locations of the NAS units.

Table B.4 Locations of NAS Unit and Port Names Specified in CCI Configuration Definition File

Location of NAS Unit	Port Name
NNC1	CL1-C-1
NNC3	CL2-C-1

After checking the CCI configuration definition file, stop CCI in both the NAS unit in which TrueCopy P-VOL is connected and in the NAS unit in which S-VOL is used (see Figure B.17).

```
$ sudo horcmshutdown.sh
```

Figure B.17 Stopping CCI (for instance 16)

Save the NAS OS LU manually to save the configured CCI configuration definition files. For more information, please refer to *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759).

- Cascade configuration of TrueCopy and ShadowImage

  In the NAS Modular system, you may use the TrueCopy pair file system and ShadowImage pair file system in a cascade configuration. In a cascade configuration, you may prepare for disaster scenario where, for example, you would not be able to recover the file system from the TrueCopy S-VOL, by backing up the file system copied from the TrueCopy P-VOL to S-VOL periodically using ShadowImage.

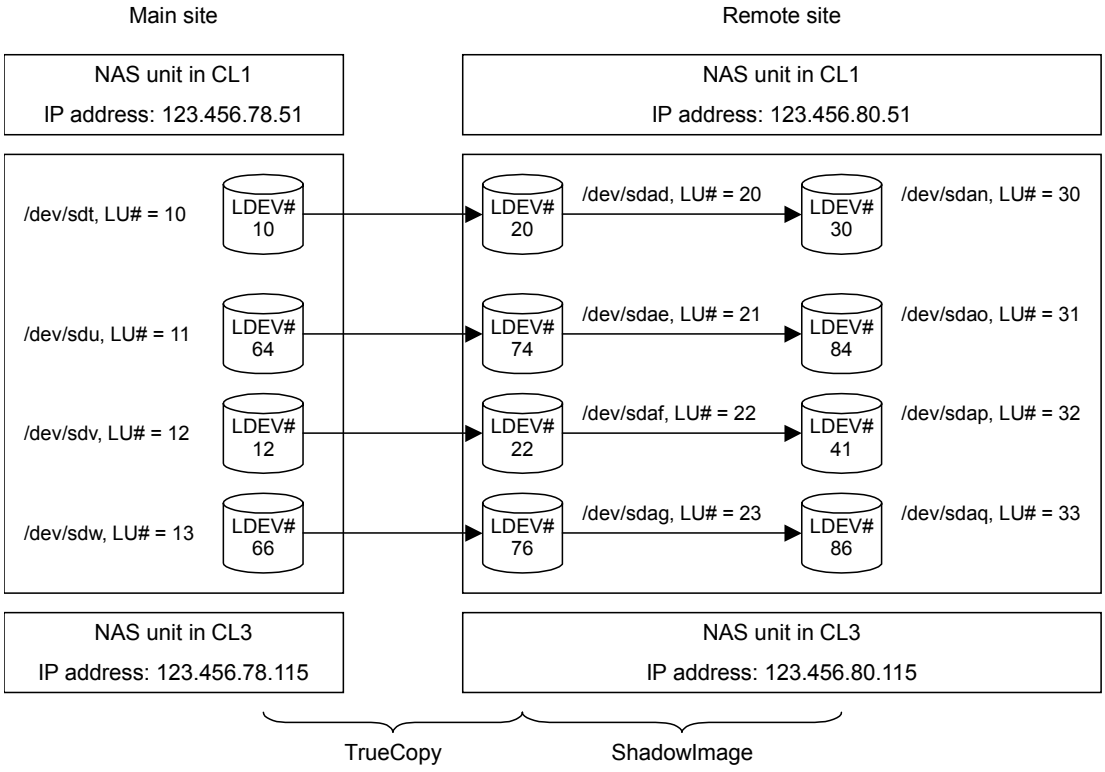


Figure B.18 Example of Cascade Configuration of TrueCopy and ShadowImage

By preparing the CCI configuration definition file as shown in Figure B.19, Figure B.20, and Figure B.21, you may operate the cascade configuration of TrueCopy and ShadowImage from CCI. When you use TrueCopy and ShadowImage in the cascade configuration, you cannot operate the cascaded ShadowImage using the GUI or CLI of the Snapshot feature.

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.78.51      20331                6000             3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 77062486)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG_TC              VG_032          CL1-C-1          0      10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG_TC              VG_033          CL1-C-1          0      11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG_TC              VG_034          CL1-C-1          0      12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG_TC              VG_035          CL1-C-1          0      13

HORCM_INST
#dev_group        ip_address      service
VG_TC             123.456.80.51    20331
VG_TC             123.456.80.115   20331
VG_SI             123.456.80.51    20332
VG_SI             123.456.80.115   20332
```

Figure B.19 Example of CCI Configuration Definition File at Main Site (instance 16)

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.80.51      20331                 6000             3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 77062490)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG_TC              VG_032          CL1-C-1          0       10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG_TC              VG_033          CL1-C-1          0       11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG_TC              VG_034          CL1-C-1          0       12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG_TC              VG_035          CL1-C-1          0       13
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG_SI              VG_014          CL1-C-1          0       10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG_SI              VG_015          CL1-C-1          0       11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG_SI              VG_015          CL1-C-1          0       12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG_SI              VG_016          CL1-C-1          0       13

HORCM_INST
#dev_group        ip_address      service
VG_TC             123.456.78.51    20331
VG_TC             123.456.78.115   20331
VG_SI             123.456.80.51    20332
VG_SI             123.456.80.115   20332
```

Figure B.20 Example of CCI Configuration Definition File at Remote Site (instance 16)

```
HORCM_MON
#ip_address        service         poll(10ms)     timeout(10ms)
123.456.80.51      20332                6000             3000

HORCM_CMD
#dev_name               dev_name               dev_name
#UnitID 0 (Serial# 77062490)
/dev/sdf

HORCM_DEV
#dev_group         dev_name        port#     TargetID     LU#     MU#
# /dev/sdt             SER =  77062486  LDEV =   10 [ FIBRE FCTBL = 3 ]
VG_TC              VG_032          CL1-C-1          0      10
# /dev/sdu             SER =  77062486  LDEV =   64 [ FIBRE FCTBL = 3 ]
VG_TC              VG_033          CL1-C-1          0      11
# /dev/sdv             SER =  77062486  LDEV =   12 [ FIBRE FCTBL = 3 ]
VG_TC              VG_034          CL1-C-1          0      12
# /dev/sdw             SER =  77062486  LDEV =   66 [ FIBRE FCTBL = 3 ]
VG_TC              VG_035          CL1-C-1          0      13
# /dev/sdan            SER =  77062486  LDEV =   30 [ FIBRE FCTBL = 3 ]
VG_SI              VG_014          CL1-C-1          0      30
# /dev/sdao            SER =  77062486  LDEV =   84 [ FIBRE FCTBL = 3 ]
VG_SI              VG_015          CL1-C-1          0      31
# /dev/sdap            SER =  77062486  LDEV =   41 [ FIBRE FCTBL = 3 ]
VG_SI              VG_016          CL1-C-1          0      32
# /dev/sdaq            SER =  77062486  LDEV =   86 [ FIBRE FCTBL = 3 ]
VG_SI              VG_017          CL1-C-1          0      33

HORCM_INST
#dev_group        ip_address      service
VG_TC             123.456.78.51    20331
VG_TC             123.456.78.115   20331
VG_SI             123.456.80.51    20331
VG_SI             123.456.80.115   20331
```

Figure B.21 Example of CCI Configuration Definition File at Remote Site (instance 17)

- Setting the CCI user environmental variables

  In the following procedure, the environment variables **HORCMINST** and **HORCC_MRCF** are corrected corresponding to a system configuration. This setup is performed on the four nodes (CL1 and CL2 of the cluster to which TrueCopy P-VOL is connected, and CL1 and CL2 of the cluster in which S-VOL is used).

1. At both sites, set up the environment variable of the CCI instance:

   For instance number 16:

   ```
   $ sudo horc_setenv HORCMINST 16
   ```

   OR

   ```
   $ export HORCMINST=16
   ```

   For instance number 17:

   ```
   $ sudo horc_setenv HORCMINST 17
   ```

   OR

   ```
   $ export HORCMINST=17
   ```

2. At both sites, set up the HOMRCF command environment variable of the CCI as TrueCopy:

   ```
   $ sudo horc_unsetenv HORCC_MRCF
   ```

   OR

   ```
   $ export HORCC_MRCF
   ```

3. If procedure 1 or 2 are done through SSH with the **sudo horc_unsetenv**, log out from the NAS unit and log in to the NAS unit again to validate these settings. If there are done through SSH with the **export**, these settings validate immediately.

   ```
   $ exit
   ssh {-1 | -2} nasroot@ <fixed IP address of NAS unit>
   ```

   To confirm the defined variables, use the following command.

   ```
   $ sudo horc_printenv
   ```

   The value of the environmental variable immediately after the installation of NAS Backup Restore Modular is shown below.

Table B.5 Environment Variable Value Immediately after Installation of NAS Backup Restore Modular

Environment Variable	Value
HORCMINST	16
HORCC_MRCF	It is not set.

B.5.4 File System Creation on a P-VOL of TrueCopy

Create a file system in TrueCopy P-VOL using the Create New File System window in File System Management in NAS Manager Modular or by using the **enas_fscreate** command. Even if you create and split the TrueCopy volume pair without creating a file system in the TrueCopy P-VOL, you cannot access the TrueCopy S-VOL in the secondary site.

B.6 Overview of Using TrueCopy for Remote Copy Operations

This section describes the overview of TrueCopy operations, CCI commands, and the commands provided by the Hitachi Network Attached Storage (NAS) series products for using TrueCopy for remote copy operation.

We describe only the arguments of the CCI commands, which are required for the basic TrueCopy operations. For other arguments, please refer to *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701).

For the specifications of the commands provided by the Hitachi NAS series products and notes, see section B.9.

This section describes the procedure for creating duplicate volumes. An overview of the operation and the corresponding sections are shown in the figure below. When the pair is in the PSUS state, S-VOL can be accessed from the remote site.

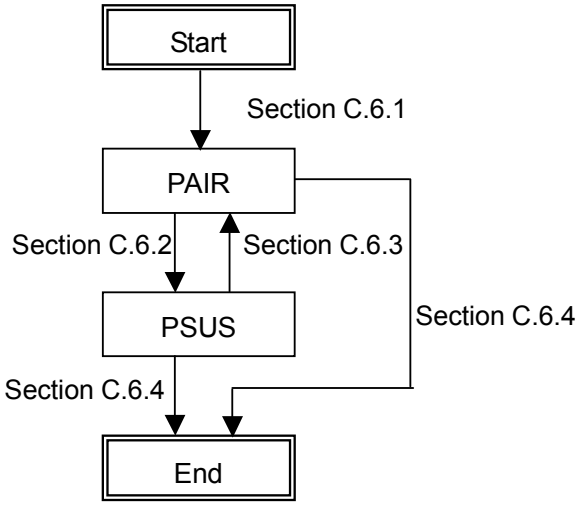


Figure B.22 Overview of TrueCopy Operations (and the Related Document Sections)

B.6.1 Starting TrueCopyOperations and Creating TrueCopy Pair

If the TrueCopy S-VOL contains a file system, delete the file system using the **enas_fsdelete** command in NAS Manager Modular before starting TrueCopy operation. If the TrueCopy S-VOL is used for the Snapshot feature in NAS Backup Restore Modular, delete the Snapshot definition using the **snapvoldel** command before starting the TrueCopy operation. If the TrueCopy S-VOL has a device that stores the differential data of NAS Sync Image Modular, release the device using the **syncstop** command before starting the TrueCopy operation.

To start TrueCopy operation and to create TrueCopy volume pair:

1. At the main site and the remote site, start CCI:

```
$ sudo horcmstart.sh       (1-instance configuration)
```

OR

```
$ sudo horcmstart.sh 16 17   (2-instance configuration)
```

2. At the remote site, reserve a device file used as a target file system.

Non-LVM

```
$ sudo horc_svol_define -d  device file number
```

LVM

```
$ sudo horc_svol_vmdefine -d  device file number, ...
```

3. At the main site, create a TrueCopy volume pair:

```
$ sudo paircreate {-g group name | -d volume name} -f never -vl
```

4. At the main site, check if the TrueCopy volume has been created:

```
$ sudo pairvolchk {-g group-name | -d volume name}
```

You can also use the **pairevtwait** command, which waits for the volumes to be paired.

```
pairvolchk: Volstat is P-VOL.[status = COPY] → Creating

pairvolchk: Volstat is P-VOL.[status = PAIR] → Created
```

B.6.2 Splitting a TrueCopy Volume Pair

When splitting a TrueCopy volume pair, you can choose either an offline backup or an online backup. With an offline backup, split the pair by un-mounting the P-VOL. With the online backup, split the pair by holding the updates to the file system temporarily without un-mounting the P-VOL.

In the offline backup method, a TrueCopy volume pair is split after NFS shares and CIFS shares are deleted and accesses from the client are completely stopped. An I/O error is reported to the application if the user deletes CIFS/NFS shares while the application is writing data to the P-VOL or the application tries to write data to the P-VOL after the user deletes CIFS/NFS shares. As a result, the application is able to see which application's data is reflected to the TrueCopy volume pair. This method can be used for almost all applications.

With online backup, the TrueCopy volume pair is split without deleting CIFS/NFS shares. Since an I/O error is not reported to the application that is writing data to the P-VOL, the application cannot see how much data is reflected to the S-VOL. Therefore, this method can be used for only to the applications that are able to keep track of the progress of writing data using journal file etc.

- TrueCopy volume pair split by offline backup

  To split TrueCopy volume pair with offline backup:

1. At the main site, stop the program that accesses the P-VOL.
2. At the main site, delete the P-VOL CIFS/NFS shares using the **enas_cifsdelete** command and the **enas_nfsdelete** command in NAS Manager Modular and un-mount the P-VOL using the **enas_fsumount** command.
3. At the main site, stop operations from NAS Sync Image Modular to the P-VOL.

   ```
   $ sudo horc_pvol_freeze –f source file system name
   ```

4. At the main site, which the P-VOL is connected, split the TrueCopy volume pair.

   ```
   $ sudo pairsplit {-g group-name | -d volume name} -rw
   ```

5. At the main site, confirm that the TrueCopy volume pair is split.

   ```
   $ sudo pairvolchk {-g group name | -d volume name }
   ```

   You can also use the **pairevtwait** command, which waits for the pair to be split (PSUS).

   ```
   $ sudo pairvolchk : Volstat is P-VOL.[status = COPY] → Splitting
   $ sudo pairvolchk : Volstat is P-VOL.[status = PSUS] → Split
   ```

6. At the main site, permit the stopped operations from NAS Sync Image Modular to the P-VOL.

   ```
   $ sudo horc_pvol_unfreeze –f source file system name
   ```

7. At the main site, mount the P-VOL using the **enas_fsmount** command in NAS Manager Modular and set CIFS/NFS shares using the **enas_nfscreate** command and the **enas_cifscreate** command.
8. At the main site, restart the program that accesses the P-VOL.
9. At the remote site, connect the target file system to the NAS unit.

   Non-LVM

   ```
   $ sudo horc_svol_import –f target file system name –d device file number
   ```

   LVM

   ```
   $ sudo horc_svol_vmimport –f target file system name –d device file number, ...
   ```

10. At the remote site, mount the S-VOL using the **enas_fsmount** command and create a shared directory using the **enas_dircreate** command or edit the shared directory using the **enas_diredit** command. After that, set CIFS/NFS shares using the **enas_nfscreate** command and the **enas_cifscreate** command.

    Note: In the NAS Sync Image Modular target file system, mount the differential-data snapshot using the **syncmount** command if necessary and set CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

11. At the remote site, start the program that accesses the S-VOL.

- TrueCopy volume pair split by online backup

  To split TrueCopy volume pair with online backup:

1. At the main site, stop the operations from NAS Sync Image Modular to the P-VOL, stop the client access request, and write the un-reflected data to the disk.

```
$ sudo horc_pvol_freeze -f source file system name
```

2. At the main site, split the TrueCopy volume pair.

```
$ sudo pairsplit {-g group name | -d volume name } -rw
```

3. At the main site, confirm that the TrueCopy volume pair is split.

```
$ sudo pairvolchk {-g group name | -d volume name }
```

   You can also use the **pairevtwait** command, which waits for the pair to be split (PSUS).

```
$ sudo pairvolchk : Volstat is P-VOL.[status = COPY] → Splitting
$ sudo pairvolchk : Volstat is P-VOL.[status = PSUS] → Split
```

4. At the main site, permit the client access stop request to P-VOL, and permit the stopped operations from NAS Sync Image Modular.

```
$ sudo horc_pvol_unfreeze -f source file system name
```

5. At the remote site, connect the target file system to the NAS unit.

   Non-LVM

```
$ sudo horc_svol_import -f target file system name -d device file number
```

   LVM

```
$ sudo horc_svol_vmimport -f target file system name -d device file number, ...
```

6. At the remote site, mount the S-VOL using the **enas_fsmount** command and create a shared directory using the **enas_dircreate** command or edit the shared directory using the **enas_diredit** command. After that, set CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

   Note: In the NAS Sync Image Modular target file system, mount the differential-data snapshot using the **syncmount** command if necessary and set CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

7. At the remote site, start the program that accesses the S-VOL.

B.6.3 Resynchronizing a TrueCopy Volume Pair

Delete the target file system using the **enas_fsdelete** command before re-synchronizing the volume pair. Deleting the target file system clears only the management area of the file system. Therefore, re-synchronizing the volume pair is not initial copy.

Note: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command and release the device which stores the differential data using the **syncstop** command.

To resynchronize the TrueCopy volume pair:

1. At the remote site, delete the CIFS/NFS shares using the **enas_cifsdelete** command and the **enas_nfsdelete** command and un-mount all file systems in the pair using the **enas_fsumount** command.

   Note: In the NAS Sync Image Modular target file system, delete the CIFS/NFS shares for the differential-data snapshot using the **enas_cifsdelete** command and the **enas_nfsdelete** command, un-mount the differential-data snapshot using the **syncumount** command, and release the differential-data storage device using the **syncstop** command.

2. At the remote site, delete the file system in the S-VOL using the **enas_fsdelete** command.

3. At the remote site, reserve a device file to be used as a target file system.

   Non-LVM

   ```
   $ sudo horc_svol_define -d device file number
   ```

   LVM

   ```
   $ sudo horc_svol_vmdefine -d device file number, ...
   ```

4. At the main site, resume the TrueCopy volume pair.

   ```
   $ sudo pairresync {-g group name | -d volume name }
   ```

5. At the main site, confirm that the TrueCopy volume pair has been resumed.

   ```
   $ sudo pairvolchk {-g group name | -d volume name }
   ```

   You can also use the **pairevtwait** command, which waits for the volumes to be paired.

   ```
   $ pairvolchk : Volstat is P-VOL.[status = COPY] → Resuming
   $ pairvolchk : Volstat is P-VOL.[status = PAIR] → Resumed
   ```

B.6.4 Deleting a TrueCopy Volume Pair

The procedure of finishing the TrueCopy operations by deleting the TrueCopy volume pair in the PSUS state differs depending on whether you will continue using the file system in S-VOL, or will destroy the file system.

When deleting the TrueCopy volume pair in the state other than PSUS, you cannot use the file system because the consistency of data in the S-VOL is not guaranteed as a file system.

To delete the TrueCopy volume pair in the PSUS state and continue to use the S-VOL file system afterwards:

1. At the main site, delete the TrueCopy volume pair.

```
$ sudo pairsplit {-g group name | -d volume name} -S
```

2. At the main site, confirm that the TrueCopy volume pair has been deleted.

```
$ sudo pairvolchk {-g group name | -d volume name}
```

   You can also use the **pairevtwait** command, which waits for the pair to be deleted.

```
$ pairvolchk : Volstat is P-VOL.[status = COPY] → Deleting
$ pairvolchk : Volstat is P-VOL.[status = SMPL] → Deleted
```

3. At the main site and the remote site, stop CCI.

```
$ sudo horcmshutdown.sh                  (1-instance configuration)
```

   OR

```
$ sudo sudo horcmshutdown.sh  16  17     (2-instance configuration)
```

Note: If you start the operations of splitting the TrueCopy volume pair with offline backup, but have not yet connected the target file system to the NAS unit at the remote site, finish connecting the target file system to the NAS unit, and then start the previously described operations. If you start the split pair operation with online backup, but do not connect the target file system to the NAS unit at the remote site, finish connecting the target file system to the NAS unit, and then start the previously described operations (see section B.6.2).

To delete the TrueCopy volume pair in PSUS state without using the S-VOL file system:

1. At the remote site, terminate the program that accesses the S-VOL.
2. At the remote site, delete CIFS/NFS shares using the **enas_cifsdelete** command and the **enas_nfsdelete** command and un-mount the S-VOL using the **enas_fsumount** command.

   Note: In the NAS Sync Image Modular target file system, delete the CIFS/NFS shares for the differential-data snapshot using the **enas_cifsdelete** command and the **enas_nfsdelete** command, un-mount the differential-data snapshot using the **syncumount** command, and release the differential-data storage device using the **syncstop** command.
3. At the remote site, delete the file system in the S-VOL using the **enas_fsdelete** command.
4. At the main site, delete the TrueCopy volume pair.

```
$ sudo pairsplit {-g group name | -d volume name} -S
```

5. At the main site, confirm that the TrueCopy volume pair has been deleted.

```
$ sudo pairvolchk {-g group name | -d volume name}
```

   You can also use the **pairevtwait** command, which waits for the pair to be deleted.

```
$ pairvolchk : Volstat is P-VOL.[status = COPY] → Deleting
$ pairvolchk : Volstat is P-VOL.[status = SMPL] → Deleted
```

6. At the main site and the remote site, stop CCI.

```
$ sudo horcmshutdown.sh                    (1-instance configuration)
```

OR

```
$ sudo sudo horcmshutdown.sh  16  17     (2-instance configuration)
```

Note: If you start the operations of splitting the TrueCopy volume pair with offline backup, but have not yet connected the target file system to the NAS unit at the remote site, finish connecting the target file system to the NAS unit, and then start the previously described operations. If you start the split pair operation with online backup, but do not connect the target file system to the NAS unit at the remote site, finish connecting the target file system to the NAS unit, and then start the previously described operations (see section B.6.2).

To delete the TrueCopy volume pair in the state other than PSUS state:

1. At the main site, delete the TrueCopy volume pair.

```
$ sudo pairsplit {-g group name | -d volume name} -S
```

2. At the main site, confirm that the TrueCopy volume pair has been deleted.

```
$ sudo pairvolchk {-g group name | -d volume name}
```

You can also use the **pairevtwait** command, which waits for the pair to be deleted.

```
$ pairvolchk : Volstat is P-VOL.[status = COPY] → Deleting
$ pairvolchk : Volstat is P-VOL.[status = SMPL] → Deleted
```

3. At the remote site, release the device file used in the target file system.

Non-LVM

```
$ sudo horc_svol_delete -d device file number
```

LVM

```
$ sudo horc_svol_vmdelete -d device file number, ...
```

4. At the main site and the remote site, stop CCI.

```
$ sudo horcmshutdown.sh                    (1-instance configuration)
```

OR

```
$ sudo sudo horcmshutdown.sh  16  17     (2-instance configuration)
```

B.7 Disaster Recovery Operations

This section describes the procedures for disaster recovery.

B.7.1 Switching Operations to the Remote Site

To recover the data from a disaster:

1. Execute SVOL-Takeover using the **horctakeover** command.

```
$ sudo horctakeover {-g group name | -d volume name}
```

2. Connect the target file system to the NAS unit.

   Non-LVM

```
$ sudo horc_svol_import -f target file system name -d device file number
```

   LVM

```
$ sudo horc_svol_vmimport -f target file system name -d device file number, ...
```

3. Mount S-VOL using the **enas_fsmount** command and create CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command; recover the file system when mounting the S-VOL.

   Note: In the NAS Sync Image Modular target file system, mount the differential-data snapshot using the **syncmount** command if necessary and set CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

4. Start the program that accesses the S-VOL.

B.7.2 Transferring Data Back to the Main Site

To transfer the data back to the main site:

1. At the main site, set up the environment variable of the CCI instance.

```
$ sudo horc_setenv HORCMINST 16  (For instance number 16)
```

   OR

```
$ sudo horc_setenv HORCMINST 17  (For instance number 17)
```

2. At the main site, set up the HOMRCF command environment variable of the CCI as TrueCopy.

```
$ sudo horc_unsetenv HORCC_MRCF
```

3. After you have logged in to the target NAS unit using SSH and set up as explained in steps 1 and 2, confirm the setup by logging out of the NAS unit and re-logging in.

```
$ exit
ssh {-1 | -2} nasroot@ <fixed IP address of NAS unit>
```

4. At the main site and the remote site, start CCI.

```
$ sudo horcmstart.sh                    (1-instance configuration)
```

   OR

```
$ sudo sudo horcmstart.sh  16  17       (2-instance configuration)
```

5. At the main site, delete the CIFS/NFS shares in the old P-VOL, un-mount the old P-VOL, and delete the file system in the old P-VOL.

   Note: When the old P-VOL is the file system managed by NAS Sync Image Modular, delete the CIFS/NFS shares under the differential-data snapshots, un-mount the differential-data snapshots, and release the differential-data storage devices before deleting the file system in the old P-VOL.

6. At the main site, reserve the old P-VOL in preparation for data transfer from the remote site to the main site.

   Non-LVM

```
$ sudo horc_svol_define -d device file number
```

   LVM

```
$ sudo horc_svol_vmdefine -d device file number, ...
```

7. Transfer the data from the remote site to the main site (create TrueCopy volume pair).

```
$ sudo paircreate {-g group name | -d volume name} -f never -vl
```

8. If the state is changed to PAIR, stop the operation in the remote site.

9. At the remote site, delete the CIFS/NFS shares in the old S-VOL using the **enas_cifsdelete** command and the **enas_nfsdelete** command and un-mount the old S-VOL using the **enas_fsumount** command.

10. At the remote site, stop the operations from NAS Sync Image Modular to the P-VOL, stop the client access request, and write the un-reflected data to the disk.

```
$ sudo horc_pvol_freeze -f source file system name
```

11. At the remote site, split TrueCopy volume pair.

```
$ sudo pairsplit {-g group name | -d volume name } -rw
```

12. At the remote site, permit the client access stop request to old S-VOL, and permit the stopped operations from NAS Sync Image Modular.

```
$ sudo horc_pvol_unfreeze -f source file system name
```

13. At the main site, connect the target file system to the NAS unit.

   Non-LVM

```
$ sudo horc_svol_import -f target file system name -d device file number
```

   LVM

```
$ sudo horc_svol_vmimport -f target file system name -d device file number, ...
```

14. At the remote site, delete the file system in the old S-VOL using the **enas_fsdelete** command.

   Note: When the old S-VOL is the file system managed by NAS Sync Image Modular, delete the CIFS/NFS shares under the differential-data snapshots, un-mount the differential-data snapshots, and release the differential-data storage devices before deleting the file system in the old S-VOL.

15. At the remote site, reserve the old S-VOL in preparation for reverse resynchronization of data from the main site to the remote site.

    Non-LVM

    ```
    $ sudo horc_svol_define -d device file number
    ```

    LVM

    ```
    $ sudo horc_svol_vmdefine -d device file number, ...
    ```

16. At the main site, reverse resynchronization of data from the main site to the remote site.

    ```
    $ sudo pairresync {-g group name | -d volume name} -swaps
    ```

17. At the main site, mount the new P-VOL using the **enas_fsmount** command, and create the CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

    Note: When the new P-VOL is the file system managed by NAS Sync Image Modular, mount the differential-data snapshot using the **syncmount** command if necessary and set CIFS/NFS shares using the **enas_cifscreate** command and the **enas_nfscreate** command.

18. At the main site, resume the operations in the main site.

B.8 CCI Log Files

This section describes the format of CCI log files, the method of downloading the log file to the SSH client, and cautions in the NAS Modular system.

B.8.1 Format of CCI Log Files

CCI log file consists of start-up logs, error log, trance and core files and is stored in the format shown in Table B.6.

"*" in Table B.6 denotes the CCI instance number (16 or 17), Host denotes the name of the node name of the target NAS unit, **PID** denotes the process ID of the CCI command, **CMD** shows the process name (horcmgr in case of CCI, or a command name in case of the CCI command), and **TIME** shows the creation time of the core file.

Table B.6 Format of the CCI Log Files in the NAS Modular System

Log File Classification	Log File Name	Log Files Format
CCI logs under operation	CCI startup log	/home/nasroot/log*/curlog/horcm_HOST.log
	Command log	/home/nasroot/log*/horcc_HOST.log
	CCI error log	/home/nasroot/log*/curlog/horcmlog_HOST/horcm.log
	CCI trace log	/home/nasroot/log*/curlog/horcmlog_HOST/horcm_PID.trc
	Command trace	/home/nasroot/log*/curlog/horcmlog_HOST/horccc_PID.trc
	Core file	/var/core/core-PID-CMD-TIME
CCI logs saved automatically	CCI startup log	/home/nasroot/log*/tmplog/horcm_HOST.log
	Command log	/home/nasroot/log*/horcc_HOST.log
	CCI error log	/home/nasroot/log*/tmplog/horcmlog_HOST/horcm.log
	CCI trace log	/home/nasroot/log*/tmplog/horcmlog_HOST/horcm_PID.trc
	Command trace	/home/nasroot/log*/tmplog/horcmlog_HOST/horccc_PID.trc
	Core file	/var/core/core-PID-CMD-TIME

B.8.2 Downloading CCI Log Files to SSH Client

You can download or delete core files output by CCI on the List of RAS Information (List of core files) window provided in NAS Manager Modular. When you examine the detailed factor of the abnormal termination of the CCI command through the log file (excluding the core file) of the CCI or want to save the log file before it is deleted, download the log using the List of RAS Information (Batch-download) window of NAS Manager Modular specifying the Backup log groups. For details, please refer to *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757).

Note: To view the CCI log files using Windows®, ensure that the text viewer can display the text containing the line feed code LF (Line Feed).

B.8.3 Notes on the Operations of the CCI Log Files

If you continue the TrueCopy operation without fixing an error, the size of the CCI lof file will be increased, and the file will affect the NAS OS LU because the CCI log file is output to NAS OS LU. Therefore, check the capacity of the log file periodically except for the trace whose capacity is limited in CCI and stop CCI before it becomes larger than 1 megabyte. Then, use the **horc_logremove** command to delete the log file. View the log file size by using the following command.

```
$ ls -l -R /home/nasroot/log*   (* is instance number 16 or 17)
```

B.9 Commands

This section describes the commands that are used in TrueCopy operations in the NAS Modular system and that are provided by Hitachi Network Attached Storage series products. For details of these commands, please refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759), the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757), and the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Sync Image Modular User's Guide* (MK-95DF758).

- Commands provided by NAS Backup Restore Modular
  - horc_devlist
  - horc_logremove
  - horc_printenv, horc_setenv, horc_unsetenv
  - horc_pvol_freeze
  - horc_pvol_unfreeze
  - horc_svol_define, horc_svol_vmdefine
  - horc_svol_delete, horc_svol_vmdelete
  - horc_svol_import, horc_svol_vmimport
- Commands provided by NAS Manager Modular
  - enas_cifscreate, enas_cifsdelete
  - enas_dircreate, enas_diredit
  - enas_fscreate, enas_fsdelete, enas_fslist, enas_fsmount, enas_fsumount
  - enas_nfscreate, enas_nfsdelete
- Commands provided by NAS Sync Image Modular
  - syncdel, synclist, syncmount, syncstop, syncumount

B.10 Messages

For further information about the messages output by the commands described in section B.9, please refer to the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759), the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757), and the *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Sync Image Modular User's Guide* (MK-95DF758).

Appendix C Command Operations on NAS Modular

This appendix describes command operations on NAS Modular. The following sections describe commands and procedures for creating pairs, splitting pairs, resynchronizing pairs and deleting pairs.

During the fail-over of the NAS unit, the commands shown in Table C.1 cannot be used. When the fail-over occurs because of a failure caused by a controller blockade or an NAS unit failure, perform the pair operation from the beginning after returning all the pairs in the group to the status as before the procedure start by executing the fail-back.

Table C.1 Commands that Cannot be Used During the Fail-over

Category	Command
NAS Backup Restore Modular commands	horc_svol_import, horc_svol_vmimport
NAS Manager Modular commands	enas_cifscreate, enas_cifsdelete
	enas_fscreate, enas_fsdelete
	enas_fsmount, enas_fsumount
	enas_nfscreate, enas_nfsde

C.1 Creating Pairs

C.1.1 Commands for Creating Pairs

Table C.2 lists commands used for creating pairs.

Table C.2 Commands for Creating Pairs

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
2		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
3	CCI commands	sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
4		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair creation.
5		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

C.1.2 Procedure for Creating Pairs

The pair is usually created in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation.

Table C.3 Procedure for Creating Pairs

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	SMPL	SMPL	–	–		
2									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
3			Public	Mount	SMPL	SMPL	–	–		
4	pairdisplay	Confirm the configuration definition file before crating pair								
5			Public	Mount	SMPL	SMPL	–	–		
6	paircreate	Creates a volume pair								
7			Public	Mount	COPY	COPY	–	–		
8	pairdisplay	Confirm a volume pair status								
9			Public	Mount	COPY	COPY	–	–		
10	pairvolchk	At this point a pair status is COPY								
11	Execute pairvolchk several times		Public	Mount	COPY	COPY	–	–		
12	pairvolchk	When a pair status change to PAIR, crating pair is completed								
13			Public	Mount	PAIR	PAIR	–	–		

C.2 Splitting Pairs

C.2.1 Commands for Splitting Pairs

Table C.4 lists commands used for splitting pairs.

Table C.4 Commands for Splitting Pairs

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
2		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
3		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
4		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
5		sudo enas_fsumount file system name	Un-mount a file system.
6		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
7		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
8		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
9		sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
10		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
11		enas_dircreate -u owner -g group name -m mode of directory to be changed path of subdirectory	Create a subdirectory.
12		enas_diredit -u owner -g group name -m mode of directory to be changed path of subdirectory	Change directory attributes.
13	CCI commands	sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
14		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair splitting.

C.2.2 Procedure for Splitting Pairs with P-VOL Mounted

The following section describes the procedure for splitting a pair when P-VOl is mounted. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.5 Procedure for Splitting Pairs with P-VOL Mounted

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	horc_pvol_freeze	Hold the access								
3			Public	Mount	PAIR	PAIR	–	–		
4	pairsplit -rw	Split a pair								
5			Public	Mount	PSUS	SSUS	–	–		
6	horc_pvol_unfreeze	Cancel suppression of operations								
7	Execute pairvolchk several times		Public	Mount	PSUS	SSUS	–	–		
8	pairvolchk	When a pair status change to PSUS, splitting pair is completed								
9			Public	Mount	PSUS	SSUS	–	–		
10									Connect the file system	horc_svol_vmimport (when LVM is not used, horc_svol_import)
11			Public	Mount	PSUS	SSUS	Un-mount	Non-public		
12									Mount	enas_fsmount
13			Public	Mount	PSUS	SSUS	Mount	Non-public		
14									Create a subdirectory / change a directory attributes	enas_dircreate/ enas_diredit
15			Public	Mount	PSUS	SSUS	Mount	Non-public		
16									Share	enas_nfscreate/ enas_cifscreate
17			Public	Mount	PSUS	SSUS	Mount	Public		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
18						Start a program that accesses the file system at the remote site.				

C.2.3 Procedure for Splitting Pairs with P-VOL Un-mounted

The following section describes the procedure for splitting a pair when P-VOl is unmounted. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.6 Procedure for Splitting Pairs with P-VOL Un-mounted

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1	Stop a program that accesses the file system at the main site.									
2			Public	Mount	PAIR	PAIR	–	–		
3	enas_nfsdelete/ enas_cifsdelete	Delete NFS/CIFS shares								
4			Non-public	Mount	PAIR	PAIR	–	–		
5	enas_fsumount	Un-mount								
6			Non-public	Un-mount	PAIR	PAIR	–	–		
7	pairsplit -rw	Split a pair								
8	Execute pairvolchk several times		Non-public	Un-mount	PSUS	SSUS	–	–		
9	pairvolchk	When a pair status change to PSUS, splitting pair is completed								
10			Non-public	Un-mount	PSUS	SSUS	–	–		
11	enas_fsmount	Mount								
12			Non-public	Mount	PSUS	SSUS	–	–		
13	enas_nfscreate/ enas_cifscreate	Share								
14			Public	Mount	PSUS	SSUS	–	–		
15	Restart a program that accesses the file system at the main site.									
16			Public	Mount	PSUS	SSUS	–	–		
17									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
18			Public	Mount	PSUS	SSUS	Un-mount	Non-public		
19									Mount	enas_fsmount
20			Public	Mount	PSUS	SSUS	Mount	Non-public		
21									Create a subdirectory/ change a directory attributes ***Note 2***	enas_dircreate/ enas_diredit
22			Public	Mount	PSUS	SSUS	Mount	Non-public		
23									Share	enas_nfscreate/ enas_cifscreate
24			Public	Mount	PSUS	SSUS	Mount	Public		
25						Start a program that accesses the file system at the remote site.				

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: It is not necessary for the same public directory name as the main site. When the main site and the public directory name are changed, it is necessary.

C.3 Resynchronizing Pairs

C.3.1 Commands for Resynchronizing Pairs

Table C.7 lists commands used for resynchronizing pairs.

Table C.7 Commands for Resynchronizing Pairs

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
2		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
3		sudo enas_fsumount file system name	Un-mount a file system.
4		sudo enas_fsdelete file system name	Delete a file system.
5		sudo horc_svol_define -d device file number	When LVM is not used, reserves device files.
6		sudo horc_svol_vmdefine -d device file number	When LVM is used, reserves device files.
7		syncumount	Un-mounts the differential-data snapshot.
8		syncstop	Releases the differential-data storage device.
9	CCI commands	sudo pairresync {-g group name | -d volume name}	Resynchronizes the split pairs.
10		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair re-synchronizing.

C.3.2 Procedure for Resynchronizing Pairs

The following section describes the procedure for resynchronizing a pair with volume status PSUS/SSUS. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.8 Procedure for Re-synchronizing Pairs

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1						Stop a program that accesses the file system at the remote site.				
2			Public	Mount	PSUS	SSUS	Mount	Public		
3									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
4			Public	Mount	PSUS	SSUS	Mount	Non-public		
5									Un-mount	enas_fsumount
6			Public	Mount	PSUS	SSUS	Un-mount	Non-public		
7									Delete file system ***Note***	enas_fsdelete
8			Public	Mount	PSUS	SSUS	–	–		
9									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
10			Public	Mount	PSUS	SSUS	–	–		
11	pairresync	Resynchronizes the pairs								
12			Public	Mount	COPY	COPY	–	–		
13	pairvolchk	At this point a pair status is COPY								
14	Execute pairvolchk several times		Public	Mount	COPY	COPY	–	–		
15	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
16			Public	Mount	PAIR	PAIR	–	–		

Note: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

C.4 Deleting Pairs

C.4.1 Commands for Deleting Pairs

Table C.9 lists commands used for deleting pairs.

Table C.9 Commands for Deleting Pairs

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
2		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
3		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
4		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
5		sudo enas_fsumount file system name	Un-mount a file system.
6		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
7		sudo enas_fsdelete file system name	Delete a file system.
8		sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
9		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
10		enas_dircreate -u owner -g group name -m mode of directory to be changed path of subdirectory	Create a subdirectory.
11		enas_diredit -u owner -g group name -m mode of directory to be changed path of subdirectory	Change directory attributes.
12		syncumount	Un-mounts the differential-data snapshot.
13		syncstop	Releases the differential-data storage device.
14		sudo horc_svol_delete	When LVM is not used, releases device files.
15		sudo horc_svol_vmdelete	When LVM is used, releases device files.
16	CCI commands	sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.
17		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.
18		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair deleting.

C.4.2 Procedure for Deleting Pairs (S-VOL Continuously Used-1)

The following section describes the procedure for deleting a pair when the S-VOL is in PAIR status and is continuously used after pair deletion. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.10 Procedure for Deleting Pairs (S-VOL Continuously Used-1)

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	pairsplit -S	Deletes a volume pair								
3			Public	Mount	PAIR	PAIR	–	–		
4	pairsplit -R	Brings S-VOL into SMPL forcibly								
5	Execute pairvolchk several times		Public	Mount	SMPL	SMPL	–	–		
6	pairvolchk	When a pair status change to SMPL, deleting is completed								
7			Public	Mount	SMPL	SMPL	–	–		
8									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
9			Public	Mount	SMPL	SMPL	Un-mount	Non-public		
10									Mount	enas_fsmount
11			Public	Mount	SMPL	SMPL	Mount	Non-public		
12									Create a subdirectory/ change a directory attributes ***Note 2***	enas_dircreate/ enas_diredit
13			Public	Mount	SMPL	SMPL	Mount	Non-public		
14									Share	enas_nfscreate/ enas_cifscreate
15			Public	Mount	SMPL	SMPL	Mount	Public		
16						Start a program that accesses the file system at the remote site.				

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: It is not necessary for the same public directory name as the main site. When the main site and the public directory name are changed, it is necessary.

C.4.3 Procedure for Deleting Pairs (S-VOL Continuously Used-2))

The following section describes the procedure for deleting a pair when the S-VOL is in PSUS/SSUS status and is continuously used after pair deletion. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.11 Procedure for Deleting Pairs (S-VOL Continuously Used-2)

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PSUS	SSUS	Mount	Public		
2	pairsplit -S	Deletes a volume pair								
3			Public	Mount	SMPL	SMPL	Mount	Public		
4	pairsplit -R	Brings S-VOL into SMPL forcibly								
5			Public	Mount	SMPL	SMPL	Mount	Public		
6	pairvolchk	When a pair status change to SMPL, deleting is completed								
7			Public	Mount	SMPL	SMPL	Mount	Public		

C.4.4 Procedure for Deleting Pairs (S-VOL Not Used-1)

The following section describes the procedure for deleting a pair when the S-VOL is in PAIR status and is not used after pair deletion. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.12 Procedure for Deleting Pairs (S-VOL Not Used-1)

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	pairsplit -S	Deletes a volume pair								
3			Public	Mount	SMPL	SMPL	–	–		
4	pairsplit -R	Brings S-VOL into SMPL forcibly								
5	Execute pairvolchk several times		Public	Mount	SMPL	SMPL	–	–		
6	pairvolchk	When a pair status change to SMPL, deleting is completed								
7			Public	Mount	SMPL	SMPL	–	–		
8									Releases device files	horc_svol_vmdelete (when LVM is not used, horc_svol_delete)
9			Public	Mount	SMPL	SMPL	–	–		

C.4.5 Procedure for Deleting Pairs (S-VOL Not Used-2)

The following section describes the procedure for deleting a pair when the S-VOL is in PSUS/SSUS status and is not used after pair deletion. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted in the following table. You should specify the appropriate options for the actual operation.

Table C.13 Procedure for Deleting Pairs (S-VOL Not Used-2)

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1						Stop a program that accesses the file system at the remote site.				
2			Public	Mount	PSUS	SSUS	Mount	Public		
3									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
4			Public	Mount	PSUS	SSUS	Mount	Non-public		
5									Un-mount	enas_fsumount
6			Public	Mount	PSUS	SSUS	Un-mount	Non-public		
7									Delete file system ***Note***	enas_fsdelete
8			Public	Mount	PSUS	SSUS	–	–		
9	pairsplit -S	Deletes a volume pair								
10			Public	Mount	SMPL	SMPL	–	–		
11	pairsplit -R	Brings S-VOL into SMPL forcibly								
12			Public	Mount	SMPL	SMPL	–	–		
13	pairvolchk	When a pair status change to SMPL, deleting is completed								
14			Public	Mount	SMPL	SMPL	–	–		

Note: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

Appendix D Failure Operations on NAS Modular

This section describes the following five assumed failure scenarios on NAS Modular:

- Operation when the main site or subsystem went down (D.2)
- Operation when the NAS cluster of the main site went down (D.3)
- Operation when multiple failures occurred in all the storages on the main site (D.4)
- Operation when multiple failures occurred in part of the storages on the main site (D.5)
- Operation when network failures occurred in the main site (D.6)

The commands and the important options are described, but specify the appropriate options referring to the following manual.

- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Manager Modular User's Guide* (MK-95DF757)
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage NAS Backup Restore Modular User's Guide* (MK-95DF759)
- *Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage Command Control Interface (CCI) User and Reference Guide* (MK-95DF701)

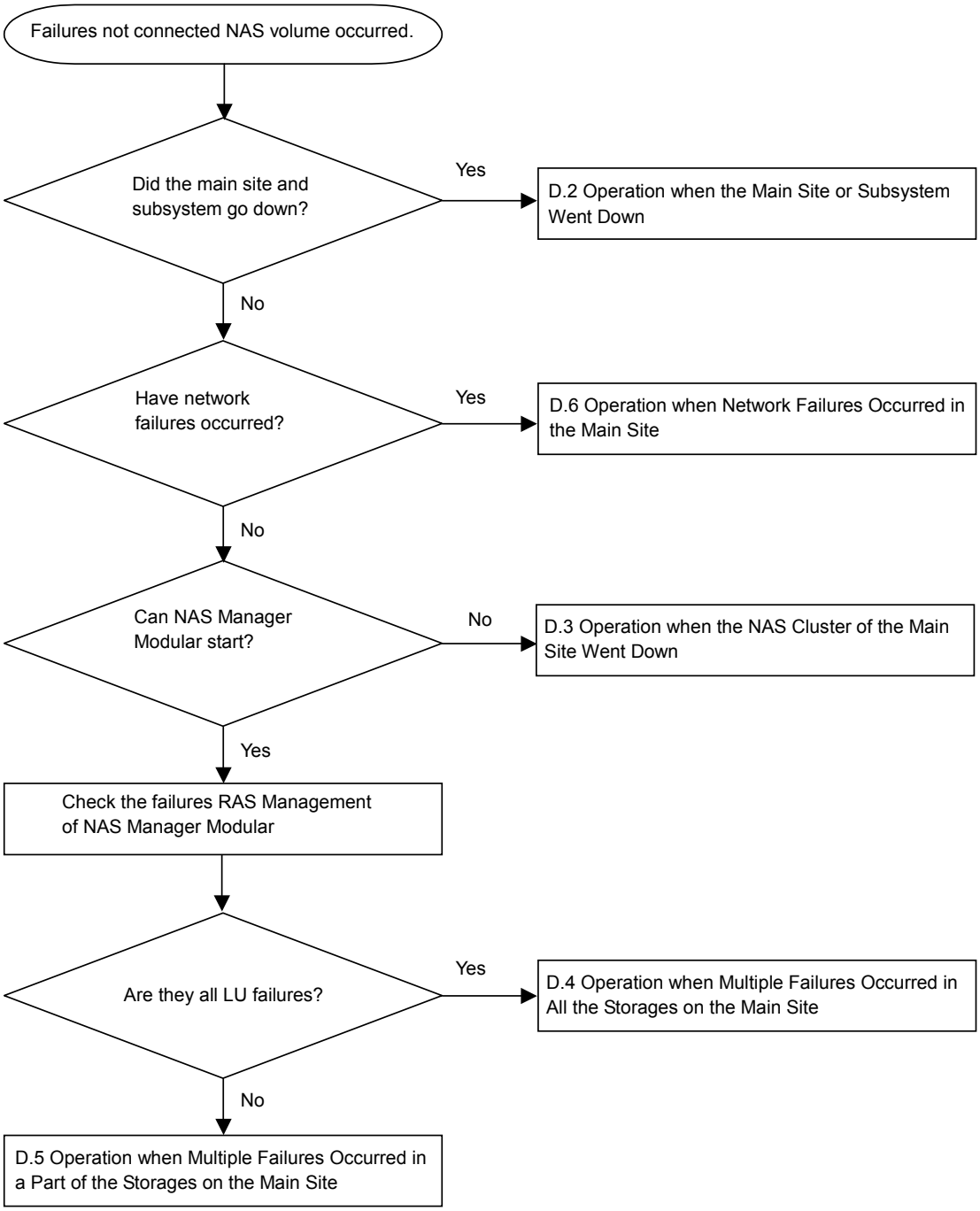
Note: During the fail-over of the NAS unit, the commands shown in Table D.1 cannot be used. When the fail-over occurs because of a failure caused by a controller blockade or an NAS unit failure, continue the pair operation procedure by executing the fail-back.

Table D.1 Commands that Cannot be Used During the Fail-over

Category	Command
NAS Backup Restore Modular commands	horc_svol_import, horc_svol_vmimport
NAS Manager Modular commands	enas_cifscreate, enas_cifsdelete
	enas_fscreate, enas_fsdelete
	enas_fsmount, enas_fsumount
	enas_nfscreate, enas_nfsde

D.1 Isolation when Failures Occur

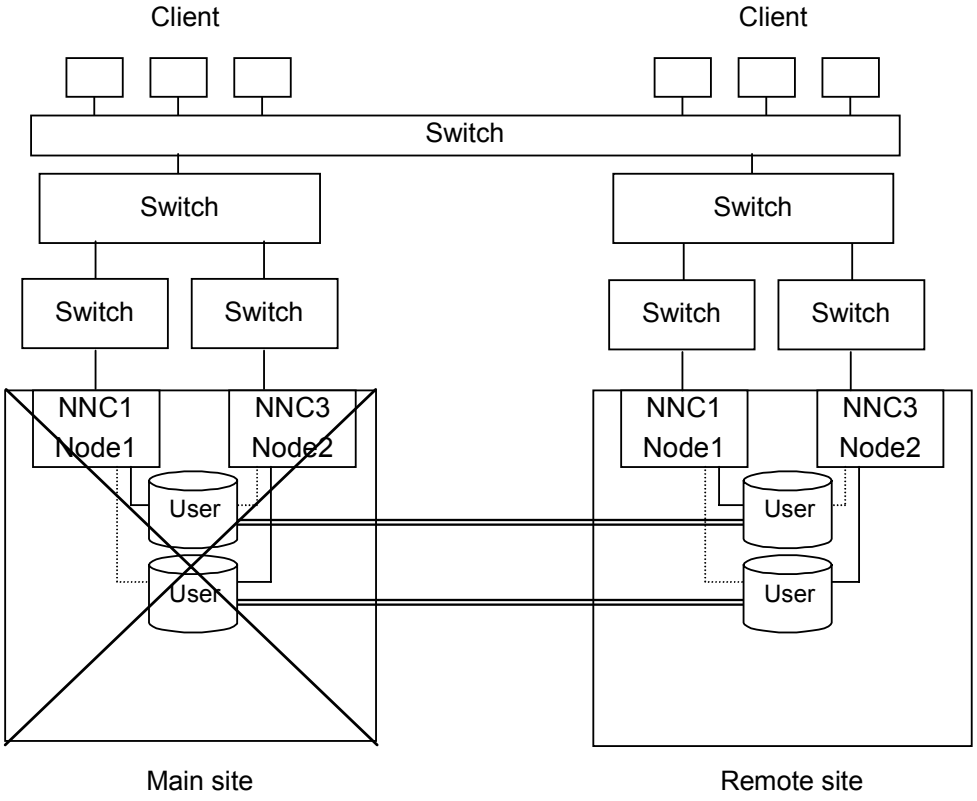
The following isolation procedure is to be performed based on the following flow chart when failures occur. If other undocumented failures occur, contact the service personnel before performing the isolation procedures. It is described by separating the cases when it can be connected to the NAS volume from the client and when it cannot be connected to the client.



D.2 Operation when the Main Site or Subsystem Went Down

D.2.1 Assumed Scenarios

The main site is struck, the business operation on the main site cannot be performed, and the business operation is continued on the remote site. The main site cannot be restored, and new subsystem was introduced.



D.2.2 Commands to be Used

The following commands are used when the main site or subsystem went down.

Table D.2 Commands for Recovery when the Main Site or Subsystem Went Down

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
2		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
3		sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
4		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
5		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
6		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
7		sudo enas_fsumount file system name	Un-mount a file system.
8		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
9		sudo enas_fsdelete file system name	Delete a file system.
10		sudo horc_setenv HORCMINST instance number	Sets up or modifies the CCI environment variable.
11		sudo horc_unsetenv HORCC_MRCF	Deletes the CCI environment variable.
12		sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
13		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
14		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
15		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
16		sudo horcmstart.sh	Start CCI (1-instance configuration)
17		sudo horcmstart.sh 16 17	Start CCI (2-instance configuration)
18	CCI commands	sudo horctakeover {-g group name | -d volume name} [-t time out]	Takeover the pair.
19		sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
20		sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.
21		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.

No.	Category	Command	Description
22		sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
23		sudo pairresync {-g group name | -d volume name} -swaps	Resynchronizes the split pairs.
24		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair.
25		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

D.2.3 Recovery Procedure from Failures

When the main site is struck, recover it in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation. It is a prerequisite that S-VOL is reserved.

Table D.3 Recovery Procedure when the Main Site or Subsystem Went Down

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	Main site is down.									
3			–	–	–	PAIR	–	–		
4						The takeover execution is decided by the customer judgment.				
5									Execute takeover	horctakeover
6			–	–	–	SSWS	–	–		
7									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
8			–	–	–	SSWS	Un-mount	Non-public		
9									Mount	enas_fsmount
10			–	–	–	SSWS	Mount	Non-public		
11									Share	enas_nfscreate/ enas_cifscreate
12			–	–	–	SSWS	Mount	Public		
13						Start the business operation at the remote site. ***Note 2***				

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
14	Main site is recovered.									
15			–	–	–	SSWS	Mount	Public		
16	NAS cluster in the main site was started.									
17			–	–	–	SSWS	Mount	Public		
18	horc_setenv	Set CCI environment								
19			–	–	–	SSWS	Mount	Public		
20	horc_unsetenv	Set CCI environment								
21			–	–	–	SSWS	Mount	Public		
22									Deletes a volume pair	pairsplit -S
23			–	–	–	SMPL	Mount	Public		
24									When a pair status change to SMPL, deleting is completed	pairvolchk
25			–	–	–	SMPL	Mount	Public		
26	horcmstart.sh	Start CCI								
27			–	–	SMPL	SMPL	Mount	Public		
28	horc_svol_vmdefin e (when LVM is not used, horc_svol_define)	Reserves the old P-VOL								
29			–	–	SMPL	SMPL	Mount	Public		
30									Confirm the configuration definition file before crating pair	pairdisplay
31			–	–	SMPL	SMPL	Mount	Public		
32									Creates a volume pair	paircreate
33			–	–	COPY	COPY	Mount	Public		
34									Confirm a volume pair status	pairdisplay
35			–	–	COPY	COPY	Mount	Public		
36									At this point a pair status is	pairvolchk

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
									COPY	
37			–	–	COPY	COPY	Mount	Public	Execute pairvolchk several times	
38									When a pair status change to PAIR, crating pair is completed	pairvolchk
39			–	–	PAIR	PAIR	Mount	Public		
40						Stop the business operation at the remote site.				
41									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
42			–	–	PAIR	PAIR	Mount	Non-public		
43									Un-mount	enas_fsumount
44			–	–	PAIR	PAIR	Un-mount	Non-public		
45									Split a pair	pairsplit -rw
46			–	–	SSUS	PSUS	Un-mount	Non-public	Execute pairvolchk several times	
47									When a pair status change to PSUS, splitting pair is completed	pairvolchk
48			–	–	SSUS	PSUS	Un-mount	Non-public		
49	horc_svol_vmimport (when LVM is not used, horc_svol_import)	Connect the file system ***Note 1***								
50			Non-public	Un-mount	SSUS	PSUS	Un-mount	Non-public		
51									Delete file system ***Note 3***	enas_fsdelete
52			Non-public	Un-mount	SSUS	PSUS	–	–		
53									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
54			Non-public	Un-mount	SSUS	PSUS	–	–		
55	pairresync -swaps	Reverse resynchronize								
56			Non-public	Un-mount	COPY	COPY	–	–		
57	pairvolchk	At this point a pair status is COPY								
58	Execute pairvolchk several times		Non-public	Un-mount	COPY	COPY	–	–		
59	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
60			Non-public	Un-mount	PAIR	PAIR	–	–		
61	enas_fsmount	Mount								
62			Non-public	Mount	PAIR	PAIR	–	–		
63	enas_nfscreate/ enas_cifscreate	Share								
64			Public	Mount	PAIR	PAIR	–	–		
65	Start the business operation at the main site. ***Note 2***									

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

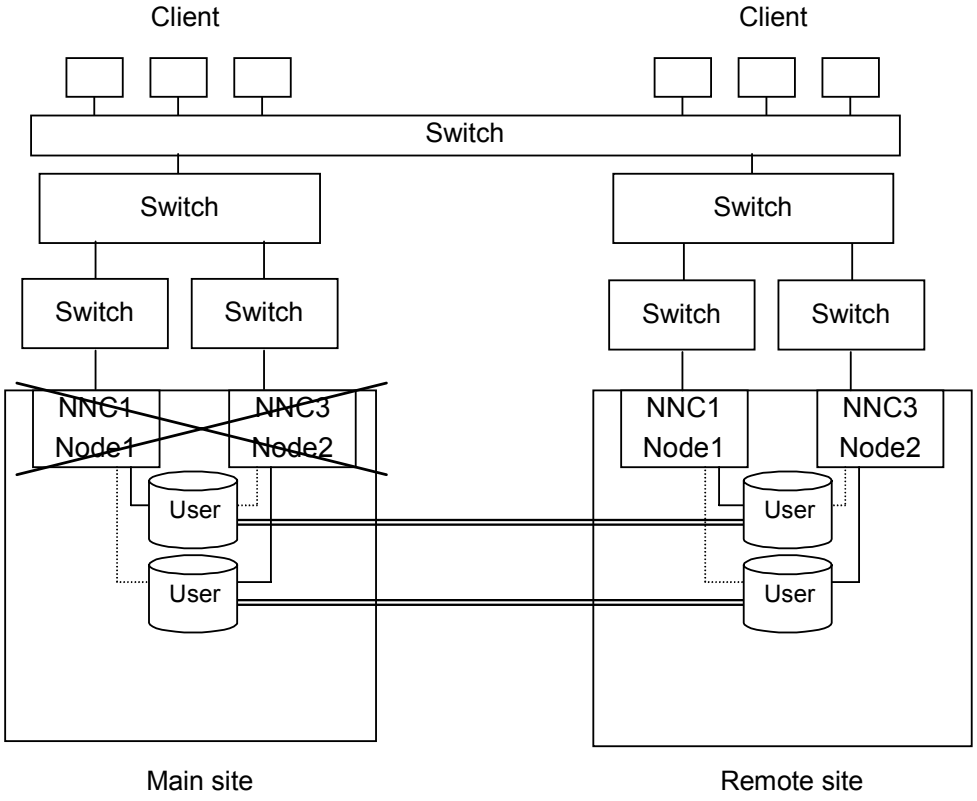
Note 2: When the takeover is performed, the IP address cannot be taken over from the primary site to the secondary site. When starting a job at the secondary site, un-mount the client from the primary site, change the IP address of the site on which the client is to be mounted to that of the secondary site, and then mount the client again. When the job is resumed at the primary site because the primary site has been restored, un-mount the client from the secondary site, return the IP address of the site on which the client is to be mounted to that of the primary site, and then mount the client again.

Note 3: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

D.3 Operation when the NAS Cluster of the Main Site Went Down

D.3.1 Assumed Scenarios

Both nodes of NAS OS on the main side went down. Because OS does not start, the business operation on the main site cannot be performed, and the business operation is continued on the remote site.



D.3.2 Commands to be Used

The following commands are used when the NAS cluster of the main site went down.

Table D.4 Commands for Recovery when the NAS Cluster of Main Site Went Down

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
2		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
3		sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
4		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
5		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
6		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
7		sudo enas_fsumount file system name	Un-mount a file system.
8		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
9		sudo enas_fsdelete file system name	Delete a file system.
10		sudo horc_setenv HORCMINST instance number	Sets up or modifies the CCI environment variable.
11		sudo horc_unsetenv HORCC_MRCF	Deletes the CCI environment variable.
12		sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
13		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
14		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
15		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
16		sudo horcmstart.sh	Start CCI (1-instance configuration)
17		sudo horcmstart.sh 16 17	Start CCI (2-instance configuration)
18	CCI commands	sudo horctakeover {-g group name | -d volume name} [-t time out]	Takeover the pair.
19		sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
20		sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.
21		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.

No.	Category	Command	Description
22		sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
23		sudo pairresync {-g group name | -d volume name} -swaps	Resynchronizes the split pairs.
24		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair.
25		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

D.3.3 Recovery Procedure from Failures

When the NAS cluster of the main site is struck, recover it in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation. It is a prerequisite that S-VOL is reserved.

Table D.5 Recovery Procedure when the NAS Cluster of the Main Site Went Down

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	NAS cluster is down.									
3			–	–	–	PAIR	–	–		
4						The takeover execution is decided by the customer judgment.				
5									Execute takeover	horctakeover
6			–	–	PSUE	SSWS	Un-mount	Non-public		
7									Confirm a volume pair status to be SSWS	pairvolchk
8			–	–	PSUE	SSWS	Un-mount	Non-public		
9									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
10			–	–	PSUE	SSWS	Un-mount	Non-public		
11									Mount	enas_fsmount
12			–	–	PSUE	SSWS	Mount	Non-public		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
13									Share	enas_nfscreate/ enas_cifscreate
14			–	–	PSUE	SSWS	Mount	Public		
15						Start the business operation at the remote site. ***Note 2***				
16	NAS cluster is recovered.									
17			Public	Mount	PSUE	SSWS	Mount	Public		
18	enas_nfsdelete/ enas_cifsdelete	Delete NFS/CIFS shares								
19			Non-public	Mount	PSUE	SSWS	Mount	Public		
20	enas_fsumount	Un-mount								
21			Non-public	Un-mount	PSUE	SSWS	Mount	Public		
22	enas_fsdelete	Delete file system ***Note 3***								
23			–	–	PSUE	SSWS	Mount	Public		
24	horc_setenv	Set CCI environment								
25			–	–	PSUE	SSWS	Mount	Public		
26	horc_unsetenv	Set CCI environment								
27			–	–	PSUE	SSWS	Mount	Public		
28	horcmstart.sh	Start CCI								
29			–	–	PSUE	SSWS	Mount	Public		
30	horc_svol_vmdefine (when LVM is not used, horc_svol_define)	Reserves the old P-VOL								
31			–	–	PSUE	SSWS	Mount	Public		
32									Confirm the configuration definition file before re-synchronizing pair	pairdisplay
33			–	–	PSUE	SSWS	Mount	Public		
34									Reverse resynchronize	pairresync -swaps
35			–	–	COPY	COPY	Mount	Public		
36									Confirm a volume pair status	pairdisplay
37			–	–	COPY	COPY	Mount	Public		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
38									At this point a pair status is COPY	pairvolchk
39			–	–	COPY	COPY	Mount	Public	Execute pairvolchk several times	
40									When a pair status change to PAIR, re-synchronizing pair is completed	pairvolchk
41			–	–	PAIR	PAIR	Mount	Public		
42						Stop the business operation at the remote site.				
43									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
44			–	–	PAIR	PAIR	Mount	Non-public		
45									Un-mount	enas_fsumount
46			–	–	PAIR	PAIR	Un-mount	Non-public		
47									Split a pair	pairsplit -rw
48			–	–	SSUS	PSUS	Un-mount	Non-public		
49									When a pair status change to PSUS, splitting pair is completed	pairvolchk
50			–	–	SSUS	PSUS	Un-mount	Non-public		
51	horc_svol_vmimport (when LVM is not used, horc_svol_import)	Connect the file system ***Note 1***								
52			Non-public	Un-mount	SSUS	PSUS	Un-mount	Non-public		
53									Delete file system ***Note 3***	enas_fsdelete
54			Non-public	Un-mount	SSUS	PSUS	–	–		
55									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
56			Non-public	Un-mount	SSUS	PSUS	–	–		
57	pairresync -swaps	Reverse resynchronize								

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
58			Non-public	Un-mount	COPY	COPY	–	–		
59	pairvolchk	At this point a pair status is COPY								
60	Execute pairvolchk several times		Non-public	Un-mount	COPY	COPY	–	–		
61	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
62			Non-public	Un-mount	PAIR	PAIR	–	–		
63	enas_fsmount	Mount								
64			Non-public	Mount	PAIR	PAIR	–	–		
65	enas_nfscreate/ enas_cifscreate	Share								
66			Public	Mount	PAIR	PAIR	–	–		
67	Start the business operation at the main site. ***Note 2***									

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: When the takeover is performed, the IP address cannot be taken over from the primary site to the secondary site. When starting a job at the secondary site, un-mount the client from the primary site, change the IP address of the site on which the client is to be mounted to that of the secondary site, and then mount the client again. When the job is resumed at the primary site because the primary site has been restored, un-mount the client from the secondary site, return the IP address of the site on which the client is to be mounted to that of the primary site, and then mount the client again.

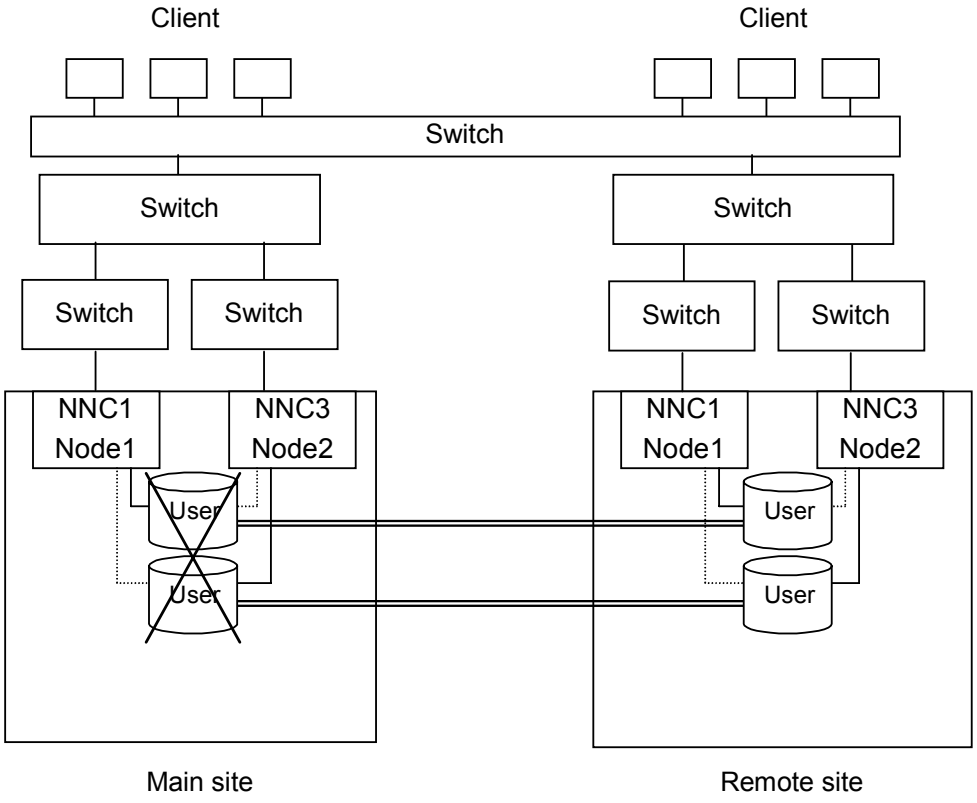
Note 3: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

D.4 Operation when Multiple Failures Occurred in All the Storages on the Main Site

D.4.1 Assumed Scenarios

When multiple failures occurred in all the storages used in the NAS user LU on the main site, the business operation cannot be performed on the main site, and the business operation is continued on the remote site. Note that ShadowImage operation is not performed.

The failed storage on the main site is recovered by the replacement (service personnel).



D.4.2 Commands to be Used

The following commands are used when multiple failures occurred in all the storages used in the NAS user LU on the main site.

Table D.6 Commands for Recovery when Multiple Failures Occurred in All the Storages Used in the NAS User LU on the Main Site

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
2		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
3		sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
4		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
5		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
6		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
7		sudo enas_fsumount file system name	Un-mount a file system.
8		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
9		sudo enas_fsdelete file system name	Delete a file system.
10		sudo horc_setenv HORCMINST instance number	Sets up or modifies the CCI environment variable.
11		sudo horc_unsetenv HORCC_MRCF	Deletes the CCI environment variable.
12		sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
13		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
14		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
15		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
16		sudo horcmstart.sh	Start CCI (1-instance configuration)
17		sudo horcmstart.sh 16 17	Start CCI (2-instance configuration)
18	CCI commands	sudo horctakeover {-g group name | -d volume name} [-t time out]	Takeover the pair.
19		sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
20		sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.

No.	Category	Command	Description
21		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.
22		sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
23		sudo pairresync {-g group name | -d volume name} -swaps	Resynchronizes the split pairs.
24		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair.
25		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

D.4.3 Recovery Procedure from Failures

When multiple failures occurred in all the storages used in the NAS user LU on the main site, recover it in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation. It is a prerequisite that S-VOL is reserved.

Table D.7 Recovery Procedure when Multiple Failures Occurred in All the Storages Used in the NAS User LU on the Main Site

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	Multiple failures occurred in all NAS user LU.									
3			–	–	PSUE	PAIR	–	–		
4						The takeover execution is decided by the customer judgment.				
5									Execute takeover	horctakeover
6			–	–	PSUE	SSWS	Un-mount	Non-public		
7									Deletes a volume pair	pairsplit -S
8			–	–	SMPL	SMPL	Un-mount	Non-public		
9									Brings S-VOL into SMPL forcibly	pairsplit -R
10			–	–	SMPL	SMPL	Un-mount	Non-public		
11									When a pair status change to SMPL, deleting is completed	pairvolchk
12			–	–	SMPL	SMPL	Un-mount	Non-public		
13									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
14			–	–	SMPL	SMPL	Un-mount	Non-public		
15									Mount	enas_fsmount
16			–	–	SMPL	SMPL	Mount	Non-public		
17									Share	enas_nfscreate/ enas_cifscreate
18			–	–	SMPL	SMPL	Mount	Public		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
19						Start the business operation at the remote site. ***Note 2***				
20	enas_nfsdelete/ enas_cifsdelete	Delete NFS/CIFS shares								
21			Non-public	Mount	SMPL	SMPL	Mount	Public		
22	enas_fsumount	Un-mount								
23			Non-public	Un-mount	SMPL	SMPL	Mount	Public		
24	enas_fsdelete	Delete file system ***Note 3***								
25			–	–	SMPL	SMPL	Mount	Public		
26	Stop the NAS cluster in the main site. ***Note 4***									
27			–	–	SMPL	SMPL	Mount	Public		
28	Shut down the NAS OS in the main site.									
29			–	–	SMPL	SMPL	Mount	Public		
30	Replace and format the storage with error in the main site.									
31			–	–	SMPL	SMPL	Mount	Public		
32	Start the NAS OS in the main site.									
33			–	–	SMPL	SMPL	Mount	Public		
34	Start the NAS cluster in the main site.									
35			–	–	SMPL	SMPL	Mount	Public		
36	horc_setenv	Set CCI environment								
37			–	–	SMPL	SMPL	Mount	Public		
38	horc_unsetenv	Set CCI environment								
39			–	–	SMPL	SMPL	Mount	Public		
40	horcmstart.sh	Start CCI								
41			–	–	SMPL	SMPL	Mount	Public		
42	horc_svol_vmdefine (when LVM is not used, horc_svol_define)	Reserves the old P-VOL								
43			–	–	SMPL	SMPL	Mount	Public		
44									Confirm the configuration definition file before crating pair	pairdisplay

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
45			–	–	SMPL	SMPL	Mount	Public		
46									Creates a volume pair	paircreate
47			–	–	COPY	COPY	Mount	Public		
48									Confirm a volume pair status	pairdisplay
49			–	–	COPY	COPY	Mount	Public		
50									At this point a pair status is COPY	pairvolchk
51			–	–	COPY	COPY	Mount	Public	Execute pairvolchk several times	
52									When a pair status change to PAIR, crating pair is completed	pairvolchk
53			–	–	PAIR	PAIR	Mount	Public		
54						Stop the business operation at the remote site.				
55									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
56			–	–	PAIR	PAIR	Mount	Non-public		
57									Un-mount	enas_fsumount
58			–	–	PAIR	PAIR	Un-mount	Non-public		
59									Split a pair	pairsplit -rw
60			–	–	SSUS	PSUS	Un-mount	Non-public	Execute pairvolchk several times	
61									When a pair status change to PSUS, splitting pair is completed	pairvolchk
62			–	–	SSUS	PSUS	Un-mount	Non-public		
63	horc_svol_vmimport (when LVM is not used, horc_svol_import)	Connect the file system ***Note 1***								
64			Non-public	Un-mount	SSUS	PSUS	Un-mount	Non-public		
65									Delete file system ***Note 3***	enas_fsdelete
66			Non-public	Un-mount	SSUS	PSUS	–	–		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
67									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
68			Non-public	Un-mount	SSUS	PSUS	–	–		
69	pairresync -swaps	Reverse resynchronize								
70			Non-public	Un-mount	COPY	COPY	–	–		
71	pairvolchk	At this point a pair status is COPY								
72	Execute pairvolchk several times		Non-public	Un-mount	COPY	COPY	–	–		
73	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
74			Non-public	Un-mount	PAIR	PAIR	–	–		
75	enas_fsmount	Mount								
76			Non-public	Mount	PAIR	PAIR	–	–		
77	enas_nfscreate/ enas_cifscreate	Share								
78			Public	Mount	PAIR	PAIR	–	–		
79	Start the business operation at the main site. ***Note 2***									

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: When the takeover is performed, the IP address cannot be taken over from the primary site to the secondary site. When starting a job at the secondary site, un-mount the client from the primary site, change the IP address of the site on which the client is to be mounted to that of the secondary site, and then mount the client again. When the job is resumed at the primary site because the primary site has been restored, un-mount the client from the secondary site, return the IP address of the site on which the client is to be mounted to that of the primary site, and then mount the client again.

Note 3: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

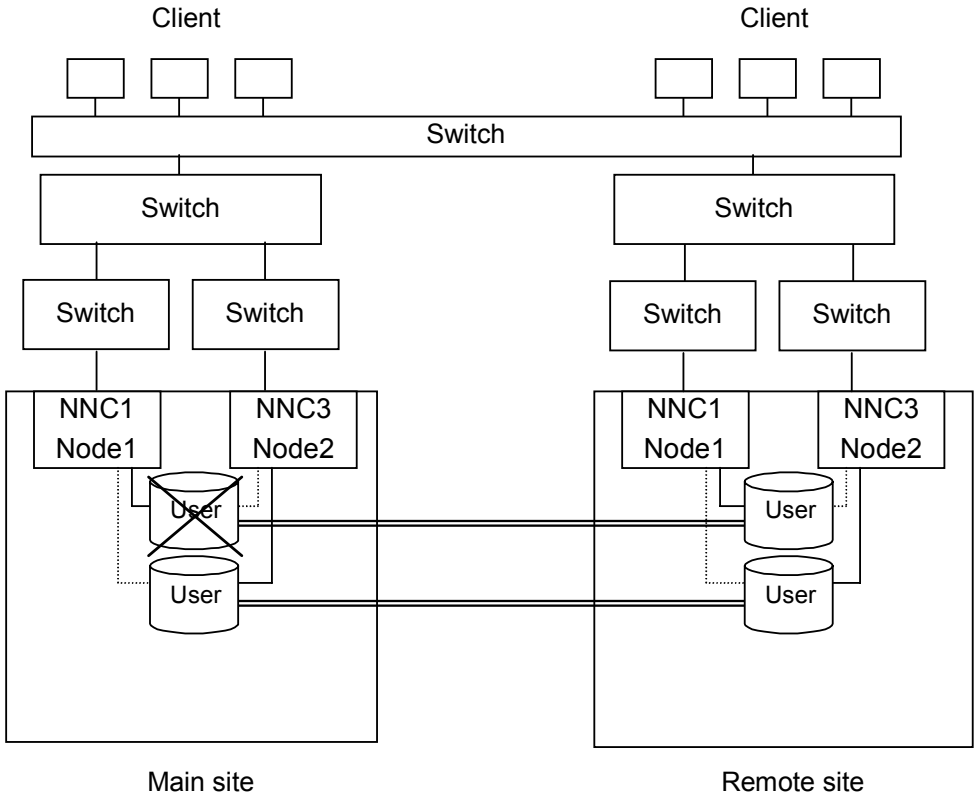
Note 4: When the file system is blocked due to a drive failure etc., the NAS OS needs to be restarted so that the blockade status recognized by the NAS OS will be released.

D.5 Operation when Multiple Failures Occurred in Part of Storages on the Main Site

D.5.1 Assumed Scenarios

When multiple failures occurred in a part of storages on the main site, the business operation cannot be performed on the main site, and the business operation is continued on the remote site. Note that ShadowImage operation is not performed.

The failed storage on the main site is recovered by the replacement (service personnel).



D.5.2 Commands to be Used

The following commands are used when multiple failures occurred in a part of storages used in the NAS user LU on the main site.

Table D.8 Commands for Recovery when Multiple Failures Occurred in a Part of Storages Used in the NAS User LU on the Main Site

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
2		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
3		sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
4		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
5		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
6		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
7		sudo enas_fsumount file system name	Un-mount a file system.
8		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
9		sudo enas_fsdelete file system name	Delete a file system.
10		sudo horc_setenv HORCMINST instance number	Sets up or modifies the CCI environment variable.
11		sudo horc_unsetenv HORCC_MRCF	Deletes the CCI environment variable.
12		sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
13		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
14		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
15		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
16		sudo horcmstart.sh	Start CCI (1-instance configuration)
17		sudo horcmstart.sh 16 17	Start CCI (2-instance configuration)
18	CCI commands	sudo horctakeover {-g group name | -d volume name} [-t time out]	Takeover the pair.
19		sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
20		sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.

No.	Category	Command	Description
21		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.
22		sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
23		sudo pairresync {-g group name | -d volume name} -swaps	Resynchronizes the split pairs.
24		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair.
25		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

D.5.3 Recovery Procedure from Failures

When multiple failures occurred in a part of storages used in the NAS user LU on the main site, recover it in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation. It is a prerequisite that S-VOL is reserved.

Table D.9 Recovery Procedure when Multiple Failures Occurred in a Part of Storages Used in the NAS User LU on the Main Site

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	Multiple failures occurred in a part of NAS user LU.									
3			–	–	PSUE	PAIR	–	–		
4						The takeover execution is decided by the customer judgment.				
5									Execute takeover	horctakeover
6			–	–	PSUE	SSWS	–	–		
7									Deletes a volume pair	pairsplit -S
8			–	–	SMPL	SMPL	Un-mount	Non-public		
9									Brings S-VOL into SMPL forcibly	pairsplit -R
10			–	–	SMPL	SMPL	Un-mount	Non-public		
11									When a pair status change to SMPL, deleting is completed	pairvolchk

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
12			–	–	SMPL	SMPL	Un-mount	Non-public		
13									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
14			–	–	SMPL	SMPL	Un-mount	Non-public		
15									Mount	enas_fsmount
16			–	–	SMPL	SMPL	Mount	Non-public		
17									Share	enas_nfscreate/ enas_cifscreate
18			–	–	SMPL	SMPL	Mount	Public		
19						Start the business operation at the remote site. ***Note 2***				
20	Replace and format the storage with error in the main site.									
21			–	–	SMPL	SMPL	Mount	Public		
22	enas_nfsdelete/ enas_cifsdelete	Delete NFS/CIFS shares								
23			Non-public	Mount	SMPL	SMPL	Mount	Public		
24	enas_fsumount	Un-mount								
25			Non-public	Un-mount	SMPL	SMPL	Mount	Public		
26	enas_fsdelete	Delete file system ***Note 3***								
27			–	–	SMPL	SMPL	Mount	Public		
28	Failover from the node1 (blocked node) to the node2 (non-blocked node) in the main site. ***Note 4***									
29			–	–	SMPL	SMPL	Mount	Public		
30	Reboot the node1 in the main site.									
31			–	–	SMPL	SMPL	Mount	Public		
32	Failback in the main site.									
33			–	–	SMPL	SMPL	Mount	Public		
34	Failover from the node2 to the node1 in the main site.									
35			–	–	SMPL	SMPL	Mount	Public		
36	Reboot the node2 in the main site.									

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
37			–	–	SMPL	SMPL	Mount	Public		
38	Failback in the main site.									
39			–	–	SMPL	SMPL	Mount	Public		
40	horc_setenv	Set CCI environment								
41			–	–	SMPL	SMPL	Mount	Public		
42	horc_unsetenv	Set CCI environment								
43			–	–	SMPL	SMPL	Mount	Public		
44	horcmstart.sh	Start CCI								
45			–	–	SMPL	SMPL	Mount	Public		
46	horc_svol_vmdefine (when LVM is not used, horc_svol_define)	Reserves the old P-VOL								
47			–	–	SMPL	SMPL	Mount	Public		
48									Confirm the configuration definition file before crating pair	pairdisplay
49			–	–	SMPL	SMPL	Mount	Public		
50									Creates a volume pair	paircreate
51			–	–	COPY	COPY	Mount	Public		
52									Confirm a volume pair status	pairdisplay
53			–	–	COPY	COPY	Mount	Public		
54									At this point a pair status is COPY	pairvolchk
55			–	–	COPY	COPY	Mount	Public	Execute pairvolchk several times	
56									When a pair status change to PAIR, crating pair is completed	pairvolchk
57			–	–	PAIR	PAIR	Mount	Public		
58						Stop the business operation at the remote site.				
59									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
60			–	–	PAIR	PAIR	Mount	Non-public		
61									Un-mount	enas_fsumount

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
62			–	–	PAIR	PAIR	Un-mount	Non-public		
63									Split a pair	pairsplit -rw
64			–	–	SSUS	PSUS	Un-mount	Non-public	Execute pairvolchk several times	
65									When a pair status change to PSUS, splitting pair is completed	pairvolchk
66			–	–	SSUS	PSUS	Un-mount	Non-public		
67	horc_svol_vmimport (when LVM is not used, horc_svol_import)	Connect the file system ***Note 1***								
68			Non-public	Un-mount	SSUS	PSUS	Un-mount	Non-public		
69									Delete file system ***Note 3***	enas_fsdelete
70			Non-public	Un-mount	SSUS	PSUS	–	–		
71									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
72			Non-public	Un-mount	SSUS	PSUS	–	–		
73	pairresync -swaps	Reverse resynchronize								
74			Non-public	Un-mount	COPY	COPY	–	–		
75	pairvolchk	At this point a pair status is COPY								
76	Execute pairvolchk several times		Non-public	Un-mount	COPY	COPY	–	–		
77	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
78			Non-public	Un-mount	PAIR	PAIR	–	–		
79	enas_fsmount	Mount								

No.	Main Site					Remote Site				
	Command	**Processing**	**NFS/ CIFS**	**FS**	**P-VOL Status**	**S-VOL Status**	**FS**	**NFS/ CIFS**	**Processing**	**Command**
80			Non-public	Mount	PAIR	PAIR	–	–		
81	enas_nfscreate/ enas_cifscreate	Share								
82			Public	Mount	PAIR	PAIR	–	–		
83	Start the business operation at the main site. ***Note 2***									

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: When the takeover is performed, the IP address cannot be taken over from the primary site to the secondary site. When starting a job at the secondary site, un-mount the client from the primary site, change the IP address of the site on which the client is to be mounted to that of the secondary site, and then mount the client again. When the job is resumed at the primary site because the primary site has been restored, un-mount the client from the secondary site, return the IP address of the site on which the client is to be mounted to that of the primary site, and then mount the client again.

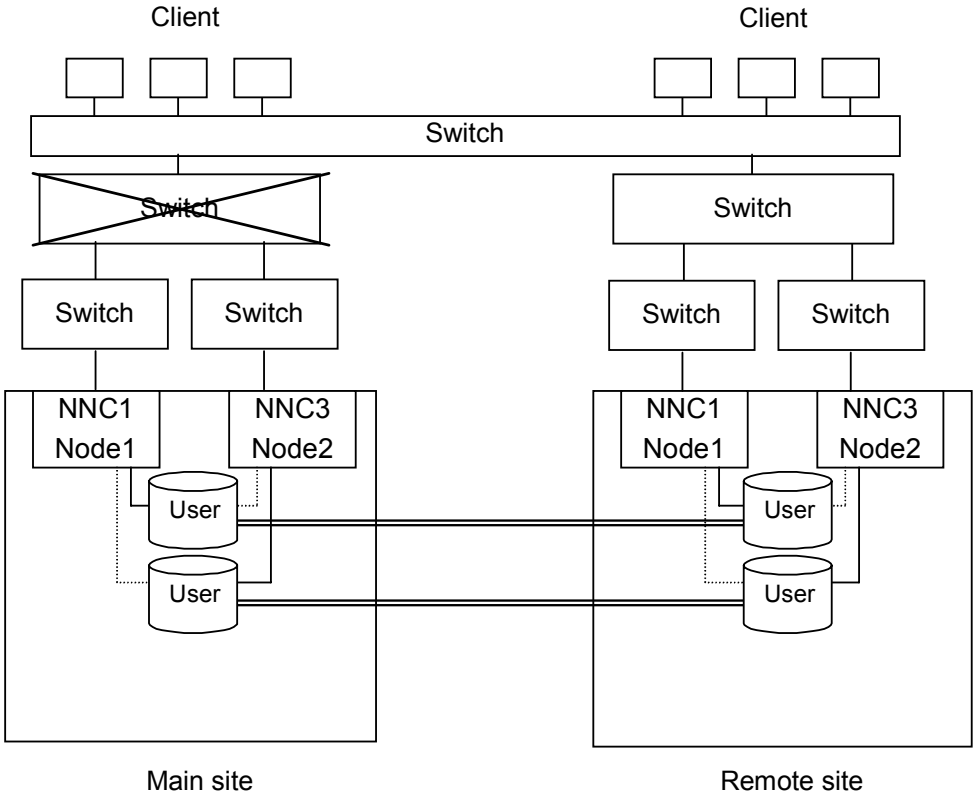
Note 3: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

Note 4: When the file system is blocked due to a drive failure etc., the NAS OS needs to be restarted so that the blockade status recognized by the NAS OS will be released.

D.6 Operation when Network Failures Occurred in the Main Site

D.6.1 Assumed Scenarios

The access from the client cannot be performed due to the switch failures in the main site.



D.6.2 Commands to be Used

Table D.10 Commands for Recovery when Network Failures Occurred in the Main Site

No.	Category	Command	Description
1	NAS Manager Modular commands	sudo horc_svol_import -f copy-destination file system name -d device file number	When LVM is not used, connects NAS unit.
2		sudo horc_svol_vmimport -f copy-destination file system name -d device file number [, device file number ...]	When LVM is used, connects NAS unit.
3		sudo enas_nfsdelete -d shared directory {-a | -H Host}	Delete an NFS share.
4		sudo enas_nfscreate -d shared directory -H Host	Create an NFS share.
5		sudo enas_cifsdelete -x CIFS share name	Delete a CIFS share.
6		sudo enas_cifscreate -x CIFS share name -d shared directory	Create a CIFS share.
7		sudo enas_fsumount file system name	Un-mount a file system.
8		sudo enas_fsmount {-r | -w} file system name	Mount a file system.
9		sudo enas_fsdelete file system name	Delete a file system.
10		sudo horc_setenv HORCMINST instance number	Sets up or modifies the CCI environment variable.
11		sudo horc_unsetenv HORCC_MRCF	Deletes the CCI environment variable.
12		sudo horc_svol_define -d device file number	When LVM is not used, reserves device file.
13		sudo horc_svol_vmdefine -d device file number [, device file number ...]	When LVM is used, reserves device file.
14		sudo horc_pvol_freeze -f copy-source file system name	Suppresses on the copy-source file system and holds access and data writes from clients.
15		sudo horc_pvol_unfreeze -f copy-source file system name	Restarts access and data writes on a copy-source file system from clients and cancels suppression of operations.
16		sudo horcmstart.sh	Start CCI (1-instance configuration)
17		sudo horcmstart.sh 16 17	Start CCI (2-instance configuration)
		sudo syncumount mount point name	Un-mounts the differential-data snapshot.
		sudo syncstop file system name	Releases the differential-data storage device.
18	CCI commands	sudo horctakeover {-g group name | -d volume name} [-t time out]	Takeover the pair.
19		sudo paircreate {-g group name | -d volume name} -f never -vl	Creates a volume pair.
20		sudo pairsplit {-g group name | -d volume name} -S	Deletes a volume pair.

No.	Category	Command	Description
21		sudo pairsplit {-g group name | -d volume name} -R	Brings S-VOL into SMPL forcibly.
22		sudo pairsplit {-g group name | -d volume name} -rw	Splits a volume pair.
23		sudo pairresync {-g group name | -d volume name} -swaps	Resynchronizes the split pairs.
24		sudo pairvolchk {-g group name | -d volume name} -ss	Checks the completion of volume pair.
25		sudo pairdisplay {-g group name | -d volume name} -fc	Displays the copy operation progress.

D.6.3 Recovery Procedure from Failures

The switch failure is usually removed by replacing the switch. However, when you want to start the operation on the remote site immediately, remove it in the following procedure. The sudo command, the options of the NAS Manager Modular command, and the CCI command are omitted when it is described in the following table. Specify the appropriate options for the actual operation.

Table D.11 Recovery Procedure when Network Failures Occurred in the Main Site

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
1			Public	Mount	PAIR	PAIR	–	–		
2	Switch obstacle occurs.									
3			Public	Mount	PAIR	PAIR	–	–		
4						The takeover execution is decided by the customer judgment.				
5									Execute takeover	horctakeover
6			Public	Mount	PSUE	SSWS	Un-mount	Non-public		
7									Confirm a volume pair status to be SSWS	pairvolchk
8			Public	Mount	PSUE	SSWS	Un-mount	Non-public		
9									Connect the file system ***Note 1***	horc_svol_vmimport (when LVM is not used, horc_svol_import)
10			Public	Mount	PSUE	SSWS	Un-mount	Non-public		
11									Mount	enas_fsmount

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
12			Public	Mount	PSUE	SSWS	Mount	Non-public		
13									Share	enas_nfscreate/ enas_cifscreate
14			Public	Mount	PSUE	SSWS	Mount	Public		
15						Start the business operation at the remote site. ***Note 2***				
16	enas_nfsdelete/ enas_cifsdelete	Delete NFS/CIFS shares								
17			Non-public	Mount	PSUE	SSWS	Mount	Public		
18	enas_fsumount	Un-mount								
19			Non-public	Un-mount	PSUE	SSWS	Mount	Public		
20	enas_fsdelete	Delete file system ***Note 3***								
21			–	–	PSUE	SSWS	Mount	Public		
22	Replace the switch.									
23			–	–	PSUE	SSWS	Mount	Public		
24	horc_setenv	Set CCI environment								
25			–	–	PSUE	SSWS	Mount	Public		
26	horc_unsetenv	Set CCI environment								
27			–	–	PSUE	SSWS	Mount	Public		
28	horcmstart.sh	Start CCI								
29			–	–	PSUE	SSWS	Mount	Public		
30	horc_svol_vmdefine (when LVM is not used, horc_svol_define)	Reserves the old P-VOL								
31			–	–	PSUE	SSWS	Mount	Public		
32									Confirm the configuration definition file before re-synchronizing pair	pairdisplay
33			–	–	PSUE	SSWS	Mount	Public		
34									Reverse resynchronize	pairresync -swaps
35			–	–	COPY	COPY	Mount	Public		

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
36									Confirm a volume pair status	pairdisplay
37			–	–	COPY	COPY	Mount	Public	Execute pairvolchk several times	
38									When a pair status change to PAIR, re-synchronizing pair is completed	pairvolchk
39			–	–	PAIR	PAIR	Mount	Public		
40						Stop the business operation at the remote site.				
41									Delete NFS/CIFS shares	enas_nfsdelete/ enas_cifsdelete
42			–	–	PAIR	PAIR	Mount	Non-public		
43									Un-mount	enas_fsumount
44			–	–	PAIR	PAIR	Un-mount	Non-public		
45									Split a pair	pairsplit -rw
46			–	–	SSUS	PSUS	Un-mount	Non-public	Execute pairvolchk several times	
47									When a pair status change to PSUS, splitting pair is completed	pairvolchk
48			–	–	SSUS	PSUS	Un-mount	Non-public		
49	horc_svol_vmimport (when LVM is not used, horc_svol_import)	Connect the file system ***Note 1***								
50			Non-public	Un-mount	PSUS	SSUS	Un-mount	Non-public		
51									Delete file system ***Note 3***	enas_fsdelete
52			Non-public	Un-mount	PSUS	SSUS	–	–		
53									Reserves S-VOL	horc_svol_vmdefine (when LVM is not used, horc_svol_define)
54			Non-public	Un-mount	PSUS	SSUS	–	–		
55	pairresync	Resynchronize								

No.	Main Site					Remote Site				
	Command	Processing	NFS/ CIFS	FS	P-VOL Status	S-VOL Status	FS	NFS/ CIFS	Processing	Command
56			Non-public	Un-mount	COPY	COPY	–	–		
57	pairvolchk	At this point a pair status is COPY								
58	Execute pairvolchk several times		Non-public	Un-mount	COPY	COPY	–	–		
59	pairvolchk	When a pair status change to PAIR, re-synchronizing pair is completed								
60			Non-public	Un-mount	PAIR	PAIR	–	–		
61	enas_fsmount	Mount								
62			Non-public	Mount	PAIR	PAIR	–	–		
63	enas_nfscreate/ enas_cifscreate	Share								
64			Public	Mount	PAIR	PAIR	–	–		
65	Start the business operation at the main site. ***Note 2***									

Note 1: Specify the same file system name as the main site for the file system name connected with NAS unit.

Note 2: When the takeover is performed, the IP address cannot be taken over from the primary site to the secondary site. When starting a job at the secondary site, un-mount the client from the primary site, change the IP address of the site on which the client is to be mounted to that of the secondary site, and then mount the client again. When the job is resumed at the primary site because the primary site has been restored, un-mount the client from the secondary site, return the IP address of the site on which the client is to be mounted to that of the primary site, and then mount the client again.

Note 3: In the NAS Sync Image Modular target file system, un-mount the differential-data snapshot using the **syncumount** command before executing the **enas_fsdelete** command, and release the device which stores the differential data using the **syncstop** command.

Acronyms and Abbreviations

CTL	Controller
CLI	Command Line Interface
Dark Fiber	The dark fiber is the optical fiber that does not work but it is laid. The optical fibers are generally laid by several dozen fibers to several hundred. Only fibers to be needed are activated and others are left as the dark fiber.
Differential data	The data to be updated from the suspended status of the pair volume to the primary volume.
Differential data control	To control the differential data constantly.
Differential data copy	To copy the updated data to the secondary volume. The data is updated from the differential data control status (the pair volume is under the suspended status) to the primary volume.
Disaster recovery	To recover the data and to keep an operation going when a critical failure.
Disc array device	Disc array subsystem. The disc array subsystem is referred to as “Disc array device” or “Disc subsystem” in this manual.
Dual copy	To write the data into P-VOL and S-VOL simultaneously with one requirement of Write.
Entire copy	To copy all data in the primary volume to the secondary volume for conforming the data of both volumes completely.
Extender	A converter that changes a signal to other signal. When the data is transmitted to a distance, an extender is used for changing a signal for Fibre Channel to a signal for a dark fiber or an Ethernet (IP).
Failover	To take over a process or a data with an alternative host when a failure occurs in a host. By using the High Availability software, an automatically switching the hosts is possible.
Fibre channel	Input/output channel using Fibre cable.
GUI	Graphical User Interface
High Availability (HA) Software	Software that automatically switches a host to a stand-by host (fail-over) during a failure of a host and disks. High Availability software is installed in more than one host respectively.
I/O	input/output
LAN	Local Area Network
LDEV	Logical Device

LU	Logical unit in a device that is connected with Fibre.
LUN	Logical Unit Number. The number of the unit that is connected with Fibre.
PC	Personal Computer
P-VOL	Primary volume, the volume on the primary side of the pair volume. The primary volume controls the pair status, and the status reflects on the secondary volume.
Pair status	The status of the logical volume that is paired.
Paired volume	Primary and secondary volume that are paired in a disk array device.
PSUE	Pair Suspended-Error
PSUS	Pair Suspended-Split
RAID	Redundant Array of Independent Disks
Resynchronization (TrueCopy)	To copy the differential data to the secondary volume for conforming the data of both the primary and secondary volumes. When the resynchronization is completed, the status changes to the pair status.
SMPL	Simplex
Status transition	To change the pair status of the pair volume.
Suspended status	The status when the update operation is suspended with keeping the pair status. Under this status, the differential data control for the updated data is performed in the primary volume.
S-VOL	Secondary volume, the volume on the secondary side of the pair volume. The primary volume controls the pair status, and the status reflects on the secondary volume.
TID	Target ID
Truck size	Truck size (sector/truck) that is fixed per the volume type.
Volume copy	To copy all data of P-VOL into S-VOL.
WDM	Wavelength Division Multiplexing Generally, WDM is to multiplex the optical signal of several channels and DWDM (Dense WDM) is to multiplex the optical signal of several dozen channels.

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