



**Hitachi Freedom Storage™
Lightning 9900™ V Series**

**Hitachi TrueCopy™ User and Reference Guide
(Synchronous and Asynchronous for UNIX®/PC Servers)**

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- Updated a warning for the Paircreate Operation (section 2.1.6)
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- Changed the name “NAS Uniblade” to “NAS Blade” (throughout document)
- Changed Hitachi NanoCopy to Hitachi Copycentral to reflect new product name (throughout document)

Referenced Documents

- *Hitachi Lightning 9900™ V Series User and Reference Guide*, MK-92RD100
- *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide*, MK-92RD101
- *Hitachi Lightning 9900™ V Series and 9900 Command Control Interface (CCI) User and Reference Guide*, MK-90RD011
- *Hitachi Lightning 9900™ V Series Hitachi TrueCopy™ - S/390® User and Reference Guide*, MK-92RD107
- *Hitachi Lightning 9900™ V Series LUN Manager User's Guide*, MK-92RD105
- *Hitachi Lightning 9900™ V Series Remote Console Error Codes*, MK-92RD132
- *Hitachi Lightning 9900™ V Series Windows® 2000 Configuration Guide*, MK-92RD121
- *Hitachi Lightning 9900™ V Series NAS Blade Backup/Restore User's Guide*, MK-93RD149
- *Hitachi Lightning 9900™ V Series NAS Blade Management User's Guide*, MK-93RD162
- *Hitachi Lightning 9900™ V Series Copycentral User's Guide and Reference*, MK-93RD154

Preface

The *Hitachi Freedom Storage™ Lightning 9900™ V Series Hitachi TrueCopy™ User and Reference Guide* describes and provides instructions for performing Hitachi TrueCopy™ operations on the Lightning 9900™ V Series (9900V) subsystem. This document assumes that:

- the user has a background in data processing and understands RAID storage subsystems and their basic functions,
- the user is familiar with the Hitachi Lightning 9900™ V Series disk array subsystem,
- the user has read and understands both the *Hitachi Lightning 9900™ V Series User and Reference Guide* (MK-92RD100) and the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide* (MK-92RD101), and
- the user is familiar with the operating system (e.g., Windows®, Solaris™) and web browser software (e.g., Internet Explorer, Netscape) on the system hosting the 9900V Storage Navigator and TrueCopy remote console software.

Note: The term “9900V” refers to the entire Hitachi Lightning 9900™ V Series subsystem family, unless otherwise noted. For further information on the Lightning 9900™ V Series subsystem, please contact your Hitachi Data Systems account team, or visit Hitachi Data Systems online at <http://www.hds.com>.

Note: This document does not cover TrueCopy - S/390® operations. For information and instructions on performing TrueCopy S/390® operations, please refer to the *Hitachi Lightning 9900™ V Series Hitachi TrueCopy™ - S/390® User and Reference Guide* (MK-92RD107).

Note: The use of Hitachi TrueCopy™, the TrueCopy remote console software, and all other Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.

Note: The TrueCopy screens shown in this document were captured on a Windows® system with the Internet Explorer web browser. The TrueCopy screens may display differently on other operating systems and browsers. Please refer to the *9900V Remote Console - Storage Navigator User's Guide* for further information on UNIX™ operating systems and browsers.

Note: The Hitachi product formerly called NanoCopy is now called Hitachi Copycentral.

Microcode Level

This document revision applies to 9900V microcode versions 21-08-2x/xx and higher.

Comments

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Chapter 1 Overview of Hitachi Copy Solutions

1.1 Hitachi TrueCopy™

The Hitachi TrueCopy™ feature enables you to create and maintain duplicate copies of all user data stored on the Hitachi Lightning 9900™ V Series subsystem for data duplication, backup, and disaster recovery purposes. Hitachi TrueCopy provides synchronous and asynchronous copy modes to accommodate a wide variety of user requirements and data copy/movement scenarios. Hitachi TrueCopy Asynchronous is unique to the Hitachi RAID storage subsystems and provides a superior hardware-based solution for data duplication, data migration, remote copy, and disaster recovery tasks. Hitachi TrueCopy is a key component of Hitachi Data Systems' solutions and service offerings.

This document describes and provides instructions for performing TrueCopy operations using the licensed 9900V Hitachi Storage Navigator remote console software. The 9900V Storage Navigator software communicates directly with the 9900V subsystems via a local-area network (LAN). The Storage Navigator software displays detailed TrueCopy information and allows you to configure and perform TrueCopy operations for the open-systems data stored on the 9900V. In the event of a system failure or disaster at the primary (main) site, the 9900V Storage Navigator software also simplifies and expedites disaster recovery procedures.

Hitachi TrueCopy operations are nondisruptive and allow the primary (main) volume of each TrueCopy volume pair to remain online to all hosts for both read and write I/O operations. Once established, TrueCopy operations continue unattended to provide continuous, real-time data backup. For fibre-channel connection, TrueCopy operations can be performed across distances of up to 30 km (18.6 miles) using single-mode longwave optical fibre cables in a switch configuration. For serial interface connection, TrueCopy operations can be performed across distances of up to 43 km (26.7 miles) using standard ESCON® support. Long-distance solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines.

Hitachi TrueCopy operations can be performed in conjunction with Hitachi ShadowImage operations (see section 1.2) to provide multiple internal copies of TrueCopy volumes. TrueCopy also supports the NAS Blade, LUN Expansion (LUSE), Virtual LVI/LUN, and FlashAccess features of the 9900V subsystem, ensuring that all user data can be protected by remote copy operations. See section 3.6 for further information on combining Hitachi TrueCopy with these and other data management features.

Hitachi TrueCopy operations can also be performed from the UNIX® or PC server host using the Command Control Interface (CCI) software product. For information and instructions on using CCI to perform TrueCopy (and/or ShadowImage) operations, please refer to the *Hitachi Lightning 9900™ V Series and 9900 Command Control Interface (CCI) User and Reference Guide* (MK-90RD011).

Note: The use of the TrueCopy remote console software and all other Hitachi Data Systems products is governed by the terms of your license agreement(s) with Hitachi Data Systems.

1.2 Hitachi ShadowImage and ShadowImage – S/390®

The Hitachi ShadowImage and ShadowImage – S/390® data duplication features enable you to set up and maintain multiple copies of logical volumes within the same Lightning 9900™ V Series subsystem. ShadowImage operations for UNIX®/PC server-based data can be performed using the licensed ShadowImage remote console software or the Command Control Interface (CCI) software on the UNIX®/PC server host. ShadowImage – S/390® operations are performed using the ShadowImage – S/390® remote console software and can also be managed via TSO and/or ICKDSF commands.

The RAID-protected ShadowImage duplicates are created within the same 9900V subsystem at hardware speeds. ShadowImage can be used in conjunction with TrueCopy to maintain multiple copies of critical data at your primary and/or secondary (remote) sites and provide maximum flexibility in data backup and duplication activities. See section 3.6.1 for further information on combining TrueCopy and ShadowImage operations.

This user's guide does not cover ShadowImage operations. For information and instructions on performing ShadowImage operations, please refer to the *Hitachi Lightning 9900™ V Series ShadowImage User's Guide* or the *Hitachi Lightning 9900™ V Series ShadowImage – S/390® User's Guide*, or contact your Hitachi Data Systems account team.

1.3 Hitachi Multiplatform Backup/Restore (HMBR)

The Hitachi Multiplatform Backup/Restore (HMBR) feature of the Hitachi Lightning 9900™ V Series subsystem can also be used in conjunction with the ShadowImage feature to provide mainframe-based backup of ShadowImage volumes. HMBR operations should be configured to back up the ShadowImage primary volumes (P-VOLs), since the ShadowImage S-VOLs are not available to hosts (except when the pair has been split). If you need to perform HMBR operations on ShadowImage S-VOLs, you must split the pairs first to allow host access.

1.4 HXRC and CC for S/390® Data

The HXRC feature of the 9900V subsystem is functionally compatible with the industry-standard IBM Extended Remote Copy (XRC) S/390® host software function. HXRC is also compatible with the DFSMS data mover which is common to the XRC environment. HXRC operations are performed in the same manner as XRC operations, by issuing XRC TSO commands from the host system to the 9900V subsystem. The HXRC feature must be enabled using the 9900V Storage Navigator software.

The Hitachi Lightning 9900™ V Series subsystem is also functionally compatible with the IBM 3990 Concurrent Copy (CC) function.

Please contact your Hitachi Data Systems account team for further information on these 9900V features, or visit Hitachi Data Systems online at <http://www.hds.com>.

Note: HXRC and CC operations, as well as TrueCopy Asynchronous operations, require additional cache to store the asynchronous recordsets. If you are performing HXRC and/or CC operations in addition to TrueCopy Asynchronous on the same 9900V subsystem, you must make sure that the subsystem has adequate cache installed and available to support the asynchronous copy workloads. Please contact your Hitachi Data Systems account team to determine how much cache will be needed for your operational configuration.

Chapter 2 Overview of TrueCopy Operations

Hitachi TrueCopy™ provides a storage-based hardware solution for disaster recovery which enables fast and accurate system recovery. Once TrueCopy operations are established, duplicate copies of data are automatically maintained for backup and disaster recovery purposes. During normal TrueCopy operations, the primary volumes remain online to all hosts and continue to process both read and write I/O operations. In the event of a disaster or system failure, the secondary copy of data can be rapidly invoked to allow recovery with a very high level of data integrity. TrueCopy can also be used for data duplication and migration tasks.

TrueCopy Synchronous provides volume-based real-time data backup and is ideal for high-priority data backup, duplication, and migration tasks. In the event of a disaster or system failure at the primary site, the secondary TrueCopy Synchronous data can be rapidly invoked to allow recovery at the volume level with an extremely high level of data integrity.

TrueCopy Asynchronous represents a unique and outstanding disaster recovery solution for large amounts of data which span multiple volumes. The TrueCopy Asynchronous group-based update sequence consistency solution enables fast and accurate database recovery, even after a “rolling” disaster, without the need for time-consuming data recovery procedures. The TrueCopy Asynchronous volume groups at the remote site can be recovered with full update sequence consistency, but the updates will be behind the primary site due to the asynchronous remote copy operations.

TrueCopy Asynchronous provides update sequence consistency for user-defined groups of volumes (e.g., large databases) as well as protection for write-dependent applications in the event of a disaster.

This overview of Hitachi TrueCopy™ operations describes:

- TrueCopy components (see section 2.1)
- TrueCopy operations (see section 2.2)
- TrueCopy Asynchronous recordset operations (see section 2.3)
- TrueCopy Asynchronous consistency group operations (see section 2.4)
- TrueCopy volume pair status and split/suspend types (see section 2.5)

2.1 Components

Hitachi TrueCopy™ operations involve the 9900V subsystems (and/or 9900) at the primary and secondary (remote) sites, the physical communications paths between these subsystems, and the 9900V TrueCopy remote console software. TrueCopy copies the original online data at the primary site to the offline backup volumes at the secondary (remote) site via the dedicated fibre-channel and/or ESCON® remote copy connections. The TrueCopy software is included in the Hitachi Storage Navigator Java applet program, and all TrueCopy functions and operations can be performed from within a web browser.

Note: Host failover software is required for effective disaster recovery with TrueCopy.

Figure 2.1 and Figure 2.2 show the TrueCopy components and their functions:

- Hitachi Lightning 9900™ V Series subsystems
 - Note:** The additional Shared Memory option is required for Hitachi TrueCopy operations.
- Main and remote control units (MCU and RCU)
- Volume pairs (P-VOLs and S-VOLs)
- TrueCopy Asynchronous consistency groups
- Remote copy connections
- Ordinary target ports, initiator ports, and RCU target ports for fibre-channel interface
- Remote control ports (RCPs) and local control ports (LCPs) for serial interface
- 9900V TrueCopy remote console software
- Host failover software

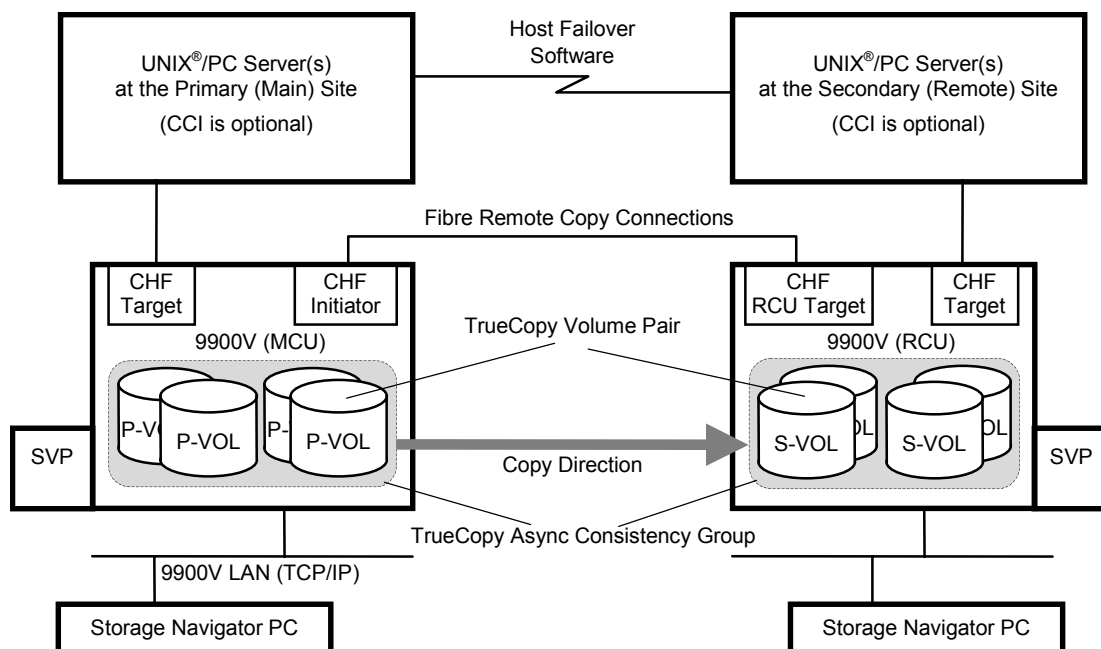


Figure 2.1 TrueCopy Components for Fibre-Channel Connection

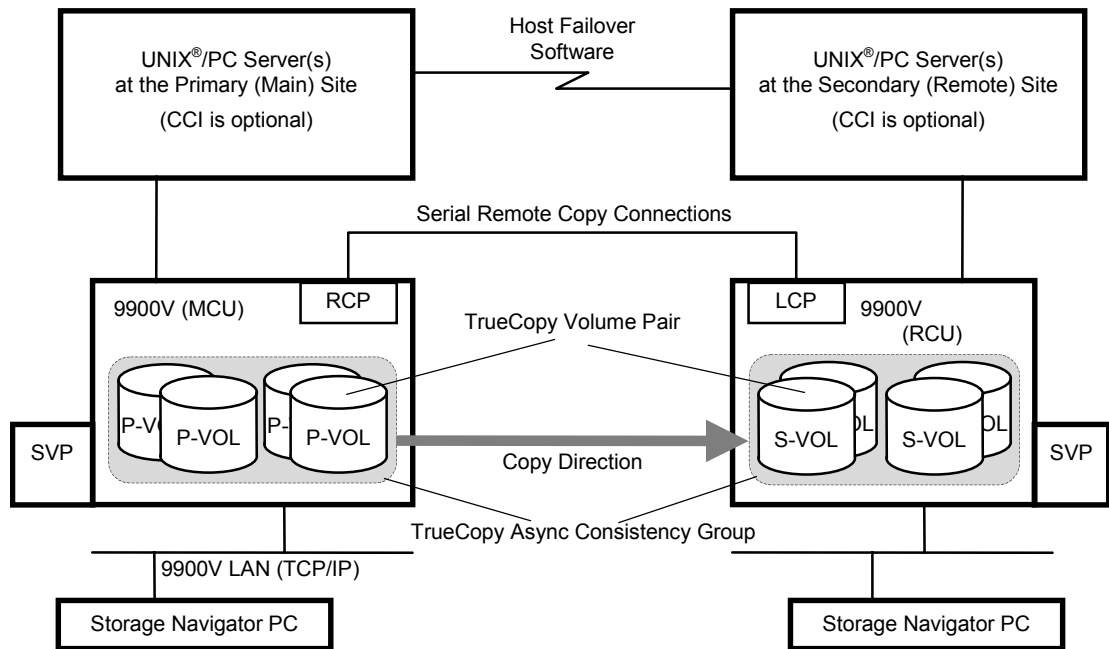


Figure 2.2 TrueCopy Components for Serial (ESCON®) Connection

Note: Please contact your Hitachi Data Systems account team for the latest information on the availability of serial-channel TrueCopy connections.

2.1.1 Lightning 9900™ V Series Storage Subsystems

Hitachi TrueCopy operations involve the primary (main) subsystems and the secondary (remote) subsystems (MCUs and RCUs). This document covers TrueCopy operations in which the main subsystem is a 9900V and the remote subsystem is a 9900V (or 9900) subsystem. The MCUs contain the TrueCopy primary volumes (P-VOLs), which contain the original data and are online to the host(s). The RCUs contain the TrueCopy secondary volumes (S-VOLs), which are the synchronous or asynchronous copies of the P-VOLs. TrueCopy supports all CU images, logical volumes, and physical hard drive options for the 9900V subsystem. TrueCopy supports RAID 1 and RAID 5 configurations.

To provide greater flexibility and enable the 9900V to be tailored to unique customer operating requirements, additional operational parameters, or system option modes, are available for the 9900V subsystem. At installation, the 9900V modes are set to their default values (**OFF**), so make sure to discuss these settings with your Hitachi Data Systems team. The 9900V modes can only be changed by the Hitachi Data Systems representative.

Table 2.1 shows the public 9900V system option modes. **Note:** This 9900V mode information was current at the time of publication of this document but may change. Please contact your Hitachi Data Systems representative for the latest information on the 9900V System Option Modes.

Table 2.1 9900V Modes for TrueCopy

Mode	Description
21	Required ON for MCUs and RCUs which connect to CNT channel extenders.
107	This is the controlling option for RecordSet. When a 9900V MCU is connected to an RCU via serial (ESCON®) interface, note the following: A. TC390 Async pairs and TrueCopy Async pairs cannot coexist in the same subsystem. B. Set MODE 107 = ON in the RCU before you create any TrueCopy Async pairs with that RCU. CAUTION: Do not set MODE 107 = ON when TC390 Async pairs exist. ON: The controlling option for RecordSet is available. OFF: The R-VOL read-only function is not available.

2.1.2 Main and Remote Control Units (MCUs and RCUs)

The main control unit (MCU) and remote control unit (RCU) control TrueCopy operations:

- The MCU is the control unit in the primary subsystem which controls the P-VOLs of the TrueCopy volume pairs. The Storage Navigator remote console PC must be LAN-attached to the MCU of each TrueCopy pair. The MCU communicates with the RCU via the dedicated remote copy connections. The MCU controls the host I/O operations to the TrueCopy P-VOLs as well as the TrueCopy initial copy and remote copy operations between the P-VOLs and S-VOLs. The MCU also manages the TrueCopy pair status and configuration information.
- The RCU is the CU in the remote subsystem which controls the S-VOLs of the TrueCopy volume pairs. The RCU assists in managing the TrueCopy pair status and configuration (e.g., rejects write I/Os to TrueCopy S-VOLs). The RCU executes the remote copy operations issued by the MCU. The secondary Storage Navigator PC should be attached to the RCUs at the remote site on a separate LAN. The RCUs should also be attached to a host system to allow sense information to be reported in case of a problem with a secondary volume or remote subsystem and to provide disaster recovery capabilities.

The MCU and RCU can be defined separately for each TrueCopy volume pair. The 9900V CU can function simultaneously as an MCU for one or more P-VOLs and as an RCU for one or more S-VOLs, provided the remote copy connections and fibre-channel or serial interface ports are properly configured. The 9900V CU provides up to 32 logical CU images (0-1F), with each CU image controlling up to 256 logical devices (LDEVs). The TrueCopy software allows you to select the desired CU image in the connected MCU and specify the desired CU image in the RCU. Hitachi TrueCopy operations can be performed on all LDEVs except for the 9900V command device. For further information on the 9900V command device, please refer to the *Hitachi Lightning 9900™ V Series and 9900 Command Control Interface (CCI) User and Reference Guide* (MK-90RD011).

Note on CU emulation for ESCON® interface: When serial interface connection is used for remote copy operations, the controller emulation of the connected ports of the MCU and RCU can be different. However, when the MCU and RCU are connected to the same host, the controller emulation of the host-connected ports of the MCU and RCU must be the same.

Note: This document provides instructions for performing TrueCopy operations with 9900V subsystems as the MCUs. If you are using 9900 subsystems as MCUs, please use the *Hitachi Lightning 9900™ V Series TrueCopy User and Reference Guide* (MK-91RD051).

2.1.3 Volume Pairs (P-VOLs and S-VOLs)

Hitachi TrueCopy performs remote copy operations for logical volume pairs created by the user. Each TrueCopy pair consists of one primary volume (P-VOL) and one secondary volume (S-VOL) which can be located in different subsystems. The TrueCopy P-VOLs are the primary volumes (LUs) which contain the original data, and the TrueCopy S-VOLs are the secondary or mirrored volumes (LUs) which contain the backup or duplicate data. The primary and secondary volumes must have the same format and capacity (and SCSI path definition is required).

During normal TrueCopy operations, the P-VOL remains available to all hosts at all times for read and write I/O operations. During normal TrueCopy operations, the RCU rejects all host-requested write I/Os for the S-VOLs. The S-VOL write enable option allows write access to an S-VOL while the pair is split and uses the S-VOL and P-VOL cylinder or track maps to resynchronize the pair (see section 2.2.4).

Hitachi TrueCopy supports the basic logical unit (LU) types available on the 9900V subsystem (e.g., OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, and OPEN-V*). TrueCopy also supports the LUN Expansion (LUSE), Virtual LVI/LUN, and FlashAccess features, ensuring that all user data can be backed up or duplicated. See section 3.2.2 for further information on LU requirements and support.

***Note:** For serial-interface remote copy connections, OPEN-V is not supported.

Hitachi TrueCopy supports a maximum of 8192 pairs (entire 9900V RCU). When TrueCopy pairs include size-expanded LUs, the maximum number of pairs decreases. When the CCI command device is defined, the maximum number of pairs in the 9900V subsystem is 8191.

2.1.4 Asynchronous Consistency Groups

A TrueCopy Asynchronous consistency group is a user-defined set of volume pairs across which update sequence consistency is maintained and ensured at the remote site. Each volume pair must be assigned to a consistency group. TrueCopy allows you to configure up to 128 consistency groups (0-7F) for each MCU and provides group-based operations for consistency groups (e.g., split and resync group). Consistency groups enable you to maintain update sequence consistency for databases which span multiple volumes, allowing immediate database recovery at the remote site when needed. See section 2.4 for further information on TrueCopy Asynchronous consistency group operations.

2.1.5 Remote Copy Connections

The remote copy connections are the physical paths used by the MCUs to communicate with the RCUs. The number of physical paths in the MCU is limited to eight per logical CU image (depending on the availability of ports). The MCUs and RCUs are connected via fibre-channel interface or serial (ESCON®) interface cables.

Note: Please contact your Hitachi Data Systems account team for the latest information on the availability of serial-channel TrueCopy connections.

- When fibre-channel interface (multimode shortwave) connections are used, two switches are required for distances greater than 0.5 km (1,640 feet), and distances up to 1.5 km (4,920 feet, 0.93 miles) are supported. When fibre-channel interface (single-mode longwave) connections are used, two switches are required for distances greater than 10 km (6.2 miles), and distances up to 30 km (18.6 miles) are supported. See section 3.3.1 for further information on installing and configuring the FC remote copy connections.
- When serial interface connections are used, ESCON® directors (ESCDs) and/or ESCON® repeaters are required for distances greater than 3 km (1.9 miles). TrueCopy operations can be performed at distances of up to 43 km (26.7 miles) using standard ESCON® support. Long-distance solutions are provided, based on user requirements and workload characteristics, using approved channel extenders and communication lines (e.g., T1/T3/ATM). **Note:** See the next section (2.1.6) for important information on serial interface connections. See sections 3.3.2 and 3.3.3 for information on installing and configuring the serial-interface remote copy connections.

The MCU-to-RCU remote copy configuration (see section 3.3.2) for TrueCopy Asynchronous has different requirements than the TrueCopy Synchronous configuration, as follows:

- TrueCopy Synchronous supports 1-to-n and n-to-1 remote copy connections ($n \leq 4$). One MCU can be connected to as many as four RCUs, and one RCU can be connected to as many as four MCUs (one MCU/RCU = one physical CU, including all 32 CU images). TrueCopy supports the dynamic switching capability of the ESCDs which is used to share the physical interface cables between the components. The ESCDs can accommodate channel-to-MCU and channel-to-RCU connections in addition to the remote copy connections.
- TrueCopy Asynchronous supports 1-to-1 remote copy connections within the same consistency group. The P-VOLs and S-VOLs of the pairs in a consistency group must be located within one physical MCU and one physical RCU. This configuration ensures backup integrity for data which is spread across multiple volumes within one 9900V subsystem (e.g., large databases).

Note: TrueCopy 1-to-n and n-to-1 configurations ($n \leq 4$) are valid for TrueCopy Asynchronous, as long as each consistency group does not span local or remote subsystems.

- Fibre remote copy supports 1-to-1 remote copy connections. One 9900V subsystem as an MCU can be connected to only one 9900V subsystem as an RCU via optical fibre cables. For the CU images within one 9900V subsystem, 1-to-4 and 4-to-1 remote copy connections are supported.

Note: Hitachi Data Systems strongly recommends that you establish at least two independent remote copy connections (one per cluster) between each MCU and RCU to provide hardware redundancy for this critical communications path.

2.1.6 Restrictions on Serial Interface Connections

Hitachi TrueCopy supports serial interface connections for combining 9900V and non-9900V subsystems as the MCU and RCU. Table 2.2 shows the supported combinations of serial interface connection between 9900V and 9900/7700E subsystems.

Table 2.2 Support for MCU-RCU Serial Interface Configurations

MCU	RCU		
	9900V Subsystem	9900 Subsystem	7700E Subsystem
9900V Subsystem	Supported in microcode version 21-04-xx and higher	Supported in microcode version 21-04-xx and higher	Supported in microcode version 21-04-xx and higher
9900 Subsystem	Supported in microcode version 21-03-xx and higher	Supported	Supported
7700E Subsystem	Supported in microcode version 21-03-xx and higher	Supported	Supported

Note: The supported configurations (21-03-xx and higher) have the following restrictions:

9900-9900V. When connecting a 9900 subsystem as the MCU and a 9900V as the RCU:

- **CU (CU#):** You can use 0x00 - 0x0F for the MCU. You can use 0x00 - 0x0F for the RCU.
Note: You cannot use 0x10 - 0x1F of 9900V.
- **Consistency group (CTG#):** You can use 0x00 - 0x3F. **Note:** You cannot use 0x40 - 0x7F of 9900V.
- **Takeover by Command Control Interface:** The CCI's takeover function that exchanges the MCU and RCU can only be used in microcode version 21-04-xx and higher.
- **9900 microcode version:** The 9900 subsystem (MCU) that is connected to a 9900V subsystem (RCU) must have microcode version 01-17-94-00/10 or later.

7700E-9900V. When connecting a 7700E subsystem as the MCU and a 9900V as the RCU:

- **Port:** You can use 1A - 2R. **Note:** You cannot use 3a - 4r of the 9900V.
- **TID (GID):** You can use 0x0F.

The required procedure to set the TID (GID) is different for when you use the SVP or Storage Navigator for TrueCopy pair operations, or when you use Command Control Interface (CCI) for pair operations.

- **SVP/Storage Navigator:** When you use the SVP or Storage Navigator for pair operations, follow steps (c) and (d) to set the TID (GID). Steps (a) and (b) are not required. **Caution:** For remote copy pair operations (including pair display) from the 7700E subsystem to the 9900V, performing pair operations from the SVP/Storage Navigator and performing pair operation from CCI cannot be used together.
- **CCI:** When you use CCI for pair operations, follow steps (a)–(d) to set the TID (GID).

To set the TID (GID):

- a) *(CCI only)* Use the CCI **raidscan** command to check the LUN information of the port which is connected to the volume for remote copy operations.

Ports whose LUNs are defined as 256 or higher cannot be used for remote copy operations. Use ports whose LUNs are defined as 0–255.

- b) *(CCI only)* Delete all the LUN definitions of the port which is connected to the volume for the 7700E remote copy operation. Volumes which are not used for remote copy operations do not have to be operated.

- c) For ports performing remote copy operations, set the GID 0x00 - 0x0E as dummies.

To set the GID 0x00 - 0x0E as dummies, set LUN Security to the port (use the **LUN Security: OFF → ON** command), and define GID 0x00 - 0x0E sequentially. The Group Name does not have to be set. For further information on setting LUN Security, please refer to the *Hitachi Lightning 9900V LUN Manager User's Guide*.

Note: Do not set any LUNs to the GID 0x00 - 0x0E.

- d) Follow step (c) to set LUN Security to the GID 0x0F, and define the LUNs in ascending order and sequentially.

- **LUN:** You can use 0x00 - 0x77. **Note:** You must register LUNs in an ascending order.
- **CU (CU#):** You can use 0x00 - 0x03 for the MCU. You can use four CU numbers from 0x00 - 0x0F for the RCU. **Note:** You cannot use 0x10 - 0x1F of the 9900V.
- **Consistency group (CTG#):** You can use 0x00 - 0x0F. **Note:** You cannot use groups 0x10 - 0x7F of the 9900V.
- **Warning for the Paircreate Operation:** Even if you specify an incorrect RCU CU number for the target port (LCP) and specify an incorrect SSID for the S-VOL for the Paircreate operation, no error message may be reported, and data may be copied to a wrong device. You should take extreme caution when performing Paircreate operations.
- **Takeover by Command Control Interface:** The CCI's takeover function that exchanges the MCU and RCU can be used only in microcode version 21-04-xx and higher.
- **7700E microcode version:** A 7700E subsystem (MCU) that is connected to a 9900V subsystem (RCU) must have microcode version 52-48-60-01/00 or later.

Notes on the supported configurations (21-04-xx and higher):

9900V-9900. When connecting a 9900V subsystem as the MCU and a 9900 as the RCU:

- **CU (CU#):** You may use sixteen CU numbers from 0x00 - 0x1F for the MCU. You may use 0x00 - 0x0F for the RCU.
- **Consistency group (CTG#):** You may use 0x00 - 0x3F. **Note:** You may not use groups 0x40 - 0x7F of the 9900V.
- **9900 microcode version:** The 9900 subsystem (RCU) that is connected to a 9900V subsystem (MCU) must have microcode version of 01-18-38 or later.

9900V-7700E. When connecting a 9900V subsystem as the MCU and a 7700E as the RCU:

- **Port:** You may use 1A - 4r for the MCU. You may use 1A - 2R for the RCU.
- **TID (GID):** You may use 0x0F.

The procedure for setting the TID (GID) is different when you use the SVP or Storage Navigator for TrueCopy pair operations, or when you use Command Control Interface (CCI) for pair operations. For further information, refer to the previous instructions on setting TID (GID) in “When connecting a 7700E subsystem as the MCU and a 9900V as the RCU”.

- **LUN:** You may use 0x00 - 0x77. **Note:** You must register LUNs in an ascending order.
- **CU (CU#):** You may use four CU numbers from 0x00 - 0x0F for the MCU. You may use 0x00 - 0x03 for the RCU. **Note:** You may not use 0x10 - 0x1F of the 9900V.
- **Consistency group (CTG#):** You can use 0x00 - 0x0F. **Note:** You may not use groups 0x10 - 0x7F of the 9900V.
- **7700E microcode version:** A 7700E subsystem (RCU) that is connected to a 9900V subsystem (MCU) must have microcode version of 52-49-16/00 or later.

2.1.7 Initiator Ports and RCU Target Ports

The initiator ports are the dedicated fibre-channel interface ports on the main subsystem (MCU) to which the RCUs (RCU target ports) are connected. The initiator ports connect to the RCUs to send write I/O operations directly to the RCUs. Any fibre-channel interface port of the 9900V subsystem can be configured as an initiator port. The TrueCopy software allows you to change the configuration of the 9900V fibre-channel ports (ordinary target port, initiator port, or RCU target port) as needed (see section 4.2.1).

Note: Two or more initiator ports must be configured before you can add the RCUs and create the TrueCopy volume pairs. The initiator ports cannot communicate with the host processor channels. To enable the host processor channels to send write I/O operations to the MCU, the host channel paths must be connected to the other fibre-channel interface ports in the MCU. Ordinary fibre-channel interface ports cannot be connected to the MCU. These ports (usually called target ports) can be connected to the host processor channels only.

The RCU target ports are the dedicated fibre-channel interface ports on the remote subsystem (RCU) to which the MCU (initiator ports) are connected. Any fibre-channel interface port of the 9900V subsystem can be configured as an RCU target port. The RCU target ports can be connected to the host channel paths via the fibre-channel switch.

2.1.8 Remote Control Ports (RCPs) and Local Control Ports (LCPs)

The remote control ports (RCPs) are the dedicated serial interface ports on the MCU to which the RCUs are connected. The RCPs emulate host processor channels to enable the MCUs to send write I/O operations directly to the RCUs. The RCPs support the dynamic switching capability provided by the ESCDs. Any serial interface port of the 9900V subsystem can be configured as an RCP. The TrueCopy software allows you to change the configuration of the 9900V serial ports (LCP or RCP) as needed (see section 4.2.1).

The local control ports (LCPs) are used for host processor channel interface. All serial interface ports on the 9900V subsystem have a default setting of LCP. An RCU port connected to an MCU must be in LCP mode to receive remote copy I/O operations from the MCU.

Note: Two or more RCPs must be configured before you can add the RCUs and create the TrueCopy volume pairs. The RCPs cannot communicate with the host processor channels and are dedicated to TrueCopy operations. The host channel interface paths must be connected to the other interface ports on the 9900V subsystem.

Note: The serial interface ports, 1S-1Z and 2S-2Z, cannot be specified as RCPs.

Note: The CHA package port that is added to DKA slot cannot be specified as RCPs.

2.1.9 9900V TrueCopy Remote Console Software

The 9900V Hitachi Storage Navigator Java™ applet program product includes TrueCopy and TrueCopy - S/390® for the Lightning 9900™ V Series subsystem. The 9900V Storage Navigator software communicates with the SVP of the 9900V subsystem via defined TCP/IP connections. For further information on 9900V Storage Navigator operations, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide* (MK-92RD101), or contact your Hitachi Data Systems account team.

If you plan to perform TrueCopy operations using CCI, you must use the TrueCopy software to add the consistency groups and select the desired group options and async options before you can add any TrueCopy pairs. These functions can only be performed using the TrueCopy remote console software. Once the consistency groups and async options have been configured, the CCI software can be used to establish and manage TrueCopy pairs.

If you will be using the 9900V Storage Navigator software to perform TrueCopy operations (not CCI), the MCU of each TrueCopy volume pair must be LAN-attached to the 9900V Storage Navigator remote console PC. You should also attach all RCUs to a 9900V Storage Navigator PC on a separate LAN at the remote site. Having a separate 9900V LAN at the remote site enables you to access the RCUs and TrueCopy S-VOLs and perform TrueCopy operations at the remote site in the event that the main site is not available (e.g., due to disaster). If you need to perform TrueCopy operations in the reverse direction from the remote site to the primary site (e.g., disaster recovery), the 9900V TrueCopy remote console software at the remote site simplifies and expedites this process.

Note: If the 9900V Storage Navigator remote console PC is not installed, please contact your Hitachi Data Systems account team for information on TrueCopy configuration services.

2.1.10 Host Failover Software

Host failover software, which transfers information between host servers at the primary and remote sites, is a critical component of any disaster recovery effort. Host failover is configured using the desired host failover software product for the platform (e.g., Microsoft Cluster Server), depending on your installation requirements and standards. The 9900V Storage Navigator software products do not provide any host failover functions.

When TrueCopy is used as a data migration tool, host failover is recommended but not required. When TrueCopy is used as a disaster recovery tool, host failover is required to ensure effective disaster recovery operations. When a TrueCopy pair is suspended due to an error condition, the MCU generates sense information which should be transferred to the remote site via the host failover software for effective disaster detection and recovery.

2.2 Remote Copy Operations

Figure 2.3 illustrates the two types of TrueCopy remote copy operations: initial copy and update copy. To reduce the overhead associated with these remote copy activities and maximize data transfer, the Lightning 9900™ V Series subsystem utilizes a special write command which is allowed only for TrueCopy initial and update copy operations. This command transfers the control parameters and the FBA-format data for consecutive updated records in a track using a single write operation. The special TrueCopy write command eliminates the overhead required for performing FBA-to-CKD and CKD-to-FBA conversions.

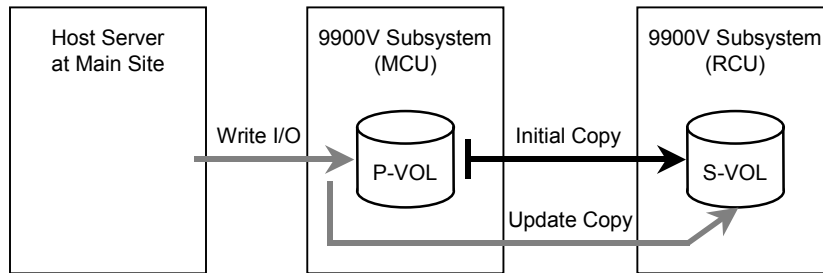


Figure 2.3 Remote Copy Operations

This section describes the following aspects of TrueCopy remote copy operations:

- Initial copy operations (see section 2.2.1),
- Update copy operations (see section 2.2.2),
- Read and Write I/O Operations for TrueCopy Volumes (see section 2.2.3),
- S-VOL Write Option (see section 2.2.4), and
- Difference management (see section 2.2.5).

2.2.1 Initial Copy Operation

The initial copy operation synchronizes the P-VOL and S-VOL independently of host I/O processes. The initial copy operation is the same for TrueCopy Sync and TrueCopy Async pairs. A TrueCopy initial copy operation takes place when you add a pair (paircreate) or resume a split/suspended pair (pairresync). When a new pair is created, the entire contents of the P-VOL are copied to the S-VOL cylinder by cylinder, except for the diagnostic and unassigned alternate tracks. You can also select **None** for the initial copy mode, which copies only cylinder #0 to the S-VOL. If **None** is selected, the user is responsible for ensuring that the P-VOL and S-VOL are already identical. The MCU cannot verify the contents of the volumes. When a split/suspended pair is resumed (pairresync), only cylinder #0 and out-of-sync cylinders/tracks (updated by write I/Os during split/suspend) are copied to the S-VOL.

Note: For further information on cylinder/track difference management, see section 2.2.5.

When the S-VOL write enable pairsplit option is used, the RCU keeps track of S-VOL updates and sends the S-VOL cylinder/track bitmap to the MCU when the split pair is resumed. In this case the MCU merges the P-VOL and S-VOL bitmaps to identify the out-of-sync cylinders/tracks.

For additional flexibility, TrueCopy provides the following options for initial copy:

- The **number of tracks** option allows you to specify how many tracks are copied simultaneously by the TrueCopy initial copy operation when creating/resuming a TrueCopy pair. This option can only be specified using the Hitachi TrueCopy remote console software (not Hitachi Command Control Interface).
- The **initial copy priority** option allows you to specify the order in which the initial copy operations are performed when creating/resuming multiple TrueCopy pairs. This option can only be specified using the TrueCopy remote console software (not CCI).
- The **maximum initial copy activity** option allows you to specify the maximum number of concurrent initial copy operations that each MCU can perform (not pair-specific). This option can only be specified using the TrueCopy remote console software (not CCI).

2.2.2 Update Copy Operation

An update copy operation occurs when the host issues a write I/O operation to the P-VOL of a TrueCopy pair. The update copy operation duplicates the P-VOL write I/O at the S-VOL to keep the volume pair synchronized. TrueCopy provides two modes for update copy operations: synchronous and asynchronous. The update copy mode is specified when you add a TrueCopy pair and cannot be changed.

For synchronous update copy mode, the MCU ensures that the P-VOL and S-VOL are synchronized at all times. The MCU does not return final ending status for the P-VOL write I/O until both the P-VOL write and its associated update copy operation at the RCU are complete. For synchronous mode, the MCU starts the update copy operation when it receives:

- a write command whose data length is short enough not to pass the track-end, or
- write data to the track-end, whose total length is long enough to pass the track-end, or
- write data to the last track for the command.

Note: No matter how long the write data is, update copy is executed for each track.

For asynchronous update copy mode, the MCU stores the P-VOL updates along with additional control information in cache, and sends the updates and control information to the RCU completely independent of the host I/O processes. These updates along with their associated control information are called TrueCopy Async recordsets. The RCU stores the TrueCopy Async recordsets in cache and performs the updates to the S-VOLs in the same order as they were performed at the MCU(s) according to the TrueCopy update sequence information. For further information on TrueCopy Asynchronous recordset operations, see section 2.3.

Priority of initial and update copy: In both TrueCopy Synchronous and TrueCopy Asynchronous, update copy has higher priority than initial copy. However, initial copy is executed based on the copy pace (3 or 15 tracks); therefore, update copy must wait this interval if initial copy is being executed. For example, if the copy pace is 15 tracks, the update copy may wait up to 15 tracks (1 cylinder). In the case of TrueCopy Asynchronous, update copy is executed asynchronously, but the same scheduling conflict can occur between the asynchronous update copy (write recordset) and initial copy.

2.2.3 Read and Write I/O Operations for TrueCopy Volumes

When an MCU receives a read command for a TrueCopy P-VOL, the MCU completes the read from either cache or the P-VOL. If the read fails, the redundancy provided by RAID technology recovers the failure. The MCU does not read the TrueCopy S-VOL for recovery.

When an MCU receives a write command for a TrueCopy Synchronous P-VOL with COPY status and the track has already been copied to the S-VOL, the MCU performs a synchronous update copy operation to complete the write at the S-VOL. When an MCU receives a write command for a TrueCopy Asynchronous P-VOL with COPY status and the track has already been copied to the S-VOL, the MCU performs an asynchronous update copy operation.

When an MCU receives a write command for a TrueCopy P-VOL with PAIR status, the user-selected update copy mode (synchronous or asynchronous) determines the sequence of events:

- **Synchronous Mode:** The MCU performs the write operation on the P-VOL, starts the update copy operation for the S-VOL, and then reports final ending status to the host only after the update copy operation is complete. If the P-VOL write or S-VOL update copy operation fails, the MCU reports a unit check, and the host system and application program will regard that write operation to the P-VOL as failed. If a failure occurs at the P-VOL or the S-VOL, the corresponding volume of the TrueCopy pair will decommit the update to maintain exact synchronization of the volumes.
- **Asynchronous Mode:** The MCU completes P-VOL write operations independently of the associated update copy operations at the S-VOL. The RCU manages the S-VOL updates according to the TrueCopy Async recordset information and maintains sequence-based data consistency for the S-VOLs. If the P-VOL write operation fails, the MCU reports a unit check and does not create the TrueCopy Async recordset for this operation. If the update copy operation fails, the RCU suspends either the affected pair or all TrueCopy Async pairs in the consistency group, depending on the type of failure. When the suspended TrueCopy pair or group is resumed (pairresync), the MCU and RCU negotiate the resynchronization of the pair(s). See section 2.5.2 for further information on suspended TrueCopy Async pairs.

The RCU does not allow a TrueCopy S-VOL to be online (mounted) during normal TrueCopy operations and rejects all host-requested write I/O operations for an S-VOL. The special TrueCopy S-VOL write enable option enables write access to an S-VOL while the pair is split (see section 2.2.4). The S-VOL write option can only be enabled when you split the pair from the MCU.

2.2.4 S-VOL Write Option

For additional flexibility, Hitachi TrueCopy provides an S-VOL write option which enables write access to the S-VOL of a split TrueCopy pair. The S-VOL write option can be selected by the user during the pairsplit-r operation and applies only to the selected pair(s). The S-VOL write option can be accessed only when you are connected to the MCU. When you resync a split TrueCopy pair which has the S-VOL write option enabled, the RCU sends the S-VOL cylinder/track bitmap to the MCU, and the MCU merges the P-VOL and S-VOL bitmaps to determine which cylinders (or tracks) are out-of sync. This ensures proper resynchronization of the pair.

2.2.5 Difference Management

The differential data (updated by write I/Os during split or suspension) between P-VOL and S-VOL is stored in each cylinder bitmap. When a split/suspended pair is resumed (pairresync), the MCU merges the P-VOL and S-VOL bitmaps, and the differential data is copied to the S-VOL. The unit of data stored in the bitmap is track or cylinder. When you add a pair (paircreate), you can select Track or Cylinder, and you can also confirm the unit. Table 2.3 shows the availability of the difference management option for TrueCopy and CCI.

Note: For mixed subsystem configurations (e.g., 9900V MCU and 9900 RCU), the difference management option is not available during the paircreate operation (preset to Cylinder).

Table 2.3 Availability of the Difference Management Option

Program Product	Unit of Data Stored in Bitmap			Confirmation
	Default (Auto) *	Track	Cylinder	
TrueCopy remote console software	Available	Available	Available	Available
Command Control Interface software	Available	Available	Available	Available

* **Default (Auto):** Track or Cylinder is automatically set according to the capacity (number of cylinders or number of cylinders set by VLL) of the volumes used for the pairs. For volumes that have 10,019 cylinders or more, Cylinder is set. For other volumes, Track is set.

To calculate the number of cylinders:

- For OPEN-3/8/9/E/L:

$$(\lceil (\lceil (\text{Max. LBA}/96) \rceil) / 15 \rceil) + 1$$

- For OPEN-V:

$$(\lceil (\lceil (\text{Max. LBA}/128) \rceil) / 15 \rceil) + 1$$

The $\lceil \dots \rceil$ symbols around a value indicate that the value should be rounded up to the next integer.

Restriction on number of pairs. When you add pairs with the setting of Track, the maximum number of pairs you can create is restricted. If you create more pairs than the maximum allowed, one or more pairs are automatically changed to Cylinder. You can restrict this automatic change of the setting. **Caution:** Before using this function, please contact your Hitachi Data Systems account team. (When you add a TrueCopy pair with Track using the CCI software, you cannot use this function, and the paircreate operation will fail.)

- The restriction on the number of pairs depends on the capacity of the volumes used for the pairs. Both the MCU and RCU are restricted. Table 2.4 shows the maximum number of pairs with Track difference management for each LU type.

The number of bitmap areas in the subsystem is 10,476. You can calculate the number of bitmap area. If the calculated bitmap area exceeds the number of bitmap area in the subsystem, adding pairs operation is restricted. To calculate the number of bitmap:

– For OPEN-3/8/9/E/L:

$$(\uparrow((\uparrow((\uparrow(\uparrow(\uparrow(\text{Max. LBA}/96)\uparrow)/15)\uparrow)+1)\times 15)/75,136)\uparrow)-1$$

– For OPEN-V:

$$(\uparrow((\uparrow((\uparrow(\uparrow(\uparrow(\text{Max. LBA}/128)\uparrow)/15)\uparrow)\times 15)/75,136)\uparrow)-1$$

The $\uparrow\ldots\uparrow$ symbols around a value indicate that the value should be rounded up to the next integer.

Table 2.4 Maximum Number of Pairs Using Track Difference Management

Basic LU Type	Number of Cylinders	Maximum Number of Pairs
OPEN-3	3,339	8,192
OPEN-8	10,017	8,192
OPEN-9	10,017	8,192
OPEN-E	19,760	3,492
OPEN-L	49,440	1,164
OPEN-V	65,535	805

2.3 TrueCopy Asynchronous Recordset Operations

The TrueCopy Async recordsets contain the P-VOL updates and the associated control information, including the sequence number of the P-VOL update, which enables the RCU to maintain update consistency of the TrueCopy Async S-VOLs. TrueCopy Async recordset operations include:

- Creating and storing recordsets at the MCU,
- Sending recordsets to the RCU,
- Storing recordsets at the RCU,
- Selecting and settling recordsets at the RCU,
- Types of recordsets, and
- Inflow control for sidefiles.

2.3.1 Creating and Storing Recordsets at the MCU

When an MCU performs an update (host-requested write I/O) on a TrueCopy P-VOL, the MCU creates a TrueCopy Async recordset which contains: the updated record, sequence number, record location (device, cylinder, track, record number), and record length. The TrueCopy Async recordsets are queued in the cache storage of the MCU and sent to the RCU independent of host I/O processes. The RCU utilizes the sequence number information in the recordsets to update the S-VOL(s) in the same order as the P-VOL(s).

The sequence number indicates the number of recordsets that the MCU has created for each consistency group. The recordset information, except for the updated records, is stored and queued in an area of cache known as sidefile cache (see section 2.3.6). **Note:** TrueCopy Asynchronous operations continue uninterrupted if the SVP reboots or even if the SVP fails.

2.3.2 Sending Recordsets to the RCU

The MCU sends the TrueCopy Async recordsets to the RCU in a similar manner as the TrueCopy Synchronous updates. The MCU's RCP or initiator ports act as host processor channels and issue special I/O operations, called remote I/Os (RIOs), to the RCU. The RIO transfers the recordsets in FBA format (not CKD) using a single channel command, eliminating the overhead associated with FBA-CKD conversion and thus providing more efficient transfer of data. The MCU can send several recordsets using a single RIO, even if their sequence numbers are not contiguous. Therefore, TrueCopy Async recordsets are usually sent to the RCU in a different order than the arrivals at the MCU. The RCU ensures that records are applied to the S-VOLs in the correct sequence. This method of remote I/O provides the most efficient use of MCU-to-RCU link resources.

Note: The parameter length and detailed specification of the TrueCopy Asynchronous channel command are different than for TrueCopy Synchronous RIOs. You must make sure that your channel extenders are capable of supporting this command. For further details, please contact your Hitachi Data Systems account team.

2.3.3 Storing Recordsets at the RCU

The RCU maintains queues to control the storing of recordsets in the sidefile and commitment of updating records in the S-VOLs. The RCU queuing mechanism for TrueCopy Async uses the sequence numbers provided by the MCU SVP to control the sequence in which S-VOL updates are applied and to check for missing updates.

Note: The MCU does not remove the sidefile entry for a recordset from its cache until it receives an I/O completion signal (device end) from the RCU. This is true even if the MCU and RCU are connected via a channel extender product. If a recordset is lost in transmission from the MCU to the RCU, the MCU's cylinder/track bitmap ensures that the missing recordset is identified and resent to the RCU.

2.3.4 Selecting and Settling Recordsets at the RCU

The RCU selects the recordset to be promoted to formal data (or “settled”) as follows:

1. The RCU checks for a valid entry at the top of each queue in the consistency group. If the top of any queue is empty (i.e., recordset not yet received), the RCU waits for that entry.
2. When the top of each queue contains a valid entry (recordset), the RCU selects the entry which has the lowest sequence number, and then settles this recordset.
3. The RCU repeats steps (1) and (2) to select and settle TrueCopy Async recordsets.

Figure 2.4 illustrates recordset selection and settling at the RCU. In this example, the top of the queue contains a valid entry: S1. The RCU selects recordset S1 to be settled, because S1 is the lowest sequence number. When S1 is removed from the MCU queue, recordset S2 becomes the top entry, but it is empty. When recordset S2 arrives, the RCU selects S2 as the next recordset to be settled. The recordset selected by the RCU is marked as “host-dirty” and treated as formal data. The RCU settles the updated records in the recordset as follows:

- If the corresponding track is in cache (track-hit), the updated records in the recordset are copied to the existing cached track, and the cache space for the sidefile is released.
- If the corresponding track is not in cache (track-miss), the RCU changes the cache designation of the sidefile to formal data. The data is not physically moved.

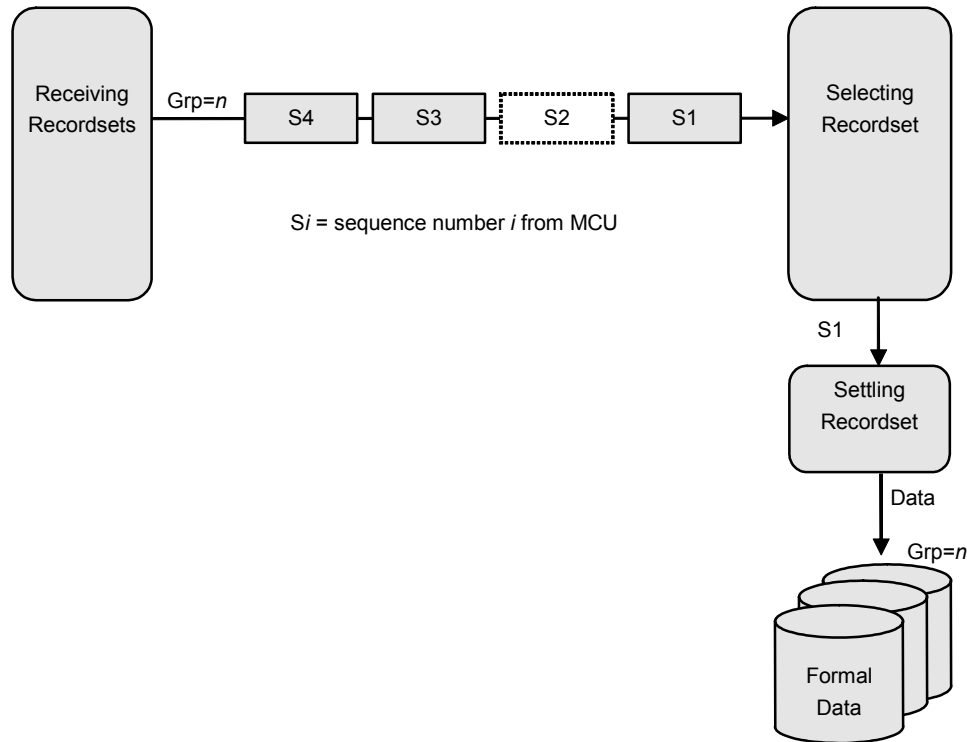


Figure 2.4 Selecting and Settling TrueCopy Async Recordsets at the RCU

2.3.5 Types of Recordsets

In addition to host update recordsets, the MCU passes control information to the RCU in special non-update recordsets. These special recordsets indicate when volume pair status changes and when an MCU power-off sequence is initiated, and also maintain sequence numbers in periods of low host activities.

2.3.6 Inflow Control of Recordsets

As described in the previous sections, both the MCU and RCU create sidefiles for storing TrueCopy (and TrueCopy - S/390®) Asynchronous recordsets. Since the sidefiles occupy exclusive space in cache, both the MCU and RCU perform inflow control to prevent an overload of the subsystem's cache resources. The 9900V subsystems use the following parameters for TrueCopy Asynchronous cache inflow control, and the TrueCopy Async Option panel (see section 4.3.1) allows you to modify these parameters:

- **Pending Update Data Rate (%)**: sidefile (TrueCopy) threshold = maximum cache % available for use by TrueCopy Asynchronous sidefiles
- **Offloading Timer (sec.)**: maximum time between TrueCopy Async recordset transfers
- **I/O Delay Start (%)**: the threshold, which is the maximum amount of cache for starting the I/O inflow control
- **I/O Delay Increase (%)**: the threshold, which is the maximum amount of cache for starting to strengthen control over the I/O inflow

Inflow Control by MCU. When the amount of MCU sidefile cache reaches the user-specified threshold (**I/O delay start**), the subsystem's I/O response is delayed. When the amount of MCU sidefile cache reaches the user-specified threshold (**I/O delay increase**), the subsystem's I/O delay starts to increase. If the MCU is not able to send a recordset to the RCU within the user-specified **offloading timer** value, the MCU suspends all affected TrueCopy Async volume pairs and resets the SCP condition to avoid hanging up the system.

Inflow Control by RCU. When the amount of RCU sidefile cache reaches the user-specified threshold (**pending update data rate**), the RCU responds with channel-command-retry requests to the RIO commands which transfer the recordsets from the MCU. The only recordset accepted by the RCU is the recordset with the sequence number required to continue settling the pending recordsets. If the RCU is not able to settle a recordset within the user-specified **offloading timer** value, the RCU suspends all TrueCopy Asynchronous volume pairs and resets the channel-command-retry condition to avoid hanging up the MCU.

Table 2.5 shows the sidefile threshold values for TrueCopy Asynchronous operations and write pending operations and describes the actions that occur when each threshold is reached.

Table 2.5 Sidefile Thresholds

Operation	Threshold(s)	Action(s)
TrueCopy Asynchronous	I/O Delay Start (threshold)= 30% Note: Threshold can be adjusted (to the desired value between 0 and 70% in 1% increment) using the TrueCopy remote console software. Specify the value not exceeding the value of I/O Delay Increase, and Sidefile threshold for the I/O Delay Start threshold.	MCU reaches threshold: I/O delay starts. If the sidefile threshold is set between 0 to 30%, the effect on the I/O delay is minimal. RCU reaches threshold: No action
TrueCopy Asynchronous	I/O Delay Increase (threshold) = 40% Note: Threshold can be adjusted (to the desired value between 0 and 70% in 1% increment) using the TrueCopy remote console software. Specify the value within range of the I/O Delay Start threshold to the Sidefile threshold for the I/O Delay Increase threshold .	MCU reaches threshold: I/O delay increases. If the sidefile threshold is set between 0 to 30%, the effect on the I/O delay is minimal. RCU reaches threshold: No action
TrueCopy Asynchronous	Sidefile threshold = 50% Note: Threshold can be adjusted using the Hitachi TrueCopy remote console software (30, 40, 50, 60, 70%).	MCU reaches threshold: I/O delay RCU reaches threshold: command retry to MCU
Write Pending	[write pending] / [avail cache - sidefile] = 70%	Command retry

Note: FlashAccess operations may decrease the total amount of cache available for TrueCopy Asynchronous operations but do not directly affect sidefile cache usage. Available cache is defined as the amount of physical cache memory installed on the subsystem minus any cache reserved for the FlashAccess feature.

Note: If you do not want to control the inflow into a sidefile, specify the value using the Pending Update Data Rate for both values of I/O Delay Start and the I/O Delay Increase, and 0 second for the Offloading Timer.

For information on HXRC and Concurrent Copy (CC) cache sidefile operations, please refer to the *Hitachi Lightning 9900™ V Series Hitachi TrueCopy™ - S/390® User and Reference Guide*. Subsystems performing TrueCopy Asynchronous in combination with HXRC and/or CC must have sufficient cache installed to handle the increased sidefile activity.

2.3.7 Graduated Delay Sidefile Management

Figure 2.5 shows the graduated delay process for TCA sidefile management. When the sidefile value reaches the high-water mark (threshold minus 20%), the 9900V subsystem begins command retry delay for host updates to TCA M-VOLs and reports a warning SIM to the host. As the amount of sidefile increases, the delay increases incrementally as shown in Figure 2.5. Mode 93 on the 9900V SVP allows you to select the delay type (long or short). This graduated delay methodology minimizes the potential for sidefile overcommitment, while at the same time providing another level of automation control.

Note: If there is a network problem, lack of bandwidth, or lack of sufficient Fibre or ESCON links, the sidefile will grow and the microcode will add delay to host I/O until the sidefile goes below a certain level again. Disabling this function will cause the pairs to suspend.

Important: SIM reporting for sidefile conditions is enabled only when SVP mode 118 is ON (refer to Table 2.1).

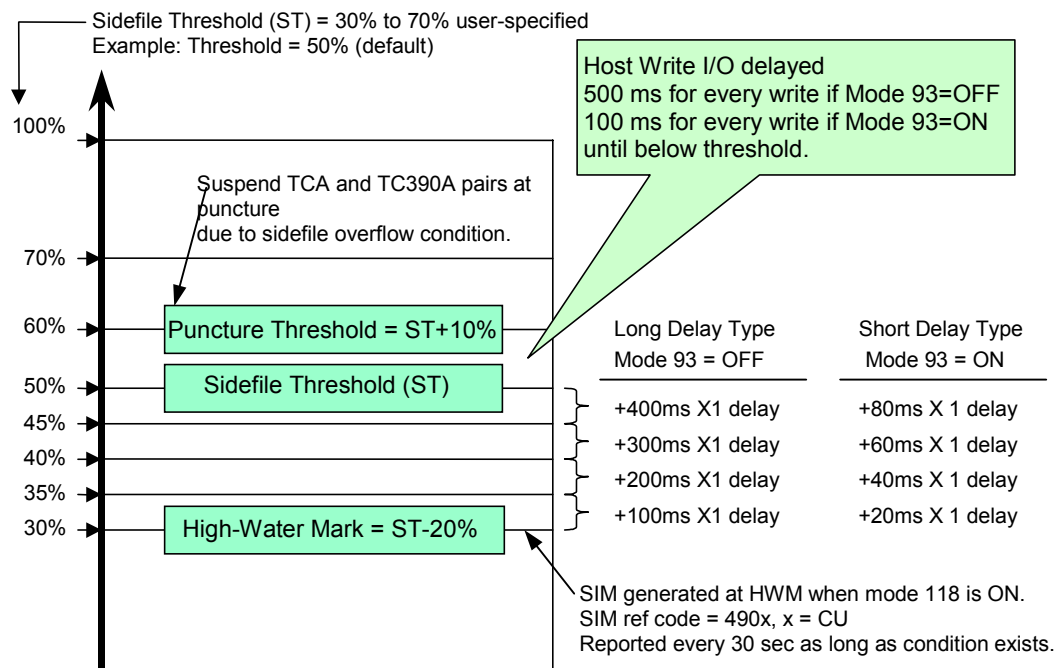


Figure 2.5 Graduated Delay Process for Sidefile Management

2.4 TrueCopy Asynchronous Consistency Group Operations

TrueCopy Asynchronous consistency groups enable update sequence consistency to be maintained across a group of volumes. The P-VOLs and S-VOLs of the pairs in a consistency group must be located within one physical MCU and one physical RCU (1-to-1 requirement). The TrueCopy consistency group operations include:

- Group options, and
- Group operations.

2.4.1 Group Options

Hitachi TrueCopy provides the following options for each consistency group: **Time Out (Copy Pending)**, and **Time Out (RCU Ready)**. These options are selected when you add a group, and can only be modified when the group does not contain any P-VOLs in the MCU.

Time Out (Copy Pending). This group option specifies the maximum delay allowed for TrueCopy Async copy operations. The RCU will suspend all S-VOLs in the group when:

- The RCU has not had any communication from the MCU within the specified time. This situation could indicate a disaster or failure at the primary site.
- The RCU has been receiving recordsets from the MCU(s) but has not been able to settle a recordset within the specified time. This situation may indicate that the RCU does not have enough resources to handle the remote copy and I/O workloads.

Time Out (RCU Ready). This group option specifies the maximum delay allowed for re-establishing MCU-RCU communications following MCU power-off. During MCU power-on, the MCU re-establishes communication with all registered RCUs. If the MCU is not able to re-establish communication with an RCU within the specified time, the MCU suspends all affected TrueCopy Asynchronous volume pairs.

2.4.2 Group Operations

Hitachi TrueCopy Asynchronous provides the following group-based operations to simplify and expedite disaster/failure recovery procedures:

- Group operations at the MCU:
 - Split (pairsplit-r) all pairs in a consistency group. See section 5.6 for a description of the **Suspend Range-Group** pairsplit option.
 - Resume (pairresync) all split or suspended pairs in a group. See section 5.7 for a description of the TrueCopy **Resume Range-Group** pairresync option.
 - Delete (pairsplit-S) all pairs in a group. See section 5.8 for a description of the **Delete Range-Group** pairdelete option.
- Group operations at the RCU:
 - Split (pairsplit-r) all pairs in a consistency group. See section 5.6 for a description of the **Suspend Range-Group** pairsplit option.
 - Delete (pairsplit-S) all split/suspended pairs in a consistency group except for any inconsistent pairs. See section 5.8 for a description of the **Delete Range-C/T** pairdelete option.
 - Delete (pairsplit-S) all pairs in a group regardless of their consistency status. See section 5.8 for a description of the **Delete Range-Group** pairdelete option.

Hitachi TrueCopy also provides the **Error level** pair option (see section 5.4) which is used to trigger automatic suspension of an entire consistency group. When a TrueCopy Async pair is suspended due to failure (not user-requested), this TrueCopy Async pair option determines whether all pairs in the same consistency group will also be suspended. If you selected the **Group** error level for the TrueCopy pair, all pairs in the same group will be suspended. If you selected the **LU** error level, only the affected TrueCopy pair will be suspended.

Note: The **Error level** pair option is very important for managing TrueCopy Asynchronous groups and planning for disaster recovery. The **Group** error level should be selected for all TrueCopy Async volumes which are essential to disaster recovery. Suspended TrueCopy S-VOLs which have the **LU** error level should not be used for disaster recovery.

2.5 TrueCopy Volume Pair Status

Hitachi TrueCopy displays the pair status for each volume in the connected 9900V subsystem. Table 2.6 lists and describes the TrueCopy pair status descriptions. The MCU maintains the status of the P-VOL and can change the pair status of the P-VOL and S-VOL. The RCU maintains the status of the S-VOL and can change the pair status of the S-VOL but not the P-VOL. The MCU will detect when the RCU changes the S-VOL status (if the path status is normal) and will change the P-VOL status accordingly. You can display the detailed pair status information at the Storage Navigator remote console PC (Hitachi TrueCopy Pairedisplay panel) or at the UNIX®/PC server host (CCI Pairedisplay command).

A volume which is not assigned to a TrueCopy pair has the status **SMPL**. When a TrueCopy pair is started, the MCU changes the status of the P-VOL and S-VOL to **COPY**. When the initial copy operation is complete, the MCU changes the status of both volumes to **PAIR**. When a TrueCopy pair is split by the user (pairsplit-r), the MCU/RCU changes the status of the P-VOL and S-VOL to **PSUS** (if the path status is normal). When a pair is suspended due to an error condition, the MCU/RCU changes the P-VOL and S-VOL status to **PSUE** (if the path status is normal). When a pair is deleted by the user from the MCU (pairsplit-S), the MCU changes the status of the P-VOL and S-VOL to **SMPL** (if path status is normal). When a pair is deleted from the RCU, the RCU changes the S-VOL status to **SMPL**, and the MCU detects the pair deletion (if path status is normal) and changes the P-VOL status to **PSUS**.

When a TrueCopy pair is split or suspended, the MCU generates a service information message (SIM) to notify the host(s). If SNMP is installed and operational for the 9900V, this SIM results in an SNMP trap which indicates the reason for suspension.

TrueCopy LUSE Pair Status

For TrueCopy LUSE pairs only, the **PDUB** status indicates that the status of the TrueCopy LUSE volume pair is **COPY** or **PAIR**, but the status of one or more individual LDEV pairs within the TrueCopy LUSE pair is **SMPL** or **PSUE** (due to some error condition).

TrueCopy Asynchronous Pair Status

The TrueCopy **Suspending** and **Deleting** transitional states occur when a request to change TrueCopy Async pair status has been accepted, but the change to the requested status (**PSUS**, **PSUE**, or **SMPL**) is not yet complete. These states are not reported to the host. In the case of **Suspending**, both the user and the MCU can request the status change. In the case of **Deleting**, only the user can request the status change. If the user requested the status change, the final status is reported at the end of the transition. If an error caused the status to change to **PSUE**, the suspended status is reported at the beginning of the transition.

Table 2.6 TrueCopy Volume Pair Status

Pair Status	Description	P-VOL Access	S-VOL Access
SMPL (simplex)	This volume is not currently assigned to a TrueCopy volume pair. When this volume is added to a TrueCopy pair, its status will change to COPY.	Read/write	Read/write
COPY	The initial copy operation for this pair is in progress. This pair is not yet synchronized. When the initial copy is complete, the status changes to PAIR.	Read/write	Read only
PAIR	This pair is synchronized. Updates to the P-VOL are duplicated on the S-VOL.	Read/write	Read only
PSUS (pair suspended-split) (see Table 2.7 for split types)	This pair is not synchronized, because the user has split this pair (pairsplit-r), or because the user has deleted this pair from the RCU (pairsplit-S). For TrueCopy Async pairs, the MCU and RCU keep track of any recordsets that were discarded during the pairsplit-r operation. While a pair is split, the MCU and RCU keep track of the P-VOL and S-VOL cylinders/tracks which are updated. - When you split a pair from the MCU, the MCU changes the status of the P-VOL and S-VOL to PSUS. When you split a pair from the RCU, the RCU changes the status of the S-VOL to PSUS. The MCU detects this (if path status is normal) and changes P-VOL status to PSUS. - When you delete a pair from the RCU, the RCU changes the S-VOL status to SMPL. The MCU detects this (if the path status is normal) and changes the P-VOL status to PSUS. You must delete the pair from the MCU in order to change the P-VOL status to SMPL.	Read/write	Read only; Read and write, if write enable split option is selected.
PSUE (pair suspended-error) (see Table 2.9 for suspend types)	This pair is not synchronized, because the MCU or RCU has suspended the pair due to an error condition. For Async pairs the MCU and RCU keep track of any recordsets that were discarded during the suspension operation. The MCU keeps track of the P-VOL cylinders/tracks which are updated while the pair is suspended. - For TrueCopy Synchronous pairs, if the MCU cannot keep the pair synchronized for any reason, the MCU changes the status of the P-VOL and S-VOL (if possible) to PSUE. - For TrueCopy Asynchronous pairs, if the MCU detects a TrueCopy Async suspension condition (see section 2.5.3), the MCU changes the P-VOL and S-VOL status (if possible) to PSUE. - For TrueCopy Asynchronous pairs, if the RCU detects a TrueCopy Async suspension condition (see section 2.5.3), the RCU changes the S-VOL status to PSUE, and the MCU detects this (if the path status is normal) and changes the P-VOL status to PSUE.	Read/write; Read only if fenced.	Read only
Pair Status for TrueCopy LUSE volumes only:			
PDUB	This TrueCopy pair consists of LUSE volumes (e.g., OPEN3*n), and an individual LDEV within this TrueCopy LUSE pair has failed due to some error condition. The status of the TrueCopy LUSE volume is PAIR or COPY, and the status of one or more LDEV pairs is PSUE or SMPL.	Read/write	Read only
Pair Status for TrueCopy Asynchronous only:			
Suspending	This pair is not synchronized. This pair is in transition from PAIR or COPY to PSUS/PSUE. When the split/suspend pair operation is requested, the status of all affected pairs changes to Suspending . When the split/suspend operation is complete, the status changes to PSUS/PSUE.	Read/write	Read only
Deleting	This pair is not synchronized. This pair is in transition from PAIR, COPY, or PSUS/PSUE to SMPL. When the pairsplit-S operation is requested, the status of all affected pairs changes to Deleting . When the pairsplit-S operation is complete, the status changes to SMPL.	Read/write	Read only

2.5.1 TrueCopy Split Types (PSUS)

Table 2.7 lists and describes the TrueCopy split types. A TrueCopy pair can be split by the user at any time after the initial copy operation is complete. The user must split a TrueCopy pair in order to perform media maintenance on the P-VOL or to access the S-VOL (S-VOL write enable).

When a TrueCopy Synchronous pair is split by the user, the MCU ensures synchronization by completing any pending update copy operation before changing the status to PSUS. After the pair status changes to PSUS, the MCU stops performing update copy operations to the S-VOL and may or may not continue accepting write I/Os for the P-VOL, depending on the P-VOL fence level and pairsplit options. If the P-VOL accepts write operations while the pair is split, the MCU keeps track of the P-VOL cylinders/tracks which are updated. If you enabled the S-VOL write option when you split the pair, the RCU keeps track of the S-VOL cylinders or tracks which are updated while the pair is split. When the pair is resumed (pairresync), the RCU sends the S-VOL bitmap to the MCU, and the MCU merges the P-VOL and S-VOL bitmaps to determine which cylinders/tracks are out-of-sync.

When a TrueCopy Asynchronous pair is split by the user, the MCU and RCU ensure synchronization by either completing or discarding any pending update copy operations according to the user-specified drain/purge pairsplit option. The MCU and RCU keep track of any recordsets that were discarded during the pairsplit operation. After the pair status changes to PSUS, the MCU stops performing recordset operations for the pair, continues accepting write I/Os for the split TrueCopy Async P-VOL, and keeps track of the P-VOL cylinders/tracks which are updated while the pair is split. If you enabled the S-VOL write option when you split the pair, the RCU also keeps track of the S-VOL cylinders/tracks which are updated while the pair is split. When the pair is resumed, the RCU sends the S-VOL bitmap to the MCU, and the MCU merges the P-VOL and S-VOL bitmaps to determine which cylinders/tracks are out-of-sync.

A split (or suspended) TrueCopy Async S-VOL has an additional status called the consistency status. The consistency status is displayed only at the RCU and indicates the S-VOL's update sequence consistency with respect to the other S-VOLs in the same group. Table 2.8 lists and describes the consistency status descriptions for split or suspended TrueCopy Async S-VOLs (the consistency status is displayed only at the RCU).

Table 2.7 Split Types (PSUS)

Type	Applies to	Description
PSUS, P-VOL by Operator	P-VOL (TrueCopy Sync only)	The user split the pair from the MCU using the P-VOL Failure option. The S-VOL split type is PSUS-by MCU .
PSUS, S-VOL by Operator	P-VOL, S-VOL	The user split the pair from the MCU or RCU using the S-VOL option.
PSUS, by MCU	S-VOL	The RCU received a request from the MCU to split the pair. The P-VOL split type is PSUS-P-VOL by Operator or PSUS-S-VOL by Operator .
PSUS, Delete pair to RCU	P-VOL	The MCU detected that the S-VOL status changed to SMPL because the user deleted the pair (pairsplit-S) from the RCU. The pair cannot be resumed because the S-VOL does not have the PSUS/PSUE status.

Table 2.8 Consistency Status for Split/Suspended TrueCopy Async S-VOLs

Consistency Status (displayed at RCU)	Description
Volume	This TrueCopy Asynchronous volume pair was probably split or suspended alone. Update sequence consistency between this S-VOL and other S-VOLs in this consistency group is not ensured. This S-VOL cannot be used for disaster recovery at the secondary site. This status is indicated when: – This pair was split by the user using the Suspend Range-LU pairsplit option. – This pair was suspended due to a failure that did not affect the entire consistency group, and the Error Level pair option for this pair is set to LU.
Group	This TrueCopy Asynchronous volume pair was split or suspended along with the other pairs in its consistency group. Update sequence consistency between this S-VOL and other S-VOLs in this consistency group is ensured. This S-VOL can be used for disaster recovery at the secondary (remote) system (after deleting the TrueCopy pair from the RCU). This status is indicated when: – This pair was split by the user using the Suspend Range-Group pairsplit option. – All pairs in this consistency group were suspended due to a failure that affected the entire consistency group (not just one pair) (e.g., MCU-RCU communication failure). – One pair in the group was suspended due to a failure that did not affect the entire group, and the Error Level pair option for this pair is set to Group.

2.5.2 TrueCopy Suspend Types

Table 2.9 lists and describes the TrueCopy suspend types, which indicate the reason for the suspension. TrueCopy Synchronous pairs can only be suspended by the MCU. TrueCopy Asynchronous pairs can be suspended by the MCU or by the RCU. For further information on TrueCopy Async suspension conditions, please see section 2.5.3.

The MCU suspends a TrueCopy pair when it detects any of the following suspension conditions:

- When the MCU detects that the user has deleted the volume pair from the RCU,
- When the MCU detects an error condition related to the RCU, S-VOL, or a TrueCopy update copy operation,
- When the MCU is unable to communicate with the RCU, or
- When the MCU detects a TrueCopy Asynchronous suspension condition.

When a TrueCopy Synchronous pair is suspended, the MCU stops performing update copy operations to the S-VOL and may or may not continue accepting write I/Os for the P-VOL, depending on the P-VOL fence level pair option. If a synchronous update copy operation fails, the MCU maintains exact synchronization by reporting a unit check and decommitting the P-VOL update, so that the host system and application program regard that write operation to the P-VOL as failed. If the MCU accepts subsequent write I/Os for a suspended P-VOL, the MCU keeps track of the P-VOL cylinders/tracks which are updated while the pair is suspended. When a suspended TrueCopy Sync pair is resumed, the MCU copies the out-of-sync P-VOL cylinders/tracks to the S-VOL. TrueCopy does not allow access to an S-VOL while the pair is suspended (only when split).

Note: You must stop host I/Os before suspending TrueCopy Synchronous pairs with the **Data** fence level and the following conditions: TrueCopy Synchronous and Asynchronous pairs exist in the same subsystem, and there are host I/Os to the TrueCopy Asynchronous pairs. If you do not stop host I/Os, the pairs might be forcibly suspended because of a time-out error, and host I/Os will be rejected.

When a TrueCopy Asynchronous pair is suspended, the MCU stops performing TrueCopy Async recordset operations for the pair. The MCU continues accepting write I/Os for the suspended P-VOL and keeps track of the P-VOL cylinders/tracks which are updated while the pair is suspended. The MCU and RCU also keep track of any recordsets that were discarded during the pair suspension. When a suspended TrueCopy Async pair is resumed, the RCU sends the S-VOL bitmap to the MCU, and the MCU merges the P-VOL and S-VOL bitmaps to determine which cylinders/tracks are out-of-sync. This method ensures that all cylinders/tracks which contain recordsets that were discarded at the RCU are resynchronized at this time.

A suspended (or split) TrueCopy Async S-VOL has an additional status called the consistency status. The consistency status is displayed only at the RCU and indicates the S-VOL's update sequence consistency with respect to the other S-VOLs in the same group. Refer to Table 2.8 for a description of consistency status for suspended/split TrueCopy Async S-VOLs.

Table 2.9 Suspend Types (PSUE)

Type	Applies to	Description
PSUE, by RCU	P-VOL, S-VOL	The MCU detected an error condition at the RCU which caused the MCU to suspend the TrueCopy volume pair. The S-VOL suspend type is PSUE-S-VOL Failure .
PSUE, S-VOL Failure	P-VOL, S-VOL	The MCU detected an error during RCU communication or an error during update copy. In this case, the S-VOL suspend type is usually PSUE-S-VOL Failure . This suspend type is also used when the number of paths falls below the minimum number of paths setting on the RCU Option panel.
PSUE, MCU IMPL	P-VOL, S-VOL TrueCopy Async	The MCU could not find valid control information in its nonvolatile memory during IMPL. This condition occurs only if the MCU is without power for more than 48 hours (i.e., power failure and fully discharged backup batteries).
PSUE, Initial Copy Failed	P-VOL, S-VOL	The TrueCopy pair was suspended before the initial copy operation was complete. The data on the S-VOL is not identical to the data on the P-VOL.
PSUE, MCU P/S OFF	S-VOL (TrueCopy Async only)	The RCU received a request from the MCU to suspend the S-VOL due to MCU power-off. The RCU stops expecting recordsets from that MCU. The P-VOL status does not change due to MCU power-off.
PSUS, Sidefile overflow (TrueCopy Async only)	P-VOL, S-VOL	The amount of sidefile exceeds the specified "current pending update data rate", and the RCU data is not transferred within the specified "offloading timer".

2.5.3 TrueCopy Asynchronous Suspension Conditions

TrueCopy Asynchronous operations involve additional suspension conditions related to the recordset operations. Both the MCU and RCU can detect TrueCopy Async suspension conditions and suspend TrueCopy Async pairs. When a TrueCopy Async pair is suspended, the cylinders/tracks which contain the following records are marked in the bitmap as modified (to be copied during the pairresync operation):

- The recordsets that were created by the MCU but not yet sent to the RCU. After marking these P-VOL cylinders/tracks as modified, the MCU discards these recordsets.
- The recordsets that were sent to the RCU but not acknowledged by the RCU. The MCU marks these P-VOL cylinders/tracks as modified and discards these recordsets. This ensures that recordsets lost during transmission to the RCU are identified and marked.
- The recordsets that reached the RCU but have not yet been settled. After marking these S-VOL cylinders/tracks as modified, the RCU discards these recordsets.
- The P-VOL records updated by host-requested write I/Os after the pair was suspended (same function as for TrueCopy Synchronous pairs).

If a recordset is lost in transmission from the MCU to the RCU, the MCU's bitmap ensures that the missing recordset is marked. After the MCU sends the recordset to the RCU, the MCU does not remove the sidefile entry for the recordset from its cache until it receives an I/O completion signal (device end) from the RCU.

Table 2.10 describes the TrueCopy Asynchronous suspension conditions and indicates which CU detects the condition and which pairs are suspended. The TrueCopy offloading timer option (see section 4.3.1) and timeout group options (see section 4.3.3) are used to control the TrueCopy Asynchronous suspension conditions. See Table 8.4 in section 8.1 for troubleshooting information for TrueCopy Asynchronous suspension conditions.

Table 2.10 TrueCopy Asynchronous Suspension Conditions

Suspension Condition	Detected by:	TrueCopy Async Pairs to be Suspended
The MCU could not send a pending recordset to the RCU before the offloading timer async option expired.	MCU	All TrueCopy Async pairs with P-VOLs in the MCU
During MCU power-on, the MCU could not establish communication with the RCU before the Time Out (RCU Ready) group option expired.	MCU	All TrueCopy Async pairs with P-VOLs in the MCU
The RCU could not settle a pending recordset before the Time Out (Copy Pending) group option expired.	RCU	All TrueCopy Async S-VOLs in the consistency group
The RCU could not communicate with the MCU before the Time Out (Copy Pending) group option expired (see section 4.3.3).	RCU	All TrueCopy Async S-VOLs in the consistency group
The RCU could not receive the recordset successfully due to a hardware failure.	RCU	Only the affected S-VOL
The RCU detected a logical error while selecting the recordset to be settled.	RCU	All TrueCopy Async S-VOLs in the consistency group, or only the affected S-VOL, depending on the type of failure and the error level pair option
The RCU could not settle the recordset due to a hardware failure, track condition, or logical error.	RCU	

Chapter 3 Preparing for TrueCopy Operations

3.1 System Requirements

Hitachi TrueCopy™ operations involve the 9900V MCUs and RCUs containing the primary and secondary volumes, the remote copy connections between the MCUs and RCUs, the host(s) at the primary and remote sites, and the licensed TrueCopy remote console software.

Note: TrueCopy can coexist with TrueCopy - S/390® (all copy modes) in the same 9900V subsystem.

The TrueCopy system requirements are:

- **MCU:** Hitachi Lightning 9900™ V Series subsystem with TrueCopy installed. **Note:** For information on performing remote copy using the 9900 as an MCU, please refer to the *Hitachi Lightning 9900™ V Series TrueCopy User and Reference Guide* (MK-91RD051).
Note: For important information about proper configuration for your operational environment, refer to Appendix B.
- **RCU:** Hitachi Lightning 9900™ V Series subsystem with TrueCopy installed. **Note:** The 9900 subsystem can also be used as an RCU connected to a 9900V MCU. For assistance with mixed subsystem configurations, please contact your Hitachi Data Systems team.
Note: The 9900V subsystems may have additional installation requirements (e.g., SVP modes, DKC-F460I-8HSE). For information on SVP modes for TrueCopy, see Table 2.1.
- **Host platforms:** The 9900V subsystem supports TrueCopy operations for a variety of UNIX®-based and PC-server platforms, including the Sun™ Solaris™, IBM® AIX®, HP-UX®, Windows NT®, and Windows® 2000 platforms. Please contact your Hitachi Data Systems account team for the latest information on 9900V platform support for TrueCopy.
- **Remote copy connections - fibre channel:**
 - Multimode or single-mode optical fibre cables are required at both the MCU and RCU.
 - For distances from 0.5 km to 1.5 km (1,640 to 4,920 feet), multimode shortwave fibre-channel interface cables with up to two switches are required.
 - For distances from 10 km to 30 km (6.2 to 18.6 miles), single-mode longwave fibre-channel interface cables with up to two switches are required.
 - For distances greater than 30 km, approved third-party channel extender products and telecommunications lines are required.**Note:** All fibre-channel remote copy activities between two 9900V subsystems (i.e., TrueCopy Sync and Async, TrueCopy - S/390® Sync and Async) can share the same remote copy connections.

- **Remote copy connections - serial** (see section 3.3.2 for further information):
 - Multimode serial interface (ESCON®) cables are required at both the MCU and RCU.
 - For distances from 3 km to 43 km (1.9 to 26.7 miles), single-mode serial interface cables with IBM 9032 or 9033 ESCON® directors (ESCDs) and/or 9036 ESCON® repeaters are required.
 - For distances greater than 9 km (5.6 miles), the extended distance facility (XDF) provided by the ESCDs and/or ESCON® repeaters is required.
 - For distances greater than 43 km (26.7 miles), approved third-party channel extender products and telecommunications lines are required. Long-distance solutions are provided based on user requirements and workload characteristics.
Note: Usage of channel extenders may require additional 9900V configuration (e.g., SVP mode 21).
Note: All serial remote copy activities between two 9900V subsystems (i.e., TrueCopy Sync and Async, TrueCopy - S/390® Sync and Async) can share the same remote copy connections.
- **Storage Navigator Software and TrueCopy license code(s):**
 - The **9900V Hitachi Storage Navigator** remote console software is required for 9900V TrueCopy operations. The TrueCopy remote console software is a component of the 9900V Hitachi Storage Navigator product.
 - The **TrueCopy license key code(s)** are required to enable the TrueCopy option(s) on the 9900V subsystem (see section 3.4). Separate license codes are required for each 9900V subsystem.

Note: Administrator or TrueCopy write access to the 9900V Storage Navigator software is required to perform TrueCopy operations. Users without Administrator or TrueCopy write access can only view TrueCopy information.

Note: You must operate the 9900V Storage Navigator software in modify mode to perform TrueCopy operations. Users in view mode can only view TrueCopy information.

Note: TrueCopy support for dynamic disks is not available at this time under certain operating conditions. For information about dynamic disks, please contact your Hitachi Data Systems technical representative.

3.2 Requirements and Restrictions

Hitachi TrueCopy™ has the following requirements and restrictions:

- One-to-one volume copy operations
- Logical unit (LU) type (also called device emulation or type)
- Consistency groups
- Accessing TrueCopy P-VOLs and S-VOLs
- Cache and NVS
- Host failover software
- Duplicate volume
- Host system crash

3.2.1 One-to-One Volume Copy Operations

Hitachi TrueCopy requires a one-to-one relationship between the logical volumes of the volume pairs. A volume (LU) can only be assigned to one TrueCopy pair at a time. TrueCopy does not support operations in which one P-VOL is copied to more than one S-VOL, or more than one P-VOL is copied to one S-VOL. Because TrueCopy operates on logical volumes rather than on files, multivolume files require special attention. For complete duplication and recovery of a multivolume file (e.g., a large database file which spans several volumes), make sure that all volumes of the file are copied to TrueCopy S-VOLs, and use TrueCopy Asynchronous to ensure update sequence consistency across this group of S-VOLs.

3.2.2 Logical Unit (LU) Types

Hitachi TrueCopy supports the basic LU types which can be configured on the 9900V subsystem (e.g., OPEN-3, OPEN-E, OPEN-8, OPEN-9, OPEN-L, OPEN-V*). The TrueCopy software displays the LU type of the P-VOLs and S-VOLs. A TrueCopy pair must consist of LUs of the same type and capacity (e.g., OPEN-3 to OPEN-3). Multiplatform volumes (e.g., 3390-3A/B/C) cannot be assigned to TrueCopy pairs. **Note:** Please contact your Hitachi Data Systems account team for the latest information on supported devices for your platform.

***Note:** For serial-interface remote copy connections, OPEN-V is not supported.

TrueCopy supports the LUN Expansion (LUSE) feature of the 9900V, which allows you to configure expanded LUs using two or more contiguous LDEVs (up to 36). When LUSE volumes are assigned to a TrueCopy pair, the P-VOL and S-VOL must contain the same type and number of LDEVs (e.g., OPEN-3*6 to OPEN-3*6). The number of LDEV pairs in a TrueCopy LUSE pair equals the number of LDEVs in each LUSE volume. When the status of all LDEV pairs within one TrueCopy LUSE pair is not the same (e.g., one LDEV pair is suspended), the pair status of the TrueCopy LUSE pair changes to PDUB.

TrueCopy also supports the Virtual LVI/LUN feature, which allows you to configure custom-size LUs which are smaller than standard-size LUs. When custom-size LUs are assigned to a TrueCopy pair, the S-VOL must have the same capacity as the P-VOL.

3.2.3 Consistency Groups

The TrueCopy Asynchronous consistency groups have the following requirements:

- Each TrueCopy Async pair must be assigned to one and only one consistency group.
- The maximum number of volume pairs in one consistency group is 4096 (4095 when the CCI command device is defined).
- The maximum number of consistency groups established for one MCU-RCU pair is 128 (00-7F). The RCU supports a maximum of 128 groups. This limit includes both TrueCopy and TrueCopy - S/390® groups (e.g., 64 TrueCopy + 64 TrueCopy - S/390®).
- A TrueCopy consistency group must consist only of TrueCopy Asynchronous pairs (no TrueCopy Synchronous pairs).

3.2.4 Accessing TrueCopy P-VOLs and S-VOLs

To ensure maximum data integrity during normal TrueCopy operations, the RCU rejects all write operations issued by a host to a TrueCopy S-VOL. If you need write access to a TrueCopy S-VOL, you must split the pair using the S-VOL write option (see section 2.2.4). When you resume (resync) the split pair, the RCU will send the S-VOL cylinder/track bitmap to the MCU to ensure proper resynchronization of the pair.

3.2.5 Cache and Nonvolatile Storage (NVS)

Cache and nonvolatile storage (NVS) must be operable for both the MCU and RCU of a TrueCopy volume pair. If not, the TrueCopy paircreate operation will fail. The remote subsystem cache should be configured to adequately support the TrueCopy remote copy workloads as well as any local workload activity.

3.2.6 Host Failover Software

The 9900V Storage Navigator software product does not provide any host failover functions for disaster recovery. Host failover software is a critical component of any disaster recovery effort. When an MCU fails to maintain synchronization of a TrueCopy pair, the MCU generates sense information. It is very important that this information be transferred to the remote site via the host failover software for effective disaster recovery.

3.2.7 Duplicate Volumes

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

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

WARNING: If the TrueCopy S-VOLs are physically attached to the same host server(s) as the TrueCopy P-VOLs, the following problem can occur:

- When a TrueCopy pair is deleted, the old S-VOL is usually offline. If the host is then restarted, the system administrator may be offered both volumes and asked which volume should be left offline. This can be confusing and is prone to error.

If the TrueCopy S-VOLs and P-VOLs are connected to the same host(s), Hitachi Data Systems strongly recommends that the S-VOLs are defined to remain offline to avoid this problem.

3.2.8 Host System Crash

The contents of the P-VOL and S-VOL of a TrueCopy pair may become inconsistent if the host system hangs (crashes) while a write operation is being performed on the TrueCopy P-VOL, and the write operation cannot be retried because of the following reasons:

- A check condition is reported to the host due to a failure in the subsystem when the write command for the TrueCopy pair is issued.
- A reset command is issued from the host and the write operation is stopped (the write operation is incomplete).

If these conditions occur, you must retry the job to complete the write operation.

3.3 Installing the Hardware

Initial installation of the TrueCopy hardware is performed by the user and the Hitachi Data Systems representative. The hardware configurations for TrueCopy Synchronous and TrueCopy Asynchronous are the same.

To install the hardware required for TrueCopy operations:

1. **User:** Identify the locations of the TrueCopy primary and secondary volumes (P-VOLs and S-VOLs), so that the TrueCopy hardware can be installed and configured properly.
2. **Hitachi Data Systems Representative:** Make sure that the MCU(s) and RCU(s) are configured for 9900V Storage Navigator operations (e.g., SVP connected to LAN). Refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide* for information and instructions on setting up Storage Navigator operations.
3. **Hitachi Data Systems Representative:** Make sure that the MCUs and RCUs are properly configured for TrueCopy operations (e.g., cache, NVS) (see section 3.2.5). Make sure that the desired SVP modes are enabled (see Table 2.1). Make sure that adequate cache is installed and available for asynchronous operations (TrueCopy Asynchronous, XRC, CC). You must also consider the amount of FlashAccess data to be stored in cache when determining the required amount of cache.
4. **Hitachi Data Systems Representative:** Make sure the MCUs are configured to report sense information to the host(s). The RCUs should also be attached to a host server to enable reporting of sense information in case of a problem with an S-VOL or RCU. If the remote site is unattended, the RCUs should be attached to a host server at the primary site, so that the system administrator can monitor the operational condition of the RCUs.
5. **Hitachi Data Systems Representative:** If power sequence control cables are used, set the power select switch for the cluster to LOCAL to prevent the MCU from being powered off by the host. Also make sure the RCU will not be powered off during TrueCopy operations. See section 5.10 for further information on powering off/on the MCUs and RCUs.
6. **Hitachi Data Systems Representative:** For fibre-channel interface connections, install the fibre-channel adapter features (e.g., DKC-F460I-8HSE). For serial interface connections, install the serial port adapter features (e.g., DKC-F460I-8S serial 8-port adapter: pair of 4-port CHE cards, 1 card per cluster, provides eight ESCON® links). If the MCU and RCU are multiplatform subsystems, there may be available serial interfaces, and additional serial port adapter features may not be required. Please refer to the Installation section of the Maintenance Manual for further information.

Note: For the DKC-F460I-8HSE, you can set each port independently as an initiator or RCU Target port, enabling you to connect hosts and remote links randomly.

7. **Hitachi Data Systems Representative:** Install the TrueCopy remote copy connections between the MCU(s) and RCU(s). This hardware (optical fibre cables, switches, ESCON® cables, ESCON® directors, etc.) is supplied by the user. See sections 3.3.1-3.3.3 for remote copy configurations. Distribute the paths between different storage clusters and ESCDs or switches to provide maximum flexibility and availability. The logical paths between the MCU and RCU must be separate from the logical paths between the host and RCU. For fibre-channel and serial interface connections, all remote copy activities between two 9900V subsystems (i.e., TrueCopy Sync, TrueCopy Async, TrueCopy - S/390® Sync, and TrueCopy - S/390® Async) can share the same remote copy connections. See section 3.3.3 for information on using channel extenders.

3.3.1 Fibre-Channel Remote Copy Connections

Figure 3.1 shows the remote copy connection configurations for fibre-channel interface TrueCopy operations. The MCU and RCU of each TrueCopy pair must be connected via multimode shortwave or single-mode longwave optical fibre cables. If you use multimode shortwave optical fibre cables, fibre cables up to 1.5 km in length and up to two switches are required for distances greater than 0.5 km. If you use single-mode longwave optical fibre cables, fibre cables up to 30 km in length and up to two switches are required for distances greater than 10 km. TrueCopy operations can be performed at distances of up to 30 km (18.6 miles) using standard single-mode longwave support. Long-distance solutions are provided using approved channel extenders and communication lines.

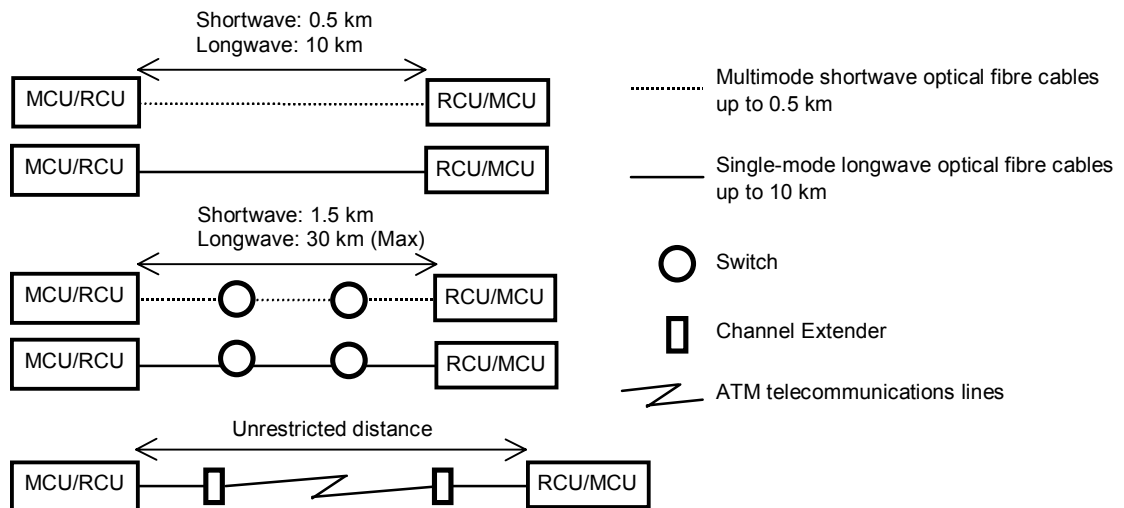
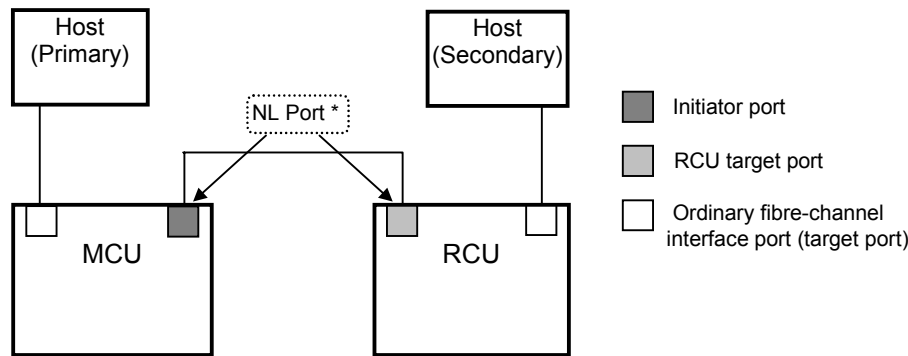


Figure 3.1 Fibre-Channel Remote Copy Connection Configurations

Note: For fibre-channel interface connections, you can use the switches as for ordinary switch connections, and no special settings are required for the 9900V subsystems.

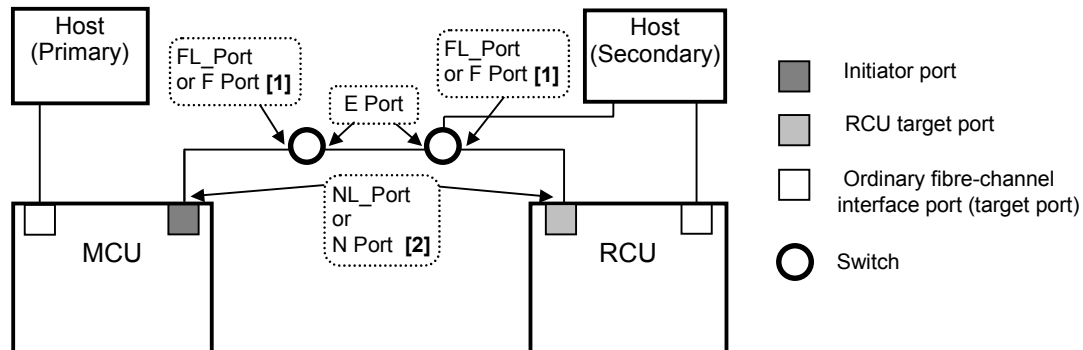
Fibre-channel interface connection provides three different configurations (see also the *Hitachi Lightning 9900™ V Series LUN Manager User's Guide*):

- **Direct connection** (see Figure 3.2): Two devices are connected directly together.
- **Switch connection** (see Figure 3.3): Up to three optical fibre cables are connected together via the switches to connect the devices. Up to two switches can be used.
- **Extender connection** (see Figure 3.4): Channel extenders and switches are used to connect the devices across large distances.



* To set ports, use LUN Manager and set port topology to: Fab off, FC-AL.

Figure 3.2 Fibre-Channel Interface Direct Connection (NL_Port)



1. Some switch vendors require F port (e.g., McData ED5000).

2. To set ports, use LUN Manager and set port topology to:

NL port: Fab on, FC-AL
N port: Fab on, Point-to-Point

Figure 3.3 Fibre-Channel Interface Switch Connection (NL_Port or N_Port)

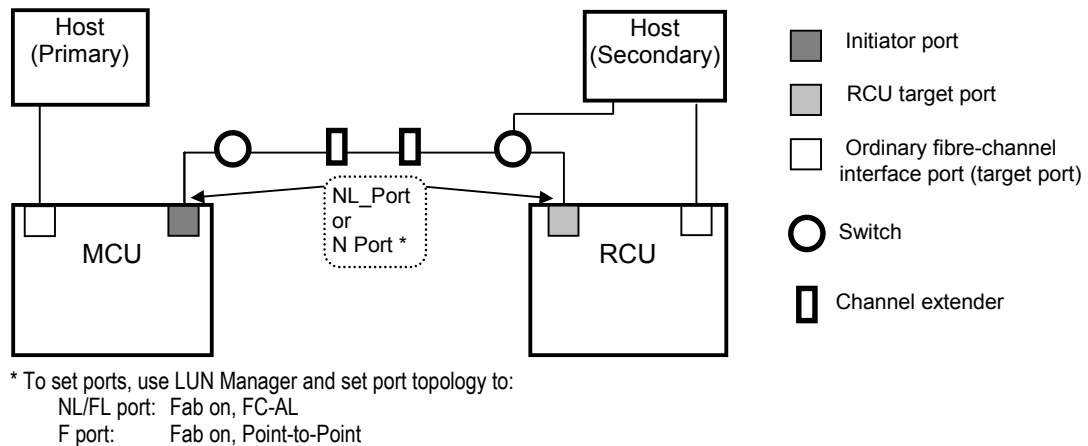


Figure 3.4 Fibre-Channel Interface Extender Connection

3.3.2 Serial Remote Copy Connections

Figure 3.5 shows the TrueCopy serial remote copy connection configurations. The MCU and RCU of each pair must be connected via multimode ESCON® cables. For distances greater than 3 km, single-mode cables up to 20 km in length and IBM 9032/9033 ESCDs and/or 9036 ESCON® repeaters are required. The IBM 9032/9033 ESCD supports the extended distance facility (XDF), which uses single-mode ESCON® cables up to 20 km. The IBM 9036 ESCON® repeater supports single-mode-to-single-mode connection or single-mode-to-multimode connection. When TrueCopy subsystems are more than 9 km apart, the XDF connections provided by the ESCDs or ESCON® repeaters are required. TrueCopy operations can be performed at distances of up to 43 km (26.7 miles) using standard ESCON® support. Long-distance solutions are provided using approved channel extenders and communication lines.

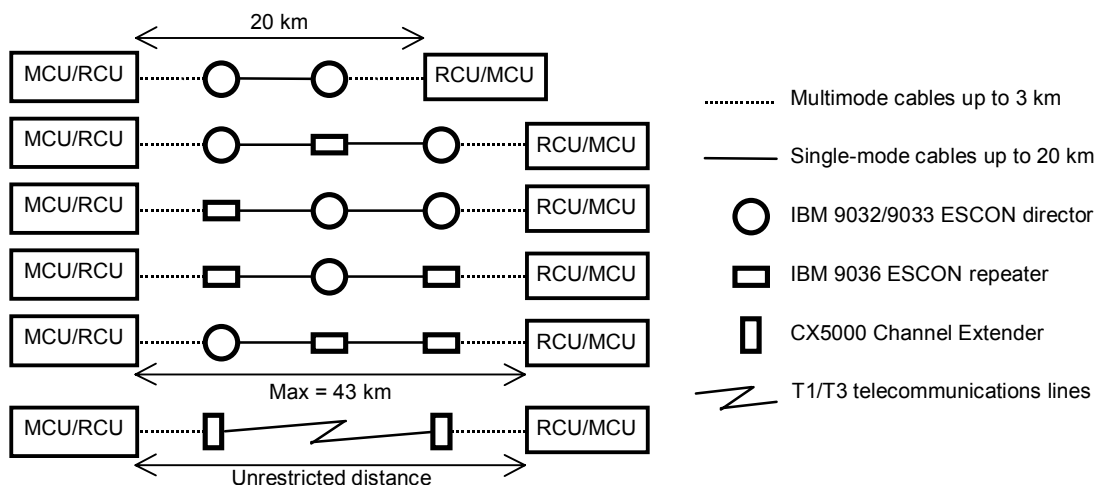


Figure 3.5 Serial Remote Copy Connection Configurations

Note: Please contact your Hitachi Data Systems account team for the latest information on the availability of serial-channel TrueCopy connections.

Dedicated ESCON® channels may be installed, or existing ESCON® channels connected by ESCDs may be used. The logical paths between the MCU and RCU must be separate from the logical paths between the host and RCU. **Note:** All remote copy activities between two 9900V subsystems (i.e., TrueCopy and TrueCopy - S/390®) can share the same remote copy connections.

The ESCDs can accommodate multiple MCU-RCU remote copy connections (see Figure 3.6). N-to-1 or 1-to-n remote copy connections ($n \leq 4$) can also be configured by using the dynamic switching capability of the ESCDs to share the physical interface cables between the components (see Figure 3.7). In addition, the ESCDs can accommodate channel-to-MCU and channel-to-RCU connections in addition to the remote copy connections (see Figure 3.8).

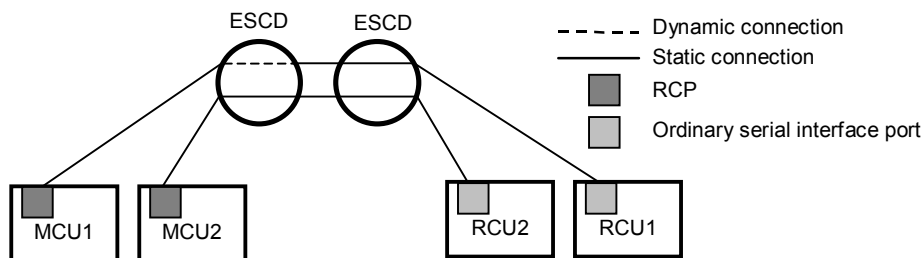


Figure 3.6 N Pairs of Remote Copy Connections

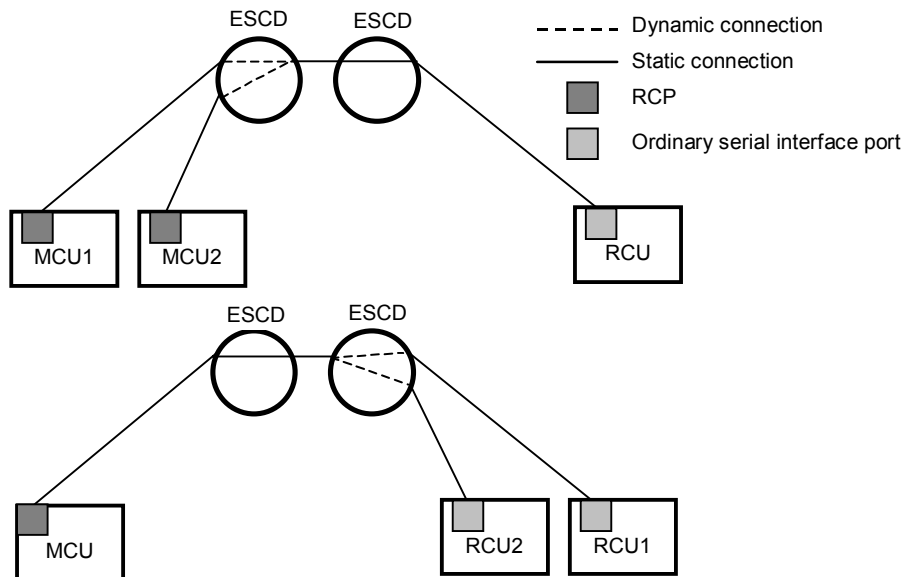


Figure 3.7 N-to-1 and 1-to-N Remote Copy Connections ($N \leq 4$)

Note: 1-to-n configurations (one main subsystem and multiple remote subsystems) are valid for TrueCopy Asynchronous, as long as a consistency group does not span remote subsystems.

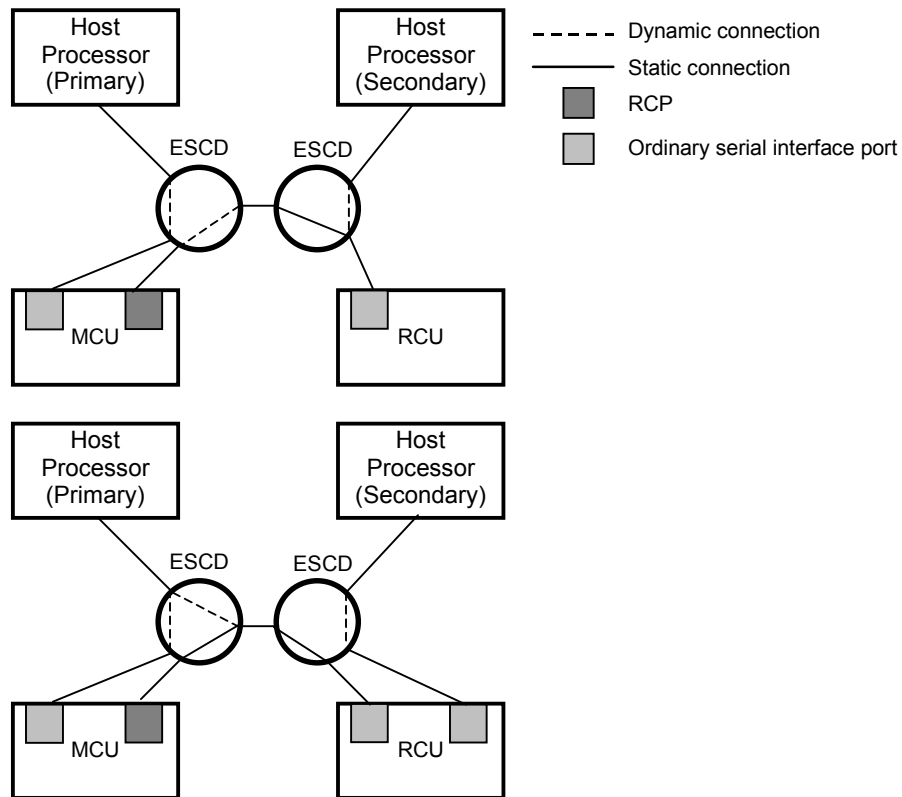


Figure 3.8 Remote Copy Connections Shared With Channel-to-RCU Connections

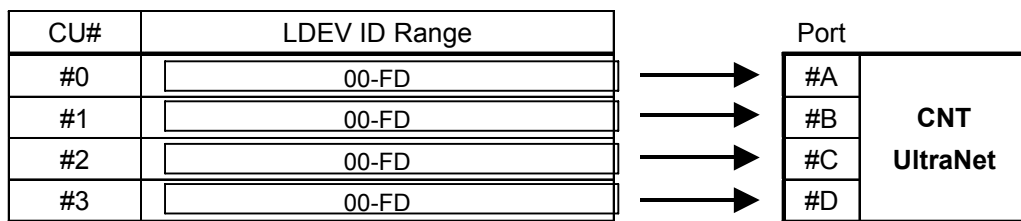
3.3.3 Channel Extenders For TrueCopy Serial

TrueCopy Asynchronous can be integrated with third-party channel extender products to provide remote data backup for distances greater than 43 km. The following information was current at the time of publication of this document, but may change. Please contact your Hitachi Data Systems account team for the latest information on channel extender support for TrueCopy.

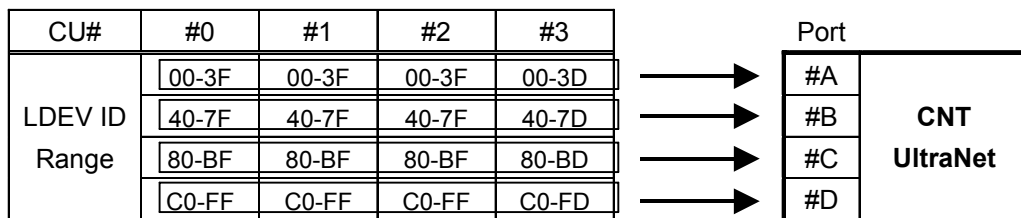
Note: For fibre-channel interface connections, you can use the switches as for ordinary switch connections, and no special settings are required for the 9900V subsystems.

- TrueCopy has been tested with the CNT UltraNet Storage Director:
 - UltraNet supports T3 and ATM (asynchronous transfer mode) communication lines.
 - UltraNet supports ATM OC-3 (optical carrier) levels. The transfer speed of OC-3 is a maximum of 155 Mb/s.
 - The transfer speed of T3 is a maximum of 44 Mb/s.

- The 9900V subsystems' serial numbers must be set on the channel extenders as follows. If the serial numbers are not set correctly, the paircreate operation will terminate with an error. For CNT UltraNet, this operation must be performed by the CNT representative.
 - Set the RCU serial number to the MCU-side extender.
 - Set the MCU serial number to the RCU-side extender.
 - Set the serial number on each CNT UltraNet port.
- Make sure that your channel extenders are capable of supporting the TrueCopy Asynchronous channel command. The parameter length and detailed specification of the TrueCopy Asynchronous channel command are different than for TrueCopy Synchronous RIOs.
- The LDEV IDs of the S-VOLs must be assigned on each port of the MCU-side extender. The maximum number of LDEVs which can be assigned on each port is 254. Figure 3.9 shows the required LDEV assignment on each extender port. If the LDEV IDs are not assigned properly, the TrueCopy paircreate operation will terminate with an error. For CNT UltraNet, this operation must also be performed by the CNT representative.



Example 1: Assigning the same LDEV IDs of a specific CU number to each port.



Example 2: Assigning specific LDEV IDs on each CU number to each port.

Figure 3.9 Assigning S-VOL LDEV IDs to the Channel Extender Ports

3.4 Enabling the TrueCopy Option(s)

You must enable the TrueCopy option(s) (Asynchronous and/or Synchronous) on the 9900V subsystems using the 9900V Storage Navigator remote console software. Each TrueCopy option requires a separate license key code, and each 9900V subsystem requires its own separate set of license key codes.

For instructions on using the 9900V Storage Navigator software and enabling the TrueCopy option(s), please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide* (MK-92RD101).

Note: When you use Storage Navigator on UNIX® workstations or in other non-Windows® environments, certain additional operating conventions must be followed. For details, refer to the *Hitachi Freedom Storage™ Lightning 9900™ V Series Remote Console - Storage Navigator™ User's Guide* (MK-92RD101).

Disabling TrueCopy

For information on disabling the TrueCopy options, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide*.

Caution: Before disabling a TrueCopy option, you must delete all affected pairs and MCU-RCU paths. Please see section 4.7 for instructions on discontinuing TrueCopy operations.

3.5 Configuring the MCUs and RCUs for TrueCopy Operations

After you have installed the TrueCopy hardware and software, you can configure the MCUs and RCUs for TrueCopy operations. The configuration depends on the interface type of the remote copy connections: fibre channel or serial.

3.5.1 Fibre-Channel Interface Configuration

To configure the MCUs and RCUs for TrueCopy fibre-channel operations:

1. Identify the volumes that will become the TrueCopy P-VOLs and S-VOLs. You need to know the subsystem S/N, SSID, and CU image of each TrueCopy volume, so that you can configure the MCUs and RCUs correctly for your desired pairs and async groups. When you create the pairs, you will need to know the port, target ID, and LUN of each volume.
2. At the RCUs (i.e., remote site), use the TrueCopy remote console software to configure the fibre-channel ports which are connected to the MCUs as RCU target ports (see Figure 3.10) (see section 4.2.1 for instructions).
3. At the main site, connect to and log in to the 9900V subsystem that you want to configure as a TrueCopy MCU. You must log in with Administrator or TrueCopy write access, and you must be in modify mode.
4. Select the **TrueCopy** button () to display the TrueCopy main panel.
5. Configure the fibre-channel ports which are connected to the RCUs as initiator ports (see Figure 3.10) (see section 4.2.1 for instructions).
6. Add the desired RCU(s) to each MCU CU image, and set the desired RCU options using the Add RCU panel (see Figure 3.11) and RCU Option panel (see Figure 3.12) (see section 4.2.2 for instructions). Enter the following information on the Add RCU panel:

RCU S/N = serial number of the RCU

Controller ID = For fibre-channel, the controller ID must be 03 (02 for 9900 RCU).

Logical Adr. (RCU CU #) = RCU CU image number (00-1F)

SSID = maximum of four SSIDs per CU image with 64 LDEVs per SSID. **Note:** If only one SSID is specified, there are 256 LDEVs per SSID.

MCU-RCU path = physical port numbers (1A-2R, 3a-4r) for each path (initiator port-to RCU target port)

7. If you plan to create TrueCopy Asynchronous pairs with P-VOLs in this MCU, configure the Async options (see Figure 3.13) (see section 4.3.1 for instructions), and add the desired consistency group(s) to the MCU (see Figure 3.14) (see section 4.3.2 for instructions).
8. When you are finished configuring this MCU, exit the TrueCopy remote console software, and disconnect from the subsystem.
9. Repeat steps (3)-(8) for each subsystem which will function as a TrueCopy MCU. After you have configured the MCUs, added the RCUs, and configured the TrueCopy Async options and consistency groups, you are ready to begin TrueCopy pair operations.

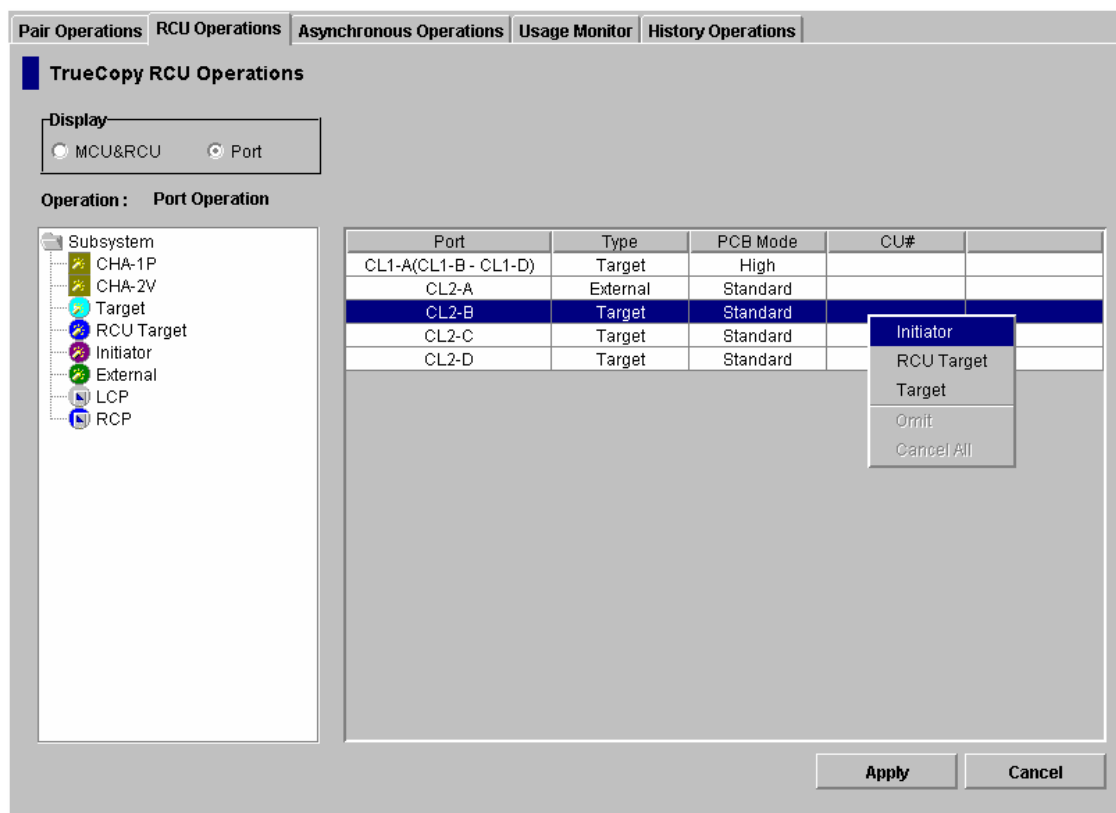
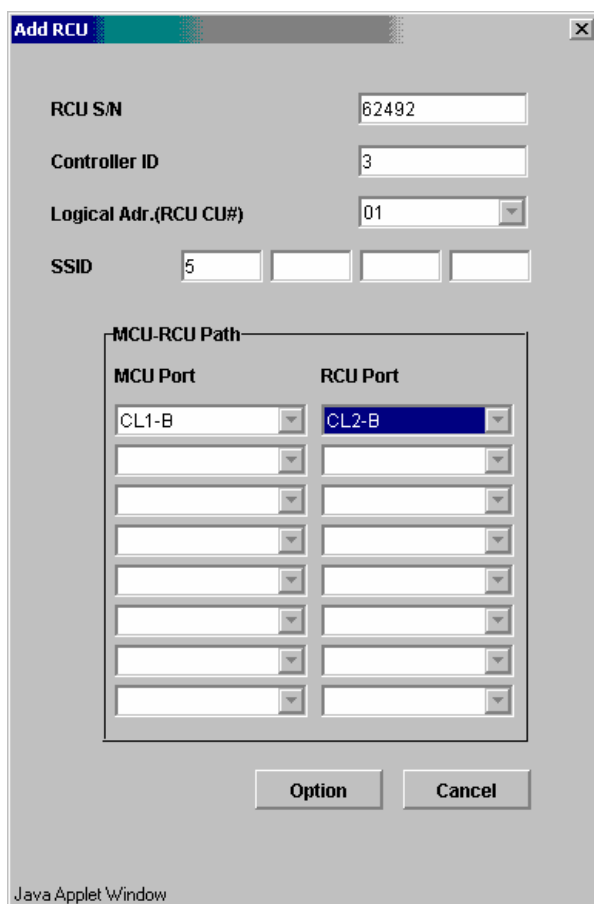


Figure 3.10 Configuring the RCU Target and Initiator Ports



Add RCU

RCU S/N: 62492

Controller ID: 3

Logical Adr.(RCU CU#): 01

SSID: 5

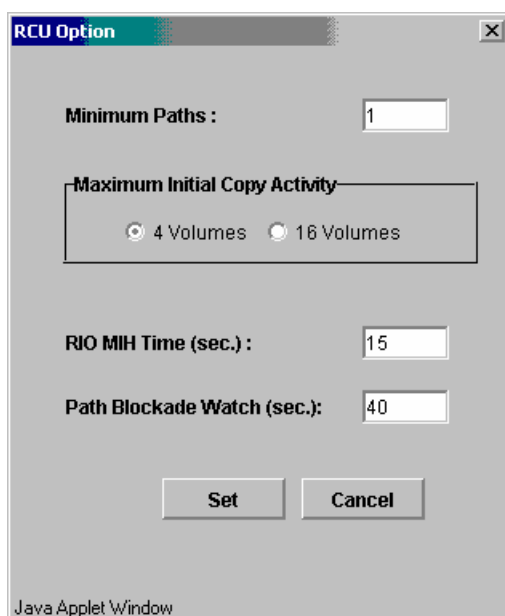
MCU-RCU Path

MCU Port	RCU Port
CL1-B	CL2-B

Option Cancel

Java Applet Window

Figure 3.11 Adding the RCUs



RCU Option

Minimum Paths : 1

Maximum Initial Copy Activity

☒ 4 Volumes ☐ 16 Volumes

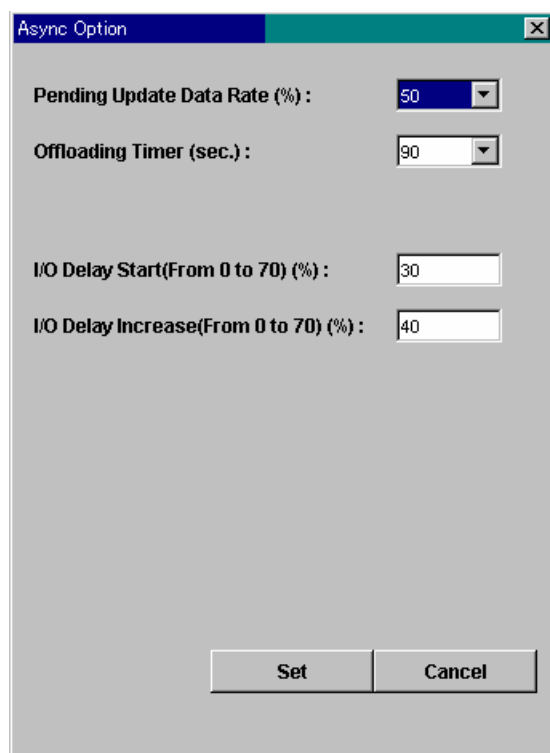
RIO MIH Time (sec.): 15

Path Blockade Watch (sec.): 40

Set Cancel

Java Applet Window

Figure 3.12 Configuring the RCU Options

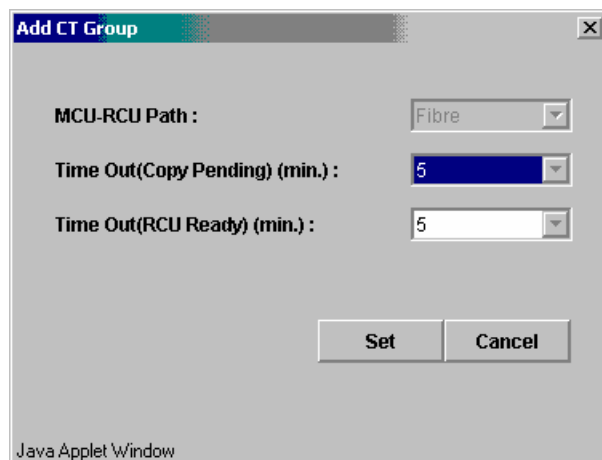


The 'Async Option' dialog box contains the following settings:

Parameter	Value
Pending Update Data Rate (%) :	50
Offloading Timer (sec.) :	90
I/O Delay Start(From 0 to 70) (%) :	30
I/O Delay Increase(From 0 to 70) (%) :	40

Buttons: Set, Cancel

Figure 3.13 Setting the Async Options



The 'Add CT Group' dialog box contains the following settings:

Parameter	Value
MCU-RCU Path :	Fibre
Time Out(Copy Pending) (min.) :	5
Time Out(RCU Ready) (min.) :	5

Buttons: Set, Cancel

Java Applet Window

Figure 3.14 Adding the Consistency Groups

3.5.2 Serial-Channel Interface Configuration

To configure the MCUs and RCUs for TrueCopy serial-channel operations:

1. Identify the volumes that will become the TrueCopy P-VOLs and S-VOLs. You need to know the subsystem S/N, SSID, and CU image of each TrueCopy volume, so that you can configure the MCUs and RCUs correctly for your desired pairs and async groups. When you create the pairs, you will need to know the port, target ID, and LUN of each volume.
2. At the main site, connect to and log in to the 9900V subsystem that you want to configure as a TrueCopy MCU. You must log in with Administrator or TrueCopy write access, and you must be in modify mode.
3. Select the **TrueCopy** button () to display the TrueCopy main panel.
4. Configure the serial-channel ports which are connected to the RCUs as RCPs (see section 4.2.1 for instructions).
5. Add the desired RCU(s) to each MCU CU image, and set the desired RCU options using the Add RCU panel and RCU Option panel (see section 4.2.2 for instructions). Enter the following information on the Add RCU panel:

RCU S/N = serial number of the RCU

Link Address = destination port address on the ESCD (00 for static link to RCU)

Logical Adr. (RCU CU #) = RCU CU image number (00-1F)

SSID = maximum of four SSIDs per CU image with 64 LDEVs per SSID. **Note:** If only one SSID is specified, there are 256 LDEVs per SSID.

MCU-RCU path = physical port numbers (1A-2R, 3a-4r) for each path (RCP-to-LCP).

6. If you plan to create TrueCopy Asynchronous pairs with P-VOLs in this MCU, configure the Async options (see section 4.3.1 for instructions), and add the desired consistency group(s) to the MCU (see section 4.3.2 for instructions).
7. When you are finished configuring this MCU, exit the TrueCopy remote console software, and disconnect from the subsystem.
8. Repeat steps (3)-(7) for each subsystem which will function as a TrueCopy MCU. After you have configured the MCUs, added the RCUs, and configured the TrueCopy Async options and consistency groups, you are ready to begin TrueCopy pair operations.

3.6 Combining TrueCopy with Other Data Management Operations

TrueCopy supports concurrent operations with the following data management functions:

- **LUN Expansion (LUSE).** LUSE volumes can be assigned to TrueCopy pairs, provided that the P-VOL and S-VOL have the same LU type and the same number of LDEVs. If you need to perform LUSE operations on an existing TrueCopy P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.
- **Virtual LVI/LUN.** Virtual LVI/LUN volumes can be assigned to TrueCopy pairs, provided that the S-VOL has the same capacity than the P-VOL. If you need to perform Virtual LVI/LUN operations on an existing TrueCopy P-VOL or S-VOL, you must delete the pair first to return the volume to SMPL status.
- **FlashAccess.** FlashAccess volumes can be assigned to TrueCopy pairs, and FlashAccess operations can be performed on TrueCopy P-VOLs and S-VOLs.
- **Hitachi SANTinel.** Hitachi SANTinel operations do not affect TrueCopy operations. Volumes which are under secure ports and/or which are assigned to World Wide Name (WWN) groups and/or LUN groups can also be assigned to TrueCopy pairs. Volumes which are assigned to TrueCopy pairs can also be assigned to secure ports, WWN groups, and/or LUN groups for Hitachi SANTinel. **Note:** TrueCopy S-VOLs cannot be accessed by any UNIX®/PC server host except when the pair is split.
- **ShadowImage.** ShadowImage volumes can be assigned to TrueCopy pairs, and TrueCopy volumes can be assigned to ShadowImage pairs. See section 3.6.1 for information on TrueCopy and ShadowImage shared volume configurations.
Note: ShadowImage is recommended for intra-subsystem copy operations. If ShadowImage is not installed, TrueCopy (Synchronous only) can be used to copy within the same 9900V subsystem. This configuration requires at least one external fibre cable or ESCON® loop.
- **Priority Access.** The initiator ports in the MCU do not support the Priority Access option.
- **Graph-Track.** The Hitachi Graph-Track (GT) software product provides detailed information on the I/O activity and hardware performance of the Hitachi Freedom Storage™ subsystems (9900V, 9900, 7700E, 7700). Graph-Track data collection does not affect 9900V subsystem operations in any way. For further information on Hitachi Graph-Track, please refer to the *Hitachi Graph-Track User's Guide* (MK-90RD032).
- **NAS Blade.** TrueCopy supports the 9900V NAS Blade feature. See Chapter 7 for information on TrueCopy operations with NAS Blade.

Note: When TrueCopy and TrueCopy - S/390® coexist in the same 9900V subsystem, each consistency group must contain either TrueCopy Async pairs or TrueCopy - S/390® Async pairs (not both), and TrueCopy and TrueCopy - S/390® share the same cache sidefile area.

3.6.1 Combining TrueCopy and ShadowImage

Hitachi TrueCopy and ShadowImage can be used together in the same subsystem and on the same volumes to provide multiple copies of data at the primary and/or remote sites. Table 3.1 describes the host pair status reporting for TrueCopy volumes, ShadowImage volumes, and TrueCopy/ShadowImage shared volumes. Table 3.2 shows the currency of the data on a shared TrueCopy/ShadowImage volume based on TrueCopy and ShadowImage pair status.

- For shared TrueCopy/ShadowImage volumes, the TrueCopy pair status is reported to the host if you query the TrueCopy P-VOL or S-VOL. To obtain the ShadowImage pair status, query the P-VOL of the ShadowImage pair.
- ShadowImage supports multiple S-VOLs for each P-VOL. If you issue a pair status query to a ShadowImage P-VOL (e.g., pairdisplay), the status for only one ShadowImage pair is reported (the pair with the S-VOL with the lowest LDEV ID). To obtain the pair status for the ShadowImage pair(s) with the other S-VOL(s), you must direct the host query to the specific S-VOL using the S-VOL's LDEV ID in the host command. The ShadowImage remote console software displays the LDEV ID and ShadowImage pair status of all S-VOLs associated with a P-VOL.

Table 3.1 Host Pair Status Reporting for TrueCopy/ShadowImage Shared Volumes

Number of TrueCopy Pairs	Number of ShadowImage S-VOLs	Pair Status Reported by 9900V
0	0	Simplex
0	1	ShadowImage pair status
0	2 or more	ShadowImage pair status for the pair whose S-VOL has the lowest LDEV ID
1	0	TrueCopy pair status
1	1	TrueCopy pair status
1	2 or more	TrueCopy pair status

Table 3.2 Data Currency of a Shared TrueCopy/ShadowImage Volume

TrueCopy Pair Status	ShadowImage Pair Status					
	COPY (PD)	PAIR	COPY(SP)	PSUS	COPY(RS/RS-R)	PSUE
COPY	Not current	Not current	Not current	CURRENT	Not current	Not current
PAIR	Not current	Not current	Not current	CURRENT	Not current	Not current
PSUS/PSUE	Not current	CURRENT	CURRENT	CURRENT	CURRENT	Not current

Figure 3.15 through Figure 3.18 show the various TrueCopy/ShadowImage configurations which share volumes. TrueCopy supports synchronous and asynchronous operations for shared TrueCopy/ShadowImage volumes.

- Figure 3.15 shows an example of a TrueCopy P-VOL which is also functioning as a ShadowImage P-VOL. This configuration allows you to use ShadowImage for on-site data backup in case of a TrueCopy failure, and to use TrueCopy to provide remote backup of the ShadowImage P-VOL in case of a ShadowImage failure.
- Figure 3.16 shows an example of a TrueCopy S-VOL which is also functioning as a ShadowImage P-VOL. This configuration allows you to use ShadowImage to provide multiple backup copies of a single TrueCopy P-VOL.
- Figure 3.17 combines the configurations shown in Figure 3.15 and Figure 3.16. Within a single TrueCopy pair, the P-VOL and S-VOL are both functioning as ShadowImage P-VOLs, providing multiple copies at the primary and remote sites.
- Figure 3.18 shows an example of a ShadowImage S-VOL which is also used as a TrueCopy P-VOL. **Caution:** This configuration requires that the ShadowImage pair be established in duplex mode (PAIR) and then split (PSUS) before the TrueCopy pair is created.

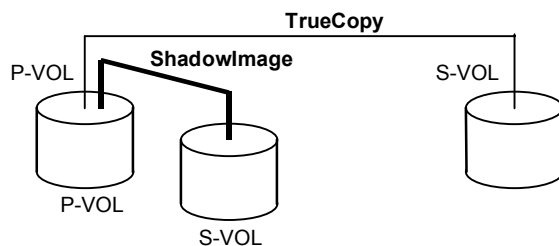


Figure 3.15 Shared TrueCopy P-VOL/ShadowImage P-VOL

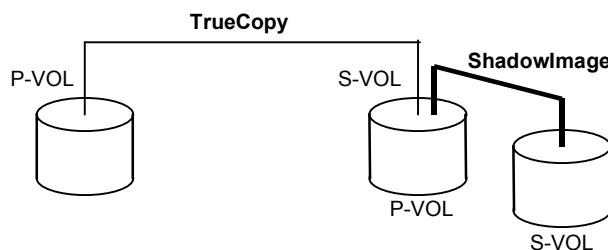


Figure 3.16 Shared TrueCopy S-VOL/ShadowImage P-VOL

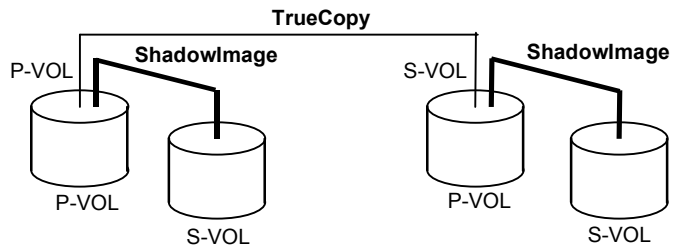


Figure 3.17 Shared TrueCopy/ShadowImage P-VOL with Shared TrueCopy S-VOL/ShadowImage P-VOL

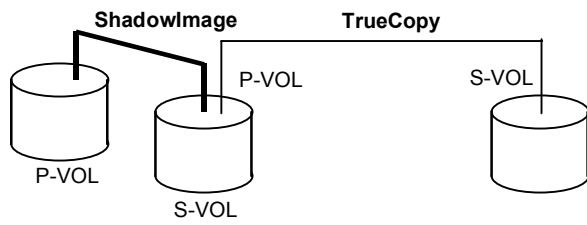


Figure 3.18 Shared ShadowImage S-VOL/TrueCopy P-VOL

Chapter 4 Performing TrueCopy Configuration Operations

The TrueCopy main panel and its five tabs (see section 4.1) provide access to all TrueCopy operations: pair operations, RCU operations, Asynchronous operations, usage monitor, and history operations. The TrueCopy configuration operations include RCU operations, Asynchronous operations, usage monitor, and history operations. The TrueCopy pair operations are described in Chapter 5.

RCU operations. The RCU operations (see section 4.2) configure the RCUs for TrueCopy operations:

- Configuring the 9900V host interface ports for MCU-RCU connection,
- Adding an RCU,
- Setting the RCU options,
- Adding/deleting logical paths to an RCU,
- Adding/deleting SSIDs for an RCU,
- Viewing RCU status, and
- Deleting an RCU.

Asynchronous operations. The Asynchronous operations (see section 4.3) configure the TrueCopy Asynchronous consistency groups and options:

- Setting the async options,
- Adding consistency groups,
- Viewing consistency group status,
- Changing the consistency group options,
- Changing the async options, and
- Deleting consistency groups.

Usage Monitor operations. The usage monitor operations (see section 4.4) enable you to collect the I/O statistics for the LDEVs on the 9900V subsystem.

History Operations. The history operations (see section 4.5) enable you to export the remote copy history file.

Optimizing TrueCopy operations. Section 4.6 provides information on optimizing TrueCopy operations and 9900V subsystem performance by selecting the appropriate TrueCopy settings and options for your operational environment and also by addressing conditions which can affect subsystem performance.

Discontinuing TrueCopy operations. Section 4.7 provides information on discontinuing TrueCopy operations. When you want to discontinue TrueCopy operations, you must perform the required operations (e.g., pair deletion, RCU deletion, port reconfiguration, etc.) in a specific order to ensure smooth operations and avoid command rejects and error conditions.

4.1 TrueCopy Main Panel

The TrueCopy main panel (see Figure 4.1) displays the TrueCopy information for the connected subsystem and provides access to all TrueCopy functions and operations. To open the TrueCopy main panel:

1. Using the 9900V Storage Navigator software, connect to and log on to the desired 9900V subsystem with Administrator access or TrueCopy write access.
2. On the Storage Navigator main panel, select modify mode to perform TrueCopy operations. Users in view mode can only view TrueCopy information.
3. Select the TrueCopy button  to open the TrueCopy main panel.

Note: For information and instructions on using the 9900V Storage Navigator Java™ applet program, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide (MK-92RD101)*.

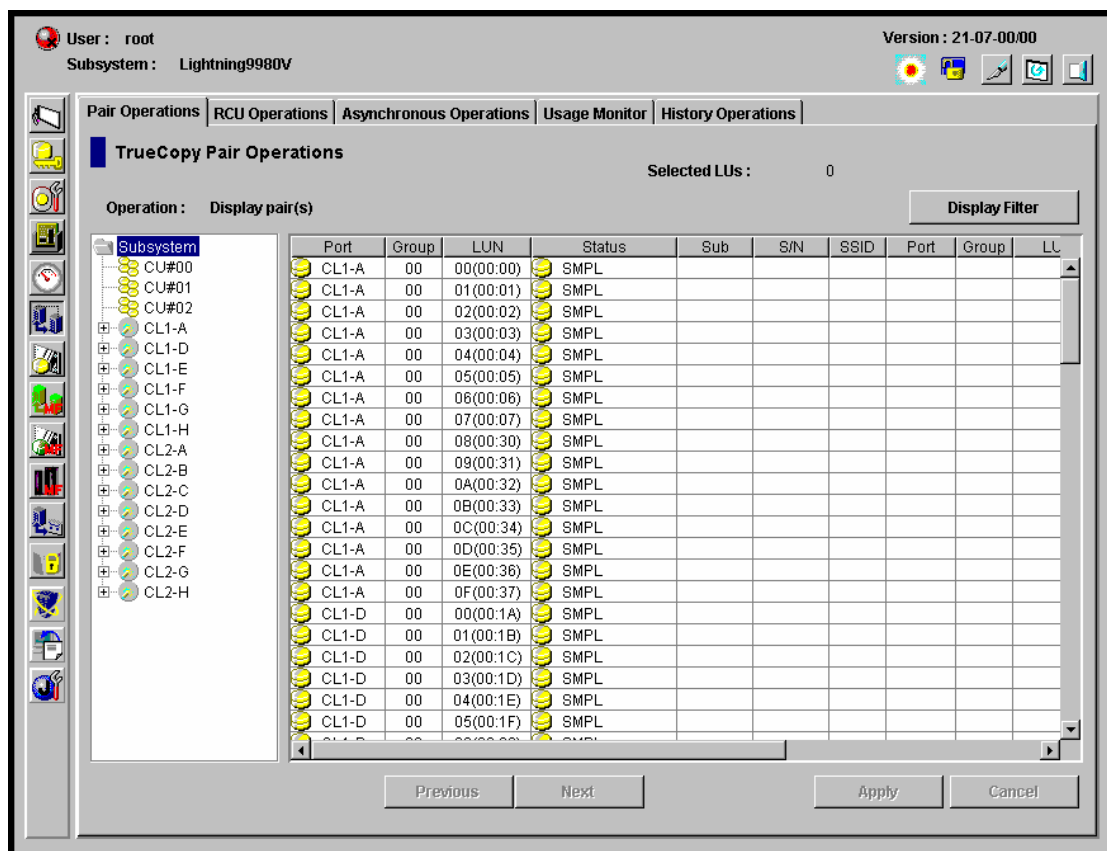


Figure 4.1 TrueCopy Main Panel

The TrueCopy main panel presents five main tabs: **Pair Operations**, **RCU Operations**, **Asynchronous Operations**, **Usage Monitor**, and **History Operations**. Table 4.1 shows the operations available for each tab. To start the operations that you set on each TrueCopy function tab, use the **Apply** button at the lower right of the TrueCopy panel.

Table 4.1 TrueCopy Functions

Tab	Menu Command	Description
Pair Operations (see Chapter 5)	Pairstatus	Displays CU information, path information, pair status, and options for TrueCopy pairs. Note: Monitoring LDEV status is not supported.
	Paircreate → Synchronous	Allows you to create new TrueCopy Synchronous pairs
	Paircreate → Asynchronous	Allows you to create new TrueCopy Asynchronous pairs
	Pairsplit - S	Allows you to delete TrueCopy pairs
	Pairsplit - r	Allows you to split or suspend TrueCopy pairs
	Pairresync	Allows you to resume TrueCopy pairs which are split or suspended
	Change Pair Option	Allows you to change the TrueCopy pair options
	Snapshot	Allows you to write the TrueCopy pair status information to a text file
RCU Operations (see section 4.2)	RCU Status	Displays the RCU status and path status for an RCU
	RCU Operation → Add RCU	Allows you to add an RCU to the connected subsystem
	RCU Operation → Delete RCU	Allows you to delete an RCU
	RCU Operation → Change RCU Option	Allows you to change the RCU options
	Edit SSID(s) & Path(s) → Add Path	Allows you to add paths to existing RCUs
	Edit SSID(s) & Path(s) → Delete Path	Allows you to delete paths for existing RCUs
	Edit SSID(s) & Path(s) → Add SSID	Allows you to add SSIDs to existing RCUs
	Edit SSID(s) & Path(s) → Delete SSID	Allows you to delete SSIDs from existing RCUs
	Port	Allows you to change the port types for the connected subsystem
Asynchronous Operations (see section 4.3)	CT Group Operation → CT Group Status	Displays status information for existing consistency groups
	CT Group Operation → Add CT Group	Allows you to assign the consistency groups to the CUs
	CT Group Operation → CT Group Option	Allows you to change the consistency group options
	CT Group Operation → Delete CT Group	Allows you to delete consistency groups
	Async Option	Allows you to change the Async options
Usage Monitor (see section 4.4)	—	Allows you to collect, view, and export I/O statistics using the Remote Copy Monitoring function
History Operations (see section 4.5)	—	Allows you to view and export the operation history of the TrueCopy volume pairs

Note: The scripting function is not supported for this version.

4.1.1 Pair Operations Tab

Please see section 5.2 for detailed information on the **Pair Operations** tab.

4.1.2 RCU Operations Tab

The **RCU Operations** tab (see Figure 4.2) displays the MCU/RCU and port information and allows you to perform the TrueCopy RCU and port configuration operations (see section 4.2).

To update the information on the **RCU Operations** tab, select another tab and then reselect the **RCU Operations** tab, or select the **Refresh** button (🔄) (top right of Storage Navigator panel). The MCU/RCU or port information is also updated when you select the **Apply** button.

CU#	Type	S/N	SSID	Paired CU#	M-R Path	Status	Num. of Path
00	RCU	62492	0004	00	Fibre	Normal	02
00	RCU	62492	0005	01	Fibre	Normal	01
00	RCU	62492	0006	02	Fibre	Normal	01
00	RCU	62492	0007	03	Fibre	Warning	02
01	RCU	62492	0005	01	Fibre	Normal	01
0D	RCU	62492	0011	0D	Fibre	Normal	01
0D	RCU	62492	0013	0F	Fibre	Normal	01
0D	MCU	62492	0011	0D			
1F	RCU	62492	0023	1F	Fibre	Normal	01
1F	RCU	62492	0022	1E	Fibre	Normal	01

Figure 4.2 RCU Operations Tab

The **RCU Operations** tab presents:

- **Display buttons:** allows you to select either **MCU&RCU** display (default) or **Port** display for the **RCU Operations** tab.
- **Operation:** indicates the current operation performed on the **RCU Operations** tab.
- **MCU&RCU display:**
 - **Outline view:** displays the CU images of the connected subsystem. Select the subsystem to display all MCU/RCU information. Select and double-click on the desired CU image to display the MCU/RCU information for that CU image. Select the desired RCU to display the SSID and path information for that RCU. You can only select one CU image or one RCU at a time.
 - **List view:** displays the detailed MCU/RCU information (see section 4.1.2.1) for the subsystem (when selected), for the selected CU image, or for the selected RCU. The MCU/RCU information can be sorted by column and in ascending or descending order. For CU images with more than one MCU-RCU path, each path is displayed in a separate row.
- **Port display:**
 - **Outline view:** displays the channel adapters (CHAs) and port types of the connected subsystem. Select the subsystem to display all CHA/port information. Select the desired channel adapter or port type to display the port information for that adapter/port type. You can only select one CHA or port type at a time.
 - **List view:** displays the detailed port information (see section 4.1.2.2) for the subsystem (if selected) or for the selected channel adapter or port type. The port information can be sorted by column and in ascending or descending order.

4.1.2.1 MCU&RCU Display on the RCU Operations Tab

When the **MCU&RCU** button is selected in the **Display** box, the **RCU Operations** tab displays the CU images in the outline view and the MCU/RCU information in the list view. Only CU images which include active MCUs or RCUs are displayed. When an MCU-RCU path fails, the TrueCopy software displays an error icon () for the affected CU image.

Select the subsystem to display all MCU/RCU information (refer to Figure 4.2).

Select the desired CU image to display the MCU/RCU information for that CU image (see Figure 4.3). You can select only one CU image at a time. The MCU/RCU information includes:

- **CU#:** CU number which is selected on the tree view
- **Type:** MCU or RCU
- **S/N and SSID:** Serial number and SSID of the other CU of the pair
- **Paired CU#:** CU number of the other CU of the pair
- **M-R Path:** Path channel type (fibre or serial) between the other CU of the pair
- **Status:** Normal indicates no path failure to the RCU. Failed indicates a failed path to the RCU. This column is blank when the connected CU is an RCU.
- **Num. of Path:** Number of paths (blank when the connected CU is an RCU)

Double-click on the selected CU image to display the RCU information for that CU image (see Figure 4.4). The RCU serial number and CU number are displayed next to the RCU icon. You can also double-click on an RCU to display the SSID and path information for that RCU in the list view (also shown in Figure 4.4). The RCU SSID and path information includes:

- **Item:** SSID or path
- **SSID:** SSID of the other CU of the pair
- **M-R Path:** Path channel type (fibre or serial) between MCU and RCU (blank when the target CU is the MCU)
- **Status:** Status of the path
- **MCU Port:** Port number on the MCU side
- **RCU Port:** Port number on the RCU side, when M-R path is fibre
- **Link Adr:** Link address, when M-R path is serial

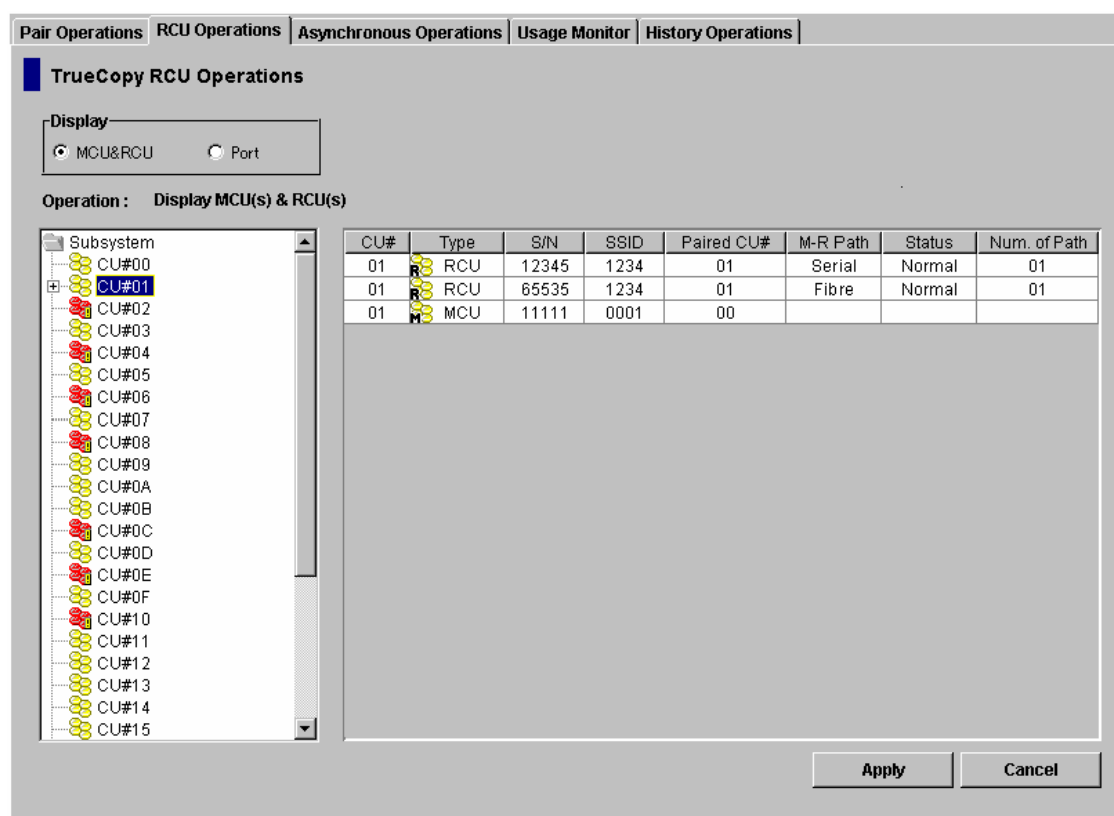


Figure 4.3 MCU&RCU Display on the RCU Operations Tab Showing CU List

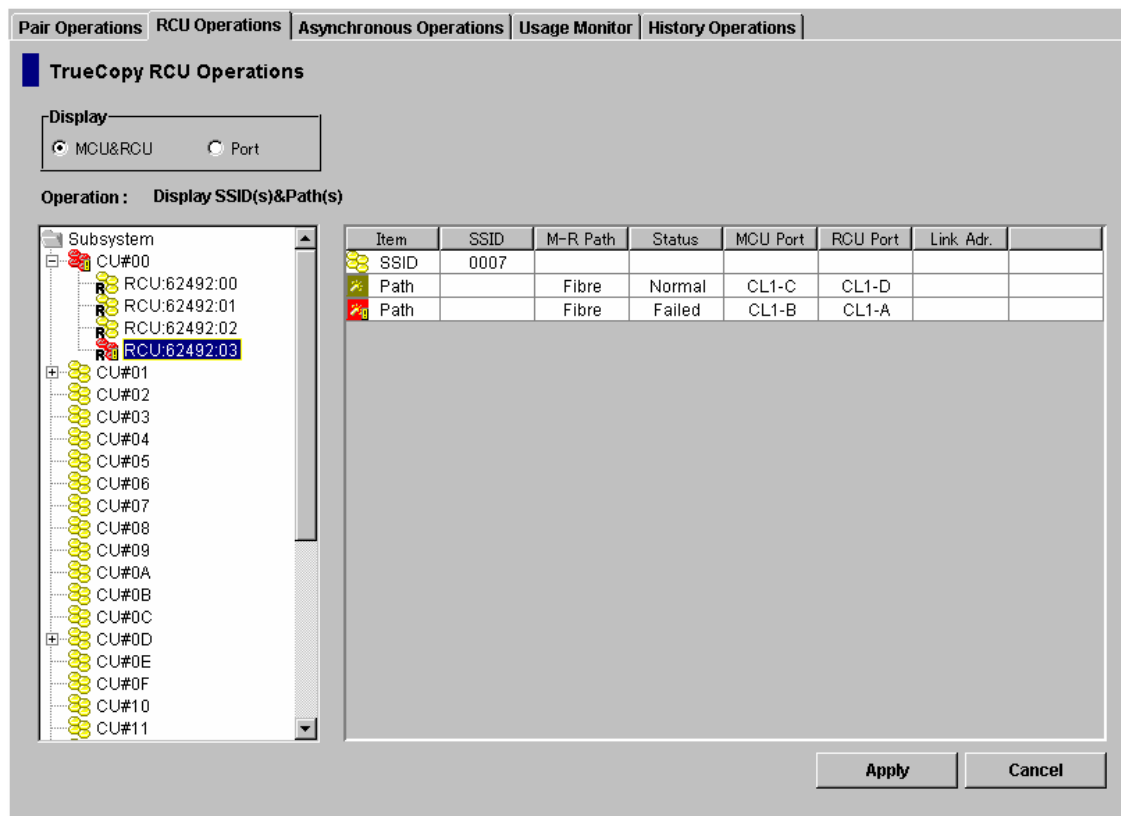


Figure 4.4 MCU&RCU Display on the RCU Operations Tab Showing RCU List

4.1.2.2 Port Display on the RCU Operations Tab

When the **Port** button is selected in the **Display** box, the **RCU Operations** tab displays the channel adapters (fibre: , serial: ) and port types (Target: , RCU Target: , Initiator: , External: , LCP: , RCP: ) in the outline view and port information in the list view. Only ports which can be selected for remote copy operations are displayed.

Select the subsystem to display all port information. Select the desired channel adapter to display the port information for that adapter (see Figure 4.5). Select the desired port type to display the port information for that port type. You can select only one channel adapter or port type at a time. The port information includes:

- **Port:** Cluster and port number (1A-4r) (e.g., CL1-A)
- **Type:** Port type: initiator, target, RCU target, External, RCP, or LCP
- **PCB Mode:** Speed mode of the (fibre-channel) port: standard, high speed, or high speed (2port)
- **CU#:** Range of CU images (00-0F or 10-1F), displayed only for serial ports

The port information in each row depends on the type of 9900V channel adapter:

- 1 port per row (standard speed) (DKC-F460I-8HSE, -8HLE, -8HSF, -8HLF) (see Figure 4.5)
- 2 ports per row (standard speed) (DKC-F460I-16HSF) (see Figure 4.6)
- 2 ports per row (high speed (2port)) (DKC-F460I-8HSE, -8HLE, -8HSF, -8HLF)(see Figure 4.7)
- 4 ports per row (high speed) (DKC-F460I-8HSE, -8HLE, -8HSF, -8HLF) (see Figure 4.8)

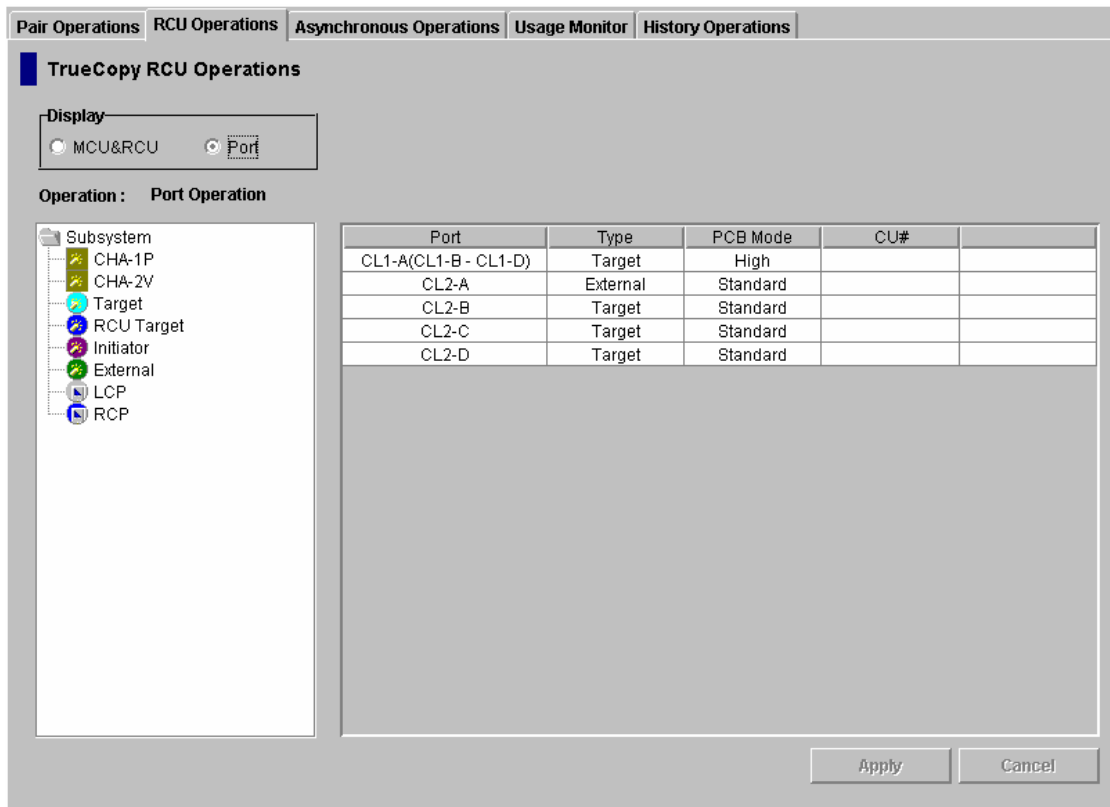


Figure 4.5 Port Display on RCU Operations Tab (standard-speed, one port per row)

Port	Type	PCB Mode	CU#	
CL2-E,CL2-F	Initiator	Standard		
CL2-G,CL2-H	RCU Target	Standard		

Figure 4.6 Port Display on RCU Operations Tab (standard-speed, two ports per row)

Port	Type	PCB Mode	CU#	
CL1-E(CL1-F)	Target	High(2Port)		

Figure 4.7 Port Display on RCU Operation Tab (high-speed (2port)), two ports per row)

Port	Type	PCB Mode	CU#	
CL1-E(CL1-F - CL1-H)	Initiator	High		

Figure 4.8 Port Display on RCU Operations Tab (high-speed, four ports per row)

4.1.3 Asynchronous Operations Tab

The **Asynchronous Operations** tab (see Figure 4.9) displays the consistency (CT) group information for the connected subsystem and allows you to perform the TrueCopy Asynchronous configuration operations (see section 4.3).

To update the information on the **Asynchronous Operations** tab, select another tab and then reselect the **Asynchronous Operations** tab, or select the **Refresh** button (🔄) (top right of Storage Navigator panel). The CT group information is also updated when you select the **Apply** button.

TrueCopy Asynchronous Operations

Operation : Display all CT groups

Pending Update Data Rate : 050 (%) Offloading Timer : 090 (sec.)
I/O Delay Start : 030 (%) I/O Delay Increase : 040 (%)

CTG	This CU	M-R Path	Paired S/N	Paired SSID	Other S/N
00					
01					
02					
03					
04					
05					
06					
07					
08					
09					
0A					
0B					
0C					
0D					
0E					
0F					
10					
11					
12					
13					
14					
15					
16					
--					

Display All
Used
Not Used

Apply Cancel

Figure 4.9 Asynchronous Operations Tab

The **Asynchronous Operations** tab presents:

- **Operation:** indicates the current operation performed on the **Asynchronous Operations** tab.
- **Pending Update Data Rate:** indicates the maximum cache % available for use by TrueCopy Asynchronous sidefiles.
- **Offloading Timer:** indicates the maximum time between TrueCopy Asynchronous recordset transfers.
- **I/O Delay Start:** indicates the threshold for starting the response delay to the host.
- **I/O Delay Increase:** indicates the threshold for increasing the response delay to the host.
- **Outline view:** allows you to display all consistency groups (default), or only the consistency groups which are already in use (**Used**), or the consistency groups which are available for use (**Not Used**). When you select the channel type (fibre:  or serial: ) , consistency groups of the selected channel type are displayed in the list view.
- **List view:** displays the following consistency group information:
 - **CTG:** Consistency group number
 - **This CU:** the CU to which the group is registered. **MCU:** The group was added from the connected CU. **RCU:** The group was added from the paired CU (connected CU is RCU). **M&R:** MCU and RCU are in the same disk subsystem.
 - **M-R Path:** Channel type: fibre or serial. If the consistency group is not in use, this column is blank.
 - **Paired S/N:** Serial number of the paired subsystem (if there is more than one RCU, the subsystem with the lowest S/N is displayed). If the consistency group is not in use, this column is blank.
 - **Paired SSID:** SSID of the paired subsystem (if there is more than one RCU, the subsystem with the lowest SSID is displayed). If the consistency group is not in use, this column is blank.
 - **Other S/N:** Exist: indicates that there is more than one RCU for the group. If there is only one RCU, this column is blank.

4.1.4 Usage Monitor Tab

The **Usage Monitor** tab (see Figure 4.10) displays the user-selected remote copy I/O statistics, displays the status of remote copy usage monitoring, and allows you to perform the TrueCopy usage monitor operations. Please see section 4.4 for information and instructions on performing usage monitor operations.

- **Status:** displays **Running** when monitoring is on; displays **Stop** when monitoring is off
Note: When monitoring is stopped, the usage monitor graph is closed. The usage monitor graph can only be displayed when monitoring is running.
- **Rate:** displays the data collection rate for usage monitoring (default = 5)
Note: When monitoring is stopped, the default value (5) is displayed in the **Rate** box.
- **Operation:** allows you to select the desired usage monitor operation (see section 4.4)
- **Update:** displays the most recent data sample time of the data on the graph

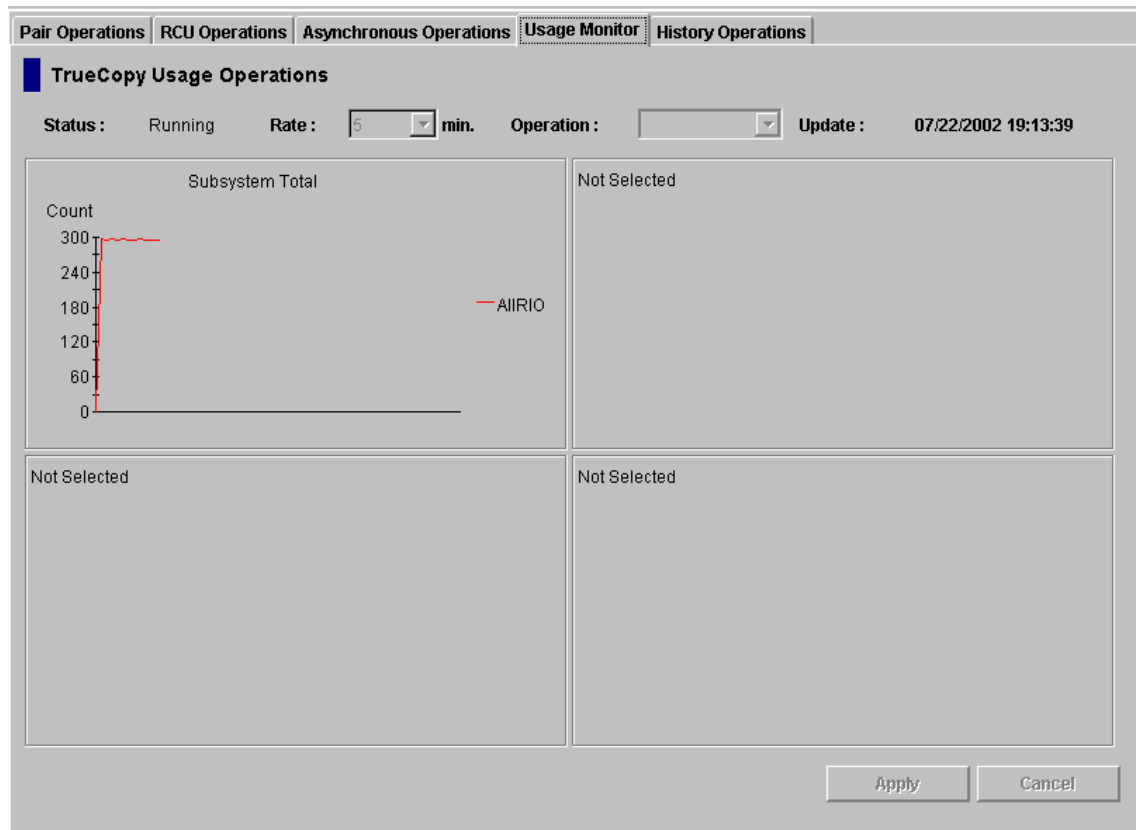
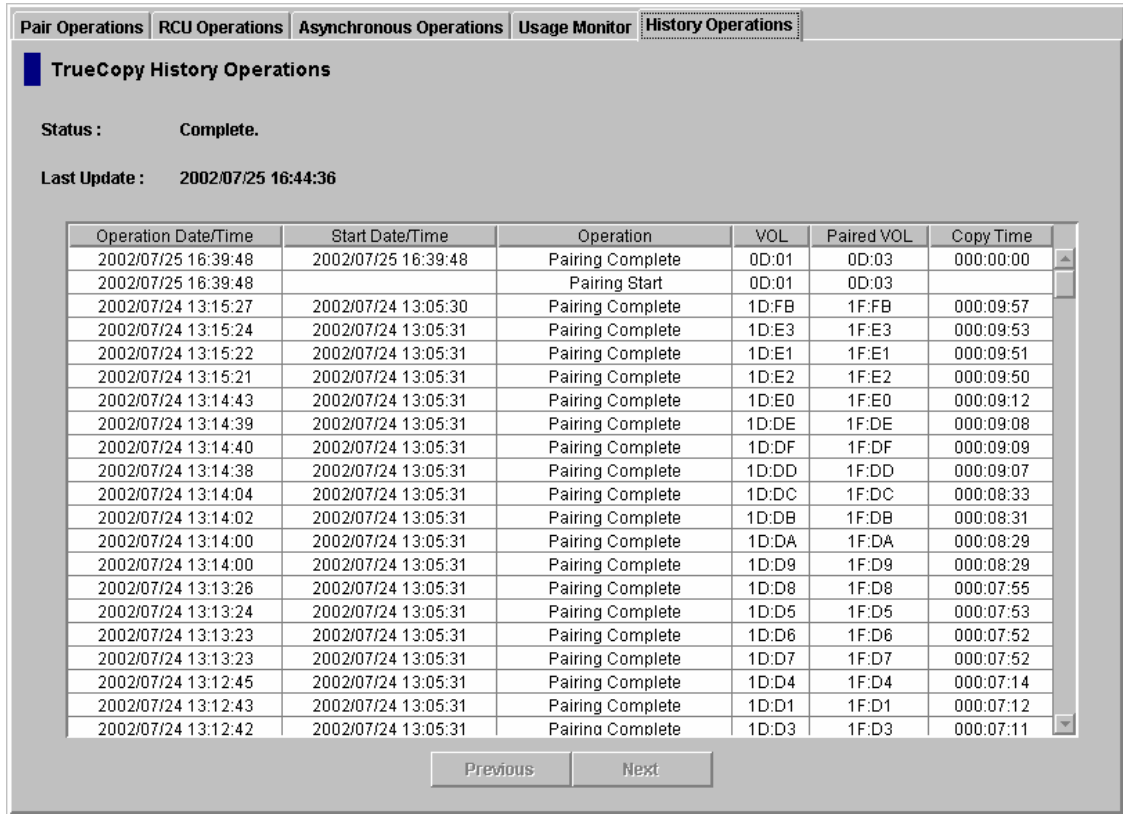


Figure 4.10 Usage Monitor Tab

4.1.5 History Operations Tab

The **History Operations** tab (see Figure 4.11) displays the history information for the TrueCopy pairs and allows you to perform TrueCopy history operations. The history information includes the records of the main status changes (e.g., pair creation, deletion, etc.) of the TrueCopy pairs. See section 4.5 for information and instructions on performing TrueCopy history operations.

To update the information on the **History Operations** tab, select the **Refresh** button () on the Storage Navigator main panel. The information on the History Operations tab is not updated by selecting another tab and then reselecting the **History Operations** tab.



Operation Date/Time	Start Date/Time	Operation	VOL	Paired VOL	Copy Time
2002/07/25 16:39:48	2002/07/25 16:39:48	Pairing Complete	0D:01	0D:03	000:00:00
2002/07/25 16:39:48		Pairing Start	0D:01	0D:03	
2002/07/24 13:15:27	2002/07/24 13:05:30	Pairing Complete	1D:FB	1F:FB	000:09:57
2002/07/24 13:15:24	2002/07/24 13:05:31	Pairing Complete	1D:E3	1F:E3	000:09:53
2002/07/24 13:15:22	2002/07/24 13:05:31	Pairing Complete	1D:E1	1F:E1	000:09:51
2002/07/24 13:15:21	2002/07/24 13:05:31	Pairing Complete	1D:E2	1F:E2	000:09:50
2002/07/24 13:14:43	2002/07/24 13:05:31	Pairing Complete	1D:E0	1F:E0	000:09:12
2002/07/24 13:14:39	2002/07/24 13:05:31	Pairing Complete	1D:DE	1F:DE	000:09:08
2002/07/24 13:14:40	2002/07/24 13:05:31	Pairing Complete	1D:DF	1F:DF	000:09:09
2002/07/24 13:14:38	2002/07/24 13:05:31	Pairing Complete	1D:DD	1F:DD	000:09:07
2002/07/24 13:14:04	2002/07/24 13:05:31	Pairing Complete	1D:DC	1F:DC	000:08:33
2002/07/24 13:14:02	2002/07/24 13:05:31	Pairing Complete	1D:DB	1F:DB	000:08:31
2002/07/24 13:14:00	2002/07/24 13:05:31	Pairing Complete	1D:DA	1F:DA	000:08:29
2002/07/24 13:14:00	2002/07/24 13:05:31	Pairing Complete	1D:D9	1F:D9	000:08:29
2002/07/24 13:13:26	2002/07/24 13:05:31	Pairing Complete	1D:D8	1F:D8	000:07:55
2002/07/24 13:13:24	2002/07/24 13:05:31	Pairing Complete	1D:D5	1F:D5	000:07:53
2002/07/24 13:13:23	2002/07/24 13:05:31	Pairing Complete	1D:D6	1F:D6	000:07:52
2002/07/24 13:13:23	2002/07/24 13:05:31	Pairing Complete	1D:D7	1F:D7	000:07:52
2002/07/24 13:12:45	2002/07/24 13:05:31	Pairing Complete	1D:D4	1F:D4	000:07:14
2002/07/24 13:12:43	2002/07/24 13:05:31	Pairing Complete	1D:D1	1F:D1	000:07:12
2002/07/24 13:12:42	2002/07/24 13:05:31	Pairing Complete	1D:D3	1F:D3	000:07:11

Figure 4.11 History Operations Tab

The **History Operations** tab presents:

- **Status** displays the current status of the history file:
 - **No history file exist.** The history file does not exist.
 - **Reading a history failed.** A failure occurred during referring to the history file.
 - **Update history ... n (%).** Updating of the history file is now in progress. "n (%)" indicates the progress (in %) of the updating process of the history file.
 - **Complete:** Updating of the history file has been completed.

Note: When the updating process is in progress, the checking process automatically continues until the updating process finishes. The updating process is checked at ten-second intervals.

- **Last Update** displays the updated date and time of the history file.
- The **History List** displays the history information for the TrueCopy pairs in the connected subsystem. TrueCopy history information is saved for seven days, and the maximum number of the information that can be saved is 65,535. By default, the list is in the order in which the information are received from the subsystem.

The **History List** displays the following information:

- **Operation Date/Time:** The date and time when the operation was completed.
- **Start Date/Time:** The date and time when the operation was started.
- **Operation:** The operations are:
 - Pairing Start:** Add pair operation was started.
 - Pairing Complete:** Add pair operation was completed.
 - Pair Delete:** The pair was deleted.
 - Suspend Operation:** Pair suspending operation was performed.
 - Pair Suspend (Failure):** The pair was suspended because of a failure.
 - Pair Resync. Start:** Resume pair operation was started.
 - Pair Resync. Complete:** Resume pair operation was completed.
- **VOL:** CU number and LDEV number of the operated volume.
- **Paired VOL:** CU number and LDEV number of the paired volume.
- **Copy Time:** The time taken for the operation (from the start of the operation to the end). Displayed only for **Pairing Complete** and **Pair Resync. Complete** operations.

Note: For TrueCopy pairs consisting of LUN Expansion (LUSE) volumes, the number of “Pair Suspend (Failure)” rows in the history list does not correspond to the number of LDEVs in the LUSE volume. For LUSE volumes with three or more LDEVs, only two rows showing “Pair Suspend (Failure)” are displayed.

Note: History information older than seven days is automatically deleted. However, if the number of operations exceeds 65,535, the oldest operations are deleted in chronological order to keep the number at 65,535, even if the operations occurred within the last week. The history file always contains the most recent operations up to a maximum of 65,535 operations. The maintenance information for an entire week may not always be available.

Note: The history information can be sorted by column and in ascending or descending order.

- **Previous** and **Next** buttons: The list displays up to a maximum of 16,384 operations at a time. Use these buttons to display the previous or next 16,384 operations.

Note: The dates and times displayed on the History panel are the 9900V SVP date/time, which may or may not correspond to the local time or host time.

4.2 RCU Operations

The RCUs are the control units which control the S-VOLs of the TrueCopy volume pairs. The RCUs are connected to the MCUs via the remote copy connections and receive and process commands from the MCUs. For TrueCopy operations, the 9900V Storage Navigator PC should be installed on a separate LAN at the remote site to allow TrueCopy commands to be issued directly to the RCU (e.g., in case of disaster or failure at the primary site).

The MCUs are the control units which control the P-VOLs of the volume pairs. The MCUs receive and process user-requested TrueCopy commands from the Storage Navigator PC, and send the remote copy operations to the RCUs. The MCUs can also function as RCUs, provided the remote copy connections are properly configured.

The RCU operations are performed separately for each CU image of each MCU and RCU to provide maximum flexibility in TrueCopy configurations. The RCU operations are:

- Configuring the host interface ports for MCU-RCU connection (see section 4.2.1),
- Adding an RCU (see section 4.2.2),
- Changing the RCU options (see section 4.2.3),
- Adding and deleting logical paths to an RCU (see section 4.2.4),
- Adding and deleting SSIDs for an RCU (see section 4.2.5),
- Viewing RCU status (see section 4.2.6), and
- Deleting an RCU (see section 4.2.7).

The **RCU Operations** tab (see section 4.1.1) allows you to perform the RCU operations. All operations performed on the **RCU Operations** tab have a common procedure. To perform any operation on the **RCU Operations** tab:

1. Select the desired display mode: **MCU&RCU**, or **Port**.
2. Select the desired CU image, channel adapter, or port type in the outline view.
3. Select the desired RCU(s) or port(s) in the list view. When adding an RCU, do not select anything in the list view.
4. Right-click on the selected item(s) to display the pop-up menu.

For the **MCU&RCU** display (see Figure 4.12), the pop-up menu commands are:

- **RCU Status:** allows you to display the RCU status (see section 4.2.6)
- **RCU Operation:** allows you to perform the following RCU operations: add RCU (fibre or serial) (section 4.2.2), change RCU option (see section 4.2.3), and delete RCU (section 4.2.7)
- **Edit SSID(s) & Path(s):** allows you to add and delete paths (see section 4.2.4), and allows you to add and delete SSIDs (see section 4.2.5)

For the **Port** display (Figure 4.13), the pop-up menu commands are (see section 4.2.1):

- **Fibre: Initiator:** allows you to change the selected fibre port(s) to initiator ports
RCU Target: allows you to change the selected fibre port(s) to RCU targets
Target: allows you to change the selected fibre port(s) to target ports
- **Serial: RCP:** allows you to change the selected serial port(s) to RCPs
LCP: allows you to change the selected serial port(s) to LCPs

5. For the **MCU&RCU** display, select the menu command for the desired operation. When two or more RCUs are selected, only the RCU Operation command is available. For the add and change operations, use the panel to perform the operation, and close the panel. There is no panel for the delete operations. The **RCU Operations** list view now displays the requested operation(s).

For the **Port** display, select the desired port type. The **RCU Operations** list view now displays the requested port change operation(s).

6. Verify the specified RCU or port operation(s). Make changes as follows:
 - a) To change an operation, select the desired operation (RCU, path, SSID, port), right-click on it, select the desired port type, or select **Modify**, make the desired changes, and close the panel. The list view displays the updated information.
 - b) To omit one or more operations, select the operation(s) to be omitted (RCU, path, SSID, port), right-click, and select **Omit**. The operation(s) is/are removed from the list view. If all operations are removed, the list view returns to its original display.
 - c) To cancel all operations, right-click on the operations, and select **Cancel All**. All operations are removed, and the list view returns to its original display.
7. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

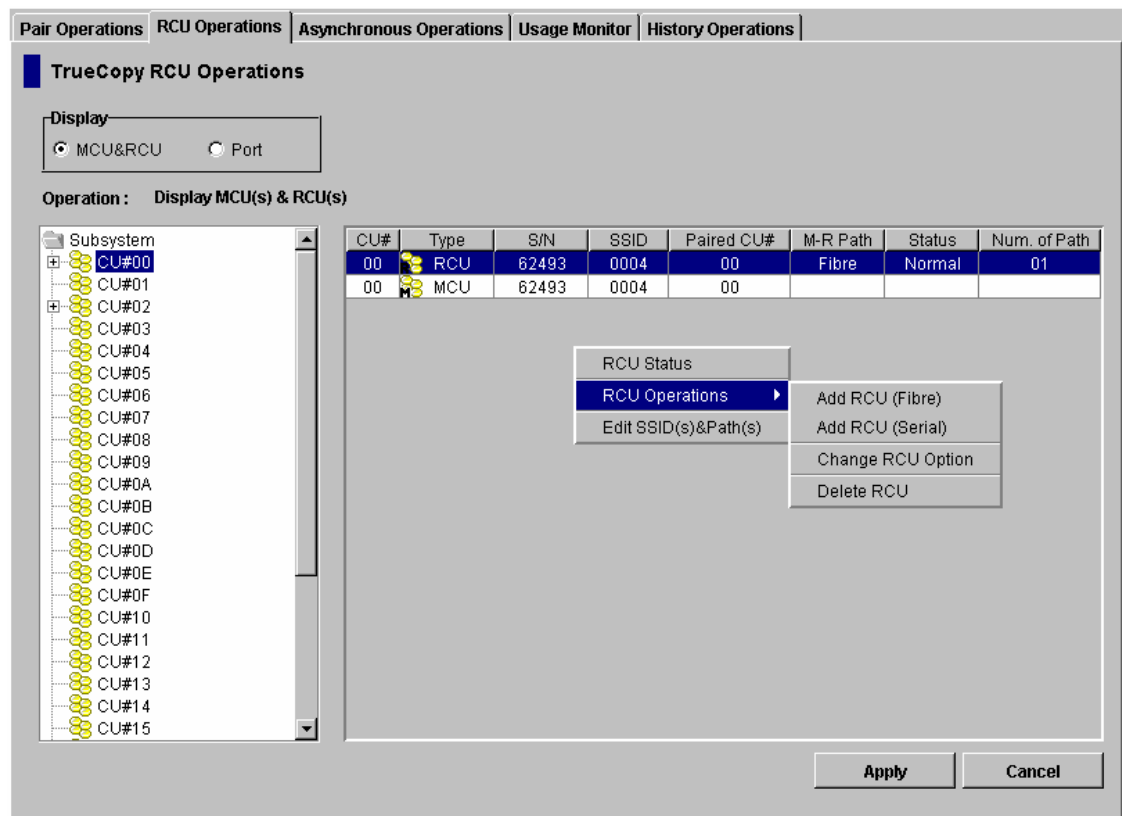


Figure 4.12 Pop-up Menu for MCU & RCU Operations

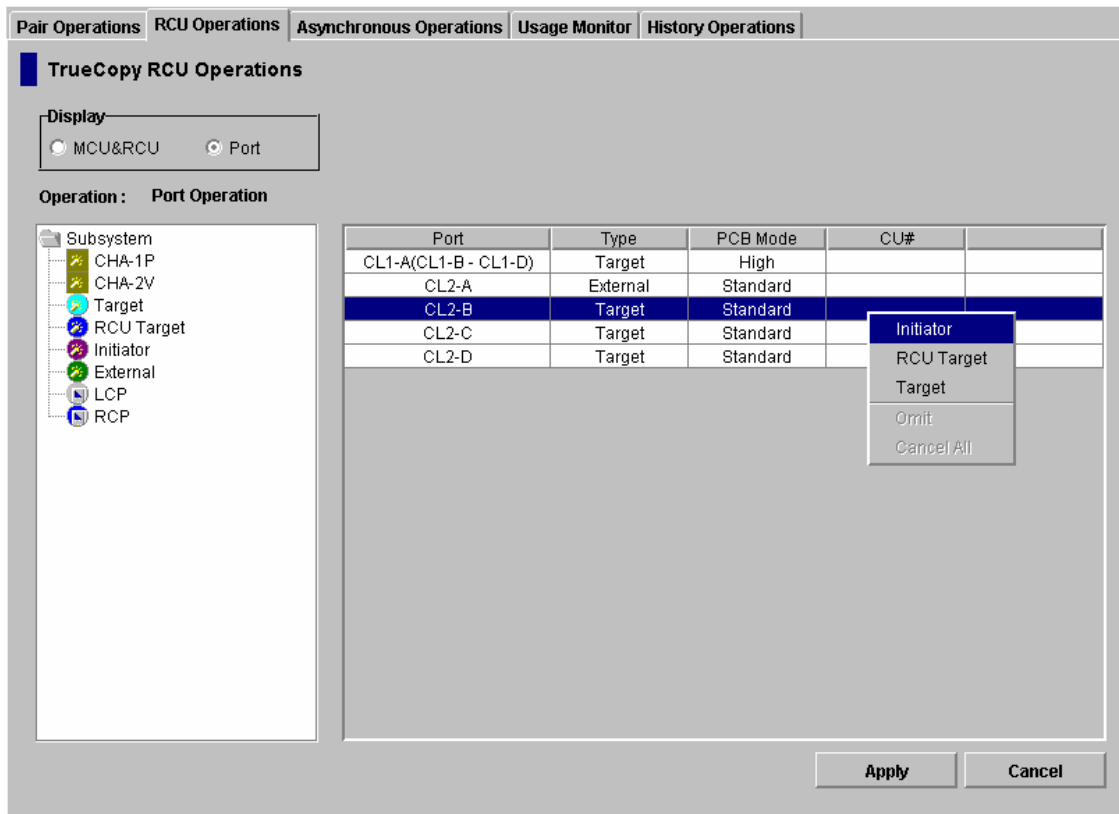


Figure 4.13 Pop-up Menu for Port Operations

4.2.1 Configuring the Host Interface Ports

The TrueCopy software allows you to change the configuration of the 9900V host interface ports as needed to accommodate the desired host and TrueCopy communications paths.

The 9900V fibre-channel interface ports can be configured as target ports (default), initiator ports, or RCU target ports (see section 2.1.7).

- **Target:** The fibre-channel ports which will be connected to the host must be configured as target ports (default). Target mode is used for host processor channel interface.
- **Initiator:** The fibre-channel ports which will be used for TrueCopy communications to the RCUs must be configured as initiator ports. Initiator mode emulates a host channel to enable the MCU to send write I/O operations directly to the RCU target port.
Note: Two or more initiator ports must be configured before you can add the RCUs and create the TrueCopy pairs.
- **RCU target:** The fibre-channel ports in the RCU that will be used to communicate with the MCUs must be configured as RCU target ports.

The 9900V serial interface ports can be configured as LCPs or RCPs (see section 2.1.8).

- **LCP:** The serial ports which will be connected to the host must be configured as LCPs (default). LCP mode is used for host processor channel interface. The serial ports in the RCU that will be used to communicate with the MCUs must also be configured as LCPs.
- **RCP** (see note below): The serial ports which will be used for TrueCopy communications to the RCUs must be configured as RCPs. RCP mode emulates a host channel to enable the MCU to send write I/O operations directly to the RCU. The RCPs must be configured before you can add the RCUs and create the TrueCopy pairs.

Note: The serial interface ports, 1S-1Z and 2S-2Z, cannot be specified as RCPs.

Note: The External port that appears on the [RCU Operations] tab cannot be used for TrueCopy.

WARNING: Before changing a fibre-channel port to an initiator port, disconnect the port from the host, delete all affected TrueCopy pairs, delete all paths from the port to the MCU (if RCU target), and then remove all channel paths to the port.

WARNING: Before changing a fibre-channel port from initiator to target or RCU target, delete all affected TrueCopy pairs, delete all paths from the initiator port to the RCU, and then delete the RCU from the MCU.

Caution: Limit the number of hosts connected to an RCU target port to 128 or fewer to avoid mistaken disconnection. If more than 128 hosts are connected to an ordinary target, some hosts may be disconnected after changing the type from target to RCU target.

To configure the 9900V fibre-channel ports:

1. Select the **RCU Operations** tab, and select the **Port** display button to display the channel adapters and port types for the connected subsystem in the outline view.
2. Select the desired channel adapter to display only the ports for that channel adapter. Select the desired port type to display all ports of the selected type.
3. Select the port(s) that you want to configure. Make sure to select only fibre ports.
4. Right-click on the selected port(s), and then select the desired port type: initiator, RCU target, or target for fibre channel.
5. Verify the requested port change operation(s) displayed in the list view.

To change one or more port operations, select the operation(s), right-click, and select the desired port type. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click, and select **Cancel All**.

WARNING: Read and follow the important warnings and caution above before starting the port change operations.

6. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

WARNING: Before changing the operation mode of a serial port from LCP to RCP, remove all channel paths to the specified port using mainframe host system console or ESCD commands.

WARNING: Before changing the mode of a port from RCP to LCP, delete all affected TrueCopy pairs, delete all paths to the RCU from that RCP, and then delete the RCU from the MCU.

To configure the 9900V serial-channel ports:

1. Select the **RCU Operations** tab, and select the **Port** display button to display the channel adapters and port types for the connected subsystem in the outline view.
2. Select the desired channel adapter to display only the ports for that channel adapter. Select the desired port type to display all ports of the selected type.
3. Select the port(s) that you want to configure. Make sure to select only serial ports.
4. Right-click on the selected port(s), and then select the desired port type: **LCP** or **RCP**.
5. Verify the requested port change operation(s) displayed in the list view.

To change one or more port operations, select the operation(s), right-click, and select the desired port type. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.

WARNING: Read and follow the important warnings and caution above before starting the port change operations.

6. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

4.2.2 Adding an RCU

You can add up to four RCUs to each MCU and establish up to eight paths to each RCU. You must add each CU image as a separate RCU to each CU image of the MCU. The logical paths are established for the CU images of the MCU and RCU separately. The maximum number of logical paths for each MCU is 32 (8 paths per RCU $\times$ 4 RCUs per MCU).

The remote copy connections and MCU ports must be properly installed and configured before you can add an RCU. When you add an RCU, the selected CU image of the connected MCU adds the specified CU image as a TrueCopy RCU and establishes the specified number of logical paths to the RCU. After you have added an RCU (and path status is normal), you can create TrueCopy pairs which have S-VOLs in the newly added RCU.

The Add RCU panel (see Figure 4.14) allows you to add an RCU to the selected CU image of the connected MCU. To open the Add RCU panel, select the **MCU&RCU** display on the **RCU Operations** tab, select the desired CU image in the outline view, right-click on the list view, select the **RCU Operations** command, and then select the **Add RCU** command.

The figure shows two side-by-side dialog boxes for adding an RCU. The left dialog is titled "Add RCU (Fibre)" and the right is "Add RCU (Serial)". Both dialogs have the following fields:

- RCU S/N: Text input field.
- Controller ID: Text input field with the value "3".
- Logical Addr.(RCU CU#): Dropdown menu with the value "00".
- SSID: Four text input fields.

Below these fields is a table titled "MCU-RCU Path".

In the "Add RCU (Fibre)" dialog, the table has two columns: "MCU Port" and "RCU Port". It contains eight rows of dropdown menus.

In the "Add RCU (Serial)" dialog, the table has two columns: "MCU Port" and "Link Address". The first row has "CL1-R" in the "MCU Port" column and "C6" in the "Link Address" column. The other seven rows are empty.

At the bottom of each dialog are two buttons: "Option" and "Cancel".

Figure 4.14 Add RCU Panel

RCU S/N: allows you to enter the five-digit serial number of the RCU being added

Controller ID: allows you to enter the controller ID (subsystem family ID) of the RCU being added. For fibre-channel interface, the controller ID for 9900V is 3, and the controller ID for the 9900 is 2.

Logical Adr. (RCU CU#): allows you to enter the CU number (0-1F) of the RCU being added

SSID: allows you to enter the SSID(s) of the RCU being added. The 9900V uses one SSID for each set of 256 volumes and four SSIDs per CU image. SSID is 4-FFFE (hexadecimal).

MCU-RCU Path: displays different boxes depending on the channel interface type (fibre or serial)

- **MCU Port:** allows you to select the MCU port number. Initiator ports and RCPs are listed.
- **RCU Port:** allows you to select the RCU port number (fibre only). You must select RCU target ports.
- **Link Address:** allows you to enter link address from 0 - FD in hexadecimal numbers (serial only). For dynamic link of remote copy connections, you must enter the destination port address on the ESCD. For static connections, you must enter 0.

The **Option** button opens the RCU Option panel (see section 4.2.3). The **Cancel** button cancels the settings you made on the Add RCU panel and closes the panel.

To add an RCU to the connected MCU:

1. Make sure the remote copy connections and ports are properly configured. Get the S/N and SSID(s) for the desired CU image of the RCU. The add RCU operation will fail without this information. The 9900V subsystem should have a label or tag indicating its S/N and SSIDs, or ask your Hitachi Data Systems representative for the RCU S/N and SSIDs.
2. Select the **RCU Operations** tab, select the **MCU&RCU** display button, and select the desired CU image in the outline view. You must add RCUs to each CU image separately.
3. Right-click on the list (an RCU does not have to be selected), select **RCU Operation**, and then select **Add RCU** to open the Add RCU panel (refer to Figure 4.14).
4. On the Add RCU panel, enter the S/N, controller ID (for fibre: 3 for 9900V, 2 for 9900), CU number, and SSID(s) for the desired RCU CU image. The MCU verifies the S/N when the paths are established, and verifies the SSIDs when the volume pairs are created. If desired, you can add and delete SSIDs later using the Add SSID panel (see section 4.2.5).
5. Select the MCU port and RCU port. The MCU will not allow you to establish less than the minimum number of paths as specified on the RCU Option panel. If desired, you can add and delete paths later using the Add Path panel (see section 4.2.4).
6. Select the **Option** button to open the RCU Option panel (see section 4.2.3), and enter the desired settings for **Minimum Paths**, **Maximum Initial Copy Activity**, **RIO MIH Time**, and **Path Blockade Watch**.

Note: When you have TrueCopy Asynchronous pairs configured on fibre-channel interface, set the same value for the **Minimum Paths** option for all RCUs.

Note: For multiplatform 9900V configurations with both TrueCopy and TrueCopy - S/390® paths, set the Maximum Initial Copy Activity to 4 Volumes.

7. Select **Set** to close the RCU Option panel, even if you made no changes. (Select **Cancel** to cancel the add RCU operations.) The list view now displays the requested add RCU operation(s) (see Figure 4.15).
8. Verify the requested operation(s) displayed in the list view. To check the path status for an RCU, select the RCU, right-click on it, and select **RCU Status** (see Table 7.2).
To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.
9. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

S/N	SSID1	SSID2	SSID3	SSID4	M-R Path	Num. of Path	MCU Port1	RCU Port1
62492	0005				Fibre	01	CL1-B	CL2-B

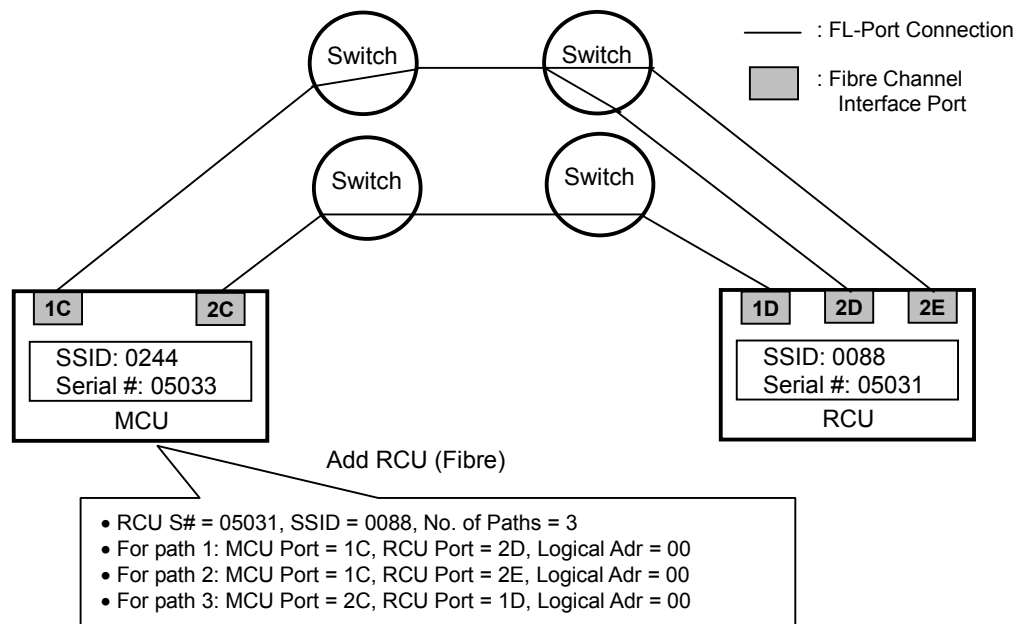
MCU Port2	RCU Port2	MCU Port3	RCU Port3	MCU Port4	RCU Port4	MCU Port5	RCU Port5	MCU Port6

RCU Port6	MCU Port7	RCU Port7	MCU Port8	RCU Port8	Min.Path	Activity	MIH Time	Path Watch
					01	04	015	40

Figure 4.15 Verifying the Add RCU Operation(s) (Fibre shown)

4.2.2.1 RCU Path Parameters

For fibre-channel interface, two types of fibre-channel ports are provided: 4-port and 2-port adapters. The port mode depends on the port type. Also, each port may have a different PCB mode setting (Standard or High). Therefore, when you configure paths among the initiator ports, target ports, and RCU target ports, please study the port modes and specify the correct mode for each port. For details on the relationship between ports and PCB modes and instructions for setting the PCB mode, please refer to the *Hitachi Lightning 9900™ V Series LUN Manager User's Guide* (MK-92RD105). Figure 4.16 shows a sample TrueCopy fibre-channel interface configuration with connections going through switches and the TrueCopy Add RCU (Fibre) panel used to define this configuration.



Add RCU (Fibre)

RCU S/N: 05031
 Controller ID: 3
 Logical Adr.(RCU CU#): 00
 SSID: 0088

MCU-RCU Path	
MCU Port	RCU Port
CL1-C	CL2-D
CL1-C	CL2-E
CL2-C	CL1-D

Option Cancel

Figure 4.16 Add RCU Operation – Fibre-Channel Interface

The RCU path parameters are similar to the channel path definitions in the I/O configuration dataset (IOCDs). In the IOCDs, a logical path is specified with a subchannel number, link destination address, and logical address for the CU. TrueCopy uses the “port” parameter instead of the subchannel number to specify the MCU’s port. For the 9900V subsystem, the logical address must correspond to the CU image number. Figure 4.16 shows a typical TrueCopy remote copy configuration with one path.

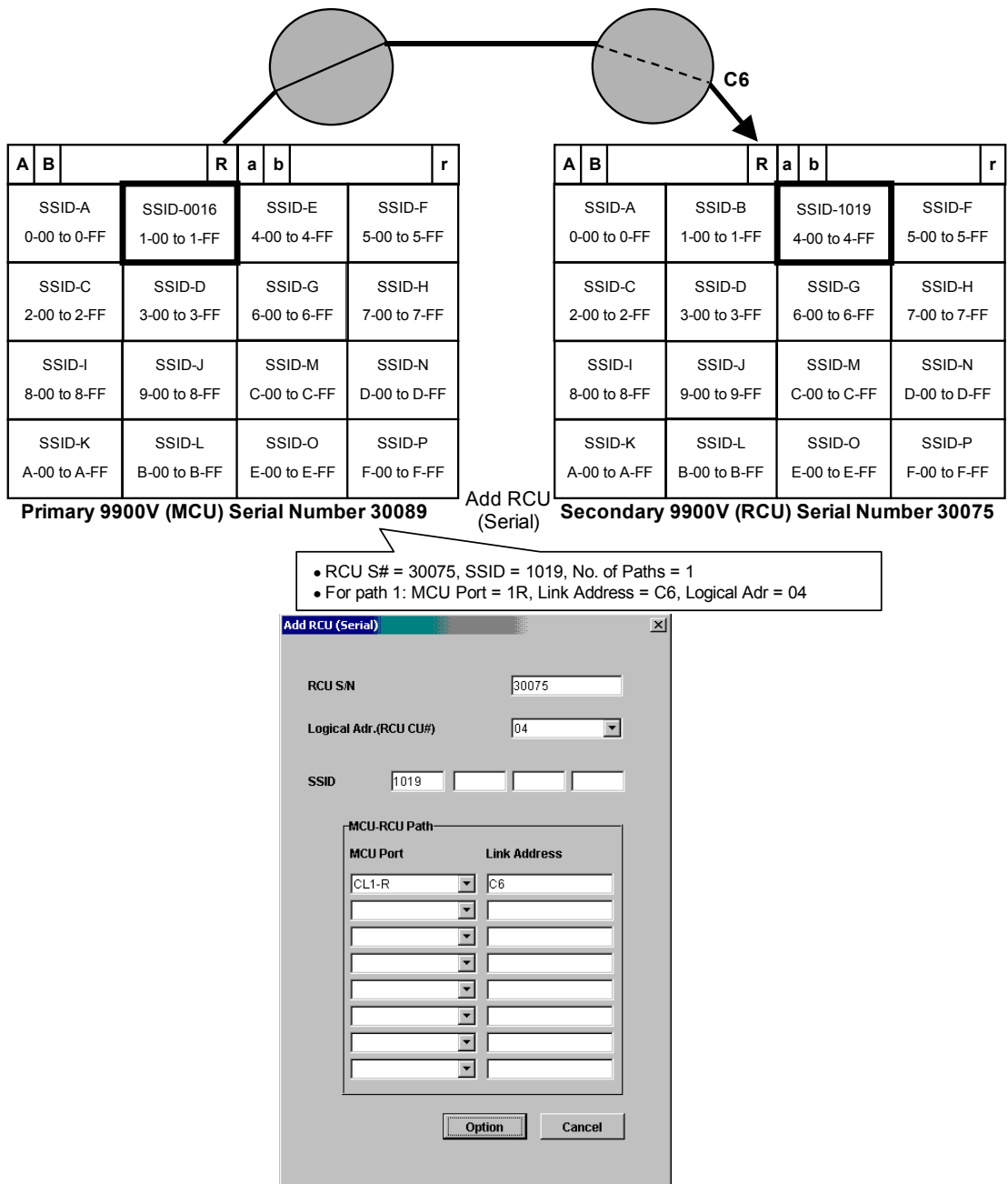


Figure 4.17 Add RCU Operation – Serial Channel Interface

4.2.3 Changing the RCU Options

The RCU Option panel (see Figure 4.18) allows you to set the RCU options for the connected MCU. The RCU options apply to all MCU CU images and to all RCUs connected to the MCU. The RCU Option panel is presented during the add RCU process, and can also be opened by right-clicking on the RCUs and selecting the **RCU Operation→Change RCU Option** command.

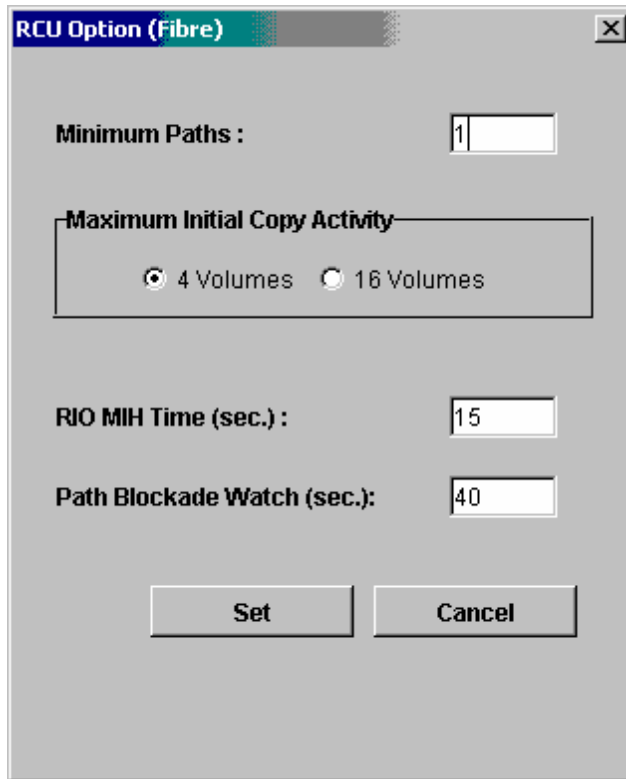
The image shows a Windows-style dialog box titled "RCU Option (Fibre)". It contains several configuration fields: "Minimum Paths" with a text box containing the value "1"; "Maximum Initial Copy Activity" with two radio buttons, "4 Volumes" (which is selected) and "16 Volumes"; "RIO MIH Time (sec.):" with a text box containing "15"; and "Path Blockade Watch (sec.):" with a text box containing "40". At the bottom of the dialog are two buttons: "Set" and "Cancel".

Figure 4.18 RCU Option Panel

The **Minimum Paths** option allows you to specify the minimum number of paths required for each RCU connected to the current MCU (default = 1). If you enter a larger number than the number of paths already set on the Add RCU panel, or if the number of paths falls below this number (e.g., failed path), an error occurs. When the error occurs, the MCU suspends all affected TrueCopy (and TrueCopy - S/390®) pairs to prevent remote copy operations from adversely affecting performance due to the inadequate number of paths. If the MCU contains TrueCopy pairs which contain critical data for disaster recovery, set the minimum number of paths to one, so that TrueCopy operations continue even if there is only one path to an RCU. If you need high performance at the MCU, set the minimum number of paths to two or more (up to eight per CU image), depending on the number of pairs managed by the MCU.

Note: When you have TrueCopy Asynchronous pairs configured on fibre-channel interface, set the same value for the **Minimum Paths** option for all RCUs.

Caution: If TrueCopy volume pairs are suspended because the number of paths has dropped below this setting, the P-VOL fence level pair option (see section 5.4) determines whether the TrueCopy Synchronous P-VOLs are fenced (i.e., reject all write operations).

The **Maximum Initial Copy Activity** setting specifies the number of concurrent initial copy operations: 4 Volumes or 16 Volumes. The default setting is 4 Volumes. TrueCopy initial copy activities can impact the performance of the main subsystem, depending on the amount of I/O activity and the number of pairs being created at the same time. The maximum initial copy activity setting of 4 Volumes allows you to limit the impact of initial copy activities on subsystem performance. For example, if you set the maximum initial copy activity to 4 Volumes and then create five TrueCopy pairs at the same time, the MCU starts the first four pairs and will not start the fifth pair until one of the first four pairs is synchronized (PAIR status). When you change the maximum initial copy activity setting, the new setting applies to pairs created after the setting was changed, not to existing pairs.

Note: The RCU options are common to both TrueCopy and TrueCopy - S/390® operations. For multiplatform 9900V configurations with both TrueCopy and TrueCopy - S/390® paths, the **Maximum Initial Copy Activity** must be set to 4 Volumes, and the most recently entered **Minimum Paths** value (entered on TrueCopy or TrueCopy - S/390® RCU Option panel) will be applied to both TrueCopy and TrueCopy - S/390® operations.

The **RIO MIH Time** setting specifies the time value for the remote I/O (RIO) missing interrupt handler (MIH), which is the wait time until data transfer from the MCU to RCU is complete. The RIO MIH time value must be from 10 to 100 seconds. The default setting is 15 seconds. This setting is available for both fibre-channel and serial interfaces. For further information on the MIH, please refer to the Hitachi 9900V TrueCopy - S/390® User and Reference Guide.

The **Path Blockade Watch** setting (fibre only) specifies the time for monitoring blockade in the fibre-channel paths on the MCU side. The path blockade watch value must be from 0 to 45 seconds. The default setting is 40 seconds.

To change the RCU options:

1. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
2. Right-click on the RCU list (you do not need to select anything), select **RCU Operation**, and select **Change RCU Option** to open the RCU Option panel (refer to Figure 4.18).
3. On the RCU Option panel, change the RCU options as desired, and select **Set** to close the RCU Option panel (or select **Cancel** to cancel the RCU option operation). The list view now displays the requested change RCU option operation.
4. Verify the requested operation(s) displayed in the list view (see Figure 4.19).
To change the change RCU option operation, select the operation, right-click, and select **Modify**. To remove the operation, select it, right-click, and select **Cancel All**.
5. To apply the settings, select the **Apply** button (lower right of TrueCopy panel). To cancel the operation and return the list view to its original display, select **Cancel**.

S/N	SSID	M-R Path	Min.Path	Activity	MIH Time	Path Watch
62492	0004	Fibre	01	04	015	40

Figure 4.19 Verifying the Change RCU Option Operation

4.2.4 Adding and Deleting Logical Paths to an RCU

Before adding a path to an RCU, make sure that the remote copy connection is properly installed, the appropriate MCU ports are configured as initiator ports (fibre) or RCPs (serial), and the appropriate MCU CU image is selected. You can add up to four RCUs to each MCU CU image and establish up to eight paths to each RCU. When you add a path to an RCU, TrueCopy will automatically start using the new path to perform TrueCopy copy activities.

The Add Path panel (see Figure 4.20) allows you to add one or more paths to an existing RCU. To open the Add Path panel, select the **MCU&RCU** display on the **RCU Operations** tab, select and double-click on the desired MCU CU image in the outline view, select the desired RCU, and then select the **Add Path** command.

The figure displays two side-by-side dialog boxes for adding paths to an RCU. The left dialog, titled "Add Path(Fibre)", contains a table with two columns: "MCU Port" and "RCU Port". The first row has "CL1-E" and "CL2-E" selected. Below this are seven more rows, each with a blue header row and a white data row. The right dialog, titled "Add Path(Serial)", contains a table with two columns: "MCU Port" and "Link Address". The first row has "CL1-C" and "00" selected. Below this are seven more rows, each with a blue header row and a white data row. Both dialogs have "Set" and "Cancel" buttons at the bottom.

MCU Port	RCU Port
CL1-E	CL2-E

MCU Port	Link Address
CL1-C	00

Figure 4.20 Add Path Panel (Fibre and Serial)

MCU Port: allows you to select the MCU port number. Initiator ports and RCPs are listed.

RCU Port: allows you to select the RCU port number (fibre only). You must select an RCU target port.

Link Address: allows you to enter the link address (serial only), which is the destination port address on the ESCD (00-FD, 00 for static link to RCU)

Note: The number of enabled fields indicates the number of paths that can be added.

To add one or more new logical paths from the connected MCU to an existing RCU:

1. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
2. Select and double-click on the desired MCU CU image in the outline, and select the RCU to which you want to add one or more paths. Alternatively, select the RCU in the list, right-click and select **Edit SSID(s) & Path(s)**. All paths to the selected RCU are listed.
3. Right-click on the path and SSID list, and select **Add Path** to open the Add Path panel (see Figure 4.21).
4. On the Add Path panel, enter the new path(s).
5. Select **Set** to close the Add Path panel. The list view now displays the requested add path operation(s).
6. Verify the requested operation(s) displayed in the list view (see Figure 4.22).
To change the add path operation, select the operation, right-click, and select **Modify**.
To remove the operation, select the operation, right-click, and select **Omit**.
7. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). The MCU will automatically begin using the new logical path for TrueCopy activities. To cancel the operation and return the list view to its original display, select **Cancel**.

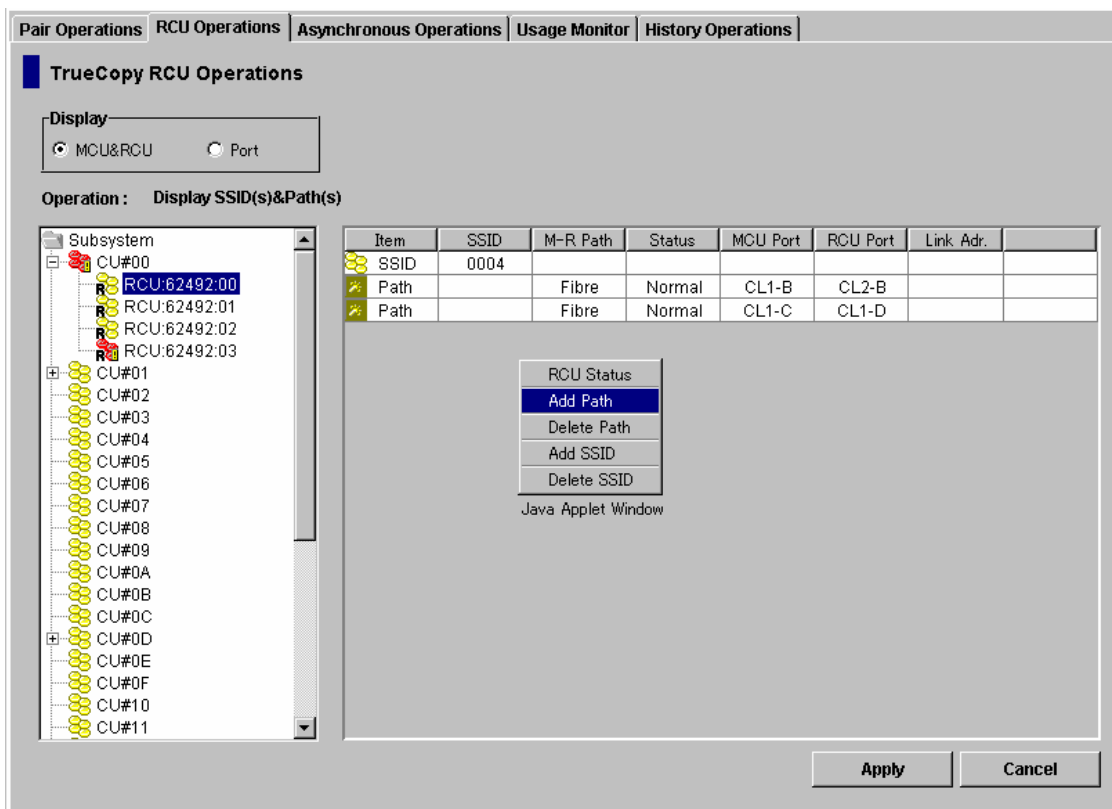


Figure 4.21 Opening the Add Path Panel

Item	SSID	M-R Path	Status	MCU Port	RCU Port	Link Adr.	
 SSID	0004						
 Path		Fibre	Normal	CL1-B	CL2-B		
 Path		Fibre	Normal	CL1-C	CL1-D		
<i>Path</i>		<i>Fibre</i>		<i>CL2-C</i>	<i>CL2-K</i>		<i>Add</i>

Figure 4.22 Verifying the Add Path Operation(s)

Before deleting a path to an RCU, make sure that the remaining number of paths will be equal to or greater than the minimum number of paths setting (on the RCU Option panel). The delete path operation will fail if the number of remaining paths is less than the minimum number of paths.

The **Delete Path** command allows you to delete a path to an existing RCU.

To delete a path from the connected MCU to an existing RCU:

1. Open the RCU Option panel, and check the **Minimum Paths** setting. If the remaining number of paths will be less than this value, the delete path operation will fail. If needed, change the **Minimum Paths** RCU option so that you can delete the desired path.
2. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
3. Select and double-click on the desired MCU CU image in the outline view, and select the RCU for which you want to delete path(s). Alternatively, select the RCU in the list, right-click and select **Edit SSID(s) & Path(s)**. All paths to the selected RCU are listed.
4. Right-click on the path that you want to delete, and then select **Delete Path**. The list view now displays the requested delete path operation(s).
5. Verify the requested operation(s) displayed in the list view (see Figure 4.23).

If you want to delete all paths to the selected RCU, you can select **Apply** now.

If you do not want to delete all paths to the selected RCU, remove the path(s) that you do not want to delete as follows: select the path, right-click, and select **Omit**.

6. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel the operation and return the list view to its original display, select **Cancel**.

Item	SSID	M-R Path	Status	MCU Port	RCU Port	Link Adr.	
 SSID	0007						
 Path		Fibre	Normal	CL1-C	CL1-D		
 <i>Path</i>		<i>Fibre</i>	<i>Failed</i>	<i>CL1-B</i>	<i>CL1-A</i>		<i>Delete</i>

Figure 4.23 Verifying the Delete Path Operation

4.2.5 Adding and Deleting SSIDs for an RCU

Before adding an SSID, make sure that the remote copy connection is properly installed. You can add three SSIDs to each RCU. Before deleting an SSID, make sure that the remaining SSIDs are still valid, or the connection between the MCU and RCU may be lost.

The Add SSID panel (see Figure 4.24) allows you to add up to three SSIDs to an existing RCU. To open the Add SSID panel, select the **MCU&RCU** display on the **RCU Operations** tab, select and double-click on the desired MCU CU image in the outline view, select the desired RCU, right-click on the RCU, and then select the **Add SSID** command.

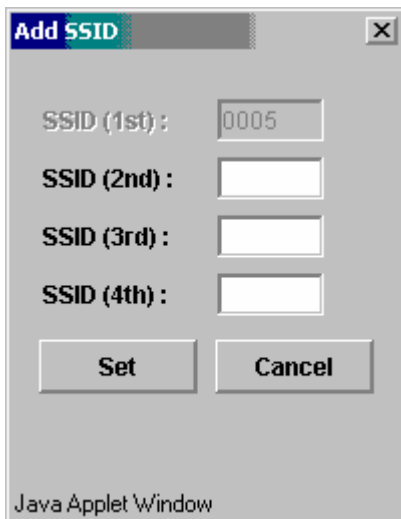


Figure 4.24 Add SSID Panel

To add one or more SSIDs to an existing RCU:

1. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
2. Select and double-click on the desired MCU CU image in the outline view, and then select the RCU to which you want to add SSID(s). Alternatively, select the RCU in the list, right-click and select **Edit SSID(s) & Path(s)**. All SSIDs for the selected RCU are listed.
3. Right-click on the path/SSID list, and then select **Add SSID** to open the Add SSID panel (see Figure 4.25).
4. On the Add SSID panel, enter the new SSID(s).
5. Select **Set** to close the Add SSID panel. The list view now displays the requested add SSID operation(s).
6. Verify the requested operation(s) displayed in the list view (see Figure 4.26).
To change an add SSID operation, select the operation, right-click, and select **Modify**. To remove an operation, select the operation, right-click, and select **Omit**.
7. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel the operation and return the list view to its original display, select **Cancel**.

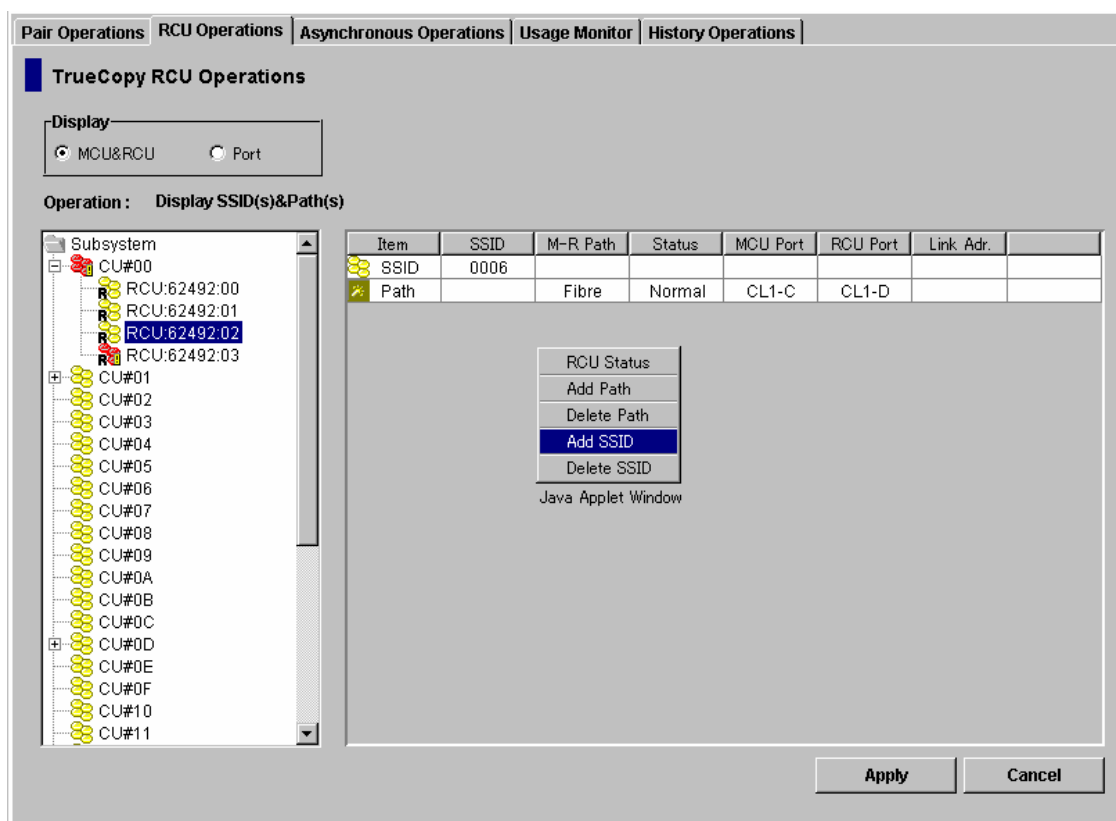


Figure 4.25 Opening the Add SSID Panel

Item	SSID	M-R Path	Status	MCU Port	RCU Port	Link Adr.	
SSID	0006						
SSID	0016						Add
SSID	002A						Add
Path		Fibre	Normal	CL1-C	CL1-D		

Figure 4.26 Verifying the Add SSID Operation

Before deleting an SSID, make sure that all affected TrueCopy pairs (pairs having S-VOLs in the RCU SSID to be deleted) have already been deleted. If all affected pairs have not been deleted, the MCU will reject the delete SSID operation to prevent accidental deletion of TrueCopy pairs.

The **Delete SSID** command allows you to delete an SSID from an existing RCU.

To delete an SSID from an existing RCU:

1. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
2. Select and double-click on the desired MCU CU image in the outline view, and then select the RCU for which you want to delete an SSID. Alternatively, select the RCU in the list, right-click and select **Edit SSID(s) & Path(s)**. All SSIDs for the selected RCU are listed.
3. Right-click on the path/SSID list, and then select **Delete SSID**. The list view now displays the requested delete SSID operation(s).
4. Verify the requested operations displayed in the list view (see Figure 4.27).
To remove an operation, select the operation, right-click, and select **Omit**.
5. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel the operation and return the list view to its original display, select **Cancel**.

Item	SSID	M-R Path	Status	MCU Port	RCU Port	Link Adr.	
 SSID	0006						
 SSID	0016						Delete
 SSID	002A						Delete
 Path		Fibre	Normal	CL1-C	CL1-D		

Figure 4.27 Verifying the Delete SSID Operation

4.2.6 Viewing RCU Status

The RCU Status panel (see Figure 4.28) displays the detailed status information for the selected RCU. Table 4.2 describes the path status descriptions. See section 8.1 for troubleshooting information for MCU-RCU paths.

To view the detailed RCU status information:

1. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
2. Select the RCU for which you want to display the status in the list view. You may only view status for one RCU at a time.
3. Right-click on the RCU, and select **RCU Status** to open the RCU Status panel.

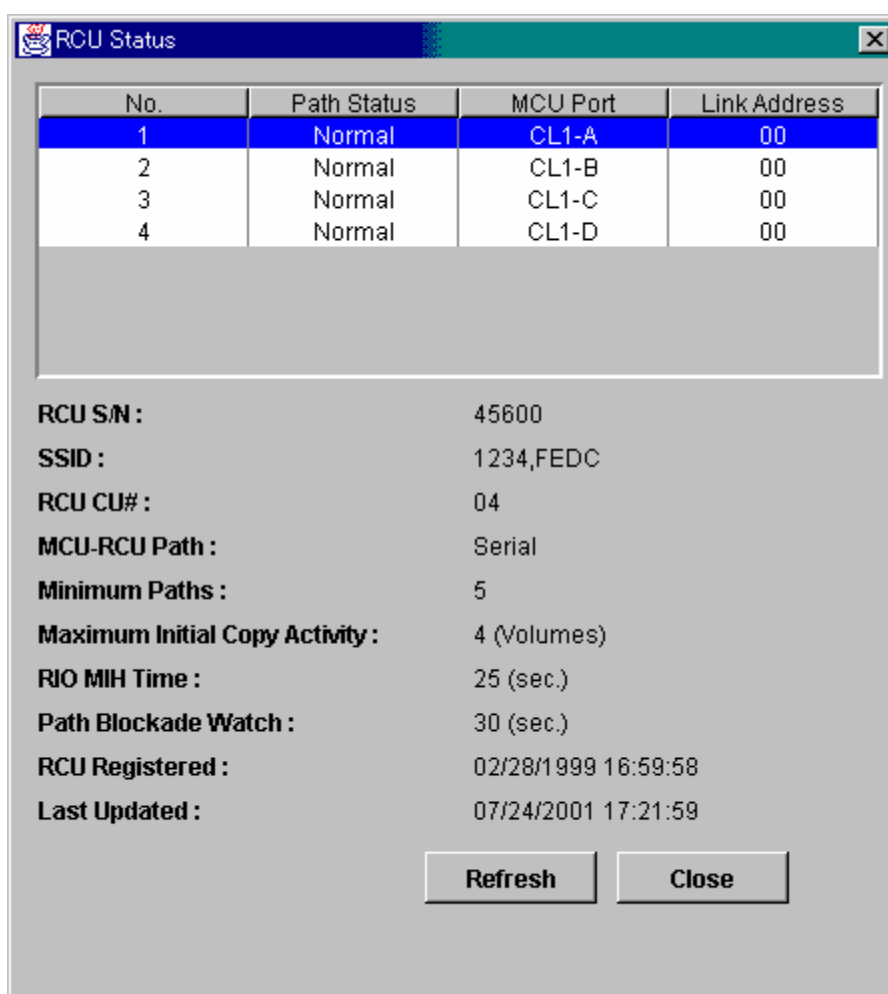


Figure 4.28 RCU Status Panel

- **Path List:**
 - **No.:** Path number (path list item number)
 - **Path Status:** Path status. Table 4.2 describes the path status descriptions.
 - **MCU Port number and Link Address number** (link address = RCU port number for fibre-channel interface)
- **RCU S/N:** Serial number of the RCU
- **SSID:** SSID(s) of the RCU
- **RCU CU#:** CU number of the RCU
- **MCU-RCU Path:** Type of channel interface between the subsystems (fibre or serial)
- **Minimum Paths:** Minimum number of MCU-RCU paths for the selected RCU
- **Maximum Initial Copy Activity:** Number of concurrent initial copy operations
- **RIO MIH Time:** Time value for the remote I/O (RIO) missing interrupt handler (MIH), which is the wait time until data transfer from the MCU to RCU is complete
- **Path Blockade Watch:** Time for monitoring blockade in the fibre-channel paths on the MCU side
- **RCU Registered:** Date and time when the RCU was added
- **Last Updated:** Date and time when the RCU was last updated

Table 4.2 Logical Path Status

Status Description	Condition
Normal	This path has been successfully established and can be used for TrueCopy remote copy activities.
Initialization Failed	The link initialization procedure with the RCU has failed, because either the physical path connection between the MCU and the RCU or the connection between the MCU and the host was missing.
Communication Timeout	A timeout error has occurred between the MCU and RCU.
Resource Shortage	The establish logical path link function has been rejected by the RCU. All logical path resources in the RCU might be used for other connections.
Serial Number Mismatch	The serial number of the control unit which is connected to this logical path does not match the serial number specified by the Add RCU panel.
Invalid Port	The interface port specified is not in the initiator or RCP mode.
RCU Port Number Mismatch	There are three possible factors: The specified port in the RCU is physically disconnected from the MCU. The port is not configured as an RCU target port. The specified port number is not available.
RCU Port Type Mismatch	The microprogram at the RCU side does not support the fibre remote copy function. Or the specified port type is not RCU target.
Communication Failed	A timeout error has occurred on the path between MCU and RCU.

4.2.7 Deleting an RCU

You can delete an RCU from an MCU only after all TrueCopy volume pairs between the MCU CU image and RCU CU image have been deleted. When you delete an RCU from an MCU, the MCU deletes all logical paths from the current MCU CU image to the selected RCU CU image. Deleting an RCU does not affect the TrueCopy operations between the other MCU CU images and that RCU. After an RCU has been deleted, you can reconfigure the remote copy connections to add another RCU to the MCU, or you can remove the remote copy connections and reconfigure the MCU ports (initiator ports to ordinary target ports for fibre, RCPs to LCPs for serial) to provide additional host channels for the MCU.

Note: If all affected TrueCopy pairs have not been deleted, the MCU will reject the delete RCU operation to prevent accidental deletion of TrueCopy pairs.

The **RCU Operation→Delete RCU** command allows you to delete an RCU from an MCU CU image. The MCU will not allow you to delete an RCU which still has pairs with the MCU.

To delete one or more RCUs from an MCU CU image:

1. Make sure that all affected TrueCopy volume pairs have been deleted.
2. Select the **RCU Operations** tab, and select the **MCU&RCU** display button.
3. Select the RCU(s) that you want to delete from the RCU list.
4. Right-click on the RCU(s), select **RCU Operation**, and then select **Delete RCU**. The list view now displays the requested delete RCU operation(s).
5. Verify the requested operation(s) displayed in the list view (see Figure 4.29). To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click, and select **Cancel All**.
6. To delete the RCU(s), select the **Apply** button (lower right of TrueCopy panel). To cancel the operation(s) and return the list view to its original display, select **Cancel**.

#	S/N	SSID
1	62492	0004

Figure 4.29 Verifying the Delete RCU Operation

4.3 Asynchronous Operations

The TrueCopy Asynchronous operations include:

- Setting the asynchronous copy options (see section 4.3.1),
- Adding consistency (CT) groups (see section 4.3.2),
- Changing the consistency group options (see section 4.3.3),
- Viewing consistency group status (see section 4.3.4), and
- Deleting consistency groups (see section 4.3.5).

The **Asynchronous Operations** tab (see section 4.1.3) allows you to perform the asynchronous operations. All operations performed on the **Asynchronous Operations** tab have a common procedure. To perform any operation on the **Asynchronous Operations** tab:

1. Select the desired display mode for the CT groups: **Display All**, **Used**, or **Not Used**.
2. Select the desired consistency group(s) in the outline view.
3. Right-click on the selected item(s) to display the pop-up menu (see Figure 4.30):
 - Async Option**: allows you to set the parameters for asynchronous copy operations (section 4.3.1).
 - CT Group Operation**: allows you to perform the following operations: add CT group (section 4.3.2), change CT group option (section 4.3.3), view CT group status (section 4.3.4), and delete CT group (section 4.3.5).
4. Select the command for the desired operation, use the panel to perform the operation, and close the panel. There is no panel for the delete CT group operation. The list view now displays the requested operation(s).
5. Verify the specified asynchronous operation(s). Make changes as follows:
 - To change an operation, select the desired operation, right-click, select **Modify**, make the desired changes, and close the panel. The list view displays the updated information.
 - To omit one or more operations, select the operation(s) to be omitted, right-click, and select **Omit**. The operation(s) is/are removed from the list view. If all operations are removed, the list view returns to its original display.
 - To cancel all operations, right-click on the operations, and select **Cancel All**. All operations are removed, and the list view returns to its original display.
6. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

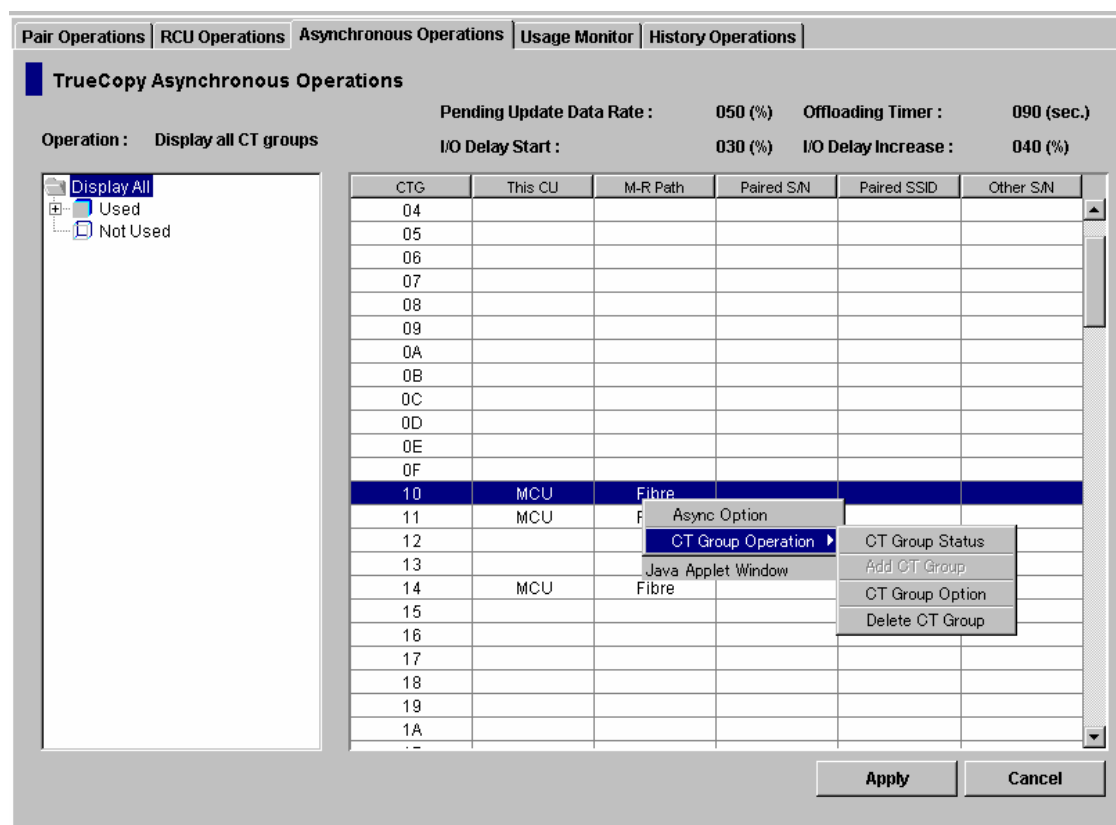


Figure 4.30 Pop-up Menu for the Asynchronous Operations Tab

4.3.1 Setting the Asynchronous Copy Options

The Async Option panel (see Figure 4.31) allows you to set and modify the TrueCopy Asynchronous copy option parameters for the connected subsystem. To open the Async Option panel, right-click on the CT groups and select the **Async Option** command.

The async options apply to the entire physical control unit, including all TrueCopy P-VOLs and S-VOLs behind the control unit.

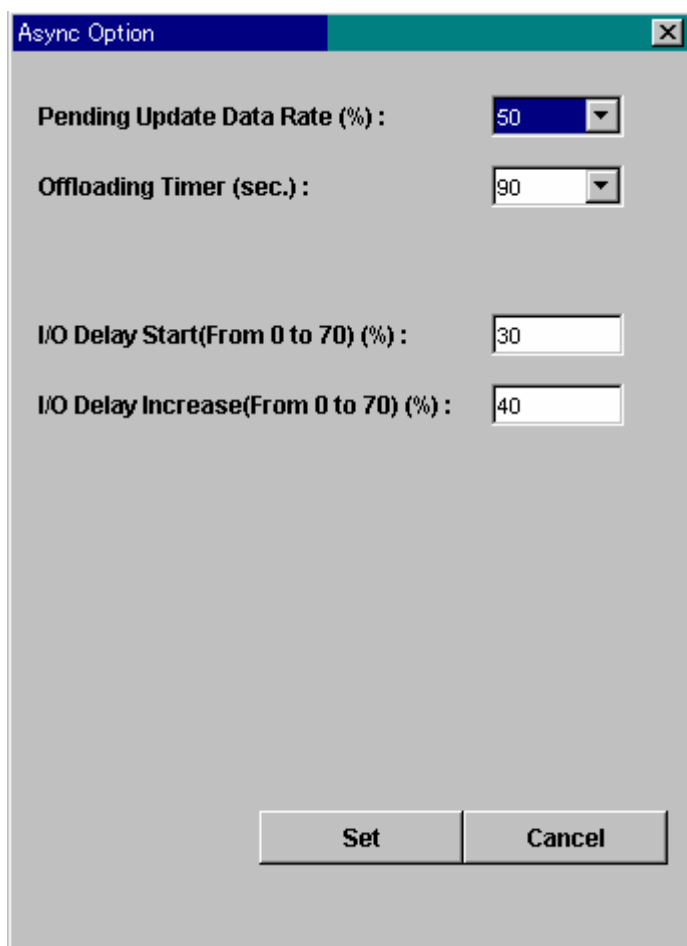


Figure 4.31 Async Option Panel

The **Pending Update Data Rate (%)** option allows you to specify the TrueCopy Asynchronous (and TrueCopy - S/390® Asynchronous) sidefile threshold, which is the maximum amount of cache that can be used for storing TrueCopy (and TrueCopy - S/390®) Async recordsets (sidefiles). You can select any value between 30% and 70% (10% increments). For further information on sidefile inflow control, please see section 2.3.6.

Note: The current pending update data rate is common to both TrueCopy and TrueCopy - S/390® operations. The most recently entered value (on the TrueCopy or TrueCopy - S/390® Async Option panel) will be applied to all TrueCopy Async operations.

Note: If one or more consistency groups exist (TrueCopy or TrueCopy - S/390®), this setting cannot be changed. This setting can only be changed when no CT groups are assigned.

Note: You can specify the Pending Update Data Rate from the Async Option Panel of TrueCopy - S/390®. If the value of the specified Pending Update Data Rate is less than the value of the I/O Delay Start or the I/O Delay Increase that you specified from the Async Option Panel of Hitachi TrueCopy, the Pending Update Data Rate is available.

The **Offloading Timer (sec.)** option allows you to specify the amount of time (0-255 seconds) that the MCU will wait to send a TrueCopy recordset to the RCU. The MCU will suspend all affected TrueCopy Async pairs, if it has not been able to offload a recordset to the RCU within the specified time (e.g., the RCU is still responding channel-command-retry).

Note: The offloading timer value should be set less than the HBA I/O timeout value.

Note: When channel-extenders are used for TrueCopy Async, the offloading timer should be set to 35 seconds or less to avoid affecting host I/O performance.

The **I/O Delay Start** option allows you to specify the threshold (0-70%), which is the maximum amount of cache for starting the inflow control for the asynchronous copy. When the amount of cache that is used for async recordsets reaches the specified value of threshold, the MCU controls the cache inflow. It follows that the delay of I/O time of MCU occurs.

The **I/O Delay Increase** option allows you to specify the threshold (0-70%), which is the maximum amount of cache for starting to strengthen control over the inflow for the asynchronous copy. When the amount of cache that is used for async recordsets reaches the specified value of threshold, the MCU controls the cache inflow. It follows that the delay of I/O time of MCU increases.

Note: Specify the value not exceeding the value of I/O Delay Increase for the value of I/O Delay Start. Specify the value not exceeding the value of Pending Update Data Rate for the value of I/O Delay Increase. If the sidefile threshold is set between 0 to 30%, the influence to the I/O delay is kept low.

Note: It is recommended that you change the values of I/O Delay Start and I/O Delay Increase when all asynchronous pairs of TrueCopy are suspended, and neither the host I/O nor sidefiles exist. If you do not want to control the inflow into a sidefile, specify the same value of the Pending Update Data Rate for both values of I/O Delay Start and I/O Delay Increase, and 0 second for the Offloading Timer.

To set the async options:

1. Select the **Asynchronous Operations** tab. You do not need to select anything in the outline view.
2. Right-click on the CT group list (you do not need to select anything), and select **Async Option** to open the Async Option panel (refer to Figure 4.31). The async options can only be modified when no TrueCopy Asynchronous pairs or groups exist in the connected CU (P-VOLs or S-VOLs).
3. On the Async Option panel, select the desired parameters. For further information on the asynchronous copy options, see above and section 2.3.6.
4. Select **Set** to close the Async Option panel. (Select **Cancel** to cancel the async option operation.) The list view now displays the requested async option operation.
5. Verify the requested operation displayed in the list view (see Figure 4.32).
To change the async option operation, select the operation, right-click, and select **Modify**. To remove the operation, select it, right-click, and select **Cancel All**.
6. To apply the settings, select the **Apply** button (lower right of TrueCopy panel). To cancel the operation and return the list view to its original display, select **Cancel**.

Pending Rate	Offloading	Delay Start	Delay Increase
050	090	030	040

Figure 4.32 Verifying the Async Option Operation

4.3.2 Adding Consistency Groups

The Add CT Group panel (see Figure 4.33) allows you to add consistency groups and select the options for the new groups. To open the Add CT Group panel, select the **Asynchronous Operations** tab, select **Display All** or **Not Used** in the outline view, select the group(s) to be added, right-click on the group(s), select **CT Group Operation**, and select **Add CT Group**.

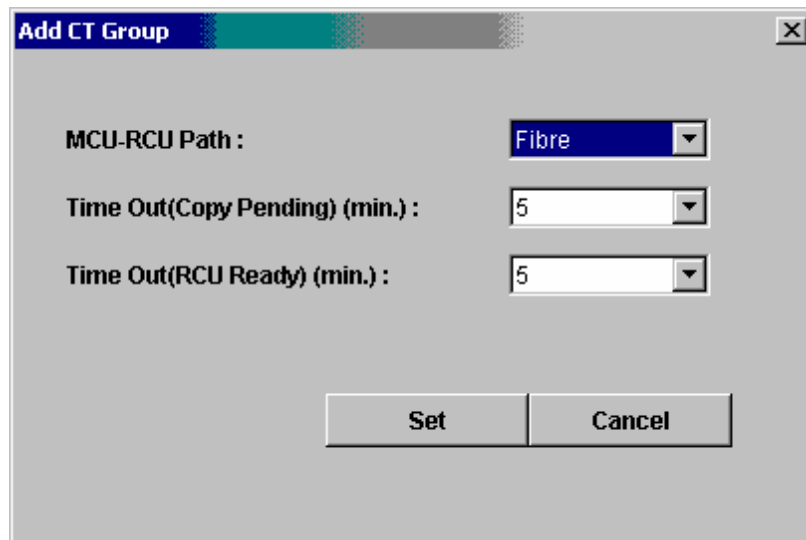


Figure 4.33 Add CT Group Panel

MCU-RCU Path: allows you to select the path type (fibre or serial) for the remote copy connections.

Time Out (Copy Pending) (min.): allows you to select the maximum delay allowed for TrueCopy Asynchronous copy (none or from 1 to 15 min., none = no timeout for copy pending). The default setting is five minutes. If the delay between the TrueCopy P-VOL update and the corresponding S-VOL update reaches the specified time, the RCU will suspend all S-VOLs in the group. A timeout occurs when the RCU was not able to settle a recordset within the specified time, or when the RCU has not had any communication from one of the MCUs in the group within the specified time.

Time Out (RCU ready) (min.): allows you to select the maximum delay allowed for re-establishing MCU-RCU communications following MCU power-off (none or from 1 to 10 min., none = no timeout for RCU ready). The default setting is five minutes. If the MCU is not able to re-establish communication with the RCU within the specified time, the MCU suspends all P-VOLs in the group.

To add one or more consistency groups to the connected MCU:

1. Make sure that the async options are configured as desired (see section 4.3.1).
2. Select the **Asynchronous Operations** tab, and select **Display All** or **Not Used** in the outline view to display the unused consistency groups in the list view.
3. Select the (unused) consistency group(s) that you want to add. The 9900V supports up to 128 consistency groups (00-7F). The 9900 subsystem supports up to 64 groups (00-3F). If you are adding a group with a 9900 RCU, select a group ID between 00 and 3F.
4. Right-click on the selected group(s), select **CT Group Operation**, and then select **Add CT Group** to open the Add CT Group panel (refer to Figure 4.33).
5. On the Add CT Group panel, select the desired path type and group options (copy pending timeout, RCU ready timeout). **Note:** You will not be able to modify the path type of the group, after you assign a pair to the group.
6. Select **Set** to close the Add CT Group panel. (Select **Cancel** to cancel the add group operations.) The list view now displays the requested add group operation(s).
7. Verify the requested operation(s) displayed in the list view (see Figure 4.34).
To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.
8. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

CTG	M-R Path	Time Out(Pending)	Time Out(Ready)
03	Fibre	005	005

Figure 4.34 Verifying the Add CT Group Operation

4.3.3 Changing the Consistency Group Options

The CT Group Option panel (see Figure 4.35) allows you to change the group options for the existing consistency groups. To open the CT Group Option panel, select the **Asynchronous Operations** tab, select **Display All** or **Used** in the outline view, select the desired group(s), right-click on the group(s), select **CT Group Operation**, and then select **CT Group Option**.

Note: If you want to change the group options, you must split all pairs in the group first.

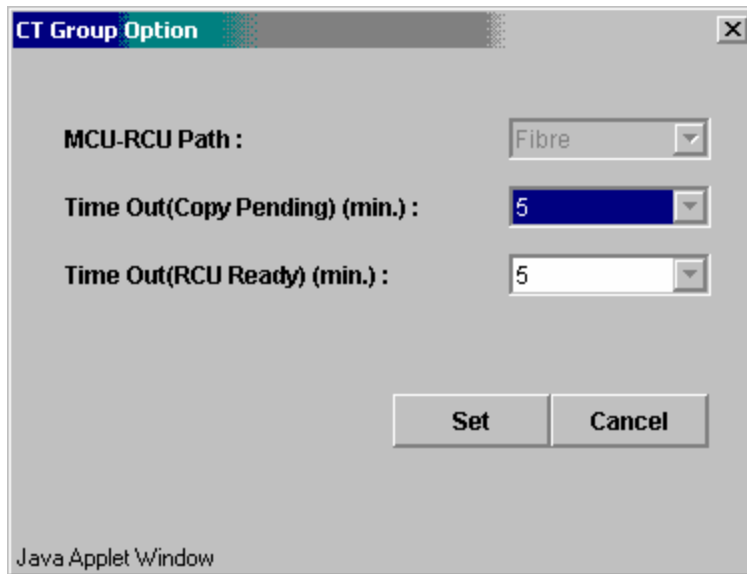


Figure 4.35 CT Group Option Panel

MCU-RCU Path: allows you to select the port type for the remote copy connections. You can only change the port type when the group does not contain any pairs.

Time Out (Copy Pending) (min.): allows you to select the maximum delay allowed for TrueCopy Asynchronous copy (none or from 1 to 15 min., none = no timeout for copy pending). The default setting is five minutes. If the delay between the TrueCopy P-VOL update and the corresponding S-VOL update reaches the specified time, the RCU will suspend all S-VOLs in the group. A timeout occurs when the RCU was not able to settle a recordset within the specified time, or when the RCU has not had any communication from one of the MCUs in the group within the specified time.

Time Out (RCU ready) (min.): allows you to select the maximum delay allowed for re-establishing MCU-RCU communications following MCU power-off (none or from 1 to 10 min., none = no timeout for RCU ready). The default setting is five minutes. If the MCU is not able to re-establish communication with the RCU within the specified time, the MCU suspends all P-VOLs in the group.

To change the group options for one or more groups:

1. Make sure that all pairs in the group(s) have been split (Pairsplit-r), so that you can change the group options. See section 5.6 for instructions on splitting pairs.
2. Select the **Asynchronous Operations** tab, and select **Display All** or **Used** in the outline view to display the existing consistency groups in the list view.
3. Select the consistency group(s) for which you want to change the options. You can only select groups for which the connected subsystem is the MCU (**This CU Type = MCU**).
4. Right-click on the selected group(s), select **CT Group Operation**, and then select **CT Group Option** to open the CT Group Option panel (refer to Figure 4.35). If the **CT Group Option** command is not enabled, you need to split the remaining pairs in this group.
5. On the CT Group Option panel, select the desired group options. For further information on the consistency group options, see above and section 2.4.1. You can only change the path type when the group does not contain any pairs.
6. Select **Set** to close the CT Group Option panel. (Select **Cancel** to cancel the group option operation.) The list view now displays the requested change group option operation(s).
7. Verify the requested operation(s) displayed in the list view (see Figure 4.36).
To change the group option operation(s), select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.
8. To apply the settings, select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.
9. When you are finished changing the CT group options, you can resume (resync) all pairs in the group(s) (Pairresync). See section 5.7 for instructions on resuming pairs.

CTG	M-R Path	Time Out(Pending)	Time Out(Ready)
<i>03</i>	<i>Fibre</i>	<i>005</i>	<i>005</i>

Figure 4.36 Verifying the CT Group Option Operation

4.3.4 Viewing Consistency Group Status

The CT Group Status panel (see Figure 4.37) displays the detailed status information for the selected TrueCopy Asynchronous consistency group.

To view the detailed consistency group status information:

1. Select the **RCU Operations** tab, and select **Display All** or **Used** in the outline view.
2. Select the desired CT group in the list view. **Note:** Select only one consistency group.
3. Right-click on the group, select **CT Group Operation**, and then select **CT Group Status** to open the CT Group Status panel.

The screenshot shows the 'CT Group Status' window. At the top, it displays 'CT Group : 03' and 'This CU Type : RCU'. Below this are two tables. The first table has columns 'S/N' and 'SSID' with values '12345' and '0008'. The second table has columns 'Port', 'Group', and 'LUN' with four rows of data. Below the tables, there are labels for 'MCU-RCU Path :', 'Time Out(Copy Pending) (min.):', and 'Time Out(RCU Ready) (min.):'. At the bottom are four buttons: 'Previous', 'Next', 'Refresh', and 'Close'.

S/N	SSID
12345	0008

Port	Group	LUN
CL1-J	00(Grp1J00)	0C(01:1C)
CL1-B	00(Group1B)	1C(01:3C)
CL1-B	00(Group1B)	1F(01:3F)
CL1-J	00(Grp1J00)	2C(01:5C)

MCU-RCU Path :
Time Out(Copy Pending) (min.): 15
Time Out(RCU Ready) (min.):

Previous Next Refresh Close

Figure 4.37 CT Group Status Panel

CT Group: Group number of the selected consistency group

This CU Type: CU type (MCU or RCU) of the selected consistency group

S/N, SSID: Serial number and SSID of the CUs of the selected consistency group

Port, Group, LUN: Pairs in the connected CU that are in the selected consistency group. The **Group** column shows the host group name in parentheses, and the **LUN** columns shows the CU:LDEV in parentheses. For LUs with more than one path, only the first path is listed.

MCU-RCU Path: Type of channel interface between the subsystems (fibre or serial)

Time Out (Copy Pending): Maximum delay allowed for TrueCopy Asynchronous copy (see section 4.3.3)

Time Out (RCU Ready): Maximum delay allowed for re-establishing MCU-RCU communications following MCU power-off (see section 4.3.3)

The **Previous** button displays status information for the consistency group number before the current consistency group. The **Next** button displays status information for the CT group after the current group. The **Refresh** button refreshes the status information.

4.3.5 Deleting Consistency Groups

A consistency group can be deleted only from the MCU and only if the MCU does not contain any P-VOLs still assigned to the group. Deleting a consistency group from an MCU does not affect the consistency groups registered at other MCUs. The RCU will automatically delete a consistency group when the last volume pair in the group is deleted.

The **CT Group Operation→Delete CT Group** command allows you to delete a group from the current MCU. The MCU will not allow you to delete a group which still has P-VOLs in the current MCU.

To delete one or more consistency groups from an MCU:

1. Make sure that all affected TrueCopy Asynchronous pairs have been deleted.
2. Select the **Asynchronous Operations** tab, and select **Display All** or **Used** in the outline view.
3. Select the consistency group(s) that you want to delete. You can only delete consistency groups from the MCU (**This CU Type = MCU**).
4. Right-click on the selected group(s), select **CT Group Operation**, and then select **Delete CT Group**. If the **Delete CT Group** command is not enabled, one of the selected groups still contains P-VOLs in this MCU. The list view now displays the requested delete CT group operation(s).
5. Verify the requested operation(s) displayed in the list view (see Figure 4.38). To remove one or more delete group operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click, and select **Cancel All**.
6. To delete the group(s), select the **Apply** button (lower right of TrueCopy panel). To cancel the operation(s) and return the list view to its original display, select **Cancel**.

CTG	M-R Path
13	Fibre
2B	Fibre
5B	Fibre

Figure 4.38 Verifying the Delete CT Group Operation

4.4 Usage Monitor Operations

The **Usage Monitor** tab (see section 4.1.4) allows you to perform the remote copy usage monitoring operations for the connected 9900V subsystem. The usage monitoring function enables you to collect I/O statistics for all LDEVs on the connected subsystem.

The usage monitor operations are:

- Starting and stopping monitoring (see section 4.4.1),
- Displaying the usage monitor graph (see section 4.4.2), and
- Exporting the usage monitor data file (see section 4.4.3).

4.4.1 Starting and Stopping Usage Monitoring

At each data sampling time interval, the usage monitoring function collects 480 pieces of data for each LDEV and up to 16,385 pieces of data for the entire subsystem.

To start remote copy usage monitoring for the connected 9900V subsystem:

1. Select the **Usage Monitoring** tab.
2. Set the desired sampling time interval (in minutes) in the **Rate** box. You can select the time interval from the drop-down list of the **Rate** box. When the desired value is not listed in the drop-down list, you can also input the time interval directly. You can input from 1 to 546 minutes. A rate of five minutes or more is recommended.
3. Select **Run** in the **Operation** box.
4. To start monitoring, select the **Apply** button (lower right of TrueCopy panel). The **Status** field will change from **Stop** to **Running**. To cancel your settings and return the panel to its original display, select **Cancel**.

Note: The collection of monitoring data continues, even if the panel is closed, until you stop monitoring operations. Monitoring data collection continues even if the SVP is rebooted. If a monitor starts, the data of the sidefile usage is stored. To obtain the stored data, use Export Tool.

To stop remote copy usage monitoring on the connected 9900V subsystem:

1. Select the **Usage Monitor** tab.
2. Select **Stop** in the **Operation** box.
3. To stop monitoring, select the **Apply** button (lower right of TrueCopy panel). The **Status** field will change from **Running** to **Stop**. To cancel your setting and return the panel to its original display, select **Cancel**.

4.4.2 Displaying the Usage Monitor Graph

When usage monitoring is running, the Usage Operations panel can display user-selected remote copy I/O statistics in real time. The I/O statistics data is collected according to the data-sampling rate selected in the **Rate** box.

The usage monitor graph plots the user-selected I/O statistics (up to 65 data points) on an x-y graph. The x-axis displays time. The y-axis displays the number of I/Os during the last sampling period. The legend (right side of the graph) indicates the data being displayed. If a value on the y-axis exceeds 10,000,000, the value is displayed in exponential notation (e.g., $1E7 = 1 \times 10^7 = 10,000,000$; $2E8 = 2 \times 10^8 = 200,000,000$). The **Update** field displays the most recent data sample time for the data on the graph.

To display the usage monitor graph:

1. Make sure that usage monitoring is running (**Status = Running**). The usage monitor graph can only be displayed when monitoring is on.
2. Right-click on the graph area of the Usage Operations panel, and select **Display Item** to open the Display Item panel (see Figure 4.39).
3. If you want to display I/O statistics for all LDEVs in the subsystem, select **Subsystem Total**. If you want to display I/O statistics for a specific LU, select **LU**, and then enter the desired LU by selecting the port and entering the group (00-7F) and LUN (00-FF).

4. In the **Monitor Data** box, select the I/O statistics data that you want to display on the graph. You must select at least two boxes. Table 4.3 describes the I/O statistics data.

Note: If you want to display Average Transfer Rate, Average Response, or Pair Synchronized, you cannot select any other statistics at the same time. The graph can only display one type of data at a time: I/O count, rate, response time, or percent.

5. Select **Set** to close the Display Item panel. The Usage Operations panel now displays a graph showing the selected I/O statistics data for the selected LU(s) (see Figure 4.40).

To enlarge the displayed graph, right-click on the graph, and select the **Large Size** command (see Figure 4.41). To return the graph to normal size, right-click on the graph, and select the **Normal Size** command.

Note: To stop displaying the usage monitor graph, right-click on the graph, and select **Close**. To stop displaying all graphs, select **Close All**. The usage monitor graph closes automatically in the following cases:

- When you stop the usage monitoring function (by selecting **Stop** in the **Operation** box, and then selecting **Apply**),
- When you select another tab,
- When you select another program product, and
- When you exit the Storage Navigator software.

Display Item

Select LU

☒ Subsystem Total

☐ LU

Port - Group - LUN

CL1-A

Monitor Data

RIO Count

☐ All RIO Count
☐ All Read Count
☐ All Write Count

Initial Copy

☐ Initial Copy RIO Count
☐ Initial Copy Hit Count
☐ Average Transfer Rate [kB/s]
☐ Average Response [ms]

Migration

☐ Migration Copy RIO Count
☐ Migration Copy Hit Count

Update Copy

☐ Update Copy RIO Count
☐ Update Copy Hit Count
☐ Average Transfer Rate [kB/s]
☐ Average Response [ms]

Restore Copy

☐ Restore Copy RIO Count
☐ Restore Copy Hit Count

Asynchronous Copy

☐ Asynchronous RIO Count
☐ Total Number of Recordset
☐ RCU Command Retries
☐ MCU Command Retries
☐ Average Transfer Rate [kB/s]
☐ Average RIO Response [ms]

Synchronization

☐ Pair Synchronized [%]
☐ Out of Synchronous Tracks

Set

Cancel

Note: The Synchronization data (Pair Synchronized(%), Out of Sync Tracks) are not available in this version.

Figure 4.39 Selecting the Data for the Usage Monitor Graph

Table 4.3 Remote Copy I/O Statistics

Statistic [1]	Description
RIO count	
All RIO count	Total number of remote I/Os
All read count	Total number of remote read I/Os
All write count	Total number of remote write I/Os
Initial copy	
Initial copy RIO count	Number of initial copy remote I/Os
Initial copy hit count	Number of initial copy hits
Average transfer rate (kB/s)	Average transfer rate (kB/sec) for initial copy remote I/Os
Average response (ms)	Average response time (msec) for initial copy remote I/Os
Migration Copy [2]	
Migration copy RIO count	Number of migration copy remote I/Os
Migration copy hit count	Number of migration copy hits
Update copy	
Update copy RIO count	Number of update copy remote I/Os
Update copy hit count	Number of update copy hits
Average transfer rate (kB/s)	Average transfer rate (kB/sec) for update copy remote I/Os
Average response (ms)	Average response time (msec) for update copy remote I/Os
Restore Copy [2]	
Restore copy RIO count	Number of restore copy remote I/Os
Restore copy hit count	Number of restore copy hits
Asynchronous copy	
Asynchronous RIO count	Number of asynchronous update copy remote I/Os
Total number of recordsets	Number of asynchronous recordsets
RCU command retries	Number of command retries due to RCU channel-command-retry messages
MCU command retries	Number of command retries due to MCU state-change-pending (SCP) messages
Average transfer rate (kB/s)	Average transfer rate (kB/sec) for TrueCopy/TC390 Async update copy remote I/Os
Average RIO response (ms)	(Total RIO process time on a subsystem or selected volume for a certain interval period) / (Asynchronous RIO count); where RIO process time = time between the async data transfer request and the actual transfer of the recordset(s) to the RCU
Synchronization [3]	
Pair Synchronized (%)	Percent completion of initial copy operations (i.e., number of synchronized pairs / total number of pairs)
Out of Sync Tracks	Number of tracks that have not yet been copied by the initial copy or resync copy operation (this applies only when suspended during initial copy or during resync copy)

Notes:

1. The RIO statistics include both TrueCopy and TrueCopy - S/390® remote copy operations (e.g., Async RIO Count = TCA RIOs + TC390A RIOs).
2. The **Migration Copy** and **Restore Copy** data apply only to internal use.
3. The **Synchronization** data cannot be displayed for TrueCopy pairs which were created by the previous version of TrueCopy (0 is always displayed).

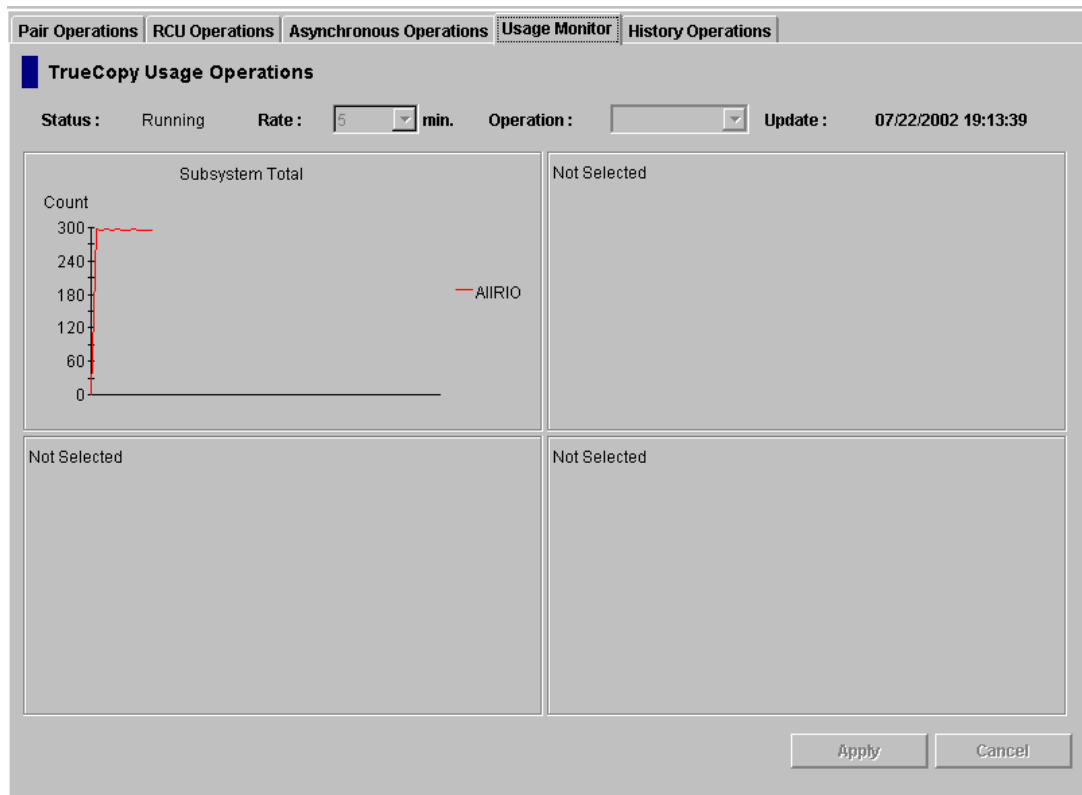


Figure 4.40 Usage Monitor Graph: Normal Size Viewing Option

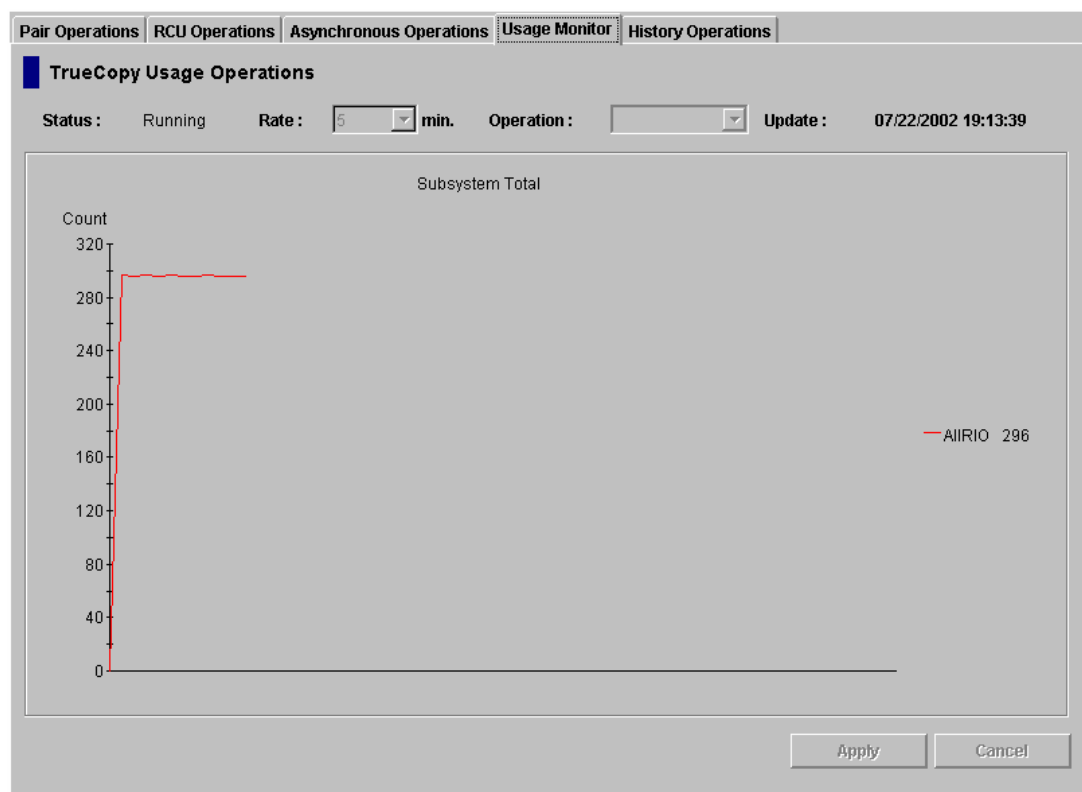


Figure 4.41 Usage Monitor Graph: Large Size Viewing Option

4.4.3 Exporting the Usage Monitor Data File

The **Export File** button () on the Hitachi Storage Navigator main panel allows you to export the usage monitoring data file.

Note: This function is intended for use by developers analyzing the performance of remote copy operations. Please note that this function is not intended for use by the customer.

To export the usage monitoring data file:

1. Select the **Usage Monitor** tab.
2. Select the **Export File** button () on the Hitachi Storage Navigator main panel to open the Export Data Files panel (see Figure 4.42).
3. On the Export Data Files panel, select **Remote Copy Usage**. Only one button can be selected on the Export Data Files panel.
4. Select **Next>>** to open the Remote Copy Usage panel (see Figure 4.43 and Figure 4.44).
5. Download the remote copy usage monitor file as follows:
 - When you are downloading the usage monitor file for the first time, select **Export Data** (see Figure 4.43), and then select **Download**.
 - After you have downloaded the usage monitor file at least once, select **Existing Export Data** (see Figure 4.44), and then select **Download**.
6. On the File Download confirmation panel, select **OK** to start the file compression process (or select **Cancel** to cancel your download request). The Compressing Files panel displays the progress of the file compression operation.

Note: When other users are using the File Export or FD Dump function, an error occurs for this operation.

Note: If file compression takes too long, the browser may time out. Close the Compressing Files panel (close () button), and restart the export operation (step 2).

Note: If you accidentally select **Cancel** during file compression, close the Compressing Files panel, wait a while, and download the file again (select **Existing Export Data**). To check the sidefile usage, use Export Tool.
7. Select **OK** on the File Download panel to open the Save As panel (or select **Cancel** to cancel your request to export the file).
8. On the Save As panel, enter the desired name and location for the export file, and select **Save** (or select **Cancel** to cancel your request to export the file).

Note: The File Export function is a browser application, so each operation panel exists individually. Other panel operations are available during file export operations.

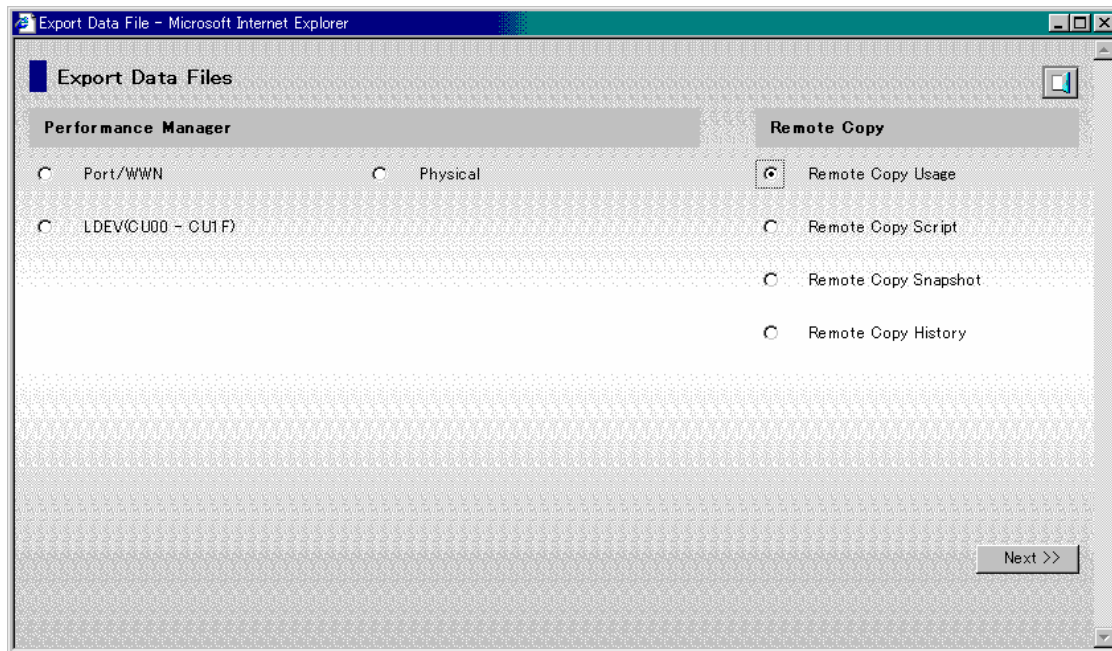


Figure 4.42 Exporting the Usage Monitor Data

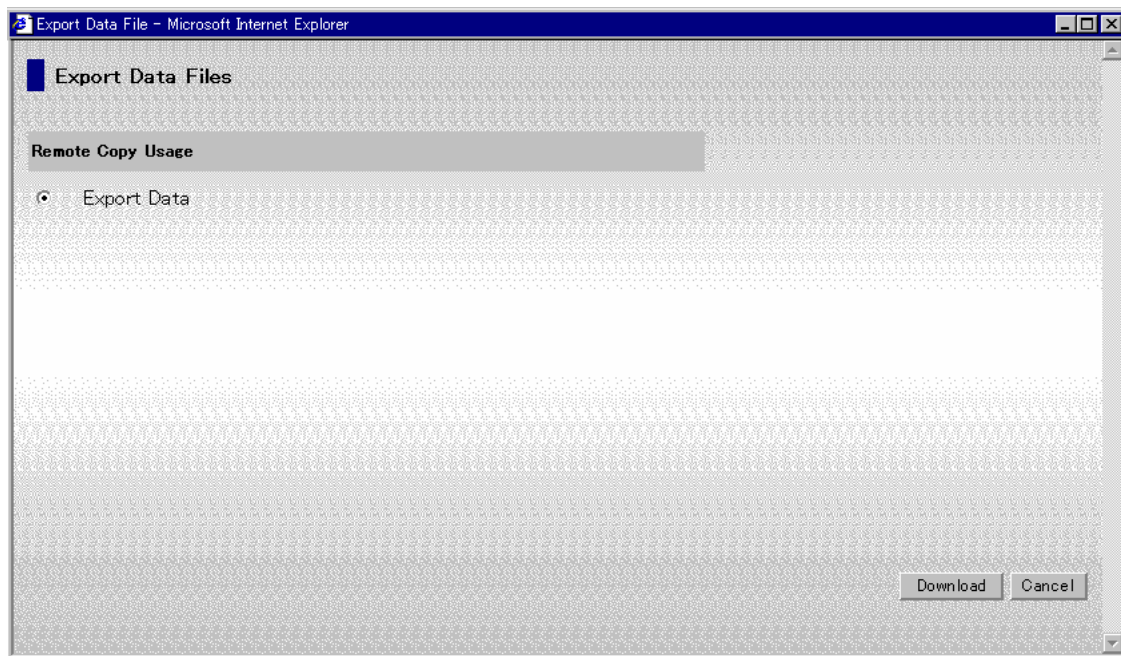


Figure 4.43 Export Data Files – Remote Copy Usage (first export operation shown)

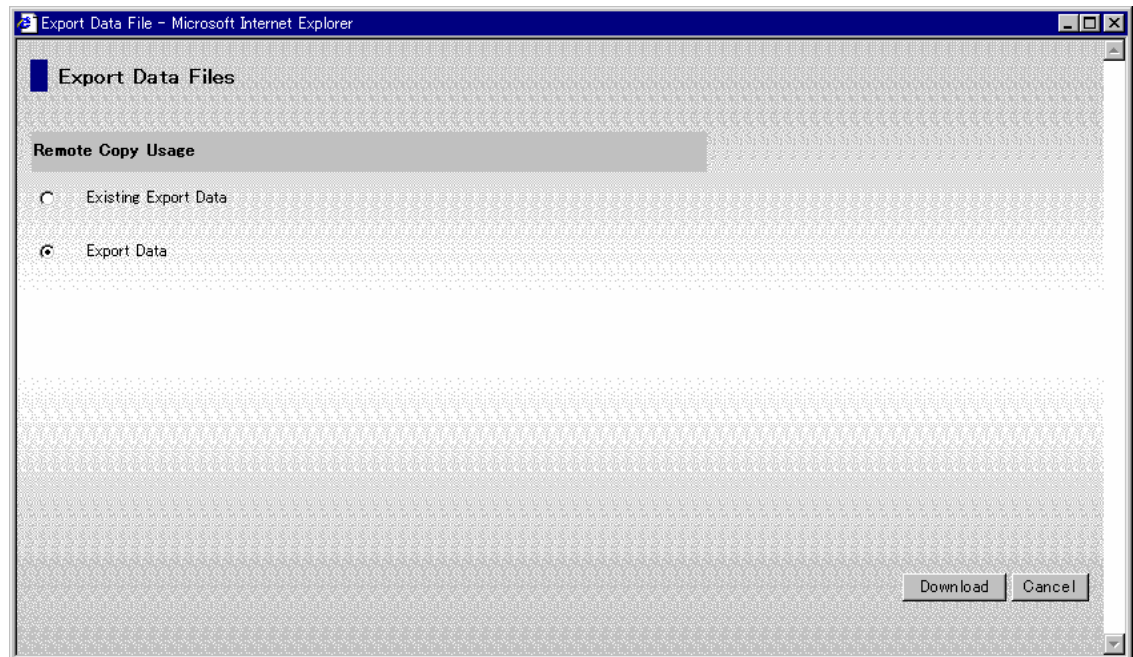


Figure 4.44 Export Data Files – Remote Copy Usage

4.5 History Operations

The **Export File** button () on the Hitachi Storage Navigator main panel allows you to export the remote copy history file. For information on the **History Operations** tab, see section 4.1.5.

To export the remote copy history file:

1. Select the **History Operations** tab.
2. Select the **Export File** button () on the Hitachi Storage Navigator main panel to open the Export Data Files panel (refer to Figure 4.42).
3. On the Export Data Files panel, select **Remote Copy History**. Only one button can be selected on the Export Data Files panel.
4. Select **Next>>** to open the Remote Copy History panel (see Figure 4.45 and Figure 4.46).
5. Download the remote copy history file as follows:
 - When you are downloading the remote copy history file for the first time, select **Export Data** (see Figure 4.45), and then select **Download**.
 - After you have downloaded the remote copy history file at least once, select **Existing Export Data** (see Figure 4.46), and then select **Download**.
6. On the File Download confirmation panel, select **OK** to start the file compression process (or select **Cancel** to cancel your download request). The Compressing Files panel displays the progress of the file compression operation.

Note: When other users are using the File Export or FD Dump function, an error occurs for this operation.

Note: If file compression takes too long, the browser may time out. Close the Compressing Files panel (close () button), and restart the export operation (step 2).

Note: If you accidentally select **Cancel** during file compression, close the Compressing Files panel, wait a while, and download the file again (select **Existing Export Data**).
7. Select **OK** on the File Download panel to open the Save As panel (or select **Cancel** to cancel your request to export the file).
8. On the Save As panel, enter the desired name and location for the export file, and select **Save** (or select **Cancel** to cancel your request to export the file).

Note: The File Export function is a browser application, so each operation panel exists individually. Other panel operations are available during file export operations.

Figure 4.47 shows the displayed history file (OCPYHIST.csv). The displayed items are:

- ① Date and time when the operation was completed.
- ② Status of the operation.
- ③ CU number and LDEV number of the operated volume.
- ④ This column is not used.
- ⑤ CU number and LDEV number of the paired volume.
- ⑥ The time taken for the operation (from the start of the operation to the end).
Displayed only for **Pairing Complete** and **Pair Resync. Complete** operations.

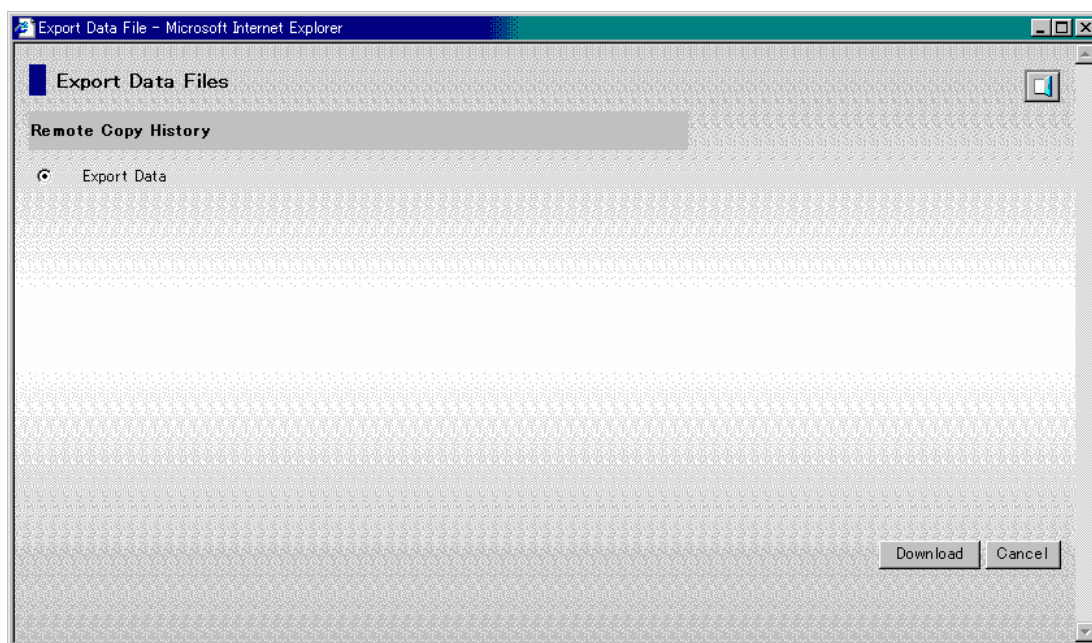


Figure 4.45 Export Data Files – Remote Copy History (first export operation shown)

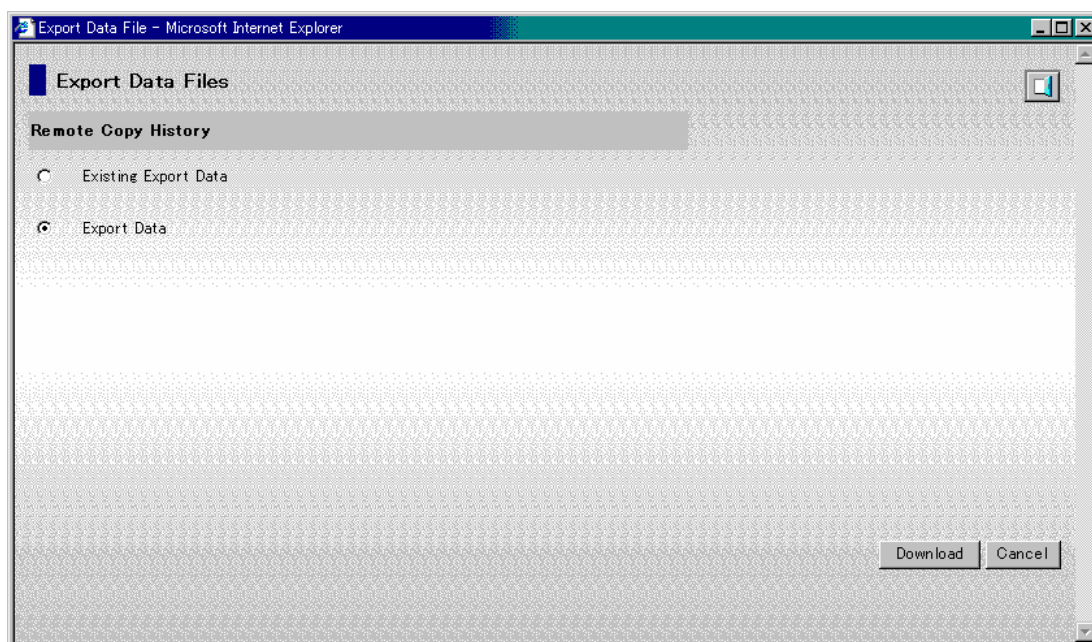


Figure 4.46 Export Data Files – Remote Copy History

```

2002/07/25 20:26:43,Pairing Start,1a:80,-----,1a:85,
2002/07/25 20:25:30,Pair Delete,00:84,-----,00:86,
2002/07/25 17:01:33,Suspend Operation,00:85,-----,00:87,
2002/07/19 20:01:58,Pair Resync. Complete,1a:80,-----,1a:9e,000:00:02
2002/07/19 20:01:56,Pair Resync. Start,1a:8a,-----,1a:a8,
2002/07/18 09:36:22,Pairing Complete,1a:80,-----,1a:85,000:00:10

```

① ② ③ ④ ⑤ ⑥

Figure 4.47 Example of TrueCopy History File (OCPYHIST.csv)

4.6 Optimizing TrueCopy Operations and Subsystem Performance

Hitachi TrueCopy operations result in increased utilization of the 9900V subsystem's channel resources because of the additional write (remote copy) operations to the secondary volumes. The TrueCopy update copy mode (synchronous or asynchronous) determines exactly how the remote copy operations will impact subsystem performance as follows:

- **Synchronous** copy mode has an additional effect on subsystem performance: increased service and disconnect time for write I/Os to TrueCopy P-VOLs due to the delay between channel-end and device-end. The length of this delay increases as the distance between the P-VOL and S-VOL increases, so that the longest delay occurs when the primary and secondary volumes are the maximum distance apart.
- **Asynchronous** copy mode eliminates all delays associated with TrueCopy Synchronous operations while providing increased protection for write-dependent applications in the event of a disaster. Write I/Os for TrueCopy Asynchronous P-VOLs are processed in the same way as writes for simplex volumes, without any increase in service or disconnect time. The asynchronous S-VOL updates are performed completely independent of all host I/O processes at the P-VOLs, and there are no restrictions on subsequent read/write operations to TrueCopy Asynchronous P-VOLs. The only performance concerns for TrueCopy Asynchronous are (1) ensuring that adequate cache resources are available for sidefiles which are used to store the recordsets at both the MCUs and RCUs, and (2) ensuring that sufficient MCU-RCU paths are defined for copy operations.

In addition to the TrueCopy update copy mode, several other factors can also affect 9900V subsystem performance. You can optimize both the TrueCopy operations and the I/O performance of the subsystems by analyzing workloads and addressing system-level conditions (e.g., number of host interface paths) which can affect subsystem performance. You can also control the impact of TrueCopy operations on subsystem performance by selecting the appropriate RCU options for each MCU (see section 4.2.3) and the appropriate update copy mode (synchronous or asynchronous), initial copy options (see section 5.3.1), and pair options (see section 5.3.2) for each TrueCopy pair. In addition, you can upgrade the TrueCopy hardware components and/or adjust the configuration of the components to improve subsystem performance under a wide range of operating conditions.

Note: For important information about proper configuration for your operational environment, refer to Appendix B.

Table 4.4 lists some of the conditions which affect subsystem performance and provides recommendations for addressing these conditions.

Table 4.4 Optimizing TrueCopy Operations and 9900V Subsystem Performance

Condition	Description	Recommendation(s)
Write-intensive workloads	Write-intensive workloads, such as database logging volumes, can have a significant impact on subsystem I/O response times.	Spread write-intensive data across several volumes to minimize queuing.
Large block size	Workloads with large write block sizes, such as DB deferred writes, can impact performance.	Spread workloads with large write block sizes across several volumes.
High host channel demand	The demand on the MCU's host channels can affect performance.	Spread the workload across several disk subsystems to utilize additional channels.
Sequential write operations	TrueCopy operations can have a negative impact on workloads with a high percentage of sequential write operations, such as batch processing operations (e.g., dump/restore, sort operations).	Avoid performing restore operations to volumes which belong to TrueCopy pairs. Instead, restore data to a scratch volume and then create the TrueCopy volume pair.
Cache size	Large cache size improves read hit performance, which allows more subsystem resources to be devoted to write operations. The resulting performance improvement can offset some or all of the performance loss due to the TrueCopy remote copy operations. TrueCopy Async (and HXRC and Concurrent Copy) requires additional cache for sidefile data. Insufficient cache resources can result in command retries, state-change-pending (SCP) notifications, and puncture conditions.	Consider increasing the cache size of the TrueCopy subsystems to handle sidefile operations and to improve overall subsystem performance. For best results, the cache and NVS capacity of the primary and secondary subsystems should be the same (the RCU sidefile requirements for TrueCopy Async are twice that of the MCU) to enable the remote site to function adequately during disaster recovery.
RCU capacity	The performance of the RCUs directly affects the performance of the MCUs. If an RCU becomes overloaded with heavy update activity, MCU and system performance can also be degraded.	Distribute TrueCopy remote copy operations among several remote subsystems to avoid overloading any one RCU.
Paths	An inadequate number of paths may decrease subsystem performance. Performing TrueCopy Synchronous operations over long distances can also degrade performance. TrueCopy Asynchronous is recommended for long distances.	Make sure to install an adequate number of paths between the primary and secondary subsystems. This is especially important for subsystems which contain both P-VOLs and S-VOLs.

4.7 Discontinuing TrueCopy Operations

If you plan to use TrueCopy for nondisruptive data migration or duplication (see section 5.9), you will configure and establish TrueCopy operations, allow TrueCopy to synchronize the volumes, redirect application I/Os (if migrating), and then discontinue TrueCopy operations. When you are ready to discontinue TrueCopy operations, you will need to perform TrueCopy operations in the correct order to avoid generating error messages. For example, TrueCopy will not allow you to delete an RCU path until you have deleted all TrueCopy pairs still using that path, and you cannot delete a group until you have deleted all TrueCopy Asynchronous pairs in that group.

To discontinue all TrueCopy operations, perform the following actions in the following order:

1. First delete all TrueCopy pairs from the MCU(s) (pairsplit-S, see section 5.8). For TrueCopy Async pairs, you can use the Delete Range-Group option to delete all pairs in a group using just one operation. Verify that the pair status has changed to SMPL for all TrueCopy volumes before continuing.
2. Delete the TrueCopy Async group(s) from the MCU(s) (see section 4.3.5). The RCU will automatically delete a group when all pairs in the group have been deleted.
3. Delete the RCUs (see section 4.2.7). Check each CU image of each MCU to make sure that all RCUs have been deleted before continuing.
4. Remove the remote copy connections (physical paths). If you are not familiar with the operation of the remote copy hardware components (e.g., switches, ESCON® directors, repeaters), please call the Hitachi Data Systems Support Center for assistance.
5. Reconfigure the 9900V ports as needed (e.g., reset the initiator ports to ordinary target ports at the MCUs) (see section 4.2.1).

Chapter 5 Performing TrueCopy Pair Operations

5.1 Preparing for TrueCopy Volume Pair Operations

Before starting TrueCopy operations, you must consider the relative importance of subsystem I/O performance and disaster recovery preparation. As described in section 4.6, remote copy operations can affect the I/O performance of the MCUs and RCUs. TrueCopy provides many options (RCU options, initial copy options, pair options, group options, async options) which allow you to control the impact of TrueCopy operations on I/O performance. These options can be set separately for each pair, for each TrueCopy Async group, and for each MCU to provide maximum flexibility. You can select options which minimize the impact of TrueCopy operations on subsystem performance, or options which maximize the effectiveness of TrueCopy operations to ensure the best level of backup data integrity. System-level factors (e.g., number of paths) can also affect TrueCopy operations and subsystem performance (see section 4.6).

For TrueCopy disaster recovery operations, you should make sure that the RCUs are attached to a host server to enable reporting of sense information and transfer of host failover information. If the remote site is unattended, you should attach the RCUs to a host server at the main site, so that the system administrator can monitor the operational condition of the RCUs.

To prepare for TrueCopy volume pair operations, you need to identify the volumes (by port, TID, and LUN and/or by LDEV ID) for which you want to establish TrueCopy remote copy operations. You should identify volumes which are required for system operation as well as volumes which contain important data to be backed up (e.g., DB log files). Copying these volumes to the remote site will enable faster disaster recovery than maintaining a current version of these files at the remote site. For large databases which span multiple volumes, you should plan to establish a TrueCopy Asynchronous consistency group for each database, so that the update sequence consistency of the database can be ensured at the remote site.

You can start creating the TrueCopy volume pairs as soon as you have:

- Identified the volumes (LUs) which will become the TrueCopy P-VOLs (and S-VOLs),
- Ensured that all system and TrueCopy requirements have been met (sections 3.1 and 3.2),
- Completed hardware and software installation (see sections 3.3 and 3.4), and
- Configured the MCUs and RCUs for TrueCopy operations (see section 3.5).

If you will be using the TrueCopy remote console software to perform TrueCopy operations, the MCU of each TrueCopy volume pair must be LAN-attached to the 9900V Storage Navigator remote console PC. You should also attach all RCUs to a 9900V Storage Navigator PC via a separate LAN at the remote site. If you will be using CCI commands instead of the Hitachi TrueCopy remote console software, please contact your Hitachi Data Systems account team for information on TrueCopy configuration services.

5.2 Pair Operations Tab

The **Pair Operations** tab (see Figure 5.1) displays the TrueCopy pair information for the connected subsystem and allows you to perform all TrueCopy volume pair operations.

To update the information on the **Pair Operations** tab, select another tab and then reselect the **Pair Operations** tab, or select the **Refresh** button (🔄) (top right of Storage Navigator panel). The pair information is also updated when you select the **Apply** button.

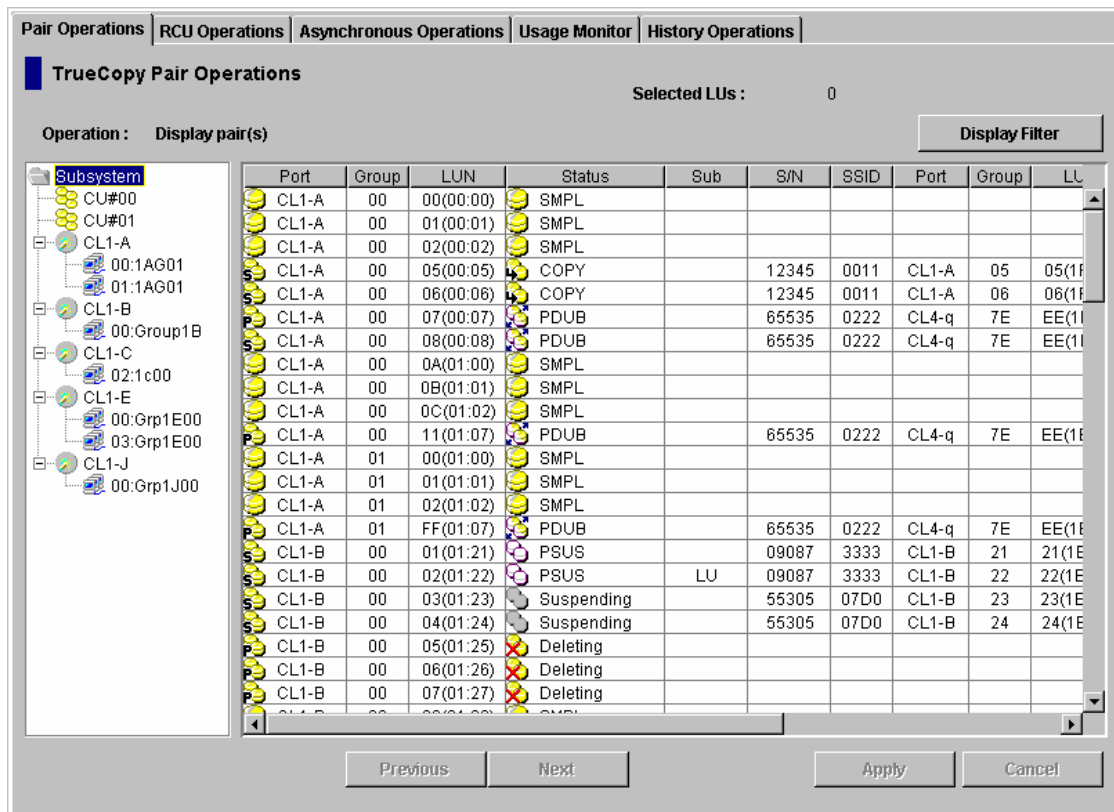


Figure 5.1 Pair Operations Tab

The **Pair Operations** tab presents:

- **Outline view:** displays the connected subsystem and the CU images, ports, and host groups which contain LUs (CU images and ports without LUs are not displayed). Select the subsystem to display all LUs, or select the desired CU image (🔗), port (🌐), or host group (🏠) to display the LUs for that CU image, port, or host group. You can only select one CU image, port, or host group at a time.
- **List view:** displays the detailed LU information (see section 5.2.1) for the selected item (subsystem, CU, or port). The LU information can be sorted by column and in ascending or descending order. For LUs with more than one path, each path is displayed in a separate row.

- **Display Filter button:** opens the Display Filter panel (see section 5.2.2), which allows you to control which volumes are displayed in the list view by host group, port (if a CU image is selected), CU image (if a port is selected), pair type (sync and/or async), volume type (P-VOL and/or S-VOL), CT group, path type, pair status, and async status.
- **Previous and Next buttons:** The list view can contain up to 256 rows. Use these buttons to display the previous or next 256 rows of LU information.

The **Pair Operations** tab allows you to perform the TrueCopy pair operations. All operations performed on the **Pair Operations** tab have a common procedure. To perform any operation on the **Pair Operations** tab:

1. Select the subsystem or the desired CU image in the outline view. **Note:** When a port is selected, paircreate operations cannot be performed.
2. Select the desired LU(s) or pair(s) in the list view.
3. Right-click on the selected LU(s)/pair(s) to display the pop-up menu (see Figure 5.2):
 - Pairedisplay:** displays the LU/pair status (see section 5.5)
 - Paircreate:** allows you to create new pairs (sync or async) (see section 5.3)
 - Pairsplit-S:** allows you to delete pairs (see section 5.8)
 - Pairsplit-r:** allows you to split (suspend) pairs (see section 5.6)
 - Pairresync:** allows you to resume pairs (see section 5.7)
 - Change Pair Option:** allows you to change the pair options (see section 5.4)
 - Snapshot:** allows you to write the pair status information to a text file (section 5.2.3)

Note: The availability of the commands (enabled/disabled) depends on the status of the LU(s) or pair(s) selected in the list view.
4. Select the command for the desired operation, use the panel to perform the operation, and close the panel. The list view now displays the requested operation(s).
5. Verify the specified pair operation(s). Make changes as follows:
 - To change an operation, select the desired operation, right-click, select **Modify**, make the desired changes, and close the panel. The list view displays the updated information.
 - To omit one or more operations, select the operation(s) to be omitted, right-click, and select **Omit**. The operation(s) is/are removed from the list view. If all operations are removed, the list view returns to its original display.
 - To cancel all operations, right-click on the operations, and select **Cancel All**. All operations are removed, and the list view returns to its original display.
6. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.
When an error occurs with an operation, the list view displays the parameters. Select the **Cancel** button on the TrueCopy panel to display the LU/pair list view.

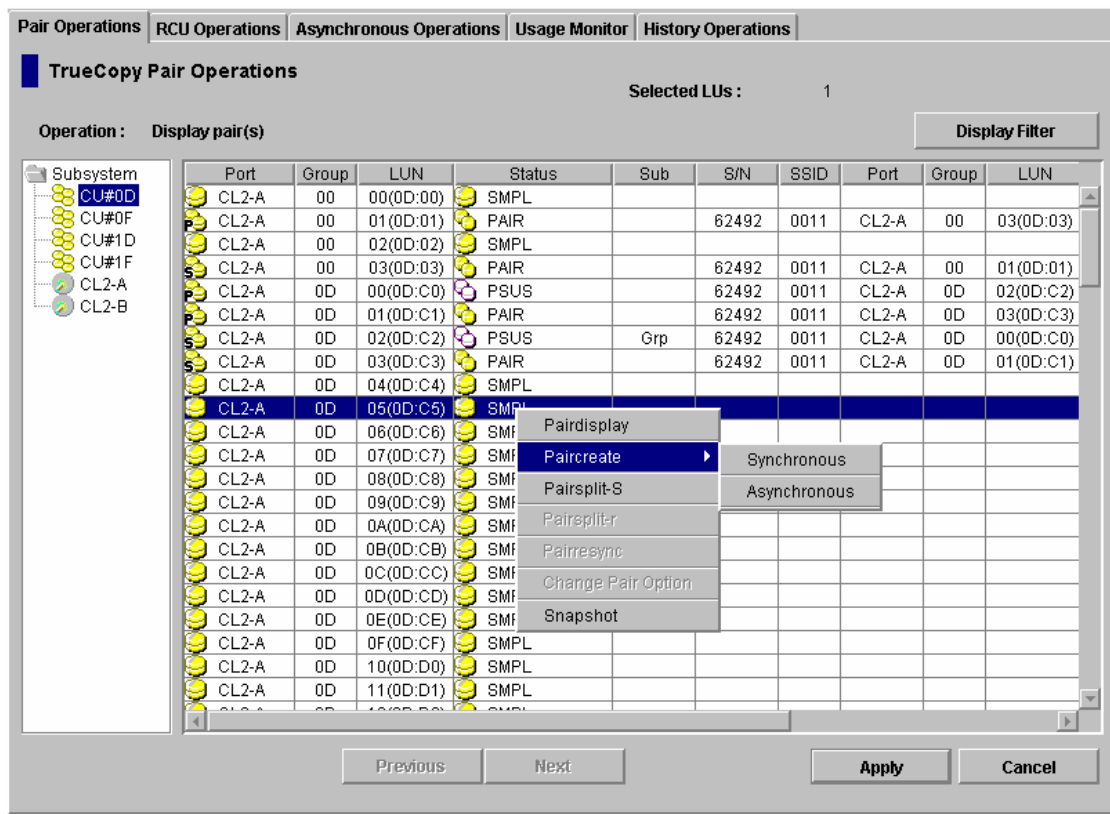


Figure 5.2 Pop-up Menu for the Pair Operations Tab

5.2.1 Volume List

The volume list on the **Pair Operations** tab displays detailed information for each volume (LU) in the selected CU image or port (or entire subsystem when the subsystem is selected). You can sort the LUs in the volume list by selecting the column heading to sort on. The **Port** column is selected by default. The screen in Figure 5.3 shows the volume list sorted by port number in ascending order. To change the sort order (ascending or descending), select the column heading.

Note: The number of columns displayed without horizontal scrolling can be changed by adjusting the font size.

Port	Group	LUN	Status	Sub	S/N	SSID	Port	Group	LUN	Type	Fence	Diff	CTG	ErrLvl
CL1-C	00	20(00:20)	SMPL				CL1-C	00	22(00:22)	Sync	Never	Track		
CL1-C	00	21(00:21)	PAIR		62492	0004	CL1-C	00	21(00:21)	Sync	Never	Track		
CL1-C	00	22(00:22)	PAIR		62492	0004	CL1-C	00	26(00:26)	Async	Never	Track	03	Group
CL1-C	00	23(00:23)	PSUS		62492	0004	CL1-C	00	27(00:27)	Async	Never	Track	03	Group
CL1-C	00	24(00:24)	PSUS		62492	0004	CL1-C	00	28(00:28)	Async	Never	Track	03	Group
CL1-C	00	25(00:25)	PAIR		62492	0004	CL1-C	00	23(00:23)	Async	Never	Track	03	Group
CL1-C	00	26(00:26)	PSUS	LU	62492	0004	CL1-C	00	24(00:24)	Async	Never	Track	03	Group
CL1-C	00	27(00:27)	PSUS	LU	62492	0004	CL1-C	00	25(00:25)	Async	Never	Track	03	Group
CL1-C	00	28(00:28)	PAIR		62492	0004								
CL1-C	00	29(00:29)	SMPL											
CL1-C	00	2A(00:2A)	SMPL											
CL1-C	00	2B(00:2B)	SMPL											
CL1-C	00	2C(00:2C)	SMPL											
CL1-C	00	2D(00:2D)	SMPL											
CL1-C	00	2E(00:2E)	SMPL											
CL1-C	00	2F(00:2F)	SMPL											
CL1-C	00	30(00:30)	SMPL											
CL1-C	00	31(00:31)	SMPL											

Figure 5.3 List View on the Pair Operations Tab

The detailed volume (LU) information includes:

- **Volume icon:** Indicates the status of volumes.
 -  : SMPL
 -  : P-VOL
 -  : S-VOL
- **Port, Group, and LUN:** port number, host group number, and LU number with LDEV ID. For LUs with more than one path, each path is displayed in a separate row.
- **Status:** (see section 2.5 for further information on TrueCopy pair status)
 -  : SMPL. The volume is not currently assigned to a TrueCopy pair. When the initial copy is started by a paircreate operation, the volume status changes to COPY.
 -  : COPY. The TrueCopy initial copy operation is in progress. Data on the pair is not fully identical. When the initial copy is complete, the status will change to PAIR.
 -  : PAIR. The volume is currently assigned to a TrueCopy pair, and the pair is synchronized. All updates from the host to the P-VOL are duplicated at the S-VOL.
 -  : PSUE. The pair has been suspended by the MCU or RCU due to an error condition. The volumes in this pair are not synchronized.
 -  : PSUS. The pair has been split by the user (pairsplit-r), or the pair has been deleted by the user from the RCU (pairsplit-S). The volumes in this pair are not synchronized.
 -  : PDUB. This TrueCopy LUSE pair is in the COPY or PAIR state, but at least one LDEV pair within the TrueCopy LUSE pair is in the SMPL or PSUE state.
 -  : Suspending. TrueCopy Asynchronous only. This pair is not synchronized. This pair is in transition from the PAIR or COPY state to the PSUS/PSUE state.
 -  : Deleting. TrueCopy Asynchronous only. This pair is not synchronized. This pair is in transition from the PAIR, COPY, or PSUS/PSUE state to the SMPL state.

- **Sub:** Suspend Sub Status
 - **Grp:** Update consistency of volume is same as that of the consistency group
 - **LU:** Update consistency of volume is not same as that of the consistency group
 - **OFF:** Suspended by the PS OFF by the MCU
- **S/N and SSID** of the other subsystem (MCU or RCU) of the volume pair
- **Port, Group, and LUN:** port number, host group number, and LUN with LDEV ID of the other volume of the volume pair
- **Type:** Pair mode: Synchronous or Asynchronous
- **Fence:** The P-VOL fence level of the TrueCopy volume pair: data, status, or never. See sections 5.3.2 and 6.1.1 for a complete description of the P-VOL fence level option.
- **Diff:** The differential data setting (bitmap table managed by cylinder or track)
- **CTG:** Consistency group number (0-7F) of the pair (only for Asynchronous pairs)
- **ErrLvl:** Error level (group or LU) of the pair (only for Asynchronous pairs)

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

5.2.2 Display Filter

The Display Filter panel (see Figure 5.4) allows you to control which volumes are displayed in the list view and which volumes are reported in the TrueCopy snapshot file (see section 5.2.3). To open the Display Filter panel, select the **Display Filter** button on the **Pair Operations** tab. **Note:** You must close the Display Filter panel to use other panels.

The selected item in the outline view (subsystem, CU image, port, or host group) determines which display filter settings are available. When the entire subsystem is selected, all settings on the Display Filter panel are available. When a CU image is selected, the CU# setting is not available. When a port is selected, the port setting is not available. When a host group is selected, the group setting is not available.

The screenshot shows a 'Display Filter' dialog box with the following controls:

- Group:** A dropdown menu with 'ALL' selected.
- Port:** A dropdown menu with 'ALL' selected.
- CU#:** A dropdown menu with 'ALL' selected.
- Type:** A dropdown menu with 'ALL' selected.
- P-VOL/S-VOL:** A dropdown menu with 'ALL' selected.
- CT Group:** A dropdown menu with 'ALL' selected.
- MCU-RCU Path:** A dropdown menu with 'ALL' selected.
- Status:** A section containing seven checkboxes, all of which are checked: SMPL, COPY, PAIR, PSUS/PSUE, PDUB, Suspending, and Deleting.
- Sub Status:** A section containing three checkboxes, all of which are checked: Grp, LU, and OFF.
- Buttons:** 'Set' and 'Reset' buttons at the bottom right.

Figure 5.4 Display Filter Panel

Group: allows you to select the host group (or all host groups) to be displayed

Port: allows you to select the port (or all ports) to be displayed

CU#: allows you to select the CU image (or all CU images) to be displayed

Type: allows you to select the pair type, sync or async (or all types), to be displayed

P-VOL/S-VOL: allows you to select the volume type, P-VOL or S-VOL (or all types), to be displayed

CT Group: allows you to select the consistency group (or all groups) to be displayed. This applies only to Asynchronous pairs

MCU-RCU Path: allows you to select the path type, fibre or serial (or all types), to be displayed

Status: allows you to display only volumes which have the selected pair status: SMPL, COPY, PAIR, PSUS/PSUE, PDUB (LUSE only), Suspending (async only), and/or Deleting (async only)

Note: When PDUB is selected, simplex volumes are not displayed.

Sub Status: allows you to select the consistency status of the Asynchronous pairs

The **Set** button applies your selections to the volume list and closes the Display Filter panel.

The **Reset** button clears your selections and displays the default settings (ALL).

5.2.3 Snapshot Function

The TrueCopy snapshot function writes the user-selected TrueCopy pair status information to a text file on the SVP, which you can then download. The status information reported in this file is determined by the selections on the Display Filter panel (see section 5.2.2). You can use this function to verify completion of your TrueCopy operations. Table 5.1 describes the Snapshot function. Figure 5.5 shows an example of a TrueCopy snapshot file.

Table 5.1 Snapshot Function

Data format	Text file. Please refer to the example shown in Figure 5.5.
Target data	The TrueCopy pairs to be reported are determined by the selections on the Display Filter panel.
Initialization	Each time the Snapshot command is selected, the previous status data is deleted and the new data is written.

```
<Snapshot at 06/07/2002 09:53:14>
Port Gr(Name) Ln Vol Status Sub S/N SSID Port Gr Ln Vol Type Fence Diff CTG EL Prio Sync
CL1-A 00(Grp1A00) 01 00:00 SMPL :
CL1-A 00(Grp1A00) 02 00:01 PAIR 12345 0001 CL1-A 01 01 1F:1E Sync(P) Data Cylinder 032 100
CL1-B 02(G-0102) 03 00:02 PAIR 12345 0001 CL1-A 01 02 1F:1D Asyn(S) Never Cylinder 0C GRP
```

Prio: Copy priority

Sync: Pairing progress (%) (This parameter is not displayed for the pairs created by the former version of TrueCopy).

Figure 5.5 Example of TrueCopy Snapshot File

To create and export (download) a TrueCopy snapshot file:

1. After completing the desired TrueCopy operations, open the Display Filter panel (see section 5.2.2), select the desired options, and then close the Display Filter panel.
2. Right-click on the volume list, and select the **Snapshot** command. When the confirmation message appears, select **OK** to create a new snapshot file, or select **Cancel** to cancel your request to create a new snapshot file.
3. If you selected **OK**, the TrueCopy snapshot file is created, and a completion message is displayed. The snapshot file lists the TrueCopy pairs currently displayed on the TrueCopy Pair Operations panel.
4. Select the **Export File** button () on the Storage Navigator main panel to open the Export Data Files panel (see Figure 5.6).
5. On the Export Data Files panel, select **Remote Copy Snapshot** (only one button can be selected at a time), and select **Next>>** to open the Remote Copy Snapshot panel.
6. If you are exporting snapshot data for the first time, select **Export Data**, and select **OK** on the confirmation panel to open the File Download panel. If you have exported snapshot data before, select **Existing Export Data** to open the File Download panel.
7. On the File Download panel, select **OK** to open the Save As panel, enter the desired name and location for the export file, and select **Save**.
8. Use a text editor (e.g., Notepad, WordPad) to open, view, and print the snapshot file.

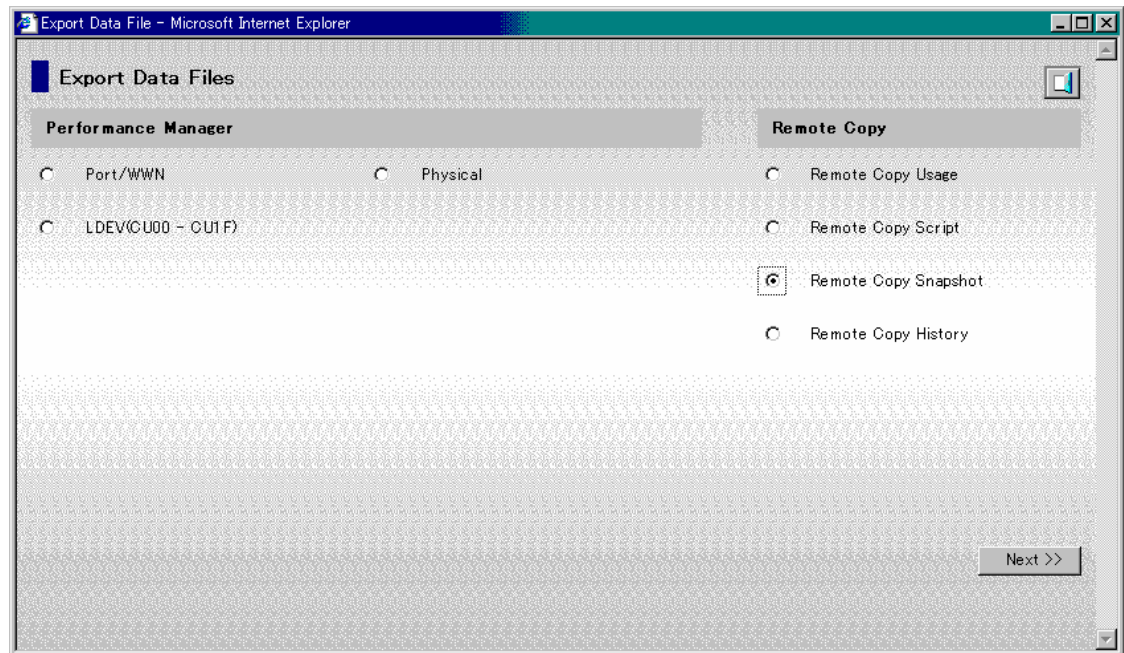


Figure 5.6 Exporting (Downloading) the Snapshot Data

5.3 Creating TrueCopy Volume Pairs (Paircreate)

The Paircreate panel (see Figure 5.7 and Figure 5.8) allows you to create new TrueCopy pairs and set the initial copy options and pair options for the new pairs. To open the Paircreate panel, select the **Pair Operations** tab, select the desired MCU CU image, select the LU(s) which will be the P-VOL(s) of the new pair(s), right-click, select **Paircreate**, and then select the desired copy mode (sync or async) for the new pair(s).

Paircreate(Synchronous)

Port - Group - LUN

P-VOL : CL1-E - 00 - 06

S-VOL : CL1-A 00 00

RCU : 62493 00 0004 Fibre

P-VOL Fence Level : Never

Initial Copy Parameters

Initial Copy : Entire Volume

Initial Copy Pace : 15 (From 1 to 15)

Priority : 32 (From 1 to 256)

Difference Management : Track

Set Cancel

Java Applet Window

Figure 5.7 Paircreate Panel for Synchronous Pairs

Paircreate(Asynchronous)

Port - Group - LUN

P-VOL : CL1-A - 00 - 06

S-VOL : CL1-A 00 0B

RCU : 62492 00 0004 Fibre

P-VOL Fence Level : Never

Initial Copy Parameters

Initial Copy : Entire Volume

Initial Copy Pace : 15 (From 1 to 15)

Priority : 32 (From 1 to 256)

Difference Management : Track

Asynchronous Parameters

CT Group : 0F

Error Level : Group

Set Cancel

Java Applet Window

Figure 5.8 Paircreate Panel for Asynchronous Pairs

■ **Port - Group - LUN**

- **P-VOL:** displays the port, group, and LUN of the selected LU(s). If you selected more than one P-VOL, the P-VOL with the lowest LUN is displayed.
- **S-VOL:** allows you to select the S-VOL(s) for the new pair(s). If you selected more than one P-VOL, select the S-VOL for the P-VOL being displayed. The S-VOLs for the rest of the P-VOLs are automatically assigned according to the LUN. For example, if you select three P-VOLs and select LUN01 as the S-VOL for the first P-VOL, the S-VOLs for the two other P-VOLs will be LUN02 and LUN03.

Note: When creating more than one pair at a time, make sure that the S-VOLs to be assigned automatically are available. If an S-VOL is not available, you will have to select the S-VOL individually.

- **RCU:** Select the RCU (serial number, CU number, SSID, and path type) for the TrueCopy pair(s) being created. The RCUs which have been added to the current MCU are displayed. The RCU must be the same for all pairs being created during one operation.

- **P-VOL Fence Level** (sync only): Select the fence level for the new pair(s) (default = Never). The fence level determines the conditions under which the MCU will reject write operations to the P-VOL. See section 5.3.2 for further information on this option.
 - **Never:** The P-VOL will never be fenced.
 - **Data:** The P-VOL will be fenced when the MCU cannot successfully execute an update copy operation for any reason.
 - **Status:** The P-VOL will be fenced only if the MCU is not able to change the S-VOL status to suspended when an update copy operation fails.
- **Initial Copy Parameters:** Select the initial copy options for the new pair(s). See section 5.3.1 for further information on the initial copy options. **Note:** These options cannot be changed after a pair has been added.
 - **Initial Copy:** **Entire** = copy all P-VOL data to S-VOL; **No Copy** = do not copy any P-VOL data to S-VOL. The default setting is Entire.

WARNING: The user must ensure that the P-VOL and S-VOL are already identical when using the **No Copy** setting.
 - **Initial Copy Pace:** desired number of tracks to be copied at one time (1-15) during the initial copy operation. The default setting is 15.
 - **Priority:** priority (scheduling order) of the initial copy operations (1-256). The default setting is 32.

Note: If the time out error occurs during the Paircreate operation, the copy operation may not be executed correctly in the order that you have set with the **Priority** parameter. The time out error may be caused by the CU configuration or a remote copy path error. Review the error, delete the pair with the error, and then retry the Paircreate operation.
- **Difference Management:** Select **Auto**, **Cylinder** or **Track** as the basis for managing the differential data. The default setting is Auto. When you select Auto, either Cylinder or Track is selected depending on the basic size of the logical unit (LU). See section 2.2.5 for further information on this option. **Note:** This option cannot be changed after a pair has been added.
- **Asynchronous Parameters** (async only):
 - **CT Group:** consistency group for the new pair(s). Consistency groups which have already been added to the current MCU are displayed. **Note:** This option cannot be changed after a pair has been added.
 - **Error Level:** error level for the new pair(s): **Group**, or **LU** (default = Group). See section 5.3.2 for further information on the error level option.

The **Cancel** button cancels the settings you have made and closes the Paircreate panel. The **Set** button sets the parameters and closes the Paircreate panel.

To create one or more new TrueCopy volume pairs:

1. At the remote site:
 - a) Make sure that the LU(s) which will be the S-VOL(s) are offline from all hosts.
 - b) Connect to the subsystem which will be the RCU for the new pair(s), and log in with Administrator or TrueCopy write access.
 - c) Make sure that the RCU remote copy port(s) is/are configured (RCU target port, RCP). See section 4.2.1 for instructions on configuring the ports.
2. At the main site:
 - a) Connect to the subsystem which will be the MCU for the new pair(s), and log in with Administrator or TrueCopy write access.
 - b) Make sure that the MCU remote copy port(s) is/are configured (initiator port, LCP). See section 4.2.1 for instructions on configuring the ports.
 - c) Make sure that the correct RCU CU image (contains the LUs that will be S-VOLs) has been added to the correct MCU CU image (contains the LUs that will be P-VOLs). See section 4.2.2 for instructions on adding an RCU.
3. Select the **Pair Operations** tab, and select the CU image or port which contains the LU(s) which will be the P-VOL(s) of the new pairs. Use the Display Filter as needed to display the desired LUs (e.g., select SMPL status only) (see section 5.2.2).
4. Select the LU(s) which will be the P-VOL(s) of the new TrueCopy pair(s). You can create multiple pairs at the same time only when: (1) the S-VOLs are in the same RCU, and (2) the pairs have the same copy mode (sync or async). You cannot create TrueCopy Sync pairs and TrueCopy Async pairs at the same time.
5. Right-click, select **Paircreate**, and then select the desired pair mode (Synchronous or Asynchronous) to open the Paircreate panel (refer to Figure 5.7 and Figure 5.8).

Note: The update copy mode, sync or async, has the greatest impact on performance and must be considered carefully (see section 2.2.2). Factors in mode selection include (but are not limited to) the use of TrueCopy (for disaster recovery or migration), the number of pairs, and the write I/O activity to the P-VOLs.
6. On the Paircreate panel, enter the desired S-VOL for the pair, and select the RCU. If you are creating multiple pairs, select the S-VOL for the P-VOL being displayed. The S-VOLs for the rest of the P-VOLs will be assigned automatically according to the LUN. For example, if you select three P-VOLs and select LUN01 as the S-VOL for the first P-VOL, the S-VOLs for the two other P-VOLs will be LUN02 and LUN03.
7. Select the desired initial copy options (see section 5.3.1) and pair options (see section 5.3.2) for the pair(s) being created. The initial copy options and pair options you select are applied to all pairs being created, and you can modify the options for each pair as needed before starting the paircreate operations (see step 9).
8. Select **Set** to close the Paircreate panel. The requested paircreate operation(s) is/are now displayed in the list view.

9. Verify the requested operation(s) displayed in the list view (see Figure 5.9). Make sure that all TrueCopy options for each new pair are correct. After a pair has been created, you can only change the fence level (sync only) and error level (async only) options.

To change one or more operation(s), select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.

10. If you want to execute the requested operation(s) as quickly as possible, select the **Use Time-Saving Mode** box (above the list view).
11. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.
The MCU will start the initial copy operations according to the initial copy priority and the maximum initial copy activities setting of the RCU.
12. On the **Pair Operations** tab, verify that the paircreate operation(s) is/are displayed correctly (COPY status) in the list view. To monitor the progress of the paircreate operation(s), select **Refresh** to update the information in the list view, or use the Pairedisplay panel (see section 5.5) to monitor the detailed status of each pair.

Note: If an error occurs, you can display the error message by right-clicking on the operation and selecting the **Error Detail** command.

WARNING: If a timeout error occurs when using the **Use Time-Saving Mode** option, confirm on the TrueCopy main panel for which LUs the paircreate operation could not be performed. Deselect the **Use Time-Saving Mode** option for the failed LUs, and retry the paircreate operation.

Note: The Paircreate operation will be rejected if the P-VOL is in the correction access or correction copy state. If this occurs, wait for the volume state to change, and then repeat this procedure. If the status is not displaying correctly, make sure that the correct CU image is selected. See section 8.1 for information on troubleshooting suspended pairs.

Port	Group	LUN	S/N	SSID	Port	Group	LUN	Type
CL2-A	0F	04	62492	0023	CL2-A	1F	08	Async

Mode	Fence	Pace	Priority	Diff	CTG	ErrLvl	Error Code
Entire	Never	15	032	Track	07	Group	

Figure 5.9 Verifying the Paircreate Operation(s)

5.3.1 Initial Copy Options

When you create new TrueCopy pairs, you select the initial copy options on the Paircreate panel. After a pair has been created (i.e., the paircreate operation has started), you cannot change the initial copy options, unless you delete and then restart the pair.

Initial Copy: specifies the initial copy mode for the new pair(s) (default = Entire):

- **Entire Volume:** The initial copy operation will copy all cylinders/tracks on the P-VOL (except diagnostic and unassigned alternate tracks) to the S-VOL.
- **No Copy:** The initial copy operation will not be performed. The MCU will begin performing update copy operations as needed. **WARNING:** The user must ensure that the P-VOL and S-VOL are already identical when using this setting.

Initial Copy Pace: specifies the maximum number of tracks (1-15) that can be copied at one time by the TrueCopy initial copy operation before the MCU accepts another host request for that P-VOL (default = 15). A high setting (e.g., 15 tracks) speeds up the initial copy operation but may affect the subsystem's I/O performance if the P-VOL is experiencing high write I/O activity. A lower setting (e.g., 3 tracks) slows down the initial copy operation to minimize the impact of the initial copy operation on the subsystem's I/O performance.

Priority: specifies the order in which the initial copy operations will be performed, if the number of requested initial copy operations is greater than the maximum initial copy activity setting on the RCU Option panel (see section 4.2.3). The highest priority is 1, and the lowest priority is 256 (current default = 32). The TrueCopy initial copy priority option can be used to spread initial copy operations across array groups and/or array domains (ACP pairs) to reduce initial copy time as well as host I/O contention.

Difference management: specifies the measurement method that TrueCopy will use to manage the differential data for the pair: auto, cylinder, or track. The default setting is Auto. When you select Auto, either Cylinder or Track is selected depending on the basic size of the logical unit (LU). See section 2.2.5 for further information on this option.

Example: Let's say that the maximum initial copy activity setting is four, and you create six pairs at the same time (for LUNs 00 through 05) with the initial copy priority set as follows:

P-VOL of Pair	Priority	The MCU will start the initial copy operations for LUNs 03, 05, 00, and 04 immediately, then start LUN 01 when one of the first four initial copy operations is complete, and then start LUN 02 when the next initial copy operation is complete. If more TrueCopy pairs are created, the MCU also prioritizes the initial copy operations by time requested, so that all pairs in the first group are started before any pair in the next group is started.
LUN 03	1	
LUN 05	2	
LUN 00	3	
LUN 04	4	
LUN 01, 02	5	

Note: If the time out error occurs during the Paircreate operation, the copy operation may not be executed correctly in the order that you have set with the **Priority** parameter. The time out error may be caused by the CU configuration or a remote copy path error. Review the error, delete the pair with the error, and then retry the Paircreate operation.

5.3.2 Pair Options

When you create new TrueCopy pairs, you select the pair options on the Paircreate panel (see section 5.3). You can change the fence level and error level pair options after a pair has been added (see section 5.4). You cannot change the difference management or CT group of an existing pair. You need to delete and then restart the pair to change these options.

Fence Level (Synchronous only): specifies the conditions under which the MCU will reject write operations to the P-VOL, which is known as “fencing”: never, data, or status (default = Never). This parameter is very important for disaster recovery planning (see section 6.1.1).

- **Never:** The P-VOL will never be fenced. If the TrueCopy pair is split or suspended, write operations to the P-VOL will be accepted. (The fence level for all TrueCopy Asynchronous pairs is Never.)
- **Data:** The P-VOL will be fenced when the MCU cannot successfully execute an update copy operation for any reason.
- **Status:** The P-VOL will be fenced only if the MCU is not able to change the S-VOL status to suspended when an update copy operation fails. If the MCU changes the S-VOL status to suspended, subsequent write operations to the P-VOL will be accepted, and the MCU will keep track of all P-VOL updates while the pair is suspended.

CT Group (Asynchronous only): specifies the consistency group number for new pairs. All TrueCopy Asynchronous pairs must be assigned to a consistency group. To change the consistency group to which a pair is assigned, you must delete and then restart the pair with the desired group selected.

Error level (Asynchronous only) (default = Group):

- **Group:** When the specified pair is suspended, all pairs in the same group will be suspended, even if the failure affects only that pair and not the entire group.
Important: Select the **Group** error level for all pairs which are essential to disaster recovery. Suspended TrueCopy Asynchronous S-VOLs with the **LU** error level should not be used for disaster recovery.
- **LU:** If the failure affects only the specified pair, then only that pair will be suspended. A failure that affects an entire group will always result in the suspension of all pairs in the group, as well as all other affected TrueCopy pairs.

5.4 Changing the Pair Options (Change Pair Option)

The Change Pair Option panel (see Figure 5.10) allows you to change the pair options (fence level, error level) for existing TrueCopy pairs. To open the Change Pair Option panel, select the **Pair Operations** tab, select the subsystem or the desired CU image, select the M-VOL(s) of the desired pair(s), right-click, and then select **Change Pair Option**.

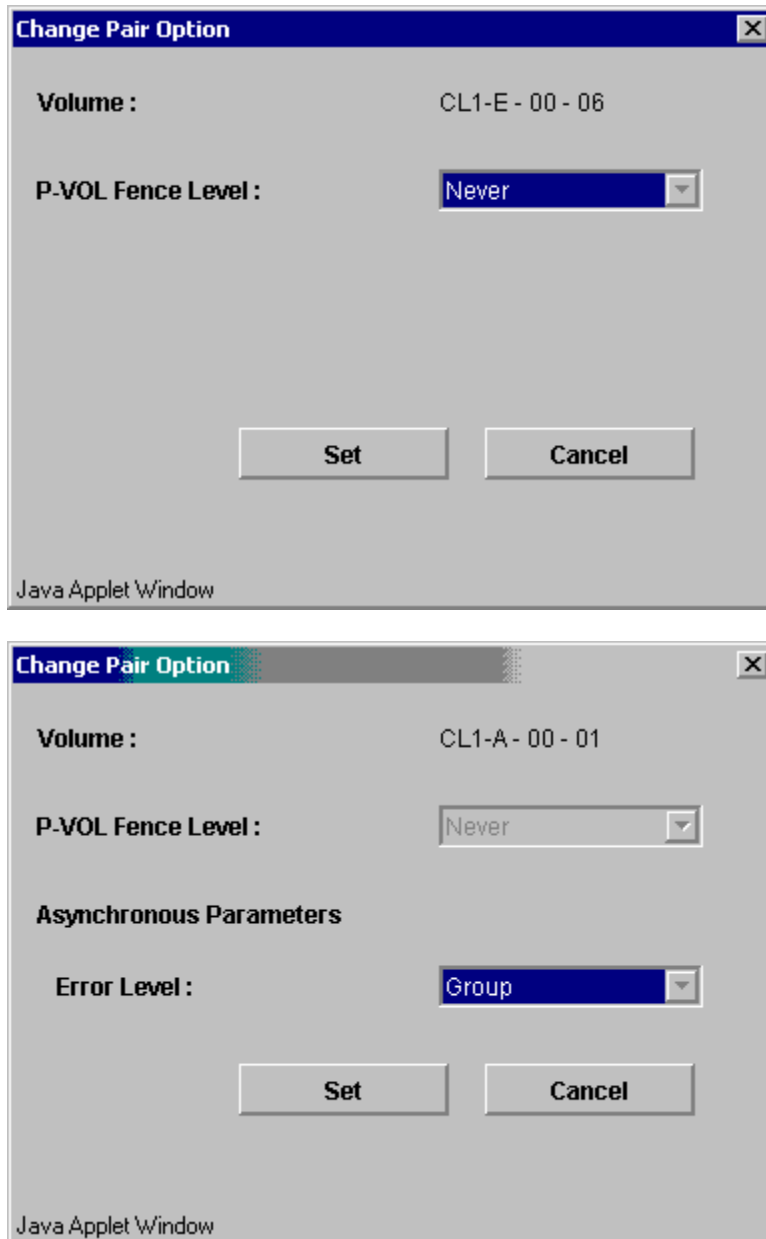


Figure 5.10 Change Pair Option Panel (Synchronous and Asynchronous)

To change the fence level or error level pair option for one or more TrueCopy volume pairs:

1. Connect to the MCU of the pair(s) for which you want to change the pair option, and open the TrueCopy main panel.
2. In the outline view, select **Subsystem**, or select the CU image or port which contains the P-VOL(s) of the pair(s).
3. In the list view, select the pair(s) for which you want to change the pair option. When **Subsystem** or a port is selected in the outline view, the volume pair(s) can be selected from the current **Volume List** (maximum 256 rows).

Select either TrueCopy Sync pairs or TrueCopy Async pairs (not both). Use the Display Filter as needed to display the desired pairs (e.g., select Async only) (see section 5.2.2).

4. Right-click, and select **Change Pair Option** to open the Change Pair Option panel (refer to Figure 5.10).
5. On the Change Pair Option panel, select the desired pair option for the selected pair(s), and select **Set** to close the Change Pair Option panel. The list view now displays the requested change pair option operation(s).
6. Verify the requested operation(s) in the list view (see Figure 5.11).
To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.
7. To perform the change pair option, select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select the **Cancel** button.
8. On the **Pair Operations** tab, verify that the change pair option operation(s) completed successfully.

Note: If an error occurs, you can display the error message by right-clicking on the operation and selecting the **Error Detail** command.

Port	Group	LUN	S/N	SSID	Fence	ErrLvl	Error Code
CL2-A	0F	04	62492	0023	Never	Group	

Figure 5.11 Verifying the Change Pair Option Operation(s)

5.5 Viewing TrueCopy Pair Status (Pairedisplay)

The Pairedisplay panel (see Figure 5.12) displays the detailed pair status information for the selected pair. To open the Pairedisplay panel, select the **Pair Operations** tab, select any item in the outline list (subsystem, CU image, or port), select the desired pair, right-click, and then select **Pairedisplay**.

The Pairedisplay panel is a window with a title bar and a close button. It displays detailed information for a selected pair, organized into two columns: P-VOL and S-VOL. Below these columns, there are several status and configuration parameters. A progress bar is shown for the pair's synchronization status. At the bottom, there are four buttons: Previous, Next, Refresh, and Close.

P-VOL		S-VOL	
CL1-B - 00(Group1B) - 28(01:68)		CL4-p - 17 - 97(1E:97)	
(OPEN-3)		(OPEN-3)	
23838.04 (MB)		23842.26 (MB)	
Pair Status :	COPY		
Pair Synchronized :	3 (%)		
RCU S/N :	65535	SSID :	0011
MCU-RCU Path :	Fibre	Update Type :	Asynchronous
Initial Copy Pace :	15 (Tracks)	Initial Copy Priority :	105
P-VOL Fence Level :	Never	S-VOL Write :	Enable
Pair Established :	02/28/2001 09:14:47		
Last Updated :	11/06/2001 11:58:29		
Difference Management :	Cylinder		
Asynchronous Parameters			
CT Group :0C			
Error Level :Group			

Previous Next Refresh Close

Figure 5.12 Pairedisplay Panel

P-VOL and S-VOL:

- Port - host group ID (host group name) - LUN (lowest LDEV number for a LUSE pair).
Note: Only the host group name of the primary site is displayed (the host group name of the secondary site is not displayed). Device emulation type.
- Device emulation type
- Capacity in MB (to two decimal places)

Pair Status: SMPL, COPY, PAIR, PSUE, PSUS, PDUB, Suspending or Deleting (see section 2.5 for further information on TrueCopy pair status). If the pair is split or suspended, the split/suspended type is also displayed.

Pair Synchronized: progress of the initial copy operation (percentage and progress bar)

RCU S/N and SSID: Serial number and SSID of the RCU (or MCU if an S-VOL is selected)

MCU-RCU Path: Channel type of the path interface between the subsystems (fibre, serial)

Update Type: Synchronous or Asynchronous

Initial Copy Pace: 1-15 tracks (disabled when status becomes PAIR)

Initial Copy Priority: 1-256 (disabled when the status becomes PAIR)

P-VOL Fence Level (sync only): Never, Data, or Status (see section 5.3.2)

S-VOL Write: Enabled or disabled for this pair (enabled only when the pair is split)

Pair Established: Date and time that the volume pair was created

Last Updated: Date and time that the volume pair status was last updated

Difference Management: Auto, cylinder or track (see section 5.3.2)

Asynchronous Parameters:

- **CT Group:** Consistency group to which the TrueCopy Async pair is assigned
- **Error Level:** Error level (group or LU) of the TrueCopy Async pair
- **Suspended by:** Consistency status (group or volume) of the TrueCopy Async pair (see section 2.5) (displayed only at the RCU and only for a split or suspended pair)

The **Previous** button displays the pair status information for the previous pair in the list view (the pair in the row above). The **Next** button displays the pair status information for the next pair in the list view (the pair in the row below). The **Refresh** button updates the pair status information. The **Close** button closes the Pairedisplay panel.

Note: The Display Filter settings (see section 5.2.2) can affect how **Previous** or **Next** is recognized.

Note: The list view displays a maximum of 256 rows at once. The **Previous** and **Next** buttons on the Pairedisplay panel can only be used for the currently displayed 256 rows.

5.6 Splitting TrueCopy Pairs (Pairsplit-r)

The Pairsplit-r panel (see Figure 5.13) allows you to split existing TrueCopy pairs and select the pairsplit options for the pair(s). To open the Pairsplit-r panel, select the **Pair Operations** tab, select any item in the outline list (subsystem, CU image, or port), select the desired pair(s), right-click, and then select **Pairsplit-r**. For further information on split TrueCopy pairs, see section 2.5.1.

Note: You can split a TrueCopy pair only after the initial copy operation is complete.

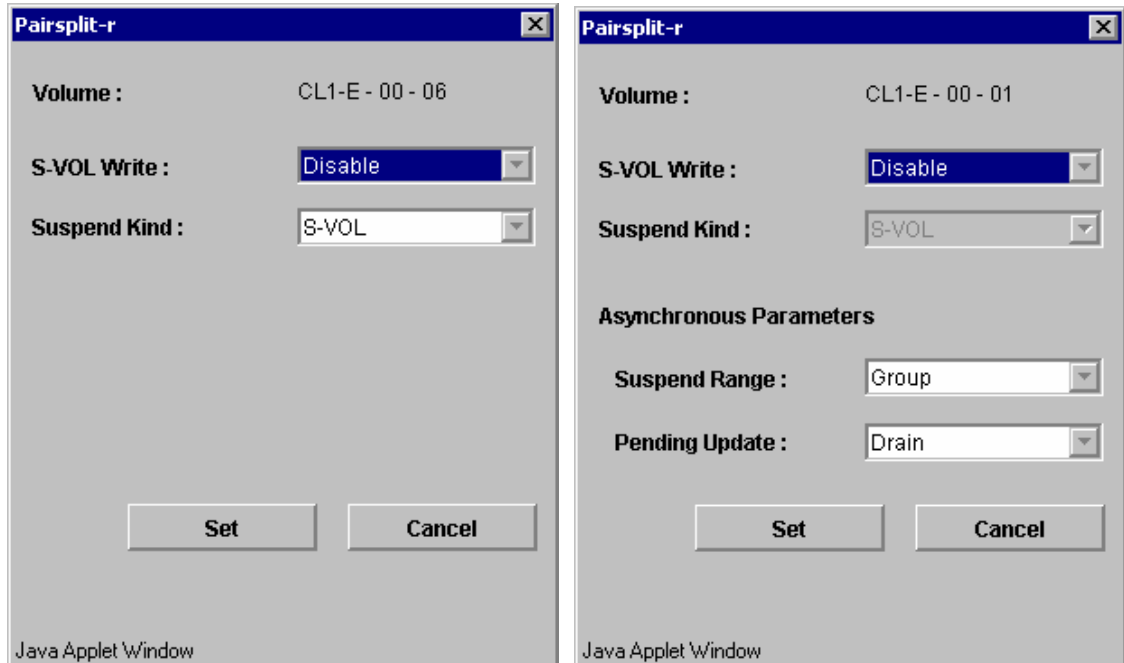


Figure 5.13 Pairsplit-r Panel (Synchronous and Asynchronous)

The pairsplit options are:

- **S-VOL Write** (default = disabled):
 - **Enable:** The S-VOL of this pair will accept read and write I/Os while the pair is split. If you select Enable and you want to resync the pair later, select the **S-VOL suspend kind** option to ensure that the P-VOL and S-VOL bitmaps are merged at the MCU. This option is available only when the selected volume is a TrueCopy P-VOL.
 - **Disable:** The S-VOL of this pair will accept only read I/Os while the pair is split.

- **Suspend Kind** (default = S-VOL):
 - **S-VOL:** The P-VOL will accept all subsequent write I/O operations, and the MCU will keep track of updates while the pair is split. Subsequent write I/O operations to the P-VOL will be accepted or rejected depending on the fence level of the pair. This setting is available from the MCU and RCU, and should be used if you need to keep the P-VOL online. All TrueCopy Asynchronous pairs have this setting.
 - **P-VOL Failure** (available only for TrueCopy Synchronous and only when connected to the MCU): The MCU will reject all write I/O operations to the P-VOL while the pair is split, regardless of the P-VOL fence level setting. This setting should be used if you need to maintain synchronization of the TrueCopy pair.
- **Asynchronous Parameters:**
 - **Suspend Range:** Group or LU. Default = Group when one pair in each group is selected. Default = Volume when two or more pairs in a group are selected.

Group: all pairs in the same consistency group(s) as the selected pair(s) will be split. You must select only one pair in each consistency group. (For the former version of TrueCopy, you could only split pairs in one group at a time.)

LU: only the specified pair(s) will be split, even if the error level of the pair is Group. **Note:** For the LU suspend range setting, if you select pairs with PAIR status and other than PAIR status in the same consistency group, unexpected suspend may occur during the pair operations (Pairsplit-r, Pairsplit-S, and Pairresync) under heavy I/O load conditions. You can estimate whether the I/O load is heavy or not from the rate of sidefile cache (around 30%), or if you cannot see the sidefile cache rate, from the frequency of host I/O. The suspend pair operations should be performed under light I/O load conditions.
 - **Pending Update:** Drain or Purge (default = Drain)

Drain: As soon as the RCU accepts the Pairsplit-r operation, the RCU will finish settling all pending recordsets for the pair. After settling all pending recordsets, if there are no recordsets for a fixed period of time, the MCU will change the pair status from Suspending to PSUS.

Note: If there is no period of time without recordsets (i.e., recordsets continue to be generated), the RCU will discontinue the original pairsplit-r operation and forcibly suspend the pair.

Purge: The MCU will change the pair status from Suspending to PSUS as soon as the RCU accepts the pairsplit-r operation. The MCU and RCU discard all pending recordsets and mark the cylinders/tracks that contain discarded recordsets as modified in the P-VOL and S-VOL bitmaps, respectively. When the pair is resumed (pairresync), the P-VOL and S-VOL bitmaps will be merged at the MCU, and all cylinders/tracks marked as modified will be copied to the S-VOL.

Note: If the MCU does not receive acknowledgement of the pairsplit-r operation from the RCU within the copy pending timeout setting, the MCU will forcibly suspend all affected TrueCopy Asynchronous pairs.

To split one or more TrueCopy volume pairs:

1. Connect to the MCU or RCU of the pair(s) to be split, open the TrueCopy main panel, and select the **Pair Operations** tab. You do not need to vary the P-VOL(s) offline.

Note: If you want to use the **S-VOL write enable** option, you must connect to the MCU and select the P-VOL of the pair(s).

2. In the outline view, select **Subsystem**, or select the CU image or port which contains the pair(s) to be split.
3. In the list view, select the TrueCopy pair(s) that you want to split. When **Subsystem** or a port is selected in the outline view, the volume pair(s) can be selected from the current **Volume List** (maximum 256 rows).

Select either TrueCopy Synchronous or TrueCopy Asynchronous pairs (not both). The pair status must be PAIR. Use the Display Filter as needed to display the desired pairs (e.g., select PAIR status and Async only) (see section 5.2.2).

Note: If a LUSE pair that you want to split has the status PDUB, perform the pairresync operation on the LUSE pair first to change the status to PAIR, and then you can split the pair. PDUB indicates that the status of one or more individual LDEV pairs within the LUSE pair is SMPL or PSUE (due to some error condition).

4. Right-click, and select **Pairsplit-r** to open the Pairsplit-r panel (refer to Figure 5.13).
5. On the Pairsplit-r panel, select the desired pairsplit options for the pair(s), and select **Set** to close the Pairsplit-r panel. The list view now displays the requested pairsplit operation(s).
6. Verify the requested operation(s) in the list view (see Figure 5.14). Make sure that the pairsplit options for each pair are correct. The suspend kind option (S-VOL or P-VOL failure) and fence level pair option (never, data, or status) determine whether the P-VOL will accept write I/O operations after the pair is split.

To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.

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

7. If you want to execute the requested operation(s) as quickly as possible, select the **Use Time-Saving Mode** box (above the list view).

Note: If you selected the **Group Suspend Range** option, time-saving mode is not available.

8. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

For TrueCopy Synchronous pairs, the MCU will complete all P-VOL write operations in progress and the associated update copy operations at the S-VOL before splitting the pair, so that the pair is synchronized at the time of pairsplit. For TrueCopy Asynchronous pairs, the pending update option (drain or purge) determines whether the pair is synchronized at the time of pairsplit.

9. On the **Pair Operations** tab, verify that the pairsplit operation(s) is/are completed successfully (PSUS status in the list view). To monitor the progress of the pairsplit operation(s), select **Refresh** to update the information in the list view, or use the Pairedisplay panel (see section 5.5) to monitor the detailed status of each pair.

Note: If an error occurs, you can display the error message by right-clicking on the operation and selecting the **Error Detail** command.

WARNING: If a timeout error occurs when the **Use Time-Saving Mode** option is selected, confirm on the TrueCopy main panel for which pairs the pairsplit-r operation could not be performed. Deselect the **Use Time-Saving Mode** option for the failed pairs, and retry the pairsplit-r operation.

Port	Group	LUN	S/N	SSID	S-VOL Wrt	Kind	Range	Mode	Error Code
CL2-A	0F	04	62492	0023	Disable	S-VOL	Group	Drain	

Figure 5.14 Verifying the Pairsplit-r Operation(s)

5.7 Resuming TrueCopy Volume Pairs (Pairresync)

While a TrueCopy pair is split or suspended, the MCU does not perform any update copy operations to the S-VOL.

- For a split/suspended TrueCopy Synchronous pair, the MCU may or may not continue accepting write I/Os for the P-VOL depending on the P-VOL fence level pair option (see section 5.3.2) and suspend kind pairsplit option (if user-requested) (see section 5.6).
- For a split/suspended TrueCopy Asynchronous pair, the MCU and RCU keep track of any recordsets that were discarded during pairsplit/suspension, and the MCU continues to accept write I/Os for the P-VOL. The MCU keeps track of the P-VOL cylinders/tracks which are updated while the pair is split/suspended.

If the RCU accepts write I/Os for a split S-VOL (S-VOL write enable pairsplit option), the RCU keeps track of the S-VOL cylinders/tracks which are updated. When the split pair is resumed, the MCU merges the P-VOL and S-VOL cylinder/track bitmaps to determine the out-of-sync cylinders/tracks and ensure accurate resynchronization.

The Pairresync panel (see Figure 5.15) allows you to resume split and suspended TrueCopy pairs and select the pairresync options. To open the Pairresync panel, select the **Pair Operations** tab, select any item in the outline list (subsystem, CU image, or port), select the desired pair(s), right-click, and then select **Pairresync**.

Pairresync

P-VOL : CL1-A - 00 - 09

P-VOL Fence Level : Never

Initial Copy Parameters

Initial Copy Pace : 15 (From 1 to 15)

Priority : 32 (From 1 to 256)

Asynchronous Parameters

Resume Range : LU

Error Level : Group

Set Cancel

Java Applet Window

Figure 5.15 Pairresync Panel for Synchronous and Asynchronous Pairs

The pairresync options are:

- **P-VOL Fence Level** (sync only): if desired, you can change the fence level of the pair(s). See section 5.3.2 for further information on the fence level pair option.
- **Initial Copy Parameters** (see section 5.3.1 for further information on these options):
 - **Initial Copy Pace** (from 1 to 15): select the number of the tracks 1-15 for the resync operation(s) (default = 15)
 - **Priority** (from 1 to 256): set the desired priority (1-256) (scheduling order) for the resync operations (default = 32)
- **Asynchronous Parameters:**
 - **Resume Range** (default = Group):

Group: all pairs in the same consistency group(s) as the selected pair(s) will be resumed. You must select only one pair in each consistency group. (For the former version of TrueCopy, you could only resume pairs in one group at a time.)

LU: only the selected TrueCopy Async pair(s) will be resumed. **Note:** For the LU resume range setting, if you select pairs with PAIR status and other than PAIR status in the same consistency group, unexpected suspend may occur during the pair operations (Pairsplit-r, Pairsplit-S, and Pairresync) under heavy I/O load conditions. You can estimate whether the I/O load is heavy or not from the rate of sidefile cache (around 30%), or if you cannot see the sidefile cache rate, from the frequency of host I/O. The resume pair operations should be performed under light I/O load conditions.
 - **Error Level:** if desired, you can change the error level of the pair(s). This option is available only when the LU Resume Range option is selected. See section 5.3.2 for further information on the error level option.

Note: If an MCU or RCU is powered off and its backup batteries are fully discharged while TrueCopy pairs are suspended, the P-VOL/S-VOL bitmaps will not be retained. In this unlikely case, the MCU/RCU will mark all cylinders/tracks of all split or suspended TrueCopy volumes as modified, so that the MCU will perform the equivalent of an entire initial copy operation when the pairs are resumed.

To resync one or more split or suspended TrueCopy volume pairs:

1. If any pair was suspended due to an error condition (use the Pairdisplay panel to view the suspend type), make sure that the error condition has been removed (see section 8.1 for troubleshooting information). The MCU will not resync the pair(s) until the error condition has been removed.
2. Connect to the MCU of the pair(s) to be resynced, open the TrueCopy main panel, and select the **Pair Operations** tab.
3. In the outline view, select **Subsystem**, or select the CU image or port which contains the pair(s) to be resynced. Use the Display Filter as needed to display the desired pairs (e.g., select Async and PSUS status only) (see section 5.2.2).

4. In the list view, select the P-VOL(s) of the pair(s) to be resynced. When **Subsystem** or a port is selected in the outline view, the volume pair(s) can be selected from the current **Volume List** (maximum 256 rows).

Select either Sync or Async pairs (not both). Select either PSUS or PSUE pairs (not both) (or PDUB pairs, see note below). If you want to use the Group Resume Range option, select only one TrueCopy Async pair in the group.

Note: You can use pairresync to change LUSE pairs from PDUB status to PAIR status.

5. Right-click, and select **Pairresync** to open the Pairresync panel (refer to Figure 5.15).
6. On the Pairresync panel, select the desired pairresync options, and select **Set** to close the Pairresync panel. The list view now displays the requested pairresync operation(s).

Note: If you want to resync all split/suspended pairs in a consistency group, select the **Group Resume Range** option on the Pairresync panel.

7. Verify the requested operation(s) in the list view (see Figure 5.16). Make sure that the pairresync options for each pair are correct.

To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.

8. If you want to execute the requested pairresync operation(s) as quickly as possible, select the **Use Time-Saving Mode** box (above the list view).

Note: If you selected the **Group Resume Range** option, time-saving mode is not available.

9. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.

10. On the **Pair Operations** tab, verify that the pairresync operation(s) is/are completed successfully (PAIR status in the list view). To monitor the progress of the pairresync operation(s), select **Refresh** to update the information in the list view, or use the Pairedisplay panel (see section 5.5) to monitor the detailed status of each pair.

Note: If an error occurs, you can display the error message by right-clicking on the operation and selecting the **Error Detail** command.

WARNING: If a timeout error occurs when the **Use Time-Saving Mode** option is selected, confirm on the TrueCopy main panel for which pairs the pairresync operation could not be performed. Deselect the **Use Time-Saving Mode** option for the failed pairs, and retry the pairresync operation.

Port	Group	LUN	S/N	SSID	Priority	Pace	Fence	ErrLvl	Range	Error Code
CL2-A	0F	04	62492	0023	032	15	Never	Group	Group	

Figure 5.16 Verifying the Pairresync Operation(s)

5.8 Deleting TrueCopy Volume Pairs (Pairsplit-S)

A TrueCopy pair should be deleted from the MCU only when it is no longer necessary to maintain a remote copy of the P-VOL. When a TrueCopy pair is deleted from the MCU, the MCU stops all update copy operations for that pair and changes the pair status of the P-VOL and S-VOL to SMPL. After a TrueCopy pair is deleted, the MCU continues to accept all subsequent write I/O operations to the P-VOL and will not keep track of the P-VOL updates.

A TrueCopy pair should be deleted from the RCU only for disaster recovery (see Chapter 6). When a TrueCopy pair is deleted from the RCU, the RCU changes the S-VOL pair status to SMPL but does not change the pair status of the corresponding P-VOL. When the MCU performs the next TrueCopy operation for that pair, the MCU detects that the S-VOL status has changed and changes the P-VOL status to PSUS-pairsplit-S to RCU. To restart a pair that was deleted from the RCU, you must first delete the pair from the MCU, and then create the pair from the MCU using the appropriate initial copy option (Entire Volume or None) to restart the pair.

If you want to delete all TrueCopy Async pairs in a consistency group, you must delete the pairs from the MCU. The TrueCopy pair status will change to Deleting when the pairsplit-S operation is accepted by the MCU and RCU, and then to SMPL after the internal pairsplit-S process is complete. If you want to delete TrueCopy Async pairs according to their consistency status (e.g., for disaster recovery), you must delete the pairs from the RCU.

WARNING: When you delete a TrueCopy pair from the RCU, remember that the S-VOL and P-VOL are identical (e.g., same volume label), and take appropriate precautions to prevent a system problem due to duplicate volumes.

WARNING: As a general rule, when you want to delete a TrueCopy Asynchronous pair from the MCU, it is strongly recommended that you perform the pairsplit-S operation after the update copy operation is completed. If you request the pairsplit-S operation while the update copy process is still in progress, it may take a long time to complete the pairsplit-S operation. However, when you urgently need to delete a TCA pair, you can perform the pairsplit-S operation from the RCU. In this case, you will find the PSUE status at the MCU after performing the pairsplit-S operation from the RCU.

The Pairsplit-S panel (see Figure 5.17) allows you to delete TrueCopy pairs and select the pairdelete options. To open the Pairsplit-S panel, select the **Pair Operations** tab, select any item in the outline list (subsystem, CU image, or port), select the desired pair(s), right-click, and then select **Pairsplit-S**.

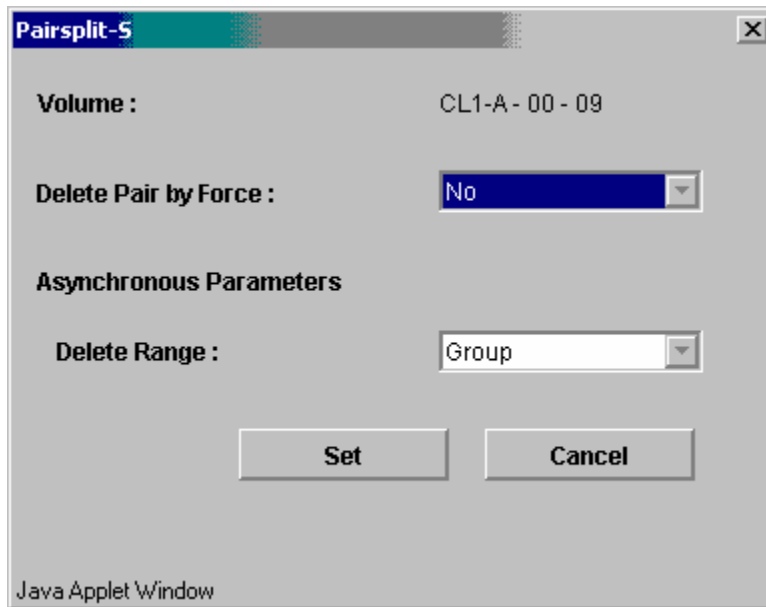


Figure 5.17 Pairsplit-S Panel for Synchronous and Asynchronous Pairs

Volume: Port - Group - LUN of the selected volume

Delete Pair by Force:

- **Yes:** The pair(s) will be deleted even if the MCU is unable to communicate with the RCU. This option may be used to free a host waiting for device-end from an MCU which cannot communicate with its RCU, thus allowing host operations to continue.
- **No:** The pair(s) will only be deleted if the MCU is able to change the pair status of the P-VOL and S-VOL to SMPL.

When the status of the pair(s) to be deleted is SMPL or Deleting, the default setting is Yes (cannot be changed). Otherwise, the default setting is No.

Asynchronous Parameters:

- **Delete Range:** The delete range option simplifies disaster recovery operations for TrueCopy Asynchronous consistency groups at the RCU (secondary (remote) subsystem).
 - **Group (MCU or RCU):** all pairs in the same consistency group(s) as the selected pair(s) will be deleted, regardless of pair status and consistency status. You must select only one pair in each consistency group. (For the former version of TrueCopy, you could only delete pairs in one group at a time.) **Caution:** Do not use this option when deleting pairs at the RCU during disaster recovery.

Note: If you delete (pairsplit-S) the TCA pair from the RCU with the Group option, while the P-VOL continues accepting I/Os, the TCA pair is forcibly suspended. This suspend is due to the S-VOL failure (not user-requested). This status is temporary, and will change to SMPL finally. In this case, it is possible that all pending recordsets are not settled.

- **C/T (RCU only):** The RCU will delete all TrueCopy Async pairs which have the consistency status of *group*.

- **LU (MCU or RCU):** The MCU/RCU will delete only the specified TrueCopy Async pair(s). This option can be used to remove individual LUs from consistency groups. **Note:** For the LU delete range setting, if you select pairs with PAIR status and other than PAIR status in the same consistency group, unexpected suspend may occur during the pair operations (Pairsplit-r, Pairsplit-S, and Pairresync) under heavy I/O load conditions. You can estimate whether the I/O load is heavy or not from the rate of sidefile cache (around 30%), or if you cannot see the sidefile cache rate, from the frequency of host I/O. The delete pair operations should be performed under light I/O load conditions.

The default delete range settings are:

- Two or more pairs in a group are selected: LU
- One pair is selected in each group and one or more P-VOLs are selected: Group
- One pair is selected in each group and all selected volumes are S-VOLs: C/T

Note: When the Delete Pair By Force option is selected for an asynchronous pair, the Delete Range option is set to Group to protect the integrity of the consistency group. This ensures that one or more pairs in a consistency group cannot be forcibly deleted.

To delete one or more TrueCopy volume pairs:

1. Connect to the MCU or RCU* of the pair(s) to be deleted, open the TrueCopy main panel, and select the **Pair Operations** tab.

***Note:** If you plan to use the C/T Delete Range option, you must connect to the RCU.

2. In the outline view, select **Subsystem**, or select the CU image or port which contains the pair(s) to be deleted. Use the Display Filter as needed to display the desired pairs (e.g., select Async only) (see section 5.2.2).
3. In the list view, select the pair(s) that you want to delete. When **Subsystem** or a port is selected in the outline view, the volume pair(s) can be selected from the current **Volume List** (maximum 256 rows).

Select either TrueCopy Sync or TrueCopy Async pairs (not both). If you plan to use the C/T or Group delete range option, select only one TrueCopy Async pair in the group.

4. Right-click, and select **Pairsplit-S** to open the Pairsplit-S panel (refer to Figure 5.17).
5. On the Pairsplit-S panel, select the desired pairdelete options, and select **Set** to close the Pairsplit-S panel. The list view now displays the requested pairsplit-S operation(s).
6. Verify the requested operation(s) in the list view (see Figure 5.18). Make sure that the pairdelete options for each pair are correct.

To change one or more operations, select the operation(s), right-click, and select **Modify**. To remove one or more operations, select the operation(s), right-click, and select **Omit**. To remove all operations, right-click on the list, and select **Cancel All**.

7. If you want to execute the requested pairsplit-S operation(s) as quickly as possible, select the **Use Time-Saving Mode** box (above the list view).

Note: If you selected the **Group Delete Range** option, time-saving mode is not available.

8. To start the operation(s), select the **Apply** button (lower right of TrueCopy panel). To cancel all operations and return the list view to its original display, select **Cancel**.
9. On the **Pair Operations** tab, verify that the pairsplit-S operation(s) is/are completed successfully (SMPL or Deleting then SMPL status, not PSUE). To monitor the progress of the pairsplit-S operation(s), select **Refresh** to update the information in the list view, or use the Pairedisplay panel (see section 5.5) to monitor the detailed status of each pair.

Note: If an error occurs, you can display the error message by right-clicking on the operation and selecting the **Error Detail** command.

Note: To restart a pair which was deleted from the RCU, first delete the pair from the MCU, and then restart the pair using the appropriate initial copy option (Entire or No Copy).

WARNING: If a timeout error occurs when the **Use Time-Saving Mode** option is selected, confirm on the TrueCopy main panel for which pair(s) the pairsplit-S operation could not be performed. Deselect the **Use Time-Saving Mode** option for the failed pair(s), and retry the pairsplit-S operation.

Port	Group	LUN	S/N	SSID	Port	Group	LUN	Mode	Range	Error Code
CL2-A	0F	04	62492	0023	CL2-A	1F	06	No	Group	

Figure 5.18 Verifying the Pairsplit-S Operation(s)

5.9 Using TrueCopy for Data Migration and Duplication

5.9.1 Data Migration Using TrueCopy Synchronous

TrueCopy Synchronous can be used for device or workload migration with minimal impact to host applications. You may need to migrate data from one LU (volume) to another for any of the following reasons:

- To load data onto new or scratch volumes (e.g., new or upgraded subsystem),
- To temporarily move data off an LU to accommodate other activities (e.g., repair), or
- To relocate LUs to balance workloads and distribute I/O activity evenly within and across subsystems for the purpose of improving subsystem and system performance.

The TrueCopy initial copy operation copies the entire contents of the P-VOL to the S-VOL. The P-VOL and S-VOL are identical and synchronized when the initial copy operation completes and the pair status changes from COPY to PAIR. The TrueCopy pair is then deleted to change the state of the devices to SMPL, and host high-availability (HA) software can then be used to complete the data migration nondisruptively. To support host-based application automation, data migration using TrueCopy must be managed by integrating the Command Control Interface (CCI) software with TrueCopy operations and host HA software functions.

Note: If you need to migrate data from other vendors' storage subsystems onto the Lightning 9900™ V Series subsystem, please contact your Hitachi Data Systems account team.

To use TrueCopy Synchronous to migrate data from one volume to another:

1. Vary the S-VOL(s) offline from all attached hosts. The S-VOLs are the target volumes onto which you are migrating the data. The P-VOLs (source volumes) can remain online.
2. Connect to the subsystem containing the volume(s) to be migrated, and then start the TrueCopy software. If not already done, install the remote copy connections and configure the ports (initiator ports for fibre, RCPs for serial) (if migrating between subsystems), and then add the RCUs.
3. On the TrueCopy main panel, select the desired CU image, select the LU(s) to be migrated, and start the TrueCopy Sync pair(s) (see section 5.3).
4. Monitor the progress of the initial copy operation(s) and the status of the pair(s) on the TrueCopy main panel. Refresh the panel as needed. When the status has changed from COPY to PAIR, the P-VOL and S-VOL are identical and synchronized.

5. If you are not using CCI commands and host software to complete the migration, use the following procedure to stop using the P-VOL(s) and switch to the S-VOL(s):
 - a) Stop all host updates to the P-VOL(s).
 - b) When all update activity to the P-VOL(s) has stopped, connect to the MCU, select the correct CU image, and delete the TrueCopy volume pair(s) (see section 5.8).
 - c) If the P-VOL(s) and S-VOL(s) are attached to the same host, vary the P-VOL(s) offline first, and then vary the S-VOL(s) online. The P-VOL(s) and S-VOL(s) have the same volume labels and cannot be online to the same host(s) at the same time.
 - d) If you want to keep the volumes synchronized, establish the same TrueCopy pair(s) in the reverse direction using the **None** initial copy option (see section 5.3.1). If the original P-VOL(s) will be temporarily unavailable for update copy operations, you can split the new pair(s) (pairsplit-r) so that the new MCU keeps track of changes.
 - e) Start the applications with the S-VOL(s). When the original P-VOL(s) become available, you can resume the pair(s) (see section 5.7).

5.9.2 Point-in-Time (PiT) Data Duplication Using TrueCopy Asynchronous

Hitachi TrueCopy Asynchronous enables you to make Point-in-Time (PiT) duplicates of groups of volumes. The TrueCopy Async **Group** and **Drain** pairsplit options can be used together to create a PiT copy, relative to an application, of an entire TrueCopy Async consistency group of volumes. To produce a PiT duplicate of an existing TrueCopy Async consistency group:

1. Stop all host updates to all TrueCopy Async P-VOLs in the group.
2. After all P-VOL updates have completed, split the TrueCopy Async group using the **Group** and **Drain** pairsplit options. If you are splitting the group at the main site, issue the pairsplit-r/group command to one P-VOL in the MCU. If you are splitting the group at the remote site, issue the pairsplit-r/group command to one S-VOL in the RCU.

Note: The copy pending timeout setting for the group determines the maximum amount of time that the pairsplit-r/drain operation can take (see description of **Drain** above).

3. When the status of all TrueCopy Async pairs in the group has changed to **PSUS**, the duplicate set of volumes is complete. If desired, you can restart the application at the main site.

5.10 Powering Off/On TrueCopy Components

The user is responsible for controlling power-off activities for subsystems involved in TrueCopy operations. If you need to power off the 9900V subsystem, please call your Hitachi Data Systems representative or the Support Center for assistance. The following sections provide instructions for performing planned outages of TrueCopy components.

If power is removed from an MCU while TrueCopy operations are in progress, the TrueCopy pairs are not affected, but the update sequence consistency of the TrueCopy Async groups at the RCU may be affected (see section 5.10.1 for further information). When power is restored to an MCU, the MCU communicates with its RCU(s) to confirm the pair status of the S-VOLs. Make sure that TrueCopy communications are fully restored (all paths have normal status) before beginning I/O operations to the P-VOLs. If the MCU accepts a write I/O operation for a P-VOL before this confirmation is complete, the MCU will suspend the pair and change the status of the P-VOL to *suspended-by RCU* (the MCU will not be able to change the pair status of the S-VOL).

If power is removed from an RCU or remote copy connection while TrueCopy operations are in progress, the MCU(s) will detect the communication failure, suspend all affected pairs, and generate SIMs reporting the failures. The MCU will change the status of the P-VOLs to *suspended-by RCU* but will not be able to change the status of the S-VOLs.

Note: If an MCU/RCU is powered off and its backup batteries are fully discharged while TrueCopy pairs are suspended, the P-VOL/S-VOL cylinder/track maps will not be retained. In this unlikely case, the MCU/RCU will mark all cylinders/tracks of all suspended TrueCopy P-VOLs as modified, so that the MCU will perform the equivalent of an entire initial copy operation when the pairs are resumed. (The S-VOL cylinder/track map is used for TrueCopy Async operations and for the TrueCopy S-VOL write enable option.)

5.10.1 Planned Outage of the MCU

A planned MCU outage does not affect TrueCopy Synchronous. For TrueCopy Asynchronous operations, the MCU must communicate with the RCU even when there are no P-VOL update I/Os from the primary system. During the power-off sequence, the MCU will automatically suspend all TrueCopy Async pairs in the PAIR and COPY states (suspend type = MCU P/S-OFF). During the power-on-reset sequence, the MCU will automatically resume these suspended pairs (pairs with other suspend types are not automatically resumed).

5.10.2 Planned Outage of the RCU or Remote Copy Connection

You must split all affected TrueCopy pairs prior to a planned outage of an RCU or of a remote copy connection component (e.g., switch, ESCON® director, channel extender). If you do not split the pairs first, the MCU(s) will detect the communication failure, suspend all affected pairs, and generate SIMs reporting the failures. To perform a planned outage of a TrueCopy RCU or remote copy connection component:

1. Identify all TrueCopy P-VOLs which will be affected by the equipment outage. You need to know the MCU, CU image, and ID (port, TID, LUN) for each of these P-VOLs.
 - a) For RCU power-off, identify all P-VOLs which are paired with S-VOLs in the RCU to be powered off.
 - b) For remote copy connection outage, identify all P-VOLs in all MCUs which use the path/component to be powered off.
2. Connect to each MCU which contains affected P-VOLs, and split all affected TrueCopy pairs. Make sure to confirm the pair status changes (**Pair Operations** tab or **Pairedisplay** panel).
3. Perform the planned outage of the RCU or remote copy connection.
4. When the RCU is fully powered on and ready to resume operations, resume (pairresync) all TrueCopy pairs at each MCU. Make sure to confirm the pair status changes.

5.10.3 Planned Outage of the MCU and RCU

When you plan an outage of TrueCopy MCUs and RCUs at the same time, the MCUs must be powered off before the RCUs and powered on after the RCUs. To perform a planned outage of a TrueCopy MCU and RCU:

1. If RCU power-on will be difficult to control (e.g., Power-Control-Interface setting), you should consider increasing or disabling the **Time Out (RCU ready)** group option (see section 2.4.1) for each TrueCopy Async group with S-VOLs in the RCU(s) to be powered off.
2. Perform the planned outage of the MCU(s) as described in section 5.10.1. Do not power-on the MCU(s) yet.
3. If an RCU to be powered off is connected to an MCU which is not powered off, make sure to split those TrueCopy pairs before powering off the RCU.
4. Perform the planned outage of the RCU(s) as described in section 5.10.2.
5. Power on the RCU(s). Make sure that they are fully operational and ready to resume operations before powering on the MCUs.
6. Power on the MCU(s), and make sure that they are ready to resume operations. If you split any pairs in step (3), you can also resume (pairresync) those pairs now.

Chapter 6 TrueCopy Disaster Recovery Operations

6.1 Preparing for Disaster Recovery

The type of disaster and the status of the TrueCopy volume pairs will determine the best approach for disaster recovery. For example, if all TrueCopy volume pairs are in the **PAIR** state when a total system failure occurs at a single point in time, the S-VOLs are current and recovery is straightforward. Unfortunately, some disasters are not so “orderly” and involve intermittent or gradual failures occurring over a longer period of time. The user should anticipate and plan for all types of failures and disasters.

The major steps in preparing for disaster recovery are:

1. Identify the volumes and groups which contain important files and data for disaster recovery. In addition to supporting TrueCopy remote copy operations as well as CCI commands, the 9900V subsystem provides battery-backed nonvolatile duplexed cache, full hardware redundancy, dynamic sparing, and an advanced RAID-5 implementation to ensure full data integrity in the event of a sudden power outage or other failure.
2. Install the Storage Navigator PC and TrueCopy hardware and software, and establish TrueCopy operations for the volumes and groups identified in step (1). Make sure to select the proper CU images/ports to access the desired volumes. Refer to Chapter 3 for TrueCopy installation instructions. Refer to Chapter 4 for instructions on performing TrueCopy configuration operations. Refer to Chapter 5 for instructions on performing TrueCopy pair operations.
3. Use the appropriate combination of TrueCopy options for disaster recovery:
 - TrueCopy Async **offloading timer** option (see section 4.3.1) and **Time Out (Copy Pending)** group option (see section 4.3.3). The copy pending timeout group option can be used to limit the time duration during which updates may be lost.
Note: The offloading timer value should be less than the HBA timeout value.
Note: When channel-extenders are used for TrueCopy Async, the offloading timer should be set to 35 seconds or less to avoid affecting host I/O performance.
 - TrueCopy Async **Error Level** pair option, and TrueCopy Synchronous **P-VOL Fence Level** pair option (see section 5.3.2).
4. Establish file and database recovery procedures. These procedures should already be established for recovering volumes which become inaccessible due to control unit failure.
5. Make sure that the host system at the primary site is configured to receive sense information from the 9900V MCUs (e.g., via CCI or SNMP).
6. Install and configure host failover software between the main and remote sites. Host failover capability is essential if you use the fence level setting of **Status** or **Never** for any TrueCopy volume pairs.

6.1.1 Considering the P-VOL Fence Level Setting

The P-VOL fence level setting (see section 5.4) for each TrueCopy Synchronous volume pair determines whether the P-VOL will be fenced when TrueCopy remote copy operations fail. Table 6.1 summarizes the effect of the fence level setting on a TrueCopy Sync P-VOL.

Note: The P-VOL fence level setting does not apply to TrueCopy Asynchronous pairs. TrueCopy Async P-VOLs are never fenced due to suspension of the pair.

Table 6.1 Effect of the Fence Level Setting on a TrueCopy P-VOL

Type of Failure		Fence Level Setting		
		Data	Status	Never
The update copy operation failed, and the MCU was able to change the status of the S-VOL to PSUE.	Write I/O operations to the P-VOL will be:	REJECTED	Accepted	Accepted
The update copy operation failed, and the MCU was NOT able to change the status of the S-VOL to PSUE.	Write I/O operations to the P-VOL will be:	REJECTED	REJECTED	Accepted

Data. When **Data** is selected, the P-VOL will be fenced if an update copy operation fails. This P-VOL fence level setting ensures that the S-VOL remains identical to the P-VOL once the TrueCopy volume pair is synchronized, but makes the P-VOL inaccessible for updates whenever TrueCopy remote copy operations fail. This setting should be considered for the most critical volumes for disaster recovery. This setting will reduce the amount of time required to analyze the currency of the S-VOL during disaster recovery efforts. This setting is also designed for applications which can continue to operate with another device pair.

Status. When **Status** is selected, the P-VOL is fenced only if the MCU is not able to change the S-VOL pair status to **PSUE**. If the MCU successfully changes the S-VOL pair status to **PSUE**, subsequent write I/O operations to the P-VOL will be accepted, and the MCU will keep track of updates to the P-VOL. This allows the volume pair to be resumed quickly using the pairresync operation (out-of-sync-cylinders/tracks only). This setting will also reduce the amount of time required to analyze the S-VOL currency during disaster recovery.

Never. When **Never** is selected, the P-VOL is never fenced when the pair is suspended. This P-VOL fence level setting ensures that the P-VOL remains available to applications for updates, even if all TrueCopy copy operations have failed. The S-VOL may no longer be in sync with the P-VOL, but the MCU will keep track of updates to the P-VOL while the pair is suspended. Host failover capability is essential if this fence level setting is used. For disaster recovery, the currency of the S-VOL is determined by using the sense information transferred via host failover or by comparing the S-VOL contents with other files confirmed to be current.

6.1.2 Setting the Fence Level

When a take-over by the S-VOL occurs as shown in Figure 6.1 (two errors have already occurred), Data(V) remains in the rollback process at the secondary host, and full recovery cannot be performed. To avoid this situation, you can define the fence level of the Redo log file as **Data**, so that the P-VOL returns an error if a data disagreement is expected to occur concerning a write request issued from the host. The **Data** fence level setting maintains full consistency between the Redo log file and the data file, since no data is written to the data file due to the write error at the log file. However, when the fence level is defined as **Data**, a write I/O causes an error even when processing has been suspended due to an error at the S-VOL. In this case, a take-over by the S-VOL occurs, and the significance of the duplex system will be lost. Therefore, if you define the fence level as **Data**, applications must be able to cope with write I/O errors by handling them. Systems that allow disk errors by means of multiplication can function with the **Data** fence level setting. For example, Oracle multiplies the Redo log file by itself (default = three times).

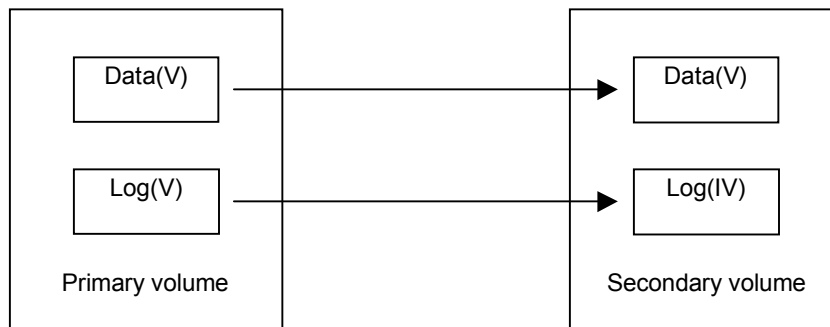


Figure 6.1 Relationship Between Log File and Data File in PAIR Status

Since most UNIX® file systems (excluding JFS and VxFS) have no journal files, the P-VOL fence level should be defined as **Never**. When a take-over by the S-VOL occurs, **fsck** is executed on the volume and the file system is cleaned up, even if the S-VOL is undefined at the secondary host. The data that will be lost depends on how much differential data is contained in the P-VOL when the S-VOL is suspended. During operation, error recovery should be performed when the suspended status (PSUE) is detected (when one error occurs).

6.1.3 Transferring Sense Information Between Sites

When the MCU (or RCU for TrueCopy Async) suspends a TrueCopy pair due to an error condition, the MCU/RCU sends sense information with unit check status to the appropriate host(s). This sense information is used during disaster recovery to determine the currency of the S-VOL, and must be transferred to the remote site via the host failover software.

6.1.4 File and Database Recovery Procedures

When a TrueCopy Synchronous pair is suspended, or when the MCU fails due to a disaster, the S-VOL may contain in-process data. A data set could be open, or transactions may not have completed. Even if you use the **Data** fence level for all TrueCopy Sync pairs, you need to establish file recovery procedures. These procedures should be the same as those used for recovering any volume which becomes inaccessible due to control unit failure. These procedures are more important if the **Status** or **Never** fence level settings are used.

TrueCopy Asynchronous does not provide any procedure for detecting and retrieving lost updates. To detect and recreate lost updates, you must check other current information (e.g., database journal log file that was active at the primary system when the disaster occurred). The TrueCopy Async consistency status (*group* or *volume*) can be useful when performing this detection and retrieval. Since this detection/retrieval process can take a while, your disaster recovery scenario should be designed so that detection/retrieval of lost updates is performed after the application has been started at the secondary system.

You should prepare for file and database recovery by using:

- Files for file recovery (e.g., database log files which have been verified as current). To ensure the currency of these files, use the **Data** fence level setting for the TrueCopy pairs which contain these important files.
- The sense information will be transferred via host failover.

Important: Remote copy and disaster recovery procedures are inherently complex. Consult your Hitachi Data Systems account team on sense-level settings and recovery procedures.

Note: See Appendix A for information on recovering a pinned track on a TrueCopy volume.

6.2 Switching Operations to the Remote Site

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

The basic procedures for switching operations to the remote backup site are:

1. Record the pair status and fence level of each TrueCopy Synchronous S-VOL.
Record the pair status and consistency status of each TrueCopy Async S-VOL (displayed only at the RCU). Suspended TrueCopy Async S-VOLs with consistency status of *group* are consistent with the other S-VOLs in the group and can be used for disaster recovery.
2. Analyze the currency of the TrueCopy Synchronous S-VOLs (see section 6.2.1) and the consistency of the TrueCopy Asynchronous S-VOLs (see section 6.2.2).
3. Perform file recovery as needed (see section 6.1.4).
4. At the remote site, connect to each RCU, and delete all TrueCopy Synchronous pairs. For TrueCopy Asynchronous pairs, delete all consistent pairs in a group at the same time using the pairsplit-S command with the C/T delete range option. This option prevents you from accidentally using inconsistent pairs for disaster recovery.
Caution: Once an S-VOL changes to simplex, you cannot distinguish it from a non-TrueCopy simplex volume. The TrueCopy Async consistency status is also discarded when the pair is deleted.
5. If necessary, use the logical volume manager to change the volume labels of the S-VOLs.
6. Make sure that all required file recovery procedures have been completed before varying the S-VOLs online.
7. At this point you may start critical applications at the remote site with the previous S-VOLs taking the place of their P-VOLs.

6.2.1 Analyzing the Currency of TrueCopy Synchronous S-VOLs

Table 6.2 shows how to determine the currency of a TrueCopy Synchronous S-VOL based on its pair status and P-VOL fence level setting. For TrueCopy Sync pairs with a P-VOL fence level setting of **Never**, further analysis will be required to determine the currency of these S-VOLs. The currency of these S-VOLs can be determined by using the sense information transferred via the host failover, or by comparing the contents of the S-VOL with other files which are confirmed to be current (e.g., database log files). These S-VOLs should be recovered using the files which are confirmed to be current.

Note: Actual data recovery must be done using recovery point data in the database redo log.

Table 6.2 Analyzing the Currency of TrueCopy Synchronous S-VOLs

Status of S-VOL	Fence Level	Currency of S-VOL
SMPL	Data Status Never	Inconsistent. This S-VOL does not belong to a TrueCopy volume pair. (Note: Even if you established a TrueCopy pair for this volume, you must regard this volume as inconsistent.)
COPY	Data Status Never	Inconsistent. This S-VOL is not synchronized because not all cylinders have been copied from the P-VOL yet. This S-VOL must be initialized (or copied from the P-VOL at a later time).
PAIR	Data Status	Current. This S-VOL is synchronized with its P-VOL.
	Never	Needs to be analyzed. This S-VOL requires further analysis to determine its level of currency.
PSUE - initial copy failed	Data Status Never	Inconsistent. This S-VOL is not synchronized because not all cylinders/tracks have been copied from the P-VOL yet. This S-VOL must be initialized (or copied from the P-VOL at a later time).
PSUS - S-VOL by operator	Data Status Never	Suspect. This S-VOL is not synchronized with its P-VOL if any write I/Os were issued to the P-VOL after the pair was split. This pair should be restarted using the Entire Volume initial copy option, but the None option can be used if you are sure that no data on the P-VOL changed.
PSUS/PSUE - all other types	Data	Current. This S-VOL is synchronized with its P-VOL.
	Status Never	Suspect. This S-VOL is not synchronized with its P-VOL if any write I/Os were issued to the P-VOL after the pair was split or suspended. Restore the consistency of this S-VOL and update it, if required. The time of suspension indicated on the Last Updated field of the Pairedisplay panel (MCU SVP time) will help to determine the last time this S-VOL was updated.

6.2.2 Analyzing the Consistency of TrueCopy Asynchronous S-VOLs

Table 6.3 shows how to determine the consistency of a TrueCopy Async S-VOL based on its pair status and consistency status. For TrueCopy Async S-VOLs with a consistency status of **LU**, the volume is not consistent with other volumes in the same group, and further analysis will be required to determine the currency of each of these S-VOLs. The currency of these S-VOLs can be determined by using the sense information transferred via host failover software or by comparing the contents of the S-VOL with other files which are confirmed to be current (e.g., database log files). These S-VOLs should be recovered using the files which are confirmed to be current.

Note: Actual data recovery must be done using recovery point data in the database redo log.

Table 6.3 Analyzing the Consistency of TrueCopy Asynchronous S-VOLs

Status of S-VOL	Usable for Recovery?	Description
PAIR COPY SMPL	No No No	These states do not usually occur during TrueCopy Asynchronous disaster recovery, because the RCU suspends all TrueCopy Async S-VOLs when communication with the MCU is lost. TrueCopy Async S-VOLs in these states should not be used for disaster recovery. Note: Simplex volumes cannot be distinguished from S-VOLs which have already been deleted by the pairsplit-S operation.
PSUE-Group	Yes	The update sequence consistency across these S-VOLs is ensured. These S-VOLs can be used for disaster recovery at the secondary system. Note: The time of the latest update indicated on the Pairedisplay panel (MCU SVP time) will help to determine the last time these S-VOLs were updated.
PSUE-LU	No	The contents of this S-VOL may be behind the other S-VOLs in the consistency group. If this volume must be consistent with the other volumes in the same group, this S-VOL should not be used for disaster recovery. The cause for this status is: – The TrueCopy Async Error Level pair option for this pair is LU (not Group), AND – This pair was suspended before the disaster/failure, at the beginning of the rolling disaster, or during the initial copy operation.

6.3 Transferring Operations Back to the Primary Site

Once the applications are running at the secondary (remote) site, the next activity is to restore the primary (main) site and transfer operations back to the primary site. To transfer operations to the primary site:

1. Bring up the host server(s) at the primary site, and make sure that all TrueCopy components are fully operational.
2. At the primary site, delete all TrueCopy pairs at the MCUs. The **Delete Pair by Force** option must be used, because the previous S-VOLs are in the SMPL state at the secondary site.
3. At the main site, delete all TrueCopy Async consistency groups at the MCUs.
4. At the main site, delete the RCUs. Remember to connect with each MCU and each CU image to make sure that all RCUs have been deleted.
5. At the main site, configure the MCU ports as needed. If you plan to use the same remote copy connections to copy back, change the existing initiator ports to ordinary target ports, or change the existing RCPs to LCPs.
6. If you plan to use the same switches, change the operating mode to the opposite direction (see section 3.3.1).

If you plan to use the same channel extenders, change the operating mode to the opposite direction. The boxes/nodes connected to the MCUs must be set to channel-mode, and the boxes/nodes connected to the RCUs must be set to device-mode.

7. At the remote site, configure the appropriate ports to enable TrueCopy operations in the reverse direction (change target ports to initiator ports for fibre, change LCPs to RCPs for serial). This enables the original RCUs to send TrueCopy remote copy operations to the original MCUs to bring the original P-VOLs up to date.
8. At the remote site, establish the same TrueCopy Async groups and TrueCopy pairs in the reverse direction to synchronize the original P-VOLs with the S-VOLs. Make sure to use the **Entire Volume** initial copy option.

6.4 Resuming Normal Operations at the Primary Site

Once the TrueCopy pairs have been established in the reverse direction, you are ready to resume normal operations at the primary (main) site. Remember that the TrueCopy terminology is now reversed: the original RCUs and S-VOLs (secondary site) are now the MCUs and P-VOLs, and the original MCUs and P-VOLs (primary site) are now the RCUs and S-VOLs.

To resume normal operations at the primary site:

1. At the secondary site, make sure that all TrueCopy pairs are in the PAIR (duplex) state. This indicates that the TrueCopy initial copy operations are complete.
2. Halt the applications at the remote site, and vary the P-VOLs (original S-VOLs) offline at the remote site. This maintains synchronization of the TrueCopy Sync pairs.
3. Split (pairsplit-r) all TrueCopy pairs at the MCUs (original RCUs) to destage any pending data from cache. Confirm that the pairs are split (PSUS) before proceeding. If an error occurs, resolve it before proceeding.
4. Delete all TrueCopy pairs at the MCUs (original RCUs). You do not need to use the **Delete Pair by Force** option. For TrueCopy Async pairs, the MCU and RCU complete all pending updates before changing the pair status to SMPL.
5. Change the TrueCopy settings at the MCUs (original RCUs) to prepare for normal TrueCopy operations. Delete the TrueCopy Async groups and the RCUs (original MCUs). If you plan to use the same remote copy connections, reconfigure the ports (change initiator ports back to ordinary target ports, change RCPs back to LCPs).
6. If you plan to use the same switches, change the operating mode back to the original direction (see section 3.3.1).

If you plan to use the same channel extenders, change the operating mode back to the original direction. The boxes/nodes connected to the MCUs must be set to channel-mode, and the boxes/nodes connected to the RCUs must be set to device-mode.
7. At the primary site, configure the initiator ports or RCPs, add the RCUs, and add the TrueCopy Async groups.
8. At the primary site, establish all TrueCopy groups and pairs in the original direction. You may use the **None** initial copy option because all P-VOLs and S-VOLs are synchronized. If there is any possibility that the volumes are not 100% synchronized, use the **Entire Volume** initial copy option to be safe.
9. Vary the MCU and P-VOLs online, and start the applications at the primary site.

Chapter 7 TrueCopy Operations with NAS Blade

This chapter describes how to use TrueCopy with the Lightning 9900V NAS Blade. This chapter assumes that:

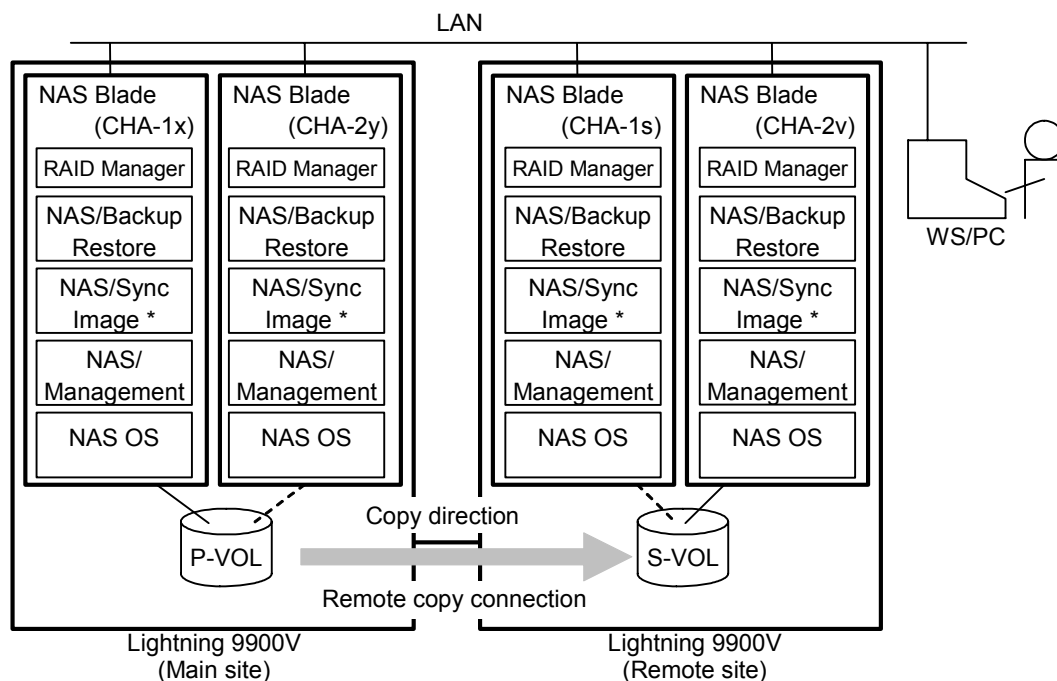
- the user is familiar with Linux® computers or UNIX® computers,
- the user has read Chapter 1 to Chapter 6 in this manual and fully understands the overview, requirements and restrictions of Hitachi TrueCopy,
- the user has read the *Command Control Interface User and Reference Guide* and has a thorough understanding of CCI operations, and
- the user has read the *Hitachi Lightning 9900™ V Series NAS Blade Backup/Restore User's Guide* and fully understands the operations of NAS Blade system.

7.1 Overview of TrueCopy Operations in NAS Blade System

The NAS Blade system enables integrated management of the data in the disk subsystem. NAS Blade utilizes the LAN environment already in place and enables the data within a disk subsystem to be shared across heterogeneous platforms. NAS Blade also enables you to copy and maintain the data stored in the disk subsystem using the remote copy feature TrueCopy in the Lightning 9900V series. With TrueCopy, you can copy data utilizing the NAS server (even in the remote center), back up data to guard against a main volume failure, and perform disaster recovery at the main site.

To use TrueCopy in the NAS Blade system, use Command Control Interface (CCI) for Linux® in Lightning 9900V series. Note that if you install Hitachi Network Attached Storage Backup/Restore on the NAS UniBlade system, CCI for Linux is installed at the same time. You do not need to install the CCI included with the Lightning 9900 V Series to the NAS Blade system.

Figure 7.1 illustrates the TrueCopy operation in the NAS Blade system.



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

Figure 7.1 Using TrueCopy in NAS Blade System

7.2 Scope of TrueCopy Function with NAS Blade

7.2.1 Scope Related to TrueCopy

- **Volume type**

Only the user LUs may be used as TrueCopy P-VOLs and S-VOLs in a NAS Blade 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 Blade can access the TrueCopy P-VOLs and S-VOLs created in a NAS Blade system. Hosts connected via serial port or fibre-channel port will not be able to access them.

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

You cannot allocate a file system that consists of 129 or more LUs and that uses Logical Volume Manager (LVM) on the NAS OS.

You cannot allocate a volume group that consists of 129 or more LUs if it contains a file system managed by NAS/Sync Image and differential-data storage devices.

- **Writing data to S-VOL when a volume pair is split**

When you split a TrueCopy volume pair in the NAS Blade system, you need to change the S-VOL to write-enable. Make sure that you 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 written to by the client, use the **enas_fsmount** command with **-r** option in Hitachi Network Attached Storage/Management when mounting the file system in S-VOL.

7.2.2 Scope Related to Command Control Interface

- **CCI (formerly HORC Manager [HORCM]) and failover/failback by NAS Blade system**

CCI is not subject to failover and failback by the NAS Blade system. Prepare the same configuration file as the main node in the standby node except **ip_address** in the **HORCM_MON** section. If a failure occurs in the NAS package while CCI is operating, and failover occurs, start CCI in the standby side and continue operating TrueCopy.

- **Protect feature**

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

- **Executing the Command Control Interface command**

To execute the Command Control Interface command using the nasroot account for logging in to a NAS package using SSH, use the **sudo** command as follows:

```
$ sudo pairdisplay -gg VG01
```

Figure 7.2 Example of Executing the pairdisplay Command in Command Control Interface using the sudo Command

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

Figure 7.3 Example of Executing the pairdisplay Command using a Shell Script Created in the SSH Client (For SSH protocol version 2).

Note: Create a shell script on the OS that the system administrator uses. For details about creating a shell script, see the appropriate documentation for that OS.

- **Special file names given from standard input to the command in Command Control Interface**

When giving special file names from 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 7.4 Example of Executing the inqraid Command using the sudo Command

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

Figure 7.5 Example of Executing the inqraid Command using a Shell Script Created in the SSH client (For SSH protocol version 2).

- **Notes for scanning the port of NAS package by the raidscan command Command Control Interface command**

Information on /dev/sda-sdi equivalent to the NAS system LU (NAS OS LU and dump LU) may be displayed when scanning the port of NAS package using the raidscan command. You should not define this information in HORCM_DEV in the configuration file because you cannot use the NAS system LU (NAS OS LU and dump LU) as P-VOL and S-VOL.

Scope Related to Features in Hitachi Network Attached Storage Backup/Restore

- **ShadowImage operations set by the Snapshot feature in Hitachi Network Attached Storage Backup/Restore**

You should not operate ShadowImage settings by the Snapshot feature using the CCI command. You should also not operate ShadowImage set by the Snapshot feature using the Lightning 9900V Storage Navigator.

Operate ShadowImage using the GUI screen in Hitachi Network Attached Storage Backup/Restore or the command in the Snapshot feature.

- **Configuring a cascade connection of TrueCopy/ShadowImage**

When configuring a cascade connection of TrueCopy/ShadowImage, set and perform ShadowImage and display the status using only CCI, and not the Snapshot feature in Hitachi Network Attached Storage Backup/Restore.

7.2.3 Scope Related to other Hitachi Network Attached Storage Products

- **Hitachi Network Attached Storage/Sync Image**

When you copy a file system managed by Hitachi Network Attached Storage/Sync Image 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 will not be able to connect them to the NAS Blade system on the remote site.

7.3 Prerequisites

7.3.1 Hardware Prerequisites

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

- *Hitachi TrueCopy User and Reference Guide* (this document)
- *Hitachi Command Control Interface (CCI) User and Reference Guide*
- *Hitachi Lightning 9900™ V Series NAS Blade Backup/Restore User's Guide*

7.3.2 Software Prerequisites

All of the following program products (PPs) must be installed in the NAS Blade which connects to P-VOL or S-VOL of TrueCopy, and their licenses must be valid.

- **For Lightning 9980V/9970V**
 - Hitachi TrueCopy
 - ShadowImage
(Required when configuring the cascade connection of TrueCopy/ShadowImage)
 - Hitachi Network Attached Storage/Base Data Control
 - Hitachi Network Attached Storage/Base File Sharing
 - Hitachi Network Attached Storage/Management
 - Hitachi Network Attached Storage/Backup Restore
 - Hitachi Network Attached Storage/Sync Image
(Required when copying the file system managed by NAS/Sync Image using TrueCopy)

7.4 Notes on Operations

■ **UID for user registration and GID for group registration in Primary/Secondary sites**

With TrueCopy, the information on the file owner (UID and GID in the primary site), and the quota information and ACL information for each user (UID in the primary site) and group (GID in the primary site) included in the source file system are copied to the secondary site. Note the UID for user registration and the GID for group registration in the primary and secondary sites (as explained in the following sections) when you are sharing the NFS/CIFS and set the quota or the ACL in the target file system.

- Register the same user name (or group name) in both sites, and the quota settings and the ACL settings are also 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 to ensure 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 by remote copy, mount the NFS client by specifying the NFS version 3. If you access the file system from the NFS client mounted by specifying NFS version 2 during online backup, the nfsd daemons wait for the online backup to complete. Consequently, the number of nfsd daemons which can be used for access to other file systems decreases.

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

When a cluster is not configured, the cluster is stopped, the nodes are stopped, and the resource groups are offline, connecting the device file or creating and mounting a file system is restricted. Due to these restrictions, the following operations performed in the target TrueCopy operation will also end in error. You therefore should not operate the cluster, nodes, and resource groups during the TrueCopy operation. Should any problems occur with the cluster, nodes, or resource groups, fix them immediately.

- Unmount and mount the source file system during the splitting of a TrueCopy pair volume.
- Connect the target file system to the NAS package.
- Unmount and delete the target file system before the TrueCopy pair is resynchronized.

- Notes on changing system configuration during the TrueCopy operations

When changing the following system configurations during TrueCopy operations, you must change the Command Control Information configuration definition files in CL1 and CL2 to which the TrueCopy P-VOL is connected, and in CL1 and CL2 where the S-VOL is used:

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

When the host name is specified in the Command Control Interface 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)

7.5 Preparing for TrueCopy Operations

7.5.1 Preparing for TrueCopy Volume Pair Operation

Prepare for creating the TrueCopy volume pairs by referring to section 5.1 in this manual.

7.5.2 Registration of 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 package in which the TrueCopy P-VOL is connected and also in the NAS package which will use the S-VOL. For the registration of the public key, refer to the *Hitachi Lightning 9900™ V Series NAS Blade Management User's Guide*, MK-93RD162.

7.5.3 Configuring the CCI Environment

7.5.3.1 Login to the Target NAS Package Using SSH

Using the `nasroot` account via SSH, log in both the NAS package in which the TrueCopy P-VOL is connected, and the NAS package which will use the S-VOL. (For information about login, refer to the appropriate documentation for each tool in a platform.)

7.5.3.2 Configuring the CCI Configuration Definition Files

To control a TrueCopy pair using CCI, you must first define the TrueCopy pair using the CCI configuration definition file.

The installation of NAS/Backup Restore creates the templates of the Command Control Interface configuration definition file in which only the HORCM_MON section and the HORCM_CMD section are described.

- The template of the Command Control Interface configuration definition file for instance number 16 is:
`/home/nasroot/horcm16.conf`
- The template of the Command Control Interface configuration definition file for instance number 17 is:
`/home/nasroot/horcm17.conf`

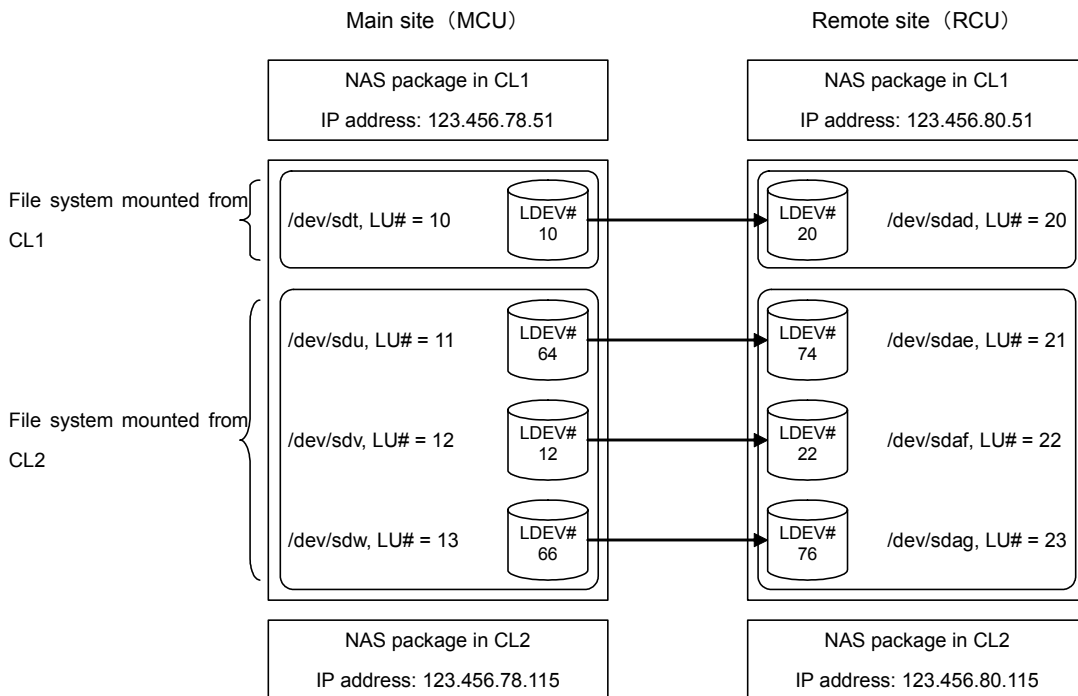
To complete the CCI configuration definition file:

1. Add the HORCM_DEV section and the HORCM_INST section to a template for the Command Control Interface configuration definition file using the `mkconf.sh` command in Command Control Interface.
2. Edit the file and create the Command Control Interface configuration definition file.

You must perform these operations in each NAS package in CL1 and CL2 where the TrueCopy P-VOL is connected, and in each NAS package in CL1 and CL2 that will use the S-VOL. You therefore need to prepare a total of four CCI configuration files, assuming one instance per NAS package. For two instances, you will need a total of eight configuration files.

In NAS Blade, you can define one or two CCI instances per NAS package. To operate only the TrueCopy pairs in CCI, you need one instance. To operate the pairs where TrueCopy and ShadowImage are cascaded, you need two instances.

In the following section, we explain how to create a CCI configuration definition file using the NAS Blade system with LUs as an example (see Figure 7.6).



Note: To enable 4 NAS packages to communicate over the LAN, you must define the network configuration. Use fixed IP addresses of all eth1 or all eth2 of each package. Do not mix eth1 or eth2 addresses.

Figure 7.6 Example of Configuration of Pair LU

Figure 7.7 is an example of:

- Adding the HORCM_DEV section and the HORCM_INST section using the mkconf.sh command in Command Control Interface

Adding the HORCM_DEV section and the HORCM_INST section to the template of the Command Control Interface configuration definition file using the mkconf.sh command in Command Control Interface.

```
$ cat /home/nasroot/horc_devfile | sudo mkconf.sh -gg Device Group Name -i 16 -a
```

Figure 7.7 Adding the HORCM_DEV section and the HORCM_INST section (For Instance Number 16)

Warning: If the `mkconf.sh` command is executed without specifying the `-a` option, the HORCM_MON section and the HORCM_CMD section in the Command Control Interface configuration definition file automatically created when NAS/Backup Restore is installed will be overwritten. In this case, delete all the lines before the HORCM_MON section, and change the entry service in the HORCM_MON section to an appropriate value based on Table 7.1.

To execute the `mkconf.sh` command, the LU that constitutes the file system to be paired must be attached to the NAS OS. The LU configuration (size and number) in the file system to be paired needs to be exactly the same in both the primary site and the secondary site.

To create the correct CCI configuration definition file, it is recommended that you 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, you can continue using the file system in the primary site. Alternatively, you may also delete it and create a file system with the same configuration using the same LU in section 7.5.5. You must delete the temporarily created file system in the secondary site before creating a file system pair.

We will explain how to create a CCI configuration definition file in the NAS package in CL1 in the primary site in the sample configuration above. You must create CCI configuration definition files for the other three NAS packages using the previously explained procedure.

Creating a template for a CCI configuration definition file. Figure 7.8 shows an example of how to create a template for a CCI configuration definition file.

```
$ 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-A-1  0    17 -   62486   70
/dev/sdk         VG     VG_001  CL1-A-1  1    18 -   62486   18
:
:
/dev/sdt         VG     VG_010  CL1-A-1  0    10 -   62486   10
/dev/sdu         VG     VG_011  CL1-A-1  0    11 -   62486   64
/dev/sdv         VG     VG_012  CL1-A-1  0    12 -   62486   12
/dev/sdw         VG     VG_013  CL1-A-1  0    13 -   62486   66
/dev/sdx         VG     VG_014  CL1-A-1  0    14 -   62486   14
/dev/sdy         VG     VG_015  CL1-A-1  0    15 -   62486   68
/dev/sdz         VG     VG_016  CL1-A-1  0    16 -   62486   16
HORCM Shutdown inst 16 !!!
Please check '/home/nasroot/horcm16.conf', '/home/nasroot/log16/curlog/horcm_*.log', and
modify 'ip
_address & service'.
#
```

Figure 7.8 Example of `mkconf.sh` Panel (for Instance Number 16)

Editing the template for the CCI configuration definition file. Table 7.1 lists the values are specified for the items included in the CCI configuration definition file in the NAS Blade system as shown in Table 7.1.

Table 7.1 Configuration Definition File Settings (HORCM_MON, HORCM_CMD) and Specified Values in NAS Blade System

Section Name	Item	Specified Values in NAS Blade System
HORCM_MON	ip_address	Unique IP address for eth1 or eth2 in the local NAS package
	service	20331 (Instance number 16) or 20332 (Instance number 17)
HORCM_CMD	dev_name	/dev/sdf

Note: The host name, instead of the fixed IP address, can be specified 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 Lightning 9900™ V Series NAS Blade Management User's Guide* for information on how to register the fixed IP address and the corresponding host name into */etc/hosts*. Refer to the same document for information on how the NAS Blade system may search the host name using NIS or DNS.

Based on Table 7.1, 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 is installed.

Change the entries **poll** and **timeout** to the appropriate values according to hardware requirements.

```

HORCM_MON
#ip_address      service      poll(10ms)      timeout(10ms)
123.456.78.51    20331              1000              3000

HORCM_CMD
#dev_name      dev_name      dev_name
#UnitID 0 (Serial# 62486)
/dev/sdf

HORCM_DEV
#dev_group      dev_name      port#      TargetID      LU#      MU#
# /dev/sdj      SER =      62486      LDEV =      70 [ FIBRE FCTBL = 3 ]
VG              VG_000      CL1-A-1      0            0
# /dev/sdk      SER =      62486      LDEV =      18 [ FIBRE FCTBL = 3 ]
VG              VG_001      CL1-A-1      0            1
:
:
# /dev/sdw      SER =      62486      LDEV =      66 [ FIBRE FCTBL = 3 ]
VG              VG_013      CL1-A-1      0            13
# /dev/sdx      SER =      62486      LDEV =      14 [ FIBRE FCTBL = 3 ]
VG              VG_014      CL1-A-1      0            14
# /dev/sdy      SER =      62486      LDEV =      68 [ FIBRE FCTBL = 3 ]
VG              VG_015      CL1-A-1      0            15
# /dev/sdz      SER =      62486      LDEV =      16 [ FIBRE FCTBL = 3 ]
VG              VG_016      CL1-A-1      0            16

HORCM_INST
#dev_group      ip_address      service
VG              127.0.0.1      52323

```

Figure 7.9 Example of CCI Configuration Definition File - 1 (for Instance Number 16)

Next, delete unnecessary LU entries (lines) for the **HORCM_DEV** section except for the LU entry (line) that you want to control using CCI (see Figure 7.11).

LUs which constitute a file system and their LDEV numbers can be reviewed using the following command.

```
$ sudo horc_devlist | grep ':File System Name$'
```

For example, in Figure 7.10, **64**, **12**, **66** are LUs that constitute the file system sample. **64**, **12**, and **66** are their LDEV numbers.

```

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

```

Figure 7.10 Example of the Command Execution which Lists LUs which Constitute the File System Sample

The device file name and the device name of the LU entry (line) you want to control using Command Control Interface are changed to an appropriate name. In changing the device file name and the device name, observe the following:

- The same device group name and the same device name need to be specified to the volumes to be paired in the primary site and in the secondary site. Specify the device group name and the device name accordingly.
- The same device group name must be specified as LUs which constitute one file system. If NAS/Sync Image manages the file system, the same device group name must be specified as LUs that constitute a file system and as LUs that constitute differential-data storage devices.

HORCM_MON					
#ip_address	service	poll(10ms)	timeout(10ms)		
123.456.78.51	20331	1000	3000		
HORCM_CMD					
#dev_name	dev_name	dev_name			
#UnitID 0 (Serial# 62486)					
/dev/sdf					
HORCM_DEV					
#dev_group	dev_name	port#	TargetID	LU#	MU#
# /dev/sdt	SER =	62486	LDEV = 10	[FIBRE FCTBL = 3]	
VG	VG_010	CL1-A-1	0	10	
# /dev/sdu	SER =	62486	LDEV = 64	[FIBRE FCTBL = 3]	
VG	VG_011	CL1-A-1	0	11	
# /dev/sdv	SER =	62486	LDEV = 12	[FIBRE FCTBL = 3]	
VG	VG_012	CL1-A-1	0	12	
# /dev/sdw	SER =	62486	LDEV = 66	[FIBRE FCTBL = 3]	
VG	VG_013	CL1-A-1	0	13	
HORCM_INST					
#dev_group	ip_address	service			
VG	127.0.0.1	52323			

Figure 7.11 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 7.2 and Figure 7.12). Specify the IP addresses of the instances in both CL1 and CL2 for a failover between NAS packages in the secondary site.

Table 7.2 Configuration Definition File Settings (HORCM_INST) and Specified Values in NAS Blade System

Section Name	Item	Specified Values in NAS Blade System
HORCM_INST	ip_address	Fixed IP address of eth1 or eth2 in the NAS package 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 (Instance number 16) or 20332 (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 Network Attached Storage/Management User's Guide* 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 Blade system can search the host name using NIS or DNS.

HORCM_MON					
#ip_address	service	poll(10ms)	timeout(10ms)		
123.456.78.51	20331	1000	3000		
HORCM_CMD					
#dev_name	dev_name	dev_name			
#UnitID 0 (Serial# 62486)					
/dev/sdf					
HORCM_DEV					
#dev_group	dev_name	port#	TargetID	LU#	MU#
# /dev/sdt	SER =	62486	LDEV = 10	[FIBRE FCTBL = 3]	
VG	VG_010	CL1-A-1	0	10	
# /dev/sdu	SER =	62486	LDEV = 64	[FIBRE FCTBL = 3]	
VG	VG_011	CL1-A-1	0	11	
# /dev/sdv	SER =	62486	LDEV = 12	[FIBRE FCTBL = 3]	
VG	VG_012	CL1-A-1	0	12	
# /dev/sdw	SER =	62486	LDEV = 66	[FIBRE FCTBL = 3]	
VG	VG_013	CL1-A-1	0	13	
HORCM_INST					
#dev_group	ip_address	service			
VG	123.456.80.51	20331			
VG	123.456.80.115	20331			

Figure 7.12 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 package in which the TrueCopy P-VOL is connected and in the NAS package which will use the S-VOL (see Figure 7.13).

```
$ 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 package using SSH and performed the above setup,
confirm the setup by once logging out of the NAS package and relogging in.
$ sudo horcmstart.sh
```

Figure 7.13 Procedure for Starting HORM Manager

By issuing the `pairstat` command in the NAS package in which TrueCopy P-VOL is connected or in which S-VOL will be used, you can see the LDEV numbers of LUs specified in the **HORCM_DEV** section (see Figure 7.13).

```
$ sudo pairstat -gg Device Group Name
```

Figure 7.14 How to Check LDEV Numbers 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 package in which P-VOL is connected (see Figure 7.15). Compare this with Figure 7.14. For information about the `horc_devlist` command, see the *Hitachi Network Attached Storage/Backup Restore User's Guide*.

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

Figure 7.15 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 package in which S-VOL will be used. Compare this with Figure 7.14.

```
$ sudo horc_devlist | grep 'Free$'
21( 33)    74 OPEN-V(3.906GB)    -- -- Normal --   Free
22( 34)    22 OPEN-V(3.906GB)    -- -- Normal --   Free
23( 35)    76 OPEN-V(3.906GB)    -- -- Normal --   Free
```

Figure 7.16 How to Check Device File Numbers and LDEV Numbers for Unused Device Files Which Can be S-VOLs

Table 7.3 lists the port names described in the **HORCM_DEV** section in the CCI configuration definition file and the locations of the NAS packages.

Table 7.3 Locations of NAS Package and Port Names Specified in CCI Configuration Definition File

Location of NAS Package		Port Name
Multi-Cabinet (MC) Model	Single-Cabinet (SC) Model	
CHA-1P	CHA-1C	CL1-A-1
CHA-1Q	CHA-1D	CL1-E-1
CHA-1R	CHA-1F	CL1-J-1
CHA-1S	-	CL1-N-1
CHA-2V	CHA-2G	CL2-A-1
CHA-2W	CHA-2J	CL2-E-1
CHA-2X	CHA-2K	CL2-J-1
CHA-2Y	-	CL2-N-1

After checking the CCI configuration definition file, stop CCI in both the NAS package in which TrueCopy P-VOL is connected and in the NAS package in which S-VOL will be used (see Figure 7.17).

```
# sudo horcmshutdown.sh 16
```

Figure 7.17 Stopping CCI (for Instance Number 16)

7.5.3.3 Cascade Configuration of TrueCopy and ShadowImage

In the NAS Blade 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 7.18 shows an example of a cascade configuration of TrueCopy and ShadowImage.

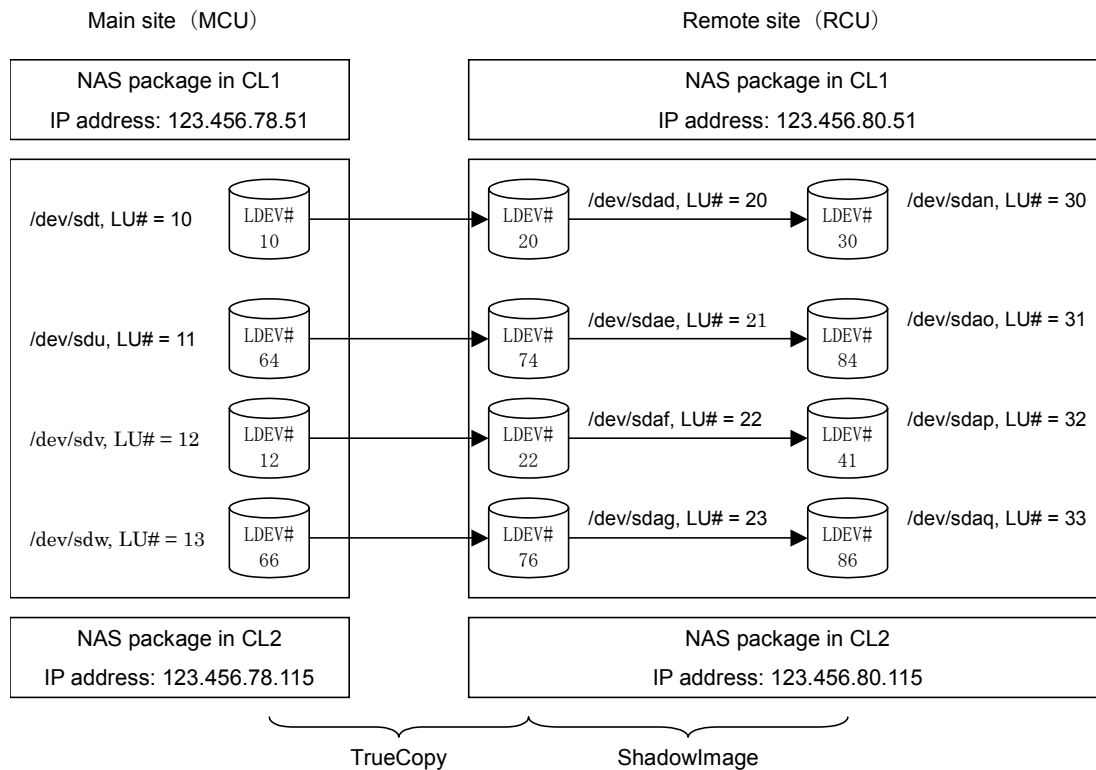


Figure 7.18 Example of Cascade Configuration of TrueCopy and ShadowImage

By preparing the CCI configuration definition file as shown in Figure 7.19, Figure 7.20, and Figure 7.21, 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 NAS Manager GUI.

```

HORCM_MON
#ip_address      service      poll(10ms)      timeout(10ms)
123.456.78.51    20331              1000              3000

HORCM_CMD
#dev_name      dev_name      dev_name
#UnitID 0 (Serial# 62486)
/dev/sdf

HORCM_DEV
#dev_group      dev_name      port#      TargetID      LU#      MU#
# /dev/sdt      SER =      62486 LDEV = 10 [ FIBRE FCTBL = 3 ]
VG_TC          VG_032      CL1-A-1      0      10
# /dev/sdu      SER =      62486 LDEV = 64 [ FIBRE FCTBL = 3 ]
VG_TC          VG_033      CL1-A-1      0      11
# /dev/sdv      SER =      62486 LDEV = 12 [ FIBRE FCTBL = 3 ]
VG_TC          VG_034      CL1-A-1      0      12
# /dev/sdw      SER =      62486 LDEV = 66 [ FIBRE FCTBL = 3 ]
VG_TC          VG_035      CL1-A-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 7.19 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              1000             3000

HORCM_CMD
#dev_name        dev_name          dev_name
#UnitID 0 (Serial# 62490)
/dev/sdf

HORCM_DEV
#dev_group      dev_name      port#      TargetID      LU#      MU#
# /dev/sdt      SER =        62486 LDEV =    10 [ FIBRE FCTBL = 3 ]
VG_TC          VG_032       CL1-A-1      0           10
# /dev/sdu      SER =        62486 LDEV =    64 [ FIBRE FCTBL = 3 ]
VG_TC          VG_033       CL1-A-1      0           11
# /dev/sdv      SER =        62486 LDEV =    12 [ FIBRE FCTBL = 3 ]
VG_TC          VG_034       CL1-A-1      0           12
# /dev/sdw      SER =        62486 LDEV =    66 [ FIBRE FCTBL = 3 ]
VG_TC          VG_035       CL1-A-1      0           13
# /dev/sdt      SER =        62486 LDEV =    10 [ FIBRE FCTBL = 3 ]
VG_SI          VG_014       CL1-A-1      0           10
# /dev/sdu      SER =        62486 LDEV =    64 [ FIBRE FCTBL = 3 ]
VG_SI          VG_015       CL1-A-1      0           11
# /dev/sdv      SER =        62486 LDEV =    12 [ FIBRE FCTBL = 3 ]
VG_SI          VG_015       CL1-A-1      0           12
# /dev/sdw      SER =        62486 LDEV =    66 [ FIBRE FCTBL = 3 ]
VG_SI          VG_016       CL1-A-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 7.20 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              1000             3000

HORCM_CMD
#dev_name      dev_name      dev_name
#UnitID 0 (Serial# 62490)
/dev/sdf

HORCM_DEV
#dev_group      dev_name      port#      TargetID      LU#      MU#
# /dev/sdt      SER =      62486 LDEV = 10 [ FIBRE FCTBL = 3 ]
VG_TC          VG_032      CL1-A-1      0      10
# /dev/sdu      SER =      62486 LDEV = 64 [ FIBRE FCTBL = 3 ]
VG_TC          VG_033      CL1-A-1      0      11
# /dev/sdv      SER =      62486 LDEV = 12 [ FIBRE FCTBL = 3 ]
VG_TC          VG_034      CL1-A-1      0      12
# /dev/sdw      SER =      62486 LDEV = 66 [ FIBRE FCTBL = 3 ]
VG_TC          VG_035      CL1-A-1      0      13
# /dev/sdan      SER =      62486 LDEV = 30 [ FIBRE FCTBL = 3 ]
VG_SI          VG_014      CL1-A-1      0      30
# /dev/sdao      SER =      62486 LDEV = 84 [ FIBRE FCTBL = 3 ]
VG_SI          VG_015      CL1-A-1      0      31
# /dev/sdap      SER =      62486 LDEV = 41 [ FIBRE FCTBL = 3 ]
VG_SI          VG_016      CL1-A-1      0      32
# /dev/sdaq      SER =      62486 LDEV = 86 [ FIBRE FCTBL = 3 ]
VG_SI          VG_017      CL1-A-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 7.21 Example of CCI Configuration Definition File at Remote Site (Instance 17)

7.5.3.4 Setting the CCI User Environmental Variable

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 will be used).

1. At both sites, set up the environment variable of the Command Control Interface instance:

```
sudo horc_setenv HORCMINST 16, or          (For instance number 16)
sudo horc_setenv HORCMINST 17              (For instance number 17)
```

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

```
sudo horc_unsetenv HORCC_MRCF
```

3. If you have logged in to the target NAS package using SSH and set up as explained in steps 1 and 2, confirm the setup by logging out of the NAS package and then logging back in:

```
exit
```

```
ssh {-1|-2} nasroot@fixed-IP-address-of-the-NAS-package
```

Enter the command shown in the following example to check the result of setting up the environment variable:

```
$ sudo horc_printenv
```

In the NAS Blade system, only the Command Control Interface user environment variables HORCMINST and HORCC_MRCF may be set up.

7.5.4 Settings for Disaster Recovery

For disaster recovery operations, perform the settings described in section 6.1.

The procedures of the TrueCopy operations for the volumes and volume groups required for disaster recovery are the same as those explained in section 7.6.1.1.

7.5.5 Create File System in TrueCopy P-VOL

Create a file system in TrueCopy P-VOL using the Create New File System panel in File System Management in NAS/Management 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.

7.6 Overview of TrueCopy Operations

This section describes the overview of operations, the CCI commands, and the commands provided by the Hitachi Network Attached Storage series products for the TrueCopy operations of remote copy and disaster recovery.

We describe only the arguments of the CCI commands which are required for the basic TrueCopy operations. For other arguments, please refer to the *Command Control Interface User and Reference Guide*.

For the specifications of the commands provided by the Hitachi Network Attached Storage series products and notes, see section 7.7.

7.6.1 Remote Copy Operation

This section describes the procedure of the remote copy operation. Figure 7.22 shows an overview of the remote copy operation and the corresponding sections. When the pair is in the PSUS state, the S-VOL can be accessed at the remote site.

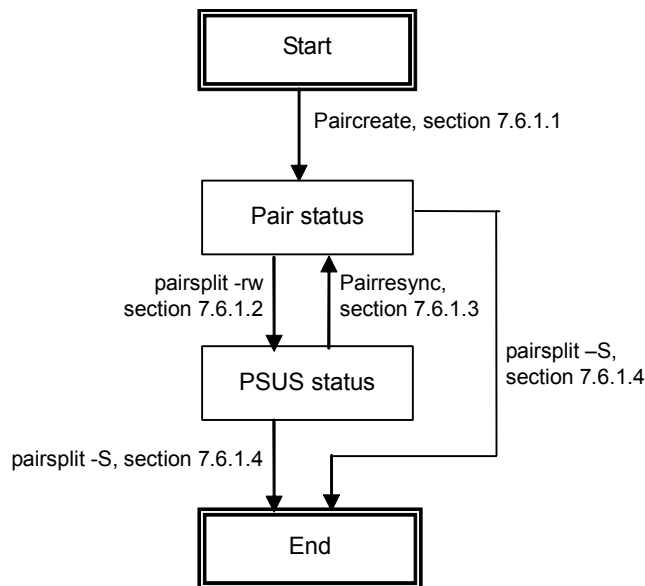


Figure 7.22 Overview of Remote Copy Operations and Sections

7.6.1.1 Starting TrueCopy Operations and Creating a TrueCopy Pair

If the TrueCopy S-VOL contains a file system, you must delete the file system using the `enas_fsdelete` command in NAS/Management before starting TrueCopy operations. Also, if the TrueCopy S-VOL is used for the Snapshot feature in NAS/Backup Restore, you need to delete the Snapshot definitions using the `snapvoldel` command before starting the TrueCopy operations. If the differential-data storage device of NAS/Sync Image is in the TrueCopy S-VOL, you must release it using the `syncstop` command before starting the TrueCopy operations.

To start TrueCopy operations and create a TrueCopy volume pair:

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

```
sudo horcmstart.sh, or (1-instance configuration)
sudo horcmstart.sh 16 17
```

2. At the remote site, reserve 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 TrueCopy volume pair.

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

4. At the main site, check the completion of TrueCopy volume pair creation.

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

Note: 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
```

7.6.1.2 Splitting a TrueCopy Volume Pair

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

During offline backup, a TrueCopy volume pair is split after completely stopping access from clients by deleting CIFS/NFS shares. Since an I/O error is reported to the application if CIFS/NFS shares are deleted while the application writes data in P-VOL, or if the application tries to write data in P-VOL after deleting CIFS/NFS shares, it can be distinguished by the application data reflected in the TrueCopy volume pair. It is therefore applicable to most applications.

During online backup, however, a TrueCopy volume pair is split without deleting CIFS/NFS shares. Since an I/O error is not reported to the application when writing data to P-VOL, it cannot be distinguished of which time data is reflected in S-VOL. For this reason, it is applicable only to the application which can identify where data was updated with a journal file etc.

Offline backup. To split the TrueCopy volume pair with offline backup:

1. At the main site, stop the program that accesses P-VOL.
2. At the main site, delete NFS/CIFS shares in the P-VOL using the `enas_nfsdelete` command and the `enas_cifsdelete` command in NAS/Management. Unmount the P-VOL using the `enas_fsmount` command.

3. At the main site, prevent NAS/Sync Image from performing operations on the P-VOL:

`sudo horc_pvol_freeze -f Source file system name`

4. At the main site, verify that the TrueCopy volume pair is split.

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

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

pairvolchk: Volstat is P-VOL.[status = COPY] => Splitting

pairvolchk: Volstat is P-VOL.[status = PSUS] => Split completes

5. At the main site, enable the operations from NAS/Sync Image on the P-VOL.

`sudo horc_pvol_unfreeze -f Source file system name`

6. At the main site, mount P-VOL using the `enas_fsmount` command in NAS/Management, and create CIFS/NFS shares using the `enas_nfscreate` command and the `enas_cifscreate` command. At the main site, restart the program which accesses the P-VOL.

7. At the remote site, connect the target file system to the NAS package.

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, ...`

8. At the remote site, mount S-VOL using the `enas_fsmount` command. Create a shared-directory using the `enas_dircreate` command, or change the attributes of a shared-directory using the `enas_diredit` command. Create CIFS/NFS shares using the `enas_nfscree` command and the `enas_cifscree` command.

Note: When the S-VOL is the file system managed by NAS/Sync Image, mount the differential-data snapshots using the `syncmount` command, and create the CIFS/NFS shares using the `enas_nfscree` command and the `enas_cifscree` command, if necessary.

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

Online backup. To split the TrueCopy volume pair with online backup:

1. At the main site, prevent NAS/Sync Image from performing operations on P-VOL, hold the write request to P-VOL, and write the unreflected 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, verify that the TrueCopy volume pair has been split.

sudo pairvolchk {-g *group-name* | -d *volume-name*}

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

pairvolchk : Volstat is P-VOL.[status = COPY] => Splitting

pairvolchk : Volstat is P-VOL.[status = PSUS] => Split completes

4. At the main site, permit the write request to P-VOL and enable the operations from NAS/Sync Image on P-VOL.

sudo horc_pvol_unfreeze -f *Source-file-system-name*

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

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.
7. Create a shared-directory using the `enas_dircreate` command or change the attributes of a shared-directory using the `enas_diredit` command.
8. Create CIFS/NFS shares using the `enas_nfscree` command and the `enas_cifscree` command.

Note: When the S-VOL is the file system managed by NAS/Sync Image, mount the differential-data snapshots using the `syncmount` command, and create the CIFS/NFS shares using the `enas_nfscree` command and the `enas_cifscree` command, if necessary.

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

7.6.1.3 Resynchronizing a TrueCopy Volume Pair

You must delete the target file system using the `enas_fsdelete` command before resynchronizing the volume pair. Deleting the target file system, however, clears only the management area of the file system. Resynchronizing the volume pair is not the same as performing initial copy.

Note: When the S-VOL is the file system managed by NAS/Sync Image, unmount the differential-data snapshots, and release the differential-data storage devices before using the `enas_fsdelete` command.

To resynchronize the TrueCopy volume pair:

1. At the remote site, reserve 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, ...`
2. At the main site, resume the TrueCopy volume pair.
`sudo pairresync {-g group name |-d volume name}`
3. At the main site, verify that the TrueCopy volume pair has been resumed.
`sudo pairvolchk {-g group name |-d volume name}`

Note: 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] => Resuming completes`

7.6.1.4 Deleting a TrueCopy Volume Pair

Completing TrueCopy operations by deleting the TrueCopy volume pair in the PSUS state will differ depending upon whether you will continue using the file system in S-VOL, or if you will destroy the file system.

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

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

1. At the main site, delete the TrueCopy volume pair.
sudo pairsplit {-g group name |-d volume name} -S
2. At the main site, verify that the TrueCopy volume pair has been deleted.
sudo pairvolchk {-g group name |-d volume name}
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, or (1-instance configuration)
sudo horcmshutdown.sh 16 17 (2-instance configuration)

Note: If you start the split pair operation with offline backup, but have not yet connected the target file system to the NAS Package at the remote site, finish connecting the target file system to the NAS Package, 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 Package at the remote site, finish connecting the target file system to the NAS Package, and then start the above operations (see section 7.6.1.2).

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

1. At the remote site, terminate the program which accesses the S-VOL.
2. At the remote site, delete CIFS/NFS shares using the `enas_nfsdelete` command and the `enas_cifsdelete` command, and unmount S-VOL using the `enas_fsumount` command.
Note: When the S-VOL is the file system managed by NAS/Sync Image, delete the CIFS/NFS shares under the differential-data snapshots using the `enas_nfsdelete` command and `enas_cifsdelete` command, unmount the differential-data snapshots using the `syncumount` command, and release the differential-data storage devices using the `syncstop` command.
3. At the remote site, delete the S-VOL file system 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, verify that the TrueCopy volume pair has been deleted.

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

```
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, or (1-instance configuration)
```

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

Note: If you start the split pair operation with offline backup, but you have not yet connected the target file system to the NAS Package at the remote site, finish connecting the target file system to the NAS Package, and then start the previously-described operations. If you start the split pair operation with online backup, but you have not yet connected the target file system to the NAS Package at the remote site, finish connecting the target file system to the NAS Package, and then start the above operations (see section 7.6.1.2).

To delete the TrueCopy volume pair in a 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, verify that the TrueCopy volume pair has been deleted.

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

```
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 or (1-instance configuration)
```

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

7.6.2 Disaster Recovery Operations

This section describes the procedures for disaster recovery operations. You may also want to refer to section 7.5.4.

7.6.2.1 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 package.

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_nfscree** command and the **enas_cifscree** command.

Recover the file system when mounting the S-VOL.

4. Start the program which accesses the S-VOL.

Note: When the S-VOL is the file system managed by NAS/Sync Image, mount the differential-data snapshots using the **syncmount** command, and create the CIFS/NFS shares using the **enas_nfscree** command and the **enas_cifscree** command, if necessary.

7.6.2.2 Transferring the 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 Command Control Interface instance:

```
sudo horc_setenv HORCMINST 16, or (For instance number 16)
```

```
sudo horc_setenv HORCMINST 17 (For instance number 17)
```

2. At the main site, set up the HOMRCF command environment variable of the Command Control Interface as TrueCopy:

```
sudo horc_unsetenv HORCC_MRCF
```

3. After you have logged in to the target NAS package using SSH and set up as explained in steps 1 and 2, confirm the setup by logging out of the NAS package and relogging in.

```
exit
```

```
ssh {-1 | -2} nasroot@fixed-IP-address-of-the-NAS-package
```

4. At the main site and at the remote site, start CCI.
`sudo horcmstart.sh`, or (1-instance configuration)
`sudo horcmstart.sh 16 17` (2-instances configuration)
5. At the main site, delete the CIFS/NFS shares in the old P-VOL, unmount 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, delete the CIFS/NFS shares under the differential-data snapshots, unmount 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 primary 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|async} -vl`
8. If the state is changed to PAIR, stop the operation in the secondary site.
9. At the remote site, delete the CIFS/NFS shares in the old S-VOL using the `enas_nfsdelete` command and the `enas_cifsdelete` command, and unmount the old S-VOL using the `enas_fsumount` command.
10. At the remote site, prevent NAS/Sync Image from performing operations on the old S-VOL.
`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, enable the operations from NAS/Sync Image on the old S-VOL.
`sudo horc_pvol_unfreeze -f Source file system name`
13. At the main site, connect the target file system to the NAS package.
 - **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, delete the CIFS/NFS shares under the differential-data snapshots, unmount 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 secondary 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_nfscreeate` command and the `enas_cifscreeate` command.

Note: When the new P-VOL is the file system managed by NAS/Sync Image, mount the differential-data snapshots using the `syncmount` command, and create the CIFS/NFS shares using the `enas_nfscreeate` command and the `enas_cifscreeate` command, if necessary.
18. At the main site, resume the operations in the primary site.

7.7 Operations of the Command Control Interface Log Files

This section explains the format of the Command Control Interface log files in the NAS Blade system, and the method of downloading log files to the SSH client, and provides notes on the operations of the Command Control Interface log files.

7.7.1 Format of the Command Control Interface Log Files

This section explains the format of the Command Control Interface log files (which consist of starting logs, error logs, trace logs, and core files). These log files are listed in Table 7.4. In Table 7.4, the * (asterisk) shows the instance number (16 or 17) of CCI; **HOST** shows the node name of the NAS package; and **PID** shows the process ID of CCI or the Command Control Interface command.

Table 7.4 Format of the Command Control Interface Log Files in the NAS Blade System

Log File Classification	Log File Name	Format of Log Files
CCI logs under operation	HORCM starting log	/home/nasroot/log*/curlog/horcm_HOST.log
	Command log	/home/nasroot/log*/horcc_HOST.log
	HORCM error log	/home/nasroot/log*/curlog/horcmlog_HOST/horcm.log
	HORCM trace log	/home/nasroot/log*/curlog/horcmlog_HOST/horcm_PID.trc
	Command trace	/home/nasroot/log*/curlog/horcmlog_HOST/horccc_PID.trc
	Core file	/home/nasroot/log*/curlog/core_HOST_PID/core
HORCM logs saved automatically	HORCM starting log	/home/nasroot/log*/tmplog/horcm_HOST.log
	Command log	/home/nasroot/log*/tmplog/horcc_HOST.log
	HORCM error log	/home/nasroot/log*/tmplog/horcmlog_HOST/horcm.log
	HORCM trace log	/home/nasroot/log*/tmplog/horcmlog_HOST/horcm_PID.trc
	Command trace	/home/nasroot/log*/tmplog/horcmlog_HOST/horccc_PID.trc
	Core file	/home/nasroot/log*/tmplog/core_HOST_PID/core

7.7.2 Downloading Log Files to the SSH Client

To review the Command Control Interface log files if the Command Control Interface command terminates in an error, or if you want to save the log files before deleting them, you may download them by executing the following **scp** command in the SSH client.

- For the log files which Command Control Interface (Instance number 16) output:

```
scp {-1|-2} -r nasroot@fixed-IP-address-of-the-NAS-  
package:/home/nasroot/log16 directory-name-on-the-SSH-client-to-  
download
```
- For the log files which Command Control Interface (Instance number 17) output :

```
scp {-1|-2} -r nasroot@fixed-IP-address-of-the-NAS-  
package:/home/nasroot/log17 directory-name-on-the-SSH-client-to-  
download
```

The following message (* means an instance number) is output and the scp command ended with return code 1. This means there are no problems.

```
scp: /home/nasroot/log*/do_not_remove: Permission denied
```

Note: If you read the Command Control Interface log files using Windows®, you must ensure that the text viewer you are using can display the text containing the line feed code LF (Line Feed).

7.7.3 Notes on the Operations of the Command Control Interface Log Files

Since the Command Control Interface log files are output to NAS OS LU, if TrueCopy operations still show an error, log files will become large and the available space on NAS OS LU will decrease. You should periodically check the capacity of the log files (except the trace files) to which Command Control Interface restricts capacity, stop CCI, and delete log files using the `horc_logremove` command before exceeding 1 M bytes. Check the capacity of log files using the following command.

```
$ ls -l -R /home/nasroot/log*      (* means an instance number 16 or 17)
```

7.8 Commands

The commands that the Hitachi Network Attached Storage series products provide for TrueCopy operations in the NAS Blade system are as follows.

- Commands that Hitachi Network Attached Storage/Backup Restore provide:
 - 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 that Hitachi Network Attached Storage/Management provide:
 - enas_cifscreate, enas_cifsdelete
 - enas_dircreate, enas_diredit
 - enas_fscreate, enas_fsdelete, enas_fslist, enas_fsmount, enas_fsumount
 - enas_nfscreate, enas_nfsdelete
- The commands that Hitachi Network Attached Storage/Sync Image provide :
 - syncdel, synclist, syncmount, syncstop, syncumount

For the details of these commands, please refer to *Hitachi Network Attached Storage/Backup Restore User's Guide*, *Hitachi Network Attached Storage/Management User's Guide*, and *Hitachi Network Attached Storage/Sync Image User's Guide*.

7.9 Message

For the details of the output messages after you input the commands that are described in section 1, please refer to *Hitachi Network Attached Storage/Backup Restore User's Guide*, *Hitachi Network Attached Storage/Management User's Guide*, and *Hitachi Network Attached Storage/Sync Image User's Guide*.

Chapter 8 Troubleshooting

8.1 Troubleshooting TrueCopy Operations

Table 8.1 provides general troubleshooting information for Hitachi TrueCopy™. Table 8.2 provides troubleshooting information for RCU paths. Table 8.3 provides troubleshooting information for suspended TrueCopy pairs (Synchronous and Asynchronous). Table 8.4 provides troubleshooting information for TrueCopy Asynchronous suspension conditions.

Note: For important information about proper configuration for your operational environment, refer to Appendix B.

See section 8.2 for a description of the TrueCopy error messages displayed on the Storage Navigator PC. See section 8.3 for a brief description of the 9900V service information messages (SIMs). If you need to call the Hitachi Data Systems Support Center, please refer to section 8.4 for instructions.

Table 8.1 General TrueCopy Troubleshooting

Error	Corrective Action
The Storage Navigator PC hangs, or TrueCopy operations do not function properly.	Make sure that the problem is not being caused by the PC or Ethernet hardware or software, and restart the PC. Restarting the Storage Navigator PC does not affect subsystem operations. Make sure that all TrueCopy requirements and restrictions are met (e.g., same LU type). See sections 3.1 and 3.2. Make sure that the MCU and RCU and remote copy connections are powered on and fully operational (NVS, cache). Check all input values and parameters to make sure that you entered the correct information on the Storage Navigator PC (e.g., RCU S/N and SSID, path parameters, P-VOL and S-VOL IDs).
An initiator or RCP channel-enable LED indicator (on the 9900V control panel) is off or flashing.	Please call the Hitachi Data Systems Support Center for assistance.
The pairs and/or RCUs are not displaying correctly.	Make sure that the correct CU image is selected.
A TrueCopy error message is displayed on the PC.	Resolve the error, and then try the TrueCopy operation again.
The RCU path status is not normal.	Check the path status (RCU Status panel), and see Table 8.2.
The pair status is <i>suspended</i> .	Check the pair status (Pairedisplay panel), and see Table 8.3.
Paircreate or pairresync operation resulted in a timeout error.	Hardware failure: If the timeout error was caused by a hardware failure, a SIM will be generated. If this occurs, call service personnel, and retry TrueCopy operations after the problem is fixed. Heavy workload: If no SIM was generated, wait for a while (5 or 6 minutes), then check the pair status of the pair(s) being created or resumed. If the pair status changed correctly, the failed operation completed after the timeout message was issued. If the pair status did not change as expected, heavy workload might have prevented the TrueCopy operation from being completed. In this case, retry the TrueCopy operation again when the subsystem has a lighter workload. If a communication error between the Storage Navigator PC and SVP occurs, refer to the <i>9900V Remote Console – Storage Navigator User's Guide</i> for instructions.
There is a pinned track on a TrueCopy volume.	See Appendix A for instructions.

Table 8.2 Troubleshooting RCU Path Status Problems (continues on next page)

Path Status	Description	Corrective Action
Initialization Failed	The link initialization procedure to the RCU failed.	Make sure that you entered the correct RCU S/N and SSID and path parameters (port, link address, logical address). Fibre: make sure the correct MCU port is configured as an initiator port and the correct RCU port is configured as an RCU target port. Serial: make sure the correct MCU port is configured as an RCP and the correct RCU port is configured as an LCP.
Communication Time Out	Communication between the MCU and RCU timed out.	Make sure the RCU is powered on and fully functional (NVS, cache). Make sure that the remote copy connection hardware (cables, connectors, switches, ESCDs, extender devices, communication lines, and all other devices connected to the extenders) are properly configured and functional. Delete the failed path. You may need to change the minimum paths setting or delete the RCU in order to delete the path. Then add the path/RCU using Edit Path or Add RCU.
Resource Shortage (MCU/RCU)	The MCU/RCU rejected the established logical path link control function because all logical path resources in the MCU/RCU are being used for other connections.	Delete the failed path, and also delete all paths and RCUs not currently in use. The MCU can be connected to up to four RCUs with up to eight paths to each RCU. Make sure that all MCU and RCU ports are properly configured: Fibre – ordinary target ports or RCU target ports for hosts, RCU target ports for MCUs, initiator ports for RCUs; Serial – LCPs for hosts and MCUs, RCPs for RCUs. If necessary, connect to the RCU to delete paths/RCUs and reconfigure ports, then reconnect to the MCU. Add the path/RCU again using Edit Path or Add RCU.
Serial Number Mismatch	The RCU's S/N does not match the specified S/N.	Make sure that you entered the correct RCU S/N and SSID and path parameters (port, link address, logical address). Delete the failed path. You may need to change the minimum paths setting or delete the RCU in order to delete the path. Then add the path/RCU using Edit Path or Add RCU. Fibre: make sure that you entered the correct Controller ID, and also make sure that the fibre-channel topology settings of the MCU and RCU ports are correct.
Invalid Port	The specified port is not configured as an RCP or initiator port, or this path already exists.	Fibre: make sure the correct MCU port is configured as an initiator port and the correct RCU port is configured as an RCU target port. Serial: make sure the correct MCU port is configured as an RCP and the correct RCU port is configured as an LCP. Make sure that you entered the correct RCU S/N and SSID and path parameters (port, link address, logical address). Delete the failed path. You may need to change the minimum paths setting or delete the RCU in order to delete the path. Then add the path/RCU using Edit Path or Add RCU.
RCU Port Number Mismatch	The specified port in the RCU is physically disconnected from the MCU.	Make sure that you entered the correct RCU port number. Correct the port number if necessary. Make sure that the MCU and RCU are physically connected. For fibre-channel interface, make sure that the fibre-channel topology settings of the MCU and RCU ports are correct.
RCU Port Type Mismatch	The specified RCU port is not configured as an RCU target port.	Make sure that the RCU port is configured as an RCU target port.

Table 8.2 Troubleshooting RCU Path Status Problems (continued)

Path Status	Description	Corrective Action
Communication Failed	The MCU connected to the RCU successfully, but logical communication timeout occurred.	Make sure that the RCU port and remote copy connection hardware (cables and switches) are properly configured and functioning.
<blank>	This path was not established.	Delete the failed path. You may need to change the minimum paths setting or delete the RCU in order to delete the path. Then add the path/RCU using Edit Path or Add RCU.

Table 8.3 Troubleshooting Suspended TrueCopy Pairs

Suspend Type	Applies to	Description	Corrective Action
PSUE, by RCU	P-VOL	The MCU detected an error condition at the RCU which caused the MCU to suspend the volume pair. The S-VOL suspend type is <i>by MCU</i> .	Clear the error condition at the RCU or S-VOL. If you need to access the S-VOL, split the pair (pairsplit-r) from the MCU using the S-VOL write enable option. Resume the pair (pairresync) from the MCU after the error condition is cleared.
PSUE, S-VOL Failure	P-VOL	The MCU detected an error during communication with the RCU or an I/O error during update copy. In this case, the suspend type for the S-VOL is usually <i>by MCU</i> .	Check the path status on the RCU Status panel (see section 4.2.6). Clear any error conditions at the RCU or S-VOL. If you need to access the S-VOL, split the pair (pairsplit-r) from the MCU using the S-VOL write enable option. Resume the pair (pairresync) from the MCU after the error condition is cleared.
PSUE, MCU IMPL	P-VOL, S-VOL	The MCU could not find valid control information in its nonvolatile memory during the IMPL procedure. This error occurs only if the MCU is without power for more than 48 hours (power failure and fully discharged batteries).	Resume the pair (pairresync) from the MCU. The MCU will perform an entire initial copy operation in response to the pairresync request.
PSUE, Initial Copy Failed	P-VOL, S-VOL	The MCU suspended this pair during the initial copy operation. The data on the S-VOL is not identical to the data on the P-VOL.	Delete the pair from the MCU. Clear all error conditions at the MCU, P-VOL, RCU, and S-VOL. Restart the initial copy operation using the Paircreate panel.
PSUE, MCU P/S-OFF	S-VOL (Async)	The MCU suspended all TrueCopy Async pairs due to MCU power-off.	None. The MCU will automatically resume these TrueCopy Async pairs during power-on.
PSUS, Sidefile Overflow	P-VOL S-VOL	The amount of sidefile exceeds the specified current pending update data rate, and the RCU data is not transferred within the specified offloading timer.	Add cache memory, increase the number of paths between MCU and RCU, or decrease the number of Async pairs or host I/Os.

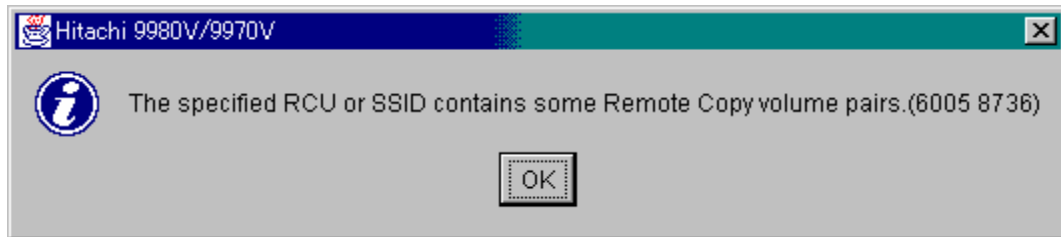
Table 8.4 provides troubleshooting instructions for the TrueCopy Async suspension conditions caused by the offloading timer async option, the group timeout options (copy pending and RCU ready), and recordset errors. Hardware failures which affect the cache storage/shared memory of the MCU or RCU may also cause the TrueCopy Async volume pairs to be suspended.

Table 8.4 Resolving TrueCopy Async Suspension Conditions

Classification	Causes of Suspension	SIM	Recovery procedure
MCU/RCU hardware	Hardware redundancy has been lost due to some blockade condition. As a result, MCU-RCU communication, creating or receiving recordset, or the staging or de-staging process could not complete. The pending recordset cannot be retained because one side of cache storage or shared memory has been blocked due to hardware failure. MCU-Creating/sending recordset failed due to unrecoverable hardware failure. RCU-Reading/settling recordset failed due to unrecoverable hardware failure. The drive parity group was in correction-access status while the TrueCopy pair was in COPY state.	DB0x DB1x DB2x	According to SIM, remove the hardware blockade or failure. Re-establish failed volume pairs (pairresync).
MCU-RCU communication	During the power-on-reset sequence, the MCU could not communicate with the RCU within the specified RCU ready timeout. The RCU could not settle the pending recordset or could not communicate with the MCU before the copy pending timeout due to MCU not-ready or inoperative facilities on the remote copy connections.	DB0x DB1x	Remove the failed condition at the RCU/MCU or on the remote copy connection. Re-establish failed pairs (pairresync).
RIO overload	The unrecoverable RIO (remote I/O) timeout occurred due to overload of the RCU or the communication facilities on the remote copy connections. No recordset could be sent within the specified copy pending timeout. The RCU could not settle the pending recordset before the copy pending timeout due to overload of the RIO or the RCU itself.	DB1x	Delete failed pairs (pairsplit-S). Reconsider the performance resources necessary, and increase resources as needed (cache amount, number of MCU-RCU paths, etc.). Re-establish failed pairs (paircreate).
RIO failure	The RIO (remote I/O) could not complete due to the failure at the RCU.	DB2x	According to SIM generated at the RCU, remove the failure. Re-establish failed pairs (pairresync).
MCU planned outage	The TrueCopy Async pairs were temporarily suspended due to a planned outage of the MCU.	DB8x	No recovery procedure is required. The MCU will automatically remove the suspension condition during the next power-on-reset sequence.

8.2 TrueCopy Error Messages

The Hitachi Storage Navigator remote console software displays error messages when error conditions occur during TrueCopy operations (see Figure 8.1). The error message describes the error and provides a part code and error code (**Part Code = 6005, Error Code = 8736** in Figure 8.1). The error message may also include a 9900V SVP error code. If you need to call the Hitachi Data Systems Support Center for assistance, please report the error code(s). Please refer to the 9900V document *Hitachi Lightning 9900™ V Series Remote Console Error Codes* (MK-92RD132) for a list of the error codes displayed on the 9900V Storage Navigator remote console PC.



Delete RCU failed because the RCU still contains one or more pairs with the current MCU.

Figure 8.1 TrueCopy Error Message for Failed Delete RCU Operation

8.3 Service Information Messages (SIMs)

The Hitachi Lightning 9900™ V Series subsystem generates a SIM when it is necessary to notify the user of a possible service requirement for the subsystem. SIMs can be generated by the channel and storage path microprocessors of the subsystem and by the service processor (SVP) of the subsystem. The SVP reports all SIMs related to TrueCopy operations. Each time a SIM is generated, the amber **Message** LED on the 9900V control panel (under the **Ready** and **Alarm** LEDs) turns on as an additional alert for the user.

The SIMs are classified according to severity for reporting and logging purposes: service, moderate, serious, or acute. All SIMs are logged on the 9900V SVP and displayed on the Storage Navigator remote console PC. During TrueCopy operations, the MCU and RCU generate a service SIM each time the pair status of the P-VOL or S-VOL changes for any reason, including normal status transitions (e.g., COPY to PAIR). SIMs generated by the MCU will include the P-VOL device ID (byte 13), and SIMs generated by the RCU will include the S-VOL device ID (byte 13). For further information on the 9900V SIMs, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide* and/or the *Hitachi Lightning 9900™ V Series User and Reference Guide*, or call the Hitachi Data Systems Support Center for assistance.

If SNMP is installed and operational for the 9900V subsystem, each SIM will result in an SNMP trap being sent to the appropriate host(s). For further information on SNMP operations, please refer to the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide*, or contact your Hitachi Data Systems account team.

8.4 Calling the Support Center

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

- The 9900V Storage Navigator configuration information saved on diskette using the FD Dump Tool (see the *Hitachi Lightning 9900™ V Series Hitachi Remote Console - Storage Navigator User's Guide*),
- The circumstances surrounding the error or failure,
- The exact content of any error messages displayed on the host system(s),
- The TrueCopy (or other) error code(s) displayed by the 9900V Storage Navigator software, and
- The reference codes and severity levels of the recent service information messages (SIMs).

The worldwide Hitachi Data Systems Support Centers are:

- Hitachi Data Systems North America/Latin America
San Diego, California, USA
1-800-348-4357
- Hitachi Data Systems Europe
Contact Hitachi Data Systems Local Support
- Hitachi Data Systems Asia Pacific
North Ryde, Australia
011-61-2-9325-3300

Appendix A Pinned Track Recovery for TrueCopy Volumes

If a pinned track occurs on a TrueCopy P-VOL or S-VOL, the MCU will suspend the pair (SIM reference code = D41x, D42x, DB1x, DB2x). Use the following procedure to ensure full data integrity of the volume pair while recovering the pinned track:

1. Connect to the MCU of the suspended pair, and select the correct CU image.
2. Delete the TrueCopy pair (pairsplit-S) which contains the volume with the pinned track.
3. If the volume is offline (e.g., S-VOL has pinned track), vary the volume online.
4. Perform your usual procedure for recovering data from a pinned track. Refer to the pinned track recovery procedures for your operating system, or contact your Hitachi Data Systems representative for assistance in recovering the pinned track.
5. If the volume was previously offline (e.g., S-VOL), make sure to vary the volume offline again.
6. Restart the volume pair using the Paircreate panel, and make sure to use the **Entire Volume** initial copy option.

Appendix B TrueCopy Load Balancing and Sidefile Management and Control

Asynchronous Remote Copy solutions, as applicable to Disaster Recovery (DR), protect operational environments by assuring data integrity and rapid recovery at an alternate location should the operational environment at the home site be disrupted. As with any implemented application or solution, impact to the operational environment must be minimal.

In an environment with a stable workload and a network (paths, channel extension, secondary capability) properly sized and implemented to support the workload requirement, solution success is virtually assured. Workload requirements, however, are not always fixed or predictable. Workloads change, coincidental application demands occur, and workload additions to satisfy growth requirements are usually inevitable.

Workload demand profiles consist of a series of “peaks and valleys” which are unpredictable in both magnitude and duration. It becomes very important that measures and methodologies be put in place to minimize the impact of these anomalies.

Caching usage is the prime method of buffering peaks when demand exceeds network capacity and the prime method of unloading when valleys occur. Cache availability is mandatory for these sequences to occur and the quantity of available cache dictates the size and duration of the peaks which can be accommodated. Cache is a shared resource in that it is the prime host access facility. It must also serve additional functions such as DFW, CFW, Concurrent Copy Sidefile, and in this case, Remote Copy Sidefile buffering.

Rules of Thumb (ROT) based on past experiences are used to provide a best effort recommendation as to the amount of cache required to sustain the environment with minimal impact to host applications. With undersized cache to accommodate these demands, probable negative effects are decreased cache hit ratios, inability to start CC sessions, busy states to Write Pending operations, and so on.

Hitachi's offerings for Asynchronous Remote Copy include TrueCopy Asynchronous (TCA Open and TCA390) and HXRC. Each is unique in both operational structure and capability, and different ROTs are used for cache sizing recommendations. For TCA, one and a half times the current, none DR, amount of cache is recommended. For HXRC, two times the current, none DR, cache is recommended. An additional methodology called **device blocking** is used to sustain the environment and is implemented for both TCA and HXRC.

This methodology is interchangeably referred to as device blocking be it at channel or device level, flow control, or device throttling. All are methods of controlling application demand thus allowing the DR solution to sustain and each is tuned to minimize impact on host operations.

With TCA, a graduated level of retry delay to application host operations is induced dependent upon the amount of residual DR data not yet serviced by the secondary. This is a device level operation and devices deemed critical may be excluded from this algorithm via host control.

With HXRC, device level blocking under threshold control by the System Data Mover is the preferred method of flow control. Devices deemed critical may be excluded.

It is essential that all components of a DR solution be sized correctly, implemented accordingly, and expectations be realized.

This design concept is considered a “best practice” for a Disaster Recovery/Business Continuation (DR/BC) environment. This concept depends upon the capability of a network implemented to support the demand of host write update activity to devices associated with the DR/BC environment without induced delay impact to host performance.

Operational requirements must dictate the direction and design of the delivered solution. The following options are recommended to lessen the host impact of the “best practice” solution.

1. Allow direct control of host impact metrics using a methodology called Load Balancing. Load balancing allows management of the thresholds for inducing host delay and for the degree of induced delay.
2. Use ShadowImage to provide a tertiary Point-in-Time (PiT) copy in support of DR/BC requirements. The PiT copy may be manually controlled at specified times or be automated on a continuing interval basis using Hitachi Copycentral. With this practice, induced host delay may be minimized, and in some cases removed, without impacting a DR/BC solution. This solution allows the tertiary copy to be used for testing and/or backup. For further information, please refer to the *Hitachi Lightning 9900™ V Series Copycentral User's Guide and Reference*.
3. Use TCA as a data replication application only. All induced delay may be removed at user discretion, and the DR/BC solution will remain usable as long as the sustained write update rate and the ability of the network to service the write updates does not over-commit the availability of cache/sidefile. Suspension of the remote copy environment in this configuration is probable dependent upon write update demand and network capability.

Acronyms and Abbreviations

Adr	address
ATM	asynchronous transfer mode
BC	business continuity
CCI	Command Control Interface
CNT	Computer Network Technology Corporation
CU	control unit
DASD	direct access storage device
DB2	Database 2
DFSMS	Data Facility Storage Management Subsystem
DR	disaster recovery
DWL	duplex write line
ESCON [®]	Enterprise System Connection (IBM trademark for optical channels)
ESCD	ESCON [®] director
ExSA	extended serial adapters
HBA	host bus adapter
HRX	Hitachi RapidXchange
I/O	input/output
IBM	International Business Machines Corporation
IMPL	initial microprogram load
IMS	Information Management System
IOCDS	I/O configuration dataset
LAN	local-area network
LCP	local control port
LED	light-emitting diode
LU	logical unit
LUN	logical unit number, logical unit
Mb/s	megabits per second
MCU	main control unit
NAS	network-attached storage
NVS	nonvolatile storage
OS	operating system
PC	personal computer system
PCB	printed circuit board
PiT	Point-in-Time
P/K	package
PSUE	pair suspended-error
PSUS	pair suspended-split
P-VOL	primary volume

RAID	redundant array of independent disks
RAID-1/-5	specific RAID architectures
RC	reference code
RCP	remote control port
RCU	remote control unit
RDC	remote dual copy
RIO	remote IO
SIM	service information message
SMPL	simplex
S/N	serial number (also abbreviated as s#)
SNMP	simple network management protocol
SSB	sense byte
SSH	secure shell
SSID	storage subsystem identification
S-VOL	secondary volume
SVP	service processor
sync	synchronous
s#	serial number (also abbreviated as S/N)
TC	TrueCopy
TCA	TrueCopy Asynchronous
VOL	volume
WS	workstation

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