

Replication Solutions

TSI1635

Notice: This document is for informational purposes only, and does not set forth any warranty, express or implied, concerning any equipment or service offered or to be offered by Hitachi Data Systems. This document describes some capabilities that are conditioned on a maintenance contract with Hitachi Data Systems being in effect, and that may be configuration-dependent, and features that may not be currently available. Contact your local Hitachi Data Systems sales office for information on feature and product availability.

Hitachi Data Systems sells and licenses its products subject to certain terms and conditions, including limited warranties. To see a copy of these terms and conditions prior to purchase or license, please call your local sales representative to obtain a printed copy. If you purchase or license the product, you are deemed to have accepted these terms and conditions.

THE INFORMATION CONTAINED IN THIS MANUAL IS DISTRIBUTED ON AN "AS IS" BASIS WITHOUT WARRANTY OF ANY KIND, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT. IN NO EVENT WILL HDS BE LIABLE TO THE END USER OR ANY THIRD PARTY FOR ANY LOSS OR DAMAGE, DIRECT OR INDIRECT, FROM THE USE OF THIS MANUAL, INCLUDING, WITHOUT LIMITATION, LOST PROFITS, BUSINESS INTERRUPTION, GOODWILL OR LOST DATA, EVEN IF HDS EXPRESSLY ADVISED OF SUCH LOSS OR DAMAGE.

Hitachi Data Systems is registered with the U.S. Patent and Trademark Office as a trademark and service mark of Hitachi, Ltd. The Hitachi Data Systems logotype is a trademark and service mark of Hitachi, Ltd.

The following terms are trademarks or service marks of Hitachi Data Systems Corporation in the United States and/or other countries:

Hitachi Data Systems Registered Trademarks

Hi-Track, ShadowImage, TrueCopy, Essential NAS Platform, Universal Storage Platform

Hitachi Data Systems Trademarks

HiCard, HiPass, Hi-PER Architecture, HiReturn, Hi-Star, iLAB, NanoCopy, Resource Manager, SplitSecond, TrueNorth, Universal Star Network

All other trademarks, trade names, and service marks used herein are the rightful property of their respective owners.

NOTICE:

Notational conventions: 1KB stands for 1,024 bytes, 1MB for 1,024 kilobytes, 1GB for 1,024 megabytes, and 1TB for 1,024 gigabytes, as is consistent with IEC (International Electrotechnical Commission) standards for prefixes for binary and metric multiples.

© Hitachi Data Systems Corporation 2012. All Rights Reserved

HDS Academy 1012

Contact Hitachi Data Systems at www.hds.com.

Contents

INTRODUCTION	VII
Welcome and Introductions	vii
Course Description	viii
Prerequisites	ix
Course Objectives	x
Course Topics	xi
Learning Paths	xii
HDS Academy Is on Twitter and LinkedIn	xiii
Collaborate and Share	xiv
1. HITACHI REPLICATION MANAGER OVERVIEW	1-1
Module Objectives	1-1
Customer Challenges	1-2
Replication Manager Overview	1-3
Centralized Enterprise-wide Replication Management	1-4
Graphical User Interface	1-5
Centralized Monitoring	1-6
Centralized Monitoring	1-11
Storage Systems View	1-13
Features	1-15
Positioning	1-17
Architecture — Open Systems and Mainframe	1-19
Architecture — Open Systems with Application Agent	1-21
Components	1-22
Device Manager Agent	1-24
Instructor Demonstration — Hitachi Command Suite	1-26
Module Summary	1-27
Module Review	1-28
2. REPLICATION MANAGER INITIAL SETUP	2-1
Module Objectives	2-1
Initial Setup	2-2
Prerequisites	2-3
Prerequisite Software	2-3
Configure Environment	2-4
Launching Hitachi Command Suite	2-4
Registering Information Sources	2-6
Refreshing Configuration from Information Sources	2-8
Refresh Configuration from Information Sources	2-9
Information Refresh in Replication Manager	2-10
Refreshing Information from Pair Management Servers	2-11
Users and Permissions	2-13
Managing Users and User Permissions	2-13
Adding Users and Assigning Permissions	2-16
Managing Security	2-17
Sites	2-18
Sites Overview	2-18
Example of Two Data Centers — Use Case	2-20
Site Example	2-23
Site Properties	2-24
Setting Up Sites	2-25
Resource Groups	2-28

Resource Groups Overview	2-28
Sites and Resource Group Relationship.....	2-30
Example of Two Data Centers — Use Case	2-31
Resource Group Function	2-34
Resource Groups.....	2-35
Resource Group Properties.....	2-39
Instructor Demonstration — Initial Setup.....	2-41
Module Summary	2-42
Module Review.....	2-43
 3. HITACHI REPLICATION PRODUCTS OVERVIEW	3-1
Module Objectives.....	3-1
Hitachi Replication Program Products.....	3-2
Hitachi Replication Products	3-2
Tools Used for Setting Up Replication.....	3-7
Requirements for All Replication Products.....	3-8
Basic Operations.....	3-9
Replication Operations.....	3-9
Copy Operations.....	3-11
Replication Operations.....	3-12
Instructor Demonstration — Hi-Track	3-16
Module Summary	3-17
Module Review.....	3-18
 4. HITACHI SHADOWIMAGE OPERATIONS WITH REPLICATION MANAGER.....	4-1
Module Objectives.....	4-1
ShadowImage In-System Replication Features.....	4-2
Licensing Considerations.....	4-3
Key ShadowImage Features.....	4-4
Key Features.....	4-5
Operations and Commands.....	4-6
Paircreate	4-7
Update	4-11
Pairsplit.....	4-13
Pairresync.....	4-16
Commands.....	4-23
Instructor Demonstration — ShadowImage.....	4-32
Launching ShadowImage Operations	4-33
Specifying Copy Type.....	4-36
Specify Pair Volumes (Source and Destination)	4-37
Specifying Pair Volumes (Source and Destination)	4-39
Pair Configuration Wizard — Group Management	4-40
Specifying Copy Group.....	4-41
Configuring Task Management Options.....	4-43
Pair Configuration Task Confirmation	4-45
Checking Task Status.....	4-46
Checking Pair Status.....	4-47
Changing Pair Status.....	4-51
Selecting Pairs	4-52
Selecting Pair Operation.....	4-53
Selecting Schedule.....	4-55
Confirming Pair Change Operation	4-56
Module Summary	4-57
Module Review.....	4-58

5. HITACHI COPY-ON-WRITE OPERATIONS WITH REPLICATION MANAGER	5-1
Module Objectives.....	5-1
Hitachi Replication Products.....	5-2
Copy-on-Write Snapshot Purposes	5-3
Copy-on-Write Snapshot Overview.....	5-4
Contrasting ShadowImage and Copy-on-Write Snapshot	5-5
Copy-on-Write Snapshot Operations.....	5-9
Setting Up Copy-on-Write.....	5-14
Operating Copy-on-Write	5-15
Instructor Demonstration — Copy-on-Write	5-16
Setting Up the Data Pool.....	5-17
Creating Virtual Volumes.....	5-21
Managing Pairs.....	5-25
Module Summary.....	5-27
Module Review	5-28
 6. HITACHI TRUECOPY OPERATIONS WITH REPLICATION MANAGER	 6-1
Module Objectives.....	6-1
Hitachi TrueCopy Benefits.....	6-2
Hitachi TrueCopy Synchronous Benefits.....	6-5
Remote Replication Solutions.....	6-7
Internal Operations of Synchronous Replication	6-8
Remote Replication Configurations	6-10
TrueCopy and ShadowImage Together.....	6-15
TrueCopy Specifications	6-17
TrueCopy Configuration Checklist	6-18
Fibre Channel Links	6-19
Pair Operations.....	6-22
Differential Bitmap Function	6-23
Advanced Pair Operations and Recovery Scenarios.....	6-27
Hitachi Open Remove Copy (HORC) Takeover Support.....	6-28
Pair Operations.....	6-38
TrueCopy Operations.....	6-40
Instructor Demonstration — Hitachi TrueCopy.....	6-41
Setting Up Remote Paths.....	6-42
Managing Pairs.....	6-46
Module Summary.....	6-50
Module Review	6-51
 7. HITACHI UNIVERSAL REPLICATOR OPERATIONS WITH REPLICATION MANAGER	 7-1
Module Objectives.....	7-1
Hitachi Universal Replicator Overview	7-2
Hitachi Universal Replicator Hardware	7-5
Hitachi Universal Replicator Components.....	7-6
Hitachi Universal Replicator Specifications	7-7
Hitachi Universal Replicator Usage	7-9
Base Journal (Initial Copy)	7-10
Update Journal (Update Copy)	7-11
Journal Restore.....	7-12
Hitachi Universal Replicator Configurations	7-13
Three Data Center Configuration.....	7-14
Hitachi Universal Replicator Operations	7-16
Instructor Demonstration — Hitachi Universal Replicator	7-17
Setting Up Remote Paths.....	7-18
Setting Up Journal Groups.....	7-21

Managing Pairs	7-28
Module Summary	7-30
Module Review	7-31
8. REPLICATION MANAGER MONITORING OPERATIONS	8-1
Module Objectives	8-1
Monitoring Copy Operations	8-2
Setting Up Alerts	8-9
Create Alert Setting Wizard	8-12
Alert Status	8-15
Instructor Demonstration — Monitoring Options	8-17
Module Summary	8-18
Module Review	8-19
9. APPLICATION REPLICAS	9-1
Module Objectives	9-1
Application Replicas	9-2
Backup and Restore Overview	9-3
Application Backup and Restore Features	9-4
Components	9-6
Application Agent	9-7
System Configuration for Remote Copy	9-8
Backup and Restore Operations	9-9
Discovering Application Agent	9-10
Creating Replicas	9-11
Create Replica Wizard	9-13
Restoring Replicas	9-14
Restoring Replica	9-15
Mounting or Unmounting Replica	9-16
Module Summary	9-17
Module Review	9-18
NEXT STEPS	N-1
GLOSSARY	G-1
EVALUATING THIS COURSE	E-1

Introduction

Welcome and Introductions

- Participant introductions
 - Name
 - Position
 - Experience
 - What you expect from the course?

2

Course Description

This 5 day instructor-led course teaches management techniques for replication on Hitachi storage systems. It explains the configuration and functions of Hitachi Replication Manager.

The course reviews replication solutions offered by Hitachi and introduces Replication Manager Application Agent. Practical use-case scenarios are presented, covering large-scale system configurations.

Hands-on labs demonstrate interactions with standard Hitachi replication software and monitoring of replication.

Prerequisites

- Recommended course:
 - TSI1990 — Hitachi Storage Provisioning Solutions

4

Course Objectives

- Upon completion of this course, you should be able to:
 - Perform initial configuration of Hitachi Replication Manager
 - Deploy large-scale system replication operations
 - Perform security management and common maintenance tasks
 - Manage storage system volumes
 - Describe the purpose and requirements of the Hitachi Replication Manager Application Agent

Course Topics

Modules	Lab Activities
1. Hitachi Replication Manager Overview	1. (optional) Installing and Configuring Hitachi Replication Manager
2. Hitachi Replication Manager Initial Setup	2. Initial Setup
3. Hitachi Replication Products Overview	
4. Hitachi ShadowImage® Operations with Replication Manager	3. Hitachi ShadowImage Operations
5. Hitachi Copy-on-Write® Operations with Hitachi Replication Manager	4. Hitachi Copy-on-Write Operations
6. Hitachi TrueCopy® Operations with Replication Manager	5. Hitachi TrueCopy Operations
7. Hitachi Universal Replicator Operations with Replication Manager	5. Hitachi Universal Replicator Operations
8. Replication Manager Monitoring Operations	
9. Application Replicas	6. Monitoring Hitachi Replication Operations

6

Learning Paths

- Are a path to professional certification
- Enable career advancement
- Are for customers, partners, and employees
 - Available on HDS.com, Partner Xchange and HDSnet
- Are available from the instructor
 - Details or copies



7

HDS.com: <http://www.hds.com/services/education/>

Partner Xchange: <https://portal.hds.com>

HDSnet: http://hdsnet.hds.com/hds_academy/

Please contact your local training administrator if you have any questions regarding Learning Paths or visit your applicable website.

HDS Academy Is on Twitter and LinkedIn



Follow the HDS Academy on [Twitter](#) for regular training updates.



[LinkedIn](#) is an online *community* which enables students and instructors to actively participate in online discussions related to Hitachi Data Systems products and training courses.

8

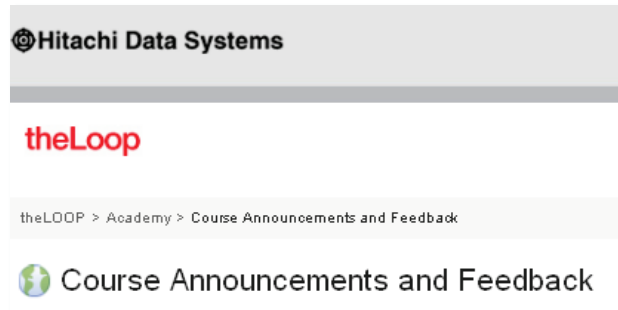
These are the URLs for Twitter and LinkedIn:

<http://twitter.com/HDSAcademy>

http://www.linkedin.com/groups?gid=3044480&trk=myg_ugrp_ovr

Collaborate and Share

- Learn what's new in the Academy
- Ask the Academy a question
- Discover and share expertise
- Shorten your time to mastery
- Give your feedback
- Participate in forums



[Academy in theLoop!](http://loop.hds.com/community/hds_academy/course_announcements_and_feedback_community)

9

theLoop:

http://loop.hds.com/community/hds_academy/course_announcements_and_feedback_community — HDS internal only

1. Hitachi Replication Manager Overview

Module Objectives

- Upon completion of this module, you should be able to:
 - List the typical challenges related to replication
 - Describe how Hitachi Replication Manager addresses the challenges associated with replication
 - List the key replication management features offered by replication management
 - Describe the architecture of Replication Manager for different environments

2

Customer Challenges

- Some of the challenges that customers typically face when managing replication are:
 - Scalability and flexibility of copy features and configuration
 - Knowledge and experience required for configuration and operation
 - Data consistency requirements by RDBMSs
 - Visibility on comprehensive replication pairs and statuses
 - Ever-growing storage of data to protect

3

RDBM – Relational Database Management System

Scalability and flexibility copy features, and configuration

- Complexity without a quality management tool

Knowledge and experience required for configuration and operation

- Heavy reliance on the individual
- Large organizations can dedicate resources for replication management but smaller organizations depend on Information Technology (IT) resources, which requires training those individuals and adds more cost

Data consistency requirements by RDBMSs

- VSS and VDI, cluster, and Volume Manager

Visibility on comprehensive replication pairs and statuses

- How many pairs, what location and what technology?
- What is their status? (Examples: PSUS, SMPL, PSUE, HOLD)

Ever growing storage capacity to protect

- Must increase and manage TBs per person

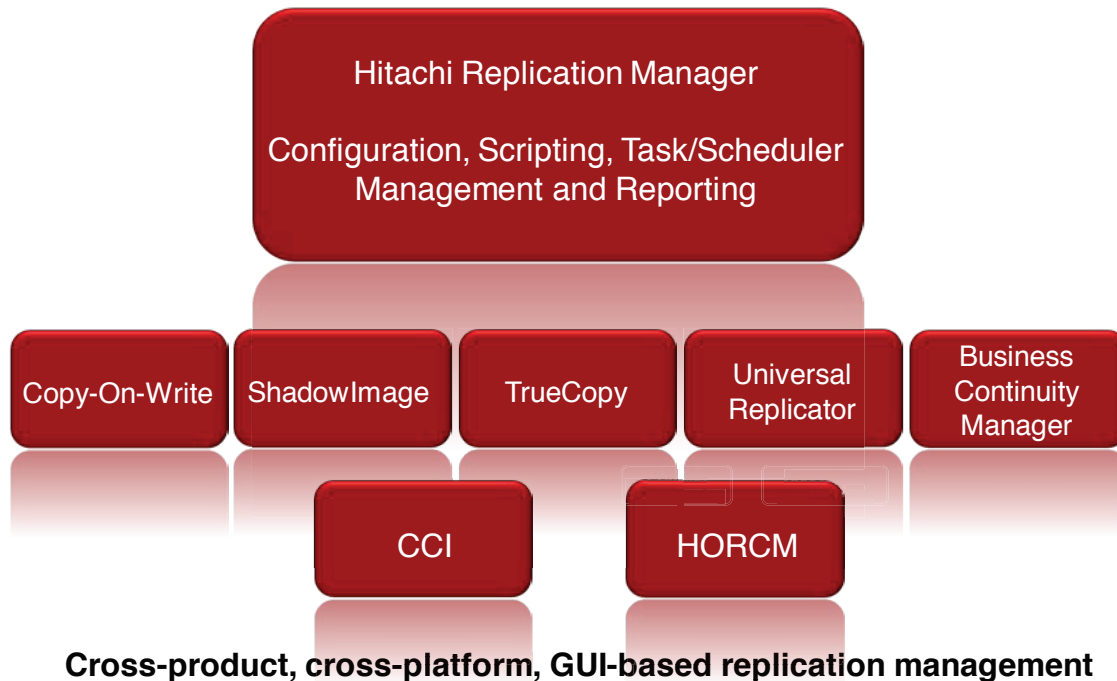
Replication Manager Overview

- Replication Manager
 - Configures, monitors, and manages Hitachi replication products for open systems and mainframe environments
 - Replication Configuration Management
 - Enables users to set up all Hitachi replication products without requiring other tools, for both local and remote storage systems
 - Multiple User Design and Role-based User Access Control
 - Achieves stringent access control for multiple users
 - Task Management
 - Allows scheduling and automation of the configuration of replicated data volume pairs

4

Hitachi Replication Manager configures, monitors and manages Hitachi replication products on both local and remote storage systems. For both open systems and mainframe environments, Replication Manager simplifies and optimizes the configuration and monitoring, operations, task management and automation for critical storage components of the replication infrastructure. Users benefit from a uniquely integrated tool that allows them to better control recovery point objectives (RPOs) and recovery time objectives (RTOs).

Centralized Enterprise-wide Replication Management



5

Replication Manager gives an enterprise-wide view of replication configuration, and allows configuring and managing from a single location. Its primary focus is on integration and usability.

For customers who leverage in-system or distance replication capabilities of their storage arrays, Hitachi Replication Manager is the software tool that configures, monitors, and manages Hitachi storage array based replication products for both open systems and mainframe environment in a way that simplifies and optimizes the:

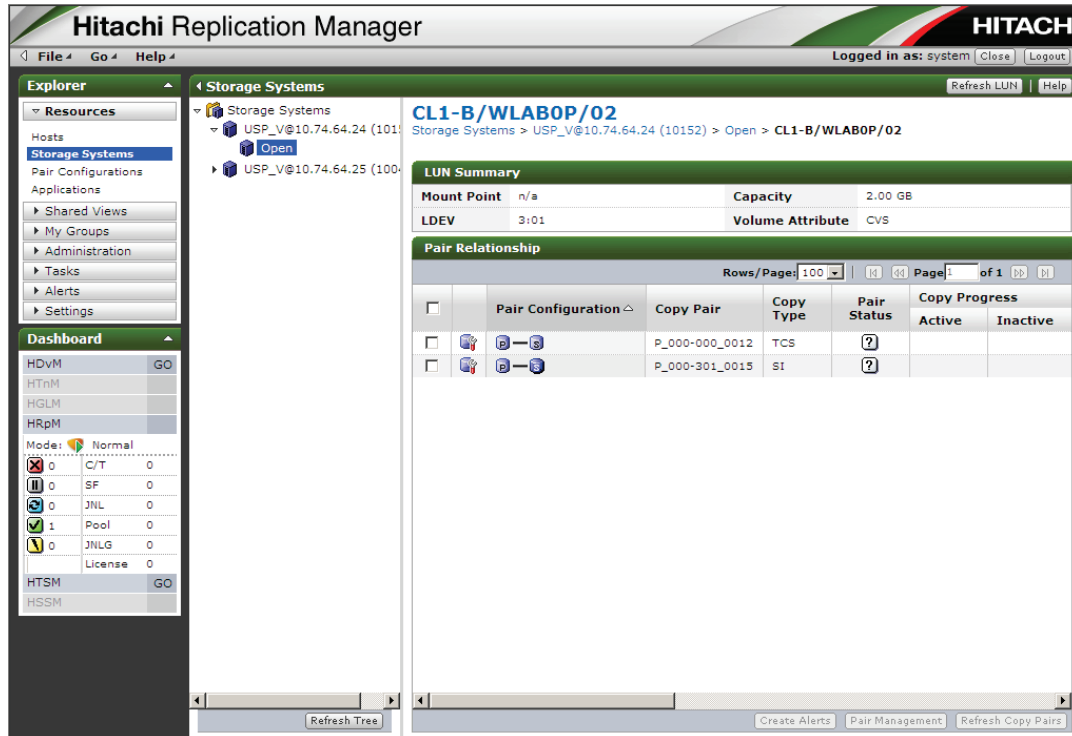
- Configuration
- Operations
- Task management and automation
- Monitoring of the critical storage components of the replication infrastructure

CCI = Command Control Interface

Hitachi Open Remote Copy Manager (name of CCI executable)

Graphical User Interface

- GUI is consistent with other HCS products.



Replication Manager GUI is consistent with other Hitachi Command Suite products:

- Explorer navigation drawers
 - ♦ Much simpler
- Consistent navigation tree
- “Bread Crumb” trail for browsing resources
- Dashboard menu
 - ♦ Displays list of Storage Command Suite products on the same management server
 - ♦ Products can be launched using the **Go** link
- Application area
 - ♦ Displays information for the option selected in Explorer menu

Centralized Monitoring

- Four views allow users to understand replication environment depending on the perspective:
 - **Hosts** view
 - **Storage Systems** view
 - **Pair Configurations** view
 - **Applications** view



7

Replication Manager provides the following four functional views that allow you to visualize pair configurations and status of the replication environment from different perspectives:

- **Hosts** view: This view lists open hosts and mainframe hosts and allows you to confirm pair status summaries for each host.
- **Storage Systems** view: This view lists open and mainframe storage systems and allows you to confirm pair status summarized for each. A storage system serving both mainframe and open system pairs is recognized as two different resources in order to differentiate open copy pairs and mainframe copy pairs.
- **Pair Configurations** view: This view lists open and mainframe hosts managing copy pairs with CCI or BCM and allows you to confirm pair status summarized for each host. This view also provides a tree structure along with the pair management structure.
- **Applications** view: This view lists the application and data protection status. This view also provides a tree structure showing the servers and their associated objects (Storage Groups, Information Stores, and Mount Points).

■ Hosts view — Perspective of hosts using the pairs

Hitachi Replication Manager

Logged in as: SystemMgr | Close | Logout

Explorer

- Resources
 - Hosts
 - Storage Systems
 - Pair Configurations
 - Applications
- Shared Views
- My Groups
- Administration
- Tasks
- Alerts
- Settings

Dashboard

HDvM GO

HTnM GO

HGLM

HRpM

Mode: Normal

C/T 0

SF 0

JNL 0

Pool 0

JNLG 0

License 0

HTSM GO

HSSM

Hosts

- BC-007
- Eclair6980
- HA8K_Node1
- HA8K_Node2
- HA8K_Node3
- HA8K_Node4
- RPM7432 (01)
- Tao_HNAS7130
- Tao_hnas6911
- Test
- bc-001
- bc-003
- bc-011
- eclair6970
- gsslab24
- hcp68140
- hcp68141
- hcp68142
- hcp68143
- hcp68144
- scsil7
- scsil7250-vmware
- scsil7415
- scsil7431

Host Summary

IP Address 172.17.23.137

LUNs Copy Groups

Paired Unpaired

Rows/Page: 100 Page 1 of 1

Port/Host Group/LUN	LDEV	Label	Capacity	Storage System
CL1-A/SWB_BC-007/00	0:70		46 MB	USP_V@172.17.41.57 (10044)
CL3-A/SWB_BC-007/00	4:00		2.00 GB	VSP@172.17.45.35 (53004)
CL3-A/SWB_BC-007/00	4:00		46 MB	VSP@172.17.45.30 (53086)
CL3-A/SWB_BC-007/01	6:12	test	46 MB	VSP@172.17.45.30 (53086)
CL4-A/SWB_BC-007/00	BD:05		46 MB	USP_V@172.17.41.58 (10033)
CL4-A/SWB_BC-007/00	4:00		2.00 GB	VSP@172.17.45.35 (53004)
CL4-A/SWB_BC-007/00	4:00		46 MB	VSP@172.17.45.30 (53086)
CL4-A/SWB_BC-007/01	6:12	test	46 MB	VSP@172.17.45.30 (53086)
CL8-A/SWB_BC-007/00	0:70		46 MB	USP_V@172.17.41.57 (10044)
CTL0-C/BC-007/01	40		1.00 GB	AMS2300@172.17.44.22 (8501)
CTL0-D/BC-007/01	40		1.00 GB	AMS2300@172.17.44.22 (8501)

Refresh Tree Pair Management

Hosts view — This view lists open hosts and mainframe hosts and allows you to confirm pair status summaries for each host.

- **Storage Systems** view — Perspective of storage systems containing the pairs

The screenshot displays the Hitachi Replication Manager interface. The left sidebar contains a navigation menu with options like Resources, Storage Systems, Pair Configurations, Applications, Shared Views, My Groups, Administration, Tasks, Alerts, and Settings. The main area is titled 'Storage Systems' and shows a list of systems including AMS2300, USP, and VSP. The 'Open' storage system is selected, showing a summary with RAW Capacity of 27.45 TB and Allocated Capacity of 13.50 TB. Below this, a table lists LUNs with their Port/Host Group, LDEV, Label, Capacity, and Copy Type (SI, TCA, TCE).

Port/Host Group/LUN	LDEV	Label	Capacity	Copy Type
CL1-A/ECB_VSP_USPV_TST/00	FA:00	erickb-testvol	25.00 GB	SI
CL1-A/EIG_SI_TEST/00	EE:00		105.00 GB	✓
CL1-A/EIG_SI_TEST/01	EE:01		105.00 GB	✓

Storage Systems view — This view lists open and mainframe storage systems and allows you to confirm pair status summarized for each. A storage system serving both mainframe and open system pairs is recognized as two different resources in order to differentiate open copy pairs and mainframe copy pairs.

- **Pair Configurations** view — Perspective of hosts managing the pairs

The screenshot displays the Hitachi Replication Manager web interface. The top navigation bar includes 'File', 'Go', and 'Help' menus, along with a 'Logged in as: SystemMgr' status. The left sidebar contains a tree view with categories like Resources, Hosts, Storage Systems, Applications, Shared Views, My Groups, Administration, Tasks, Alerts, and Settings. The main content area is titled 'Pair Configurations' and shows a hierarchical view of configurations. The selected configuration is 'Tamer_Test' under 'BC-007' and 'horcm10.conf'. The right pane displays a 'Copy Group Summary' table and a 'Pairs' table.

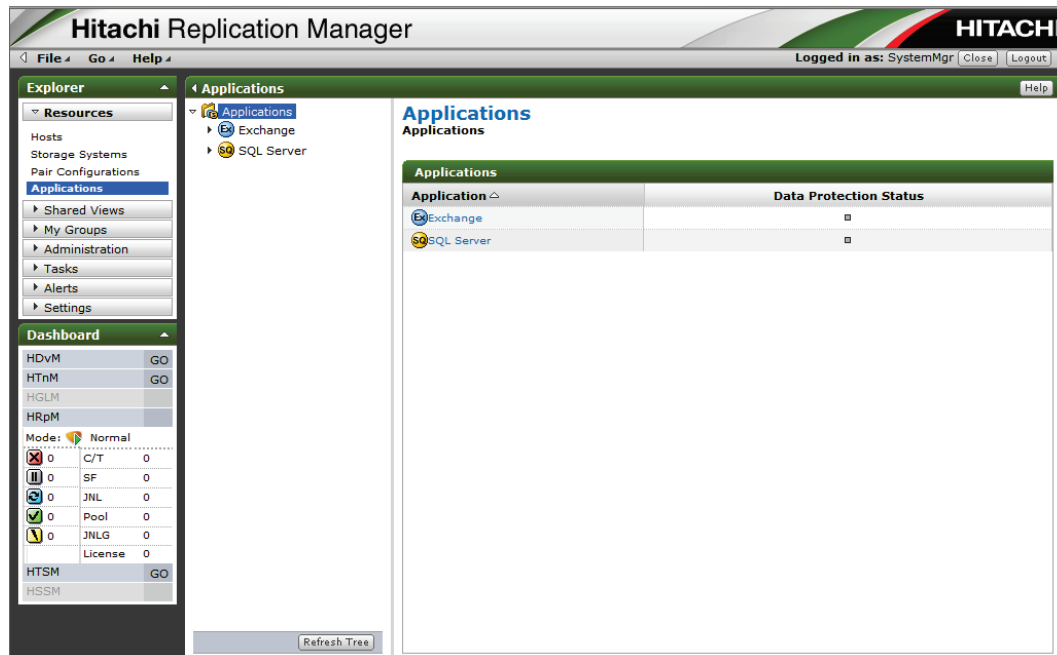
Category	Value
C/T Delta	SI
Side File / Journal Usage	TCA / TCE / SDR
Primary Server	BC-007
Primary Config File	horcm10.conf
Secondary Server	BC-007
Secondary Config File	horcm11.conf
CTGID	0
MU	0
Visible / Total	1 / 1

Copy Pair	Copy Type	Pair Status	Copy Progress	Primary
			Active	Inactive
P_BC07-BC24_0009	SI	?		

10

Pair Configurations view — This view lists open and mainframe hosts managing copy pairs with CCI or BCM and allows you to confirm pair status summarized for each host. This view also provides a tree structure along with the pair management structure.

- **Applications** view — Perspective of applications (MS-Exchange/MS-SQL Server) being managed



11

Applications view — This view lists the application and data protection status. This view also provides a tree structure showing the servers and their associated objects (Storage Groups, Information Stores, and Mount Points).

Centralized Monitoring

- Provides a quick alert mechanism of potential problems using SNMP or email:
 - Unexpected changes in copy status
 - Exceeded user-defined thresholds
 - Resource utilization (journals and sidefile)
 - Recovery Point Objective (RPO) of Target Copy Group

	Alert Name ^	Resource Type	Enabled / Disabled	Alert Action		Monitoring	
				Email	SNMP	Metrics	Condition
☐	test	Copy Group	Enabled		☒	Pair Status	☐ ☐ ☐ ☒ ☐

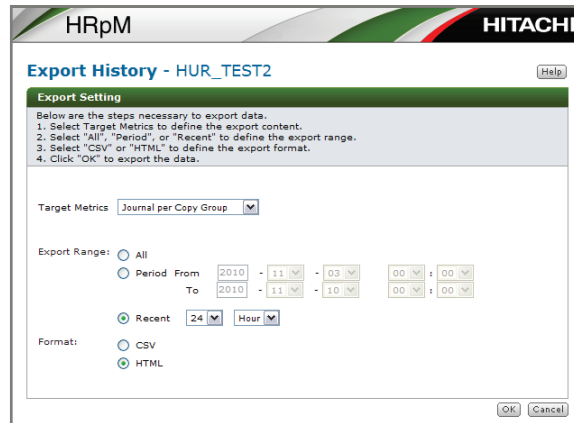
12

Replication Manager can send an alert when a monitored target, such as a copy pair or buffer, satisfies a preset condition. The conditions that can be set include: thresholds for copy pair statuses, performance information, and copy license usage. You can specify a maximum of 1,000 conditions.

Alert notification is useful for enabling a quick response to a hardware failure or for determining the cause of a degradation in transfer performance. Alert notifications are also useful for preventing errors due to buffer overflow and insufficient copy licenses, thereby facilitating the continuity of normal operation. Because you can receive alerts by email or SNMP traps, you can also monitor the replication environment while you are logged out of Replication Manager.

■ Exporting Replication Manager management information

- Determine cause of error
- Analyze performance information
 - Write delay time (C/T delta) on a copy group basis
 - Sidefile usage on a copy group basis
 - Journal volume usage on a copy group basis
 - Journal volume usage on a journal group basis (in open systems)
 - Pool volume usage on a pool basis (in open systems)
 - History of received alerts
 - Event logs



13

You can export Replication Manager management information to a file in CSV or HTML format. Using the exported file, you can determine the cause of an error, establish corrective measures, and analyze performance information. If necessary, you can edit the file or open it with another application program. You can export a maximum of 20,000 data items at a time.

Historical performance information items can be exported.

The following performance information items can be exported:

- Write delay time (C/T delta) on a copy group basis
- Sidefile usage on a copy group basis
- Journal volume usage on a copy group basis
- Journal volume usage on a journal group basis (in open systems)
- Pool volume usage on a pool basis (in open systems)
- The history of received alerts
- Event logs

When you export management information, you can specify a time period to limit the amount of information that will be exported. However you can export only information whose data retention period has not expired. The retention period can be managed by a user with the Admin (Replication Manager management) permission.

Reports - C/T deltas and resource utilization between source devices and their targets for both open and mainframe groups

Storage Systems View

- Additional information available on the tabs

14

The Storage Systems view provides information about LUNs (Paired and Unpaired), Journal Groups, copy licenses, command devices and pools.

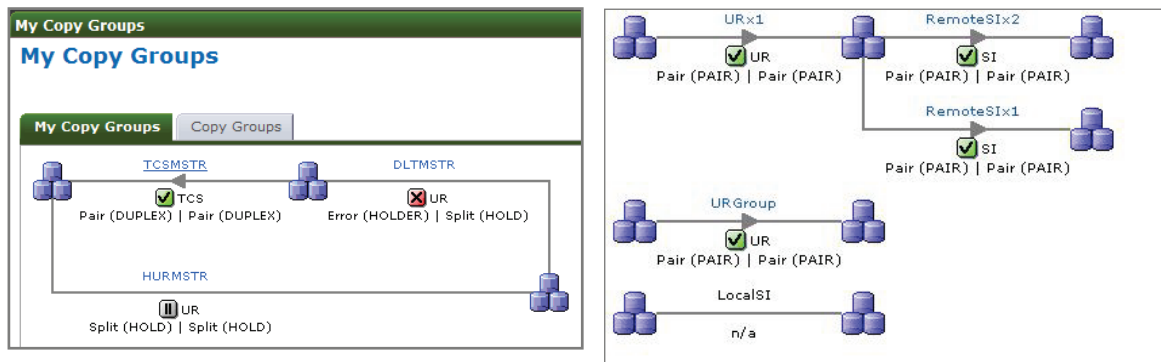
- **LUNs (Paired)** tab shows the list of LDEVs that are already configured as Copy Pairs.
 - ♦ Clicking on a specific LUN provides detailed information about the Copy Pair, Copy Type, Pair Status, and much more.
 - ♦ A filter dialog is available for **LUNs** tab, which makes it easier to find target volumes. You can filter LUNs by using attributes such as Port, HSD, Logical Group, Capacity, Label and Copy Type.
- The **Cmd Devs** tab displays the command devices list configured on the storage systems.
- The **Pools** tab displays detailed information for both Copy on Write and dynamic provisioning pools.
- The **JNLGs** tab displays list of Journal Groups that are configured on the storage system. This tab is only available for Universal Storage Platform.
- The **Remote Path** tab displays the remote paths configured for TrueCopy and Universal Replicator software.

- The **Copy Licenses** tab displays the replication related licenses that are installed on the storage systems.

You can also manage (create, edit, delete) resources using the above tabs. Copy Licenses for program products need to be installed through the Element Manager for the storage system.

Features

- “Single pane of glass”
 - Integrated console for multi-site replication pairs
 - Consolidated monitoring for Copy Pair status and remote copy metrics
- Visual representation of replication structure
 - Copy groups, sites, all volume pairs



15

Visual Representation of Replication Structure

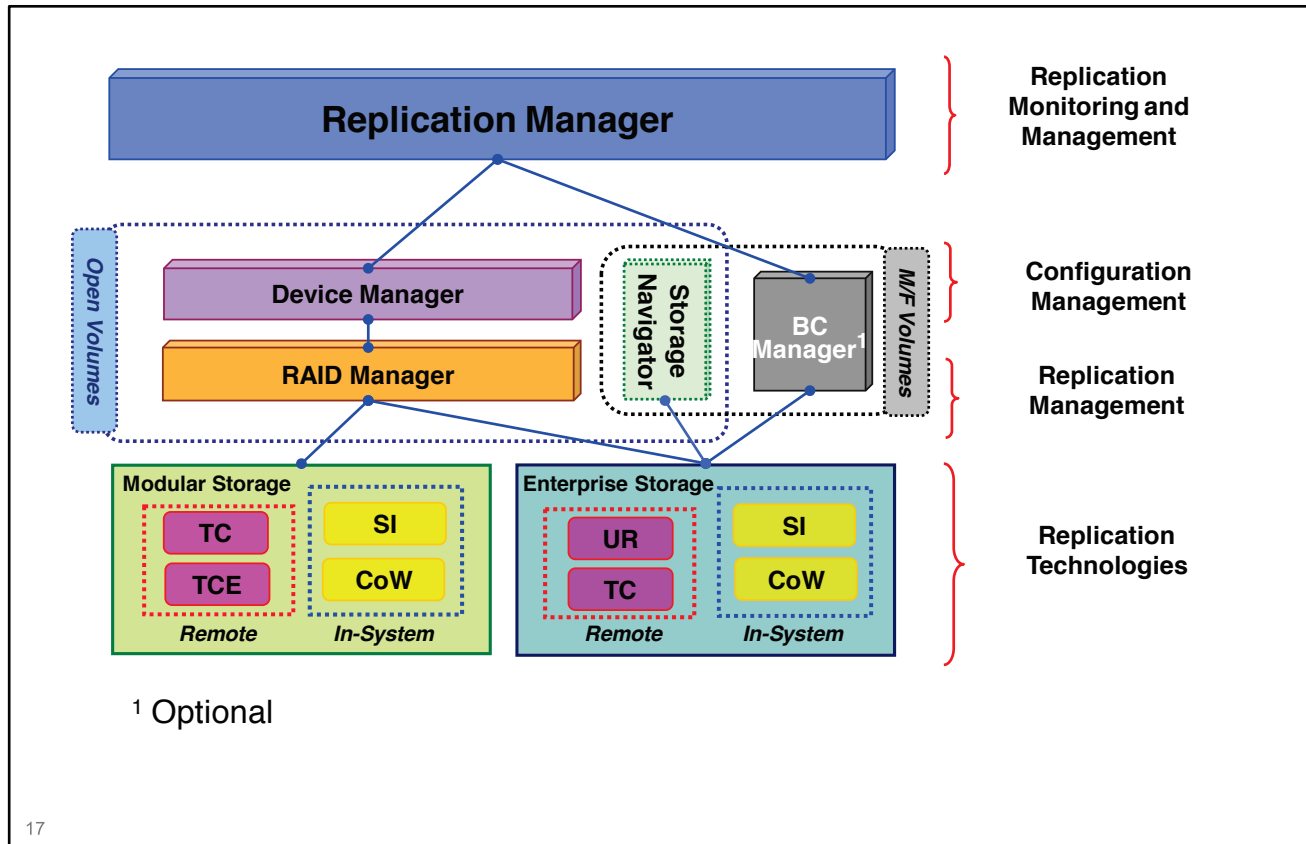
Copy Groups: A group of Copy Pairs created for management purposes, as required by a particular task or job. By specifying a Copy Group, you can perform operations such as changing the Pair Status of multiple Copy Pairs at once.

Using My Copy Groups feature, a user can register a Copy Group into My Copy Groups, choosing those that are most important to monitor, and see how Copy Groups are related and check Copy Pair statuses in a single window. My Copy Groups is also the default screen after you log in to the Replication Manager interface.

Sites: With Replication Manager, you can define logical sites in the GUI just as you would define actual physical sites (actual data centers). It allows you to manage resources more efficiently if you set up separate sites because it is easier to locate a required resource among many resources displayed in the GUI.

- **Pair Volume Lifecycle Management**
 - Simplified replication configuration from setup to deletion
 - Setup > Definition > Creation (Initial copy) > Operation > Monitoring > Alerting > Deletion
- **Storage System Configuration Functions**
 - Set up functionality required for copy pair management
 - Setting command devices, DMLU, Journal Groups and pools
 - Setting up Remote Paths for remote replication
- **Copy Pair Creation or Deletion**
 - Pair Configuration wizard
 - Intuitive pair definition screen with topological view
 - Task Scheduler
 - Scheduler functionality that allows users to execute the copy operations at off-peak time

Positioning

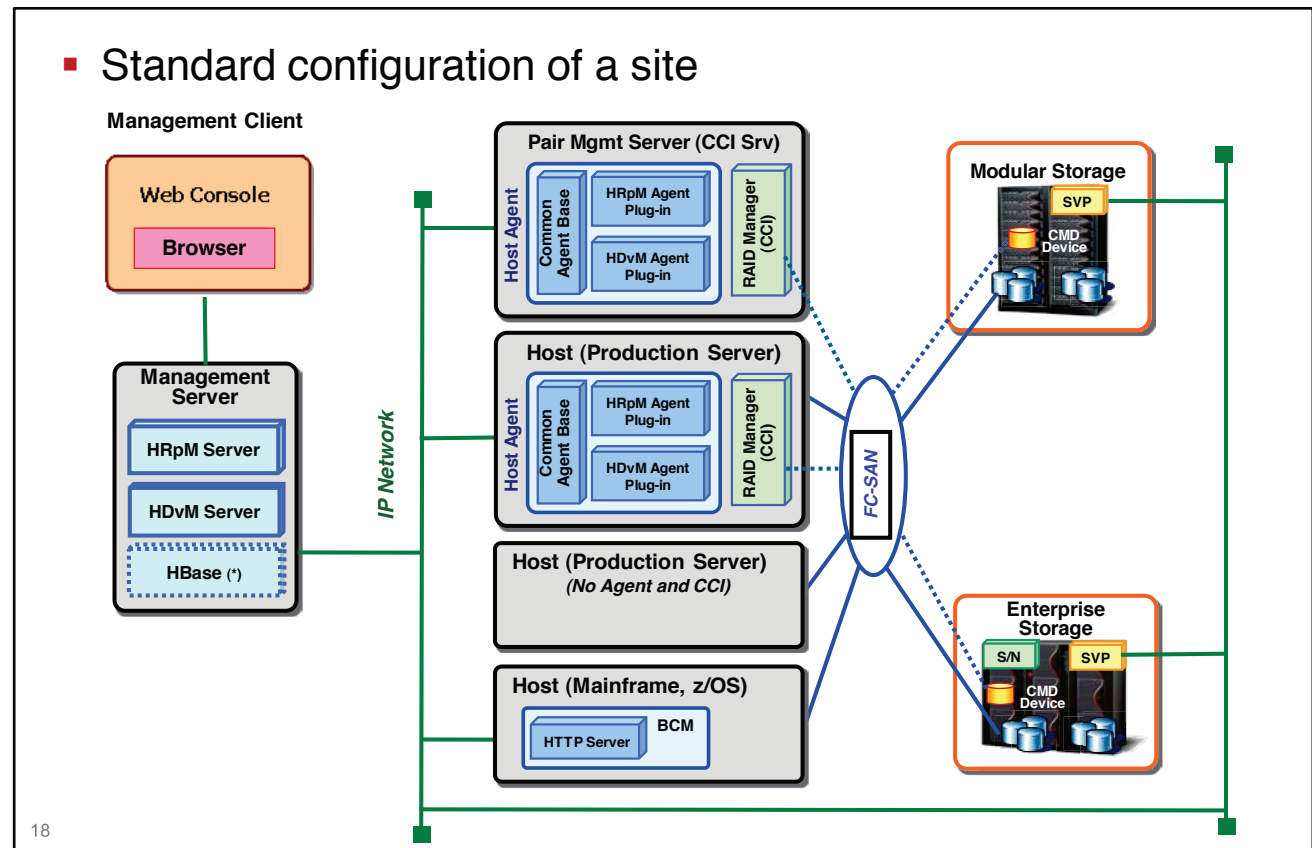


- Replication Manager provides monitoring for both enterprise storage systems (open and mainframe volumes) and modular storage systems (open volumes)
- Replication Manager requires, and is dependent on Hitachi Device Manager and uses RAID Manager (CCI) and Device Manager agent for monitoring open volumes
 - ♦ Device Manager provides volume configuration management
 - ♦ RAID Manager (CCI) is used by Replication Manager for watching pair status
- For monitoring mainframe volumes, Replication Manager can work with or without Hitachi Business Continuity Manager (BCM) software or Mainframe Agent.
 - ♦ As of release 6.3, Replication Manager supports monitoring of IBM environments (z/OS, z/VM, z/VSE and z/Linux) and non-IBM environments using only the Device Manager (without Business Continuity Manager or Mainframe Agent installed). Replication Manager retrieves the status of TCS/TCA/SI, and UR copy pairs directly from storage arrays, without depending on mainframe host types. The minimum interval of automatic refresh for this configuration is 30 minutes.
 - ♦ The status of FC and XRC copy pairs are not supported at this time

Diagram Legend

- TC stands for Hitachi TrueCopy Remote Replication
- TCE stands for Hitachi TrueCopy Extended Distance
- SI stands for Hitachi ShadowImage Replication
- UR stands for Hitachi Universal Replicator
- CoW stands for Hitachi Copy-on-Write Snapshot
- RAID Manager stands for Hitachi Command Control Interface (CCI)

Architecture — Open Systems and Mainframe



In the diagram:

- HDvM stands for Hitachi Device Manager
- HRpM stands for Hitachi Replication Manager
- BCM stands for Business Continuity Manager
- HBase stands for Hitachi Command Suite Common Component Base

Standard system configuration of a site is comprised of:

1. **Management Server:** Replication Manager gets installed with Device Manager. HBase is automatically installed by the Device Manager installation. It is highly recommended to use the same version number, major and minor, for Device Manager server and Replication Manager server.

2. **Pair Management Server (Open Systems):**

Host Agent: Only a single host agent is provided for the Device Manager and Replication Manager. One agent install on the server works for Device Manager and Replication Manager.

RAID Manager (CCI): The Replication Manager requires RAID Manager to manage replication pair volumes. The servers on which the RAID Manager is

installed must have a host agent so that Replication Manager can recognize and manage the pair volume instances.

3. **Pair Management Server (Mainframes):**

Business Continuity Manager: This software product works on the mainframe and manages replication pair volumes assigned for the mainframe computers. Business Continuity Manager 5.0 or later or Mainframe Agent 6.0 or later can be used. The Replication Manager can monitor and manage the mainframe replication volumes by communicating with the Business Continuity Manager. Support for management functions was added in v6.2.

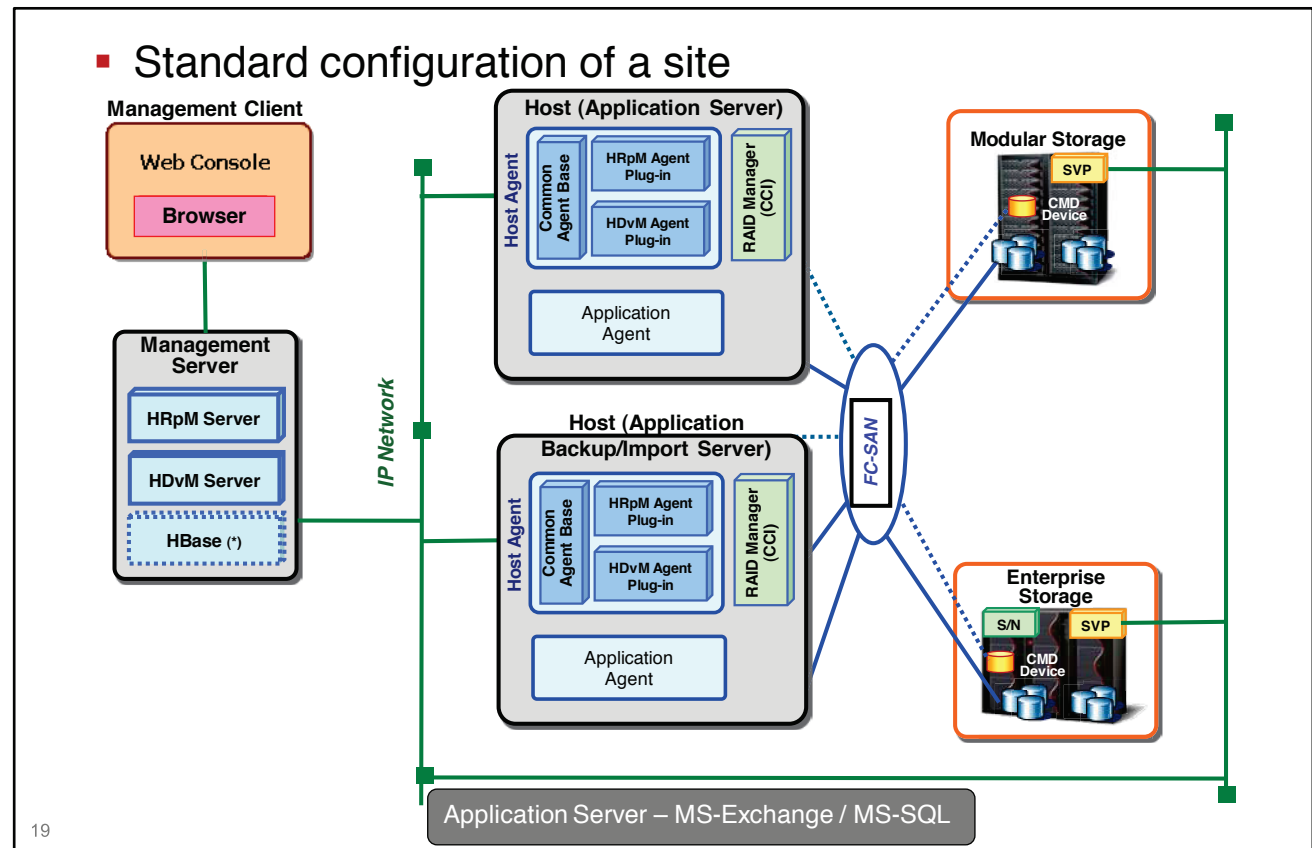
4. **Host (Production Server):** A host runs application programs. The installation of Device Manager agent is optional. Replication Manager can acquire the host information (host name, IP address, and mount point) if the agent is installed on it.

IBM HTTP Server is required on Mainframe Host when using either of the following:

- ♦ IPv6 connection between HRpM and BCM.
- ♦ HTTPS (secure) connection between HRpM and BCM.

BCM program itself does not have above capabilities, so the IBM HTTP Server is utilized to perform these functions. IBM HTTP Server works as “proxy server” between HRpM and BCM.

Architecture — Open Systems with Application Agent



Note: Depending on the configuration, backup servers are not required for SQL Server configurations.

* HBASE – Represents the common components for HCS.

Components

- Replication Manager is composed of:
 - Management Server
 - Device Manager *
 - Replication Manager
 - Management Client
 - Web client
 - Pair Management Server (Open Systems)
 - Device Manager agent
 - RAID Manager (CCI)
 - Pair Management Server (Mainframe)
 - Business Continuity Manager or Mainframe Agent
 - Host (Application Server)
 - Application Agent

** One HRpM Server can manage and monitor volumes from multiple HDvM Servers*

20

HDvM – Hitachi Device Manager

HRpM – HiCommand Replication Monitor

Management Server: A management server provides management information in response to requests from management clients. Device Manager is prerequisite software for Replication Manager. Replication Manager and Device Manager are installed on the same management server. If multiple sites are used, a management server is required for each site. Also, the management server at the remote site can be used to manage pairs when the local site management server fails.

Management Client: A management client runs on a web browser and provides access to the instance of Replication Manager.

Pair Management Server (open systems/mainframes): A Pair Management server collects management information, including Copy Pair statuses and performance information for remote copying. If multiple sites are used, at least one Pair Management server is required for each site. More than one Pair Management server can be setup at each site.

A Pair Management server can also be a host (Application server).

- CCI and a Device Manager agent are installed on each Pair Management server for open systems
- Business Continuity Manager or Mainframe Agent is installed on each Pair Management server for mainframes

TIP: When determining whether to set up Pair Management servers to be independent of hosts, consider security and the workloads on the hosts.

Host (Application Server): Application programs are installed on a host. A host can be used as a Pair Management server, if required.

The Device Manager agent is optional if the server is used as a host. (and not pair management server).

HRpM = HiCommand Replication Monitor

Device Manager Agent

- Device Manager agent is a program that runs on a host to collect host and storage system information, and reports that data to the Device Manager server.
- It collects:
 - Host machine information, such as host names, IP addresses, Host Bus Adapter (HBA) Worldwide Name (WWN), and iSCSI name
 - Information about LDEVs allocated to the host, such as LDEV number, storage system, Logical Unit Number (LUN), and LDEV type
 - Information about file systems allocated to the host, such as file system types, mount points, and usage
 - Copy pair information, such as pair types and statuses
- Replication Manager management server uses this information for displaying and managing the pair information.

Continued...

21

LDEV – logical device

- Device Manager agent is the common agent for Device Manager and Replication Manager.
- You download the agent installer from the Device Manager Web Client.
- Install the agent using an operating system account with administrator or root permissions.
- To operate the CCI instances running on the Device Manager agent, the service permissions must be changed from LocalSystem to an operating system user with administrator permissions.

Note: Refer to the [Hitachi Device Manager Agent Installation Guide](#).

22

CCI – Command Control Interface

Instructor Demonstration — Hitachi Command Suite



Instructor Demonstration

- Hitachi Command Suite
 - Installation
 - Register Storage in HDvM



23

Module Summary

- This module:
 - Listed the typical challenges related to replication
 - Described how Hitachi Replication Manager addresses the challenges associated with replication
 - Listed the key replication management features offered by Replication Management
 - Described the architecture of Replication Manager for different environments

Module Review

1. What are the key features of Hitachi Replication Manager?
2. List the components of Hitachi Replication Manager configuration.
3. What role does Device Manager agent play in Replication Manager operations?

2. Replication Manager Initial Setup

Module Objectives

- Upon completion of this module, you should be able to:
 - List the prerequisites for Hitachi Replication Manager
 - Perform an initial setup
 - Describe the purpose of using sites
 - Create a site and use the Site function
 - Describe the purpose of using resource groups
 - Create and use resource groups

2

Initial Setup

- Prerequisites Validation
- Configure Environment
- Set Up Users and Permissions
- Create Resource Groups
- Organize Resources — Sites

3

Prerequisites

Prerequisite Software

- Before starting Hitachi Replication Manager operations, confirm that:
 - The Pair Management servers are set up with:
 - Device Manager Agent
 - CCI
 - Command Device
 - These resources are added to Device Manager:
 - Storage systems
 - Hosts (Device Manager Agent optional)
 - Pair Management servers (Device Manager Agent required)
 - License keys for replication products, Device Manager and Replication Manager are installed.
 - Microcode versions are at recommended levels, as required for the program products.

5

Hitachi Device Manager Agent: After the Device Manager agents are installed, configure *hdevmagt_account.bat* and *hdevmagt_schedule.bat*

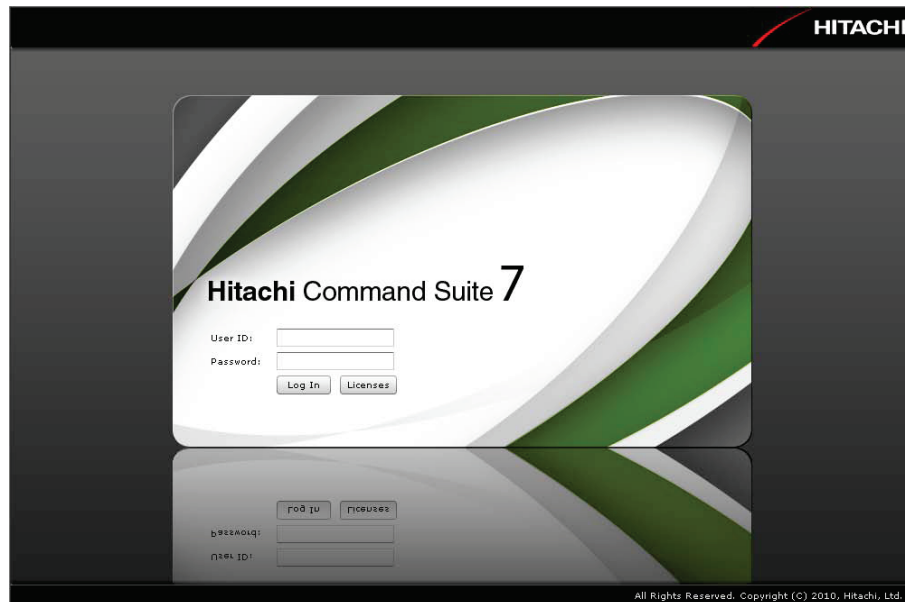
Configure Hitachi Device Manager: After installing Device Manager, add to Device Manager the storage systems, hosts, and Pair Management servers to be managed in Replication Manager.

Note: HDvM 7.0 supports agent-less discovery of hosts using the host data collector. The agent-less discovery is used for reporting host information and does not support replication operations.

For performing replication operations using Replication Manager, a Pair Management Server must be setup with HDvM Agent, CCI and Command Device.

Configure Environment

Launching Hitachi Command Suite



<http://<server IP address>:23015/ReplicationManager/>

or

<http://<server hostname>:23015/ReplicationManager/>

7

In the Web browser address bar, enter the login URL for the management server where Replication Manager is installed. The Back To Login window appears, followed by the User Login window.

When you log in to Replication Manager for the first time, you must use the built-in default user account and then specify Replication Manager user settings. The user ID and password of the built-in default user account are as follows:

- User ID: System
- Password: manager (default)

If Replication Manager user settings have already been specified, you can use the user ID and password of a registered user to log in. If you enabled authentication using an external authentication server, use the password registered in that server.

- Launch from Hitachi Command Suite main window.

The screenshot shows the Hitachi Command Suite 7 interface. The 'Tools' menu is open, and 'Replication Manager' is selected. The main window displays several dashboards:

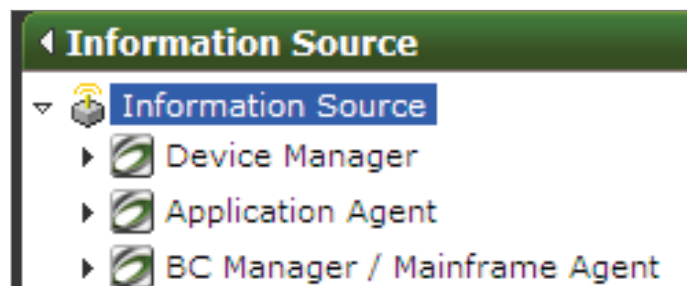
- Storage System:** A table listing storage systems with columns for Name, Capacity, and Status. The 'All Storage System' row is expanded, showing details for VSP@172.17.45.35, VSP@172.17.45.30, USP_V@172.17.41.58, and USP_V@172.17.41.57.
- Datacenter Utilization:** A bar chart showing utilization for Total (133.40 TB), SSD (550.19 GB), and SAS/FC (132.87 TB). The chart is color-coded by status: Open-Allocated (blue), Open-Unallocated (green), Open-Reserved (yellow), Main-frame (purple), and Free (light green).
- Failed Tasks:** A table listing failed tasks with columns for Task, Task Type, and Description. The 'Create-5', 'Create-6', and 'Create-8' tasks are listed.
- Top 10 Consumers:** A table listing the top 10 consumers of storage capacity with columns for Host, Capacity, Allocated Physical Capacity, and Used Capacity. The hosts listed are Scott_Hold_was_I6ISV3, Scott_Hold_was_I6ISV4, SAS_Workstation_HBA2, GEHP9000, SEB_hold_LUNs, SAS_Workstation_HBA1, and Joe_Pena.

At the bottom of the window, there is a status bar showing: Waiting: 0, In Progress: 0, Completed: 13, Failed: 0.

Hitachi Replication Manager can also be launched from the HCS main window menu option.

Registering Information Sources

- Information sources provide environment configuration to Replication Manager.
- Possible information sources:
 - Device Manager Server
 - Application Agent (MS-SQL and MS-Exchange)
 - BC Manager and Mainframe Agent
- The Device Manager server on which Replication Manager is installed is registered as information source automatically.



9

Before you can use Replication Manager to manage resources, you must register an information source. In open systems, this information source is the Device Manager server. In mainframe systems, this information source is either Business Continuity Manager or Mainframe Agent. Once the information sources are registered, you can view host information, information about the connected storage systems, and copy pair configuration information as Replication Manager resources. You can register a maximum of 100 information sources.

■ Adding a New Information Source

The screenshot displays the Replication Manager web interface. On the left is the 'Explorer' sidebar with a tree view containing 'Resources', 'Shared Views', 'My Groups', 'Administration', 'Information Source', and 'Dashboard'. The 'Information Source' section is expanded, showing 'Device Manager', 'Application Agent', and 'BC Manager / Mainframe'. The main panel shows the 'Device Manager' configuration page. At the top, there's a 'Device Manager Setting List' table with columns: Name, Host ID, Protocol, and Port. A red box highlights the first row: 'local HDvM', 'localhost', 'HTTP', and '2001'. Below this, the 'Add Device Manager' dialog box is open. It contains fields for *Name (Site2), *Host ID (wLAB05), Protocol (HTTP selected), *Port (2001), *User ID (system), and *Password (masked). There is a checkbox for 'Acquire the pair configuration managed by the Device Manager during the registration.' and a note about configuration settings. At the bottom of the dialog, there are 'OK' and 'Cancel' buttons. In the bottom right corner of the main window, there are buttons for 'Add HDvM' (highlighted with a red box) and 'Remove HDvM'.

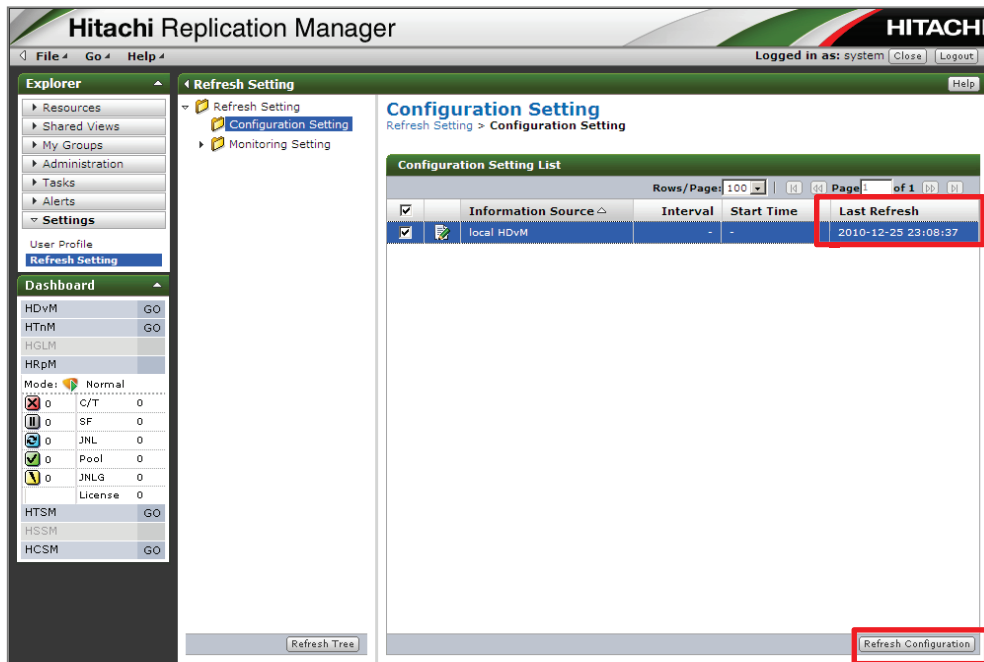
10

Ensure that you have the following Device Manager server information:

- IP address or host name
- Protocol to be used for communication with Replication Manager (HTTP or HTTPS)
- Port number (the server.http.port value in the server.properties file for the Device Manager server)
- User ID and password where you can log in to the Device Manager server

Refreshing Configuration from Information Sources

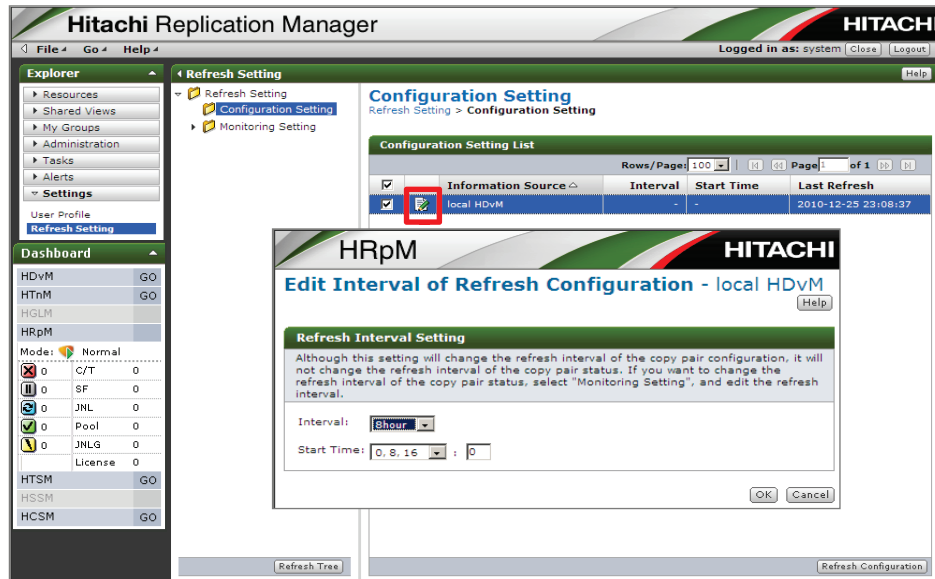
- **Refresh Configuration** to collect the latest information from the information sources into Replication Manager.



On your first login to Replication Manager, execute the **Refresh Configuration** option to ensure that the Replication Manager repository gets synchronized with the local Device Manager server. Any addition of a new Information Source should be followed by a Refresh Configuration.

Refresh Configuration from Information Sources

- Configure automatic Refresh Configuration to collect the latest information from the information sources into Replication Manager.



12

To minimize effects on operation, determine the refresh interval and start time carefully so that configuration information is refreshed while machine use is not heavy. You can also disable periodic refreshing if the configuration does not change.

In open systems, when Device Manager is set to refresh information periodically, specify the refresh settings so that Replication Manager refreshes information after the Device Manager server database is refreshed.

Information Refresh in Replication Manager

- You can configure Replication Manager to refresh information:
 - Manually at any time in a sub-window
 - Automatically
- Set up automatic refresh of configuration information using two types of settings:
 - Automatic updating in conjunction with storage systems refresh operations
 - Periodic updating based on a specified refresh interval
- Information may be updated often if both settings are enabled.
 - Therefore we recommend that if you want to enable the periodic update setting, you disable the automatic update setting.

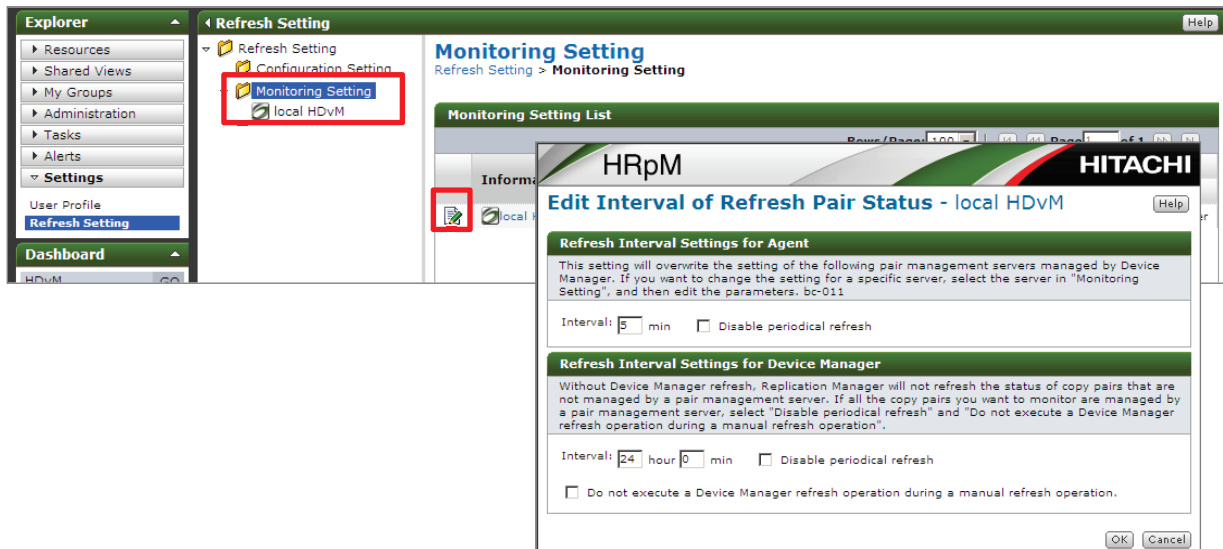
13

The following information is automatically refreshed every five minutes, regardless of the refresh settings for configuration information:

- Journal group status
- Journal volume usage on a journal group basis
- Pool status
- Pool volume usage on a pool basis

Refreshing Information from Pair Management Servers

- Refresh Setting globally for Pair Management and Device Manager Server.



14

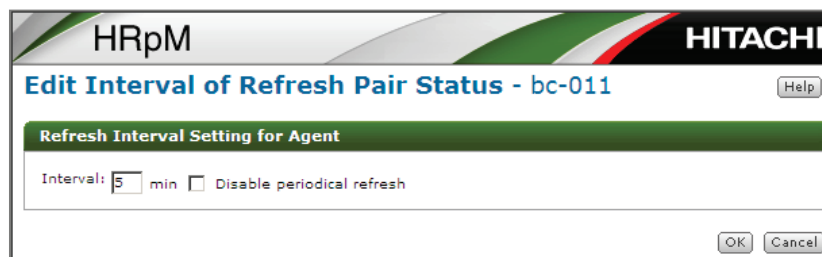
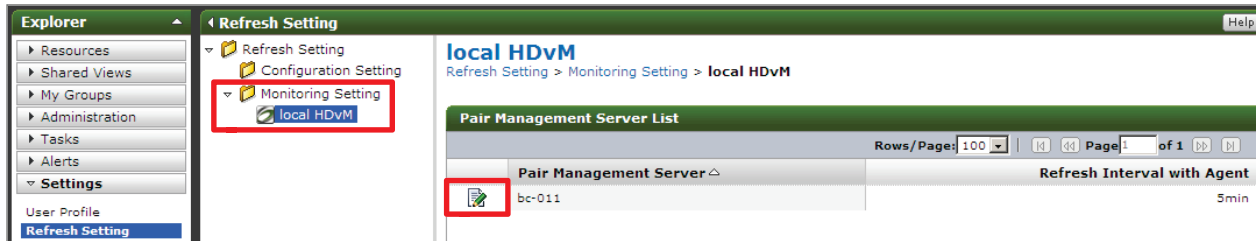
Refresh Interval Settings for Agent

Specify the copy pair status refresh interval for the pair management server that belongs to the information source. If you change the pair status refresh interval settings in this item, the new settings replace the settings made for each pair management server in the Edit Interval of Refresh Pair Status - pair-management-server-name dialog box.

Refresh Interval Settings for Device Manager

Specify the copy pair status refresh interval by refreshing Device Manager when monitoring copy pairs that are not managed by the pair management server.

- Refresh settings for Individual Pair Management Server.



15

The information-source-name (Device Manager) sub-window lets you view the pair status refresh interval for pair management servers managed by the Device Manager server.

Users and Permissions

Managing Users and User Permissions

- Hitachi Replication Manager implements access control in two ways:
 - User permissions restrict the operations that users can perform.
 - Resource groups restrict the range of resources that specific users can access.

■ Permissions Associated with Each Management Role

Management Role	Permission	Description
User Management	Admin*	Permits the user to log in, use all Storage Command Suite products, and set up other users.
Replication Manager Management	Admin	Permits the user to set up Replication Manager resources and the accessible ranges (resource groups) for all users, including oneself. This role also enables the user to perform all administrative tasks within the resource groups except specifying user settings.
	Modify	Enables the user to manage the resources in resource groups set up by users who have the Admin permission of the Replication Manager management role.
	View	Enables the user to view the resources in resource groups set up by users who have the Admin permission of the Replication Manager Management role.

18

* By default, users who have the Admin permission of the User Management role cannot perform any Replication Manager operations other than user management. To perform these operations, such users must be granted the Replication Manager management permissions.

- All users can set up personal profiles and Replication Manager licenses regardless of their permissions.
- The built-in user ID **System** lets you manage all users in Hitachi Command Suite. You cannot change or delete this user ID or its permissions.

System

Users and Permissions > Users > System

User Profile

User ID	System
Status	Active
Full Name	
E-mail	
Description	Built-in account

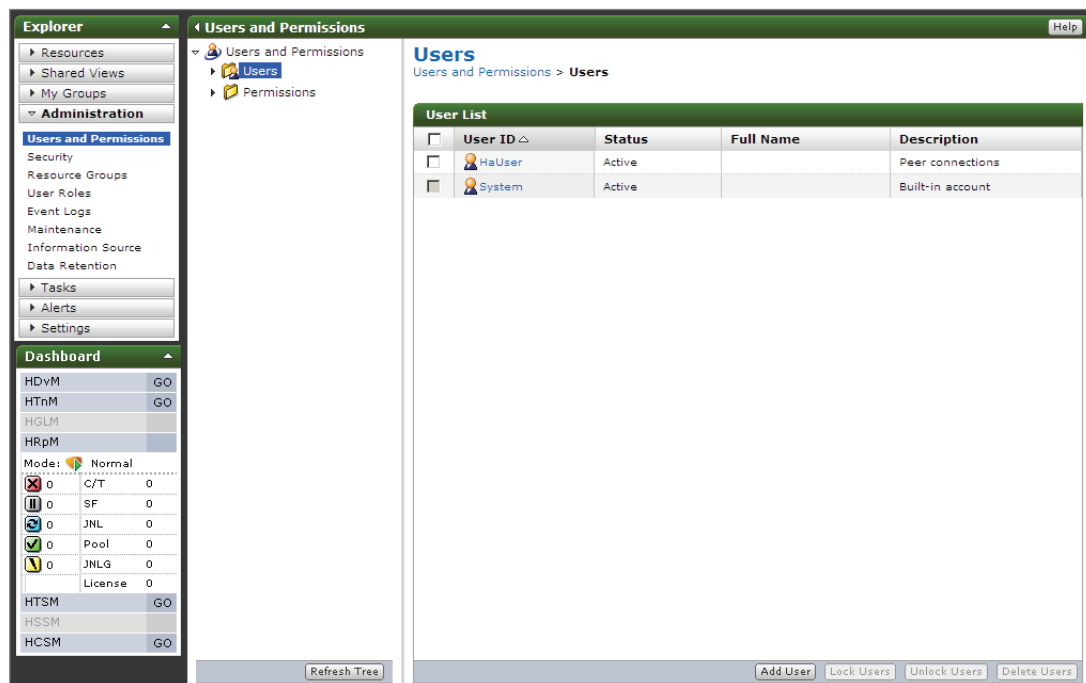
Granted Permission

Application ▾	Admin	Modify	Execute	View	Peer
User Management	✓				
HDvM	✓	✓		✓	✓
HTnM	✓			✓	
HRpM	✓	✓		✓	
HTSM	✓	✓	✓	✓	

19

Peer is internally used by an agent.

Adding Users and Assigning Permissions



20

- In the **Explorer** menu, click the **Administration** drawer to select the **Users and Permissions** option.
- Click **Add User**. The Add User dialog box appears.
- Enter the user details and then click **OK**.

Managing Security

- Replication Manager provides the following security functions:
 - Sets password policy to prevent users from specifying easy-to-guess passwords.
 - Enables automatic locking of user accounts if successive login attempts fail.
 - Displays a warning banner in the user login window.



21

Sites

Sites Overview

- **Sites** provide a grouping functionality of resources for easier management on Replication Manager GUI.
 - In a complex replication environment, storage systems might be located at many sites. You can group resources to create logical sites whenever necessary.
 - Grouping resources based on the actual sites simplifies resource management because you can then use a GUI for management.
 - It provides the same functionality as the existing resources drawer with logical structure.
 - Users can define sites and register associated resources.

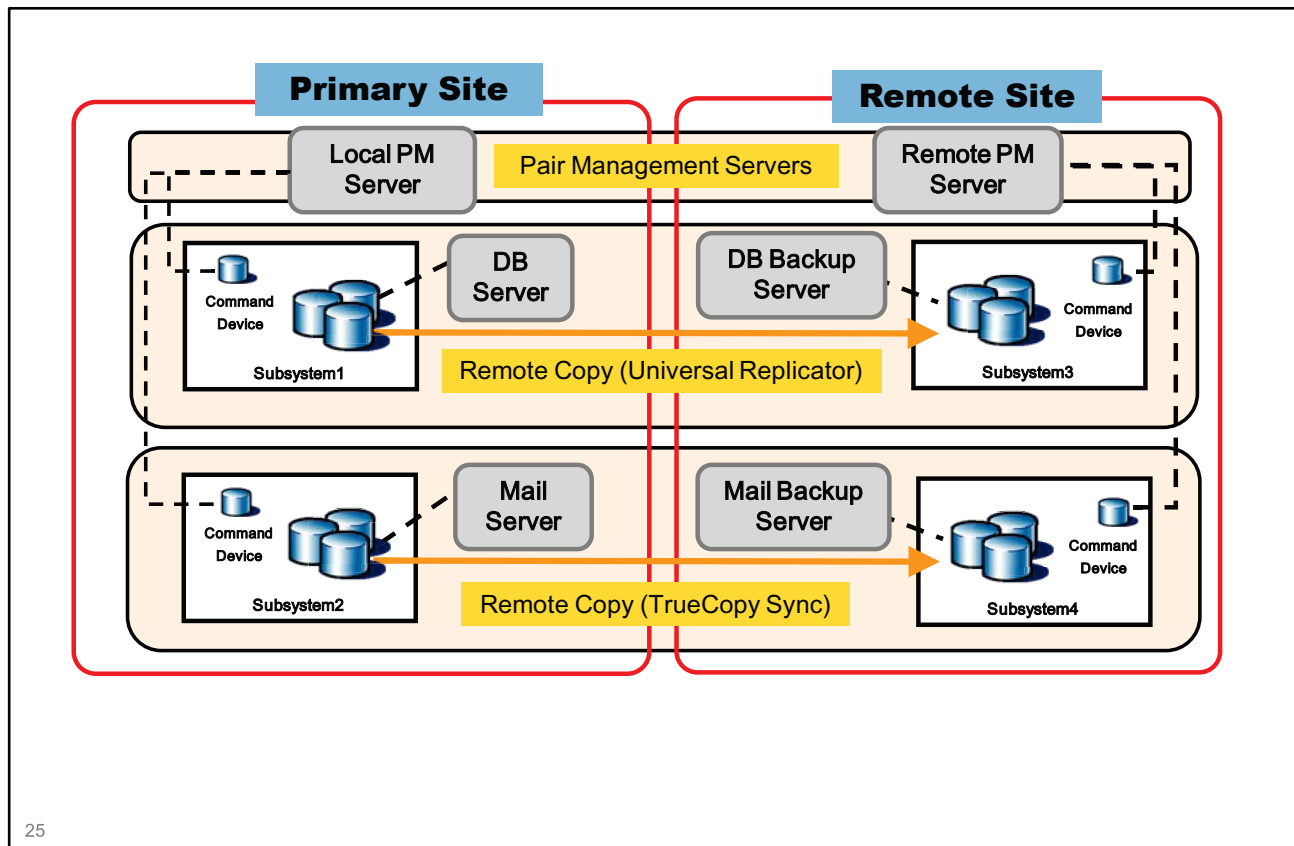
- Sites are managed by users with the Admin (Replication Manager Management) permission.
- Sites consists of hosts, storage systems, applications, and copy pair configuration definitions (pair management servers).
- A resource can belong to only one site.

24

Note: You can specify hosts, storage systems, application and copy pair configuration definitions (pair management servers) for any site. Although you can specify more than one resource for each site, you cannot specify a particular resource for more than one site.

With Replication Manager, you can use the GUI to define logical sites just as you would define actual physical sites (actual data centers). If you set up separate sites, you can manage resources more efficiently because the GUI makes it easy to locate a required resource among the many resources displayed.

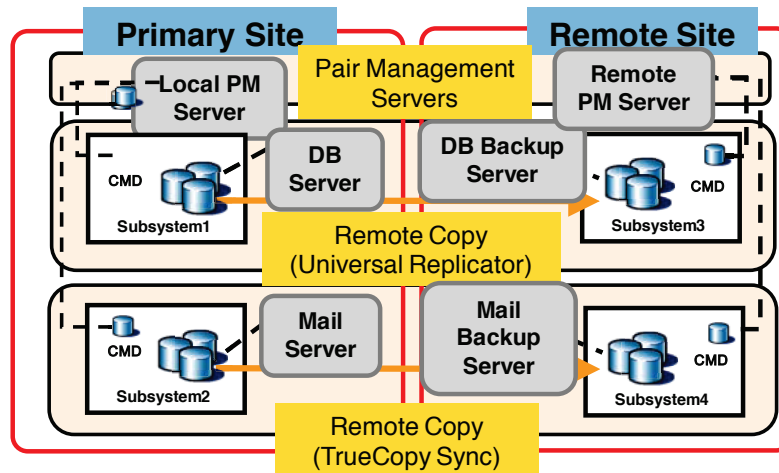
Example of Two Data Centers — Use Case



25

■ Site Configuration

- Create a *Primary Site* and *Remote Site* and place each server based on its physical location.
 - Place *Local PM Server*, *DB Server*, and *Mail Server* into Primary Site.
 - Place *Remote PM Server*, *DB Backup Server* and *Mail Backup Server* into Remote Site.

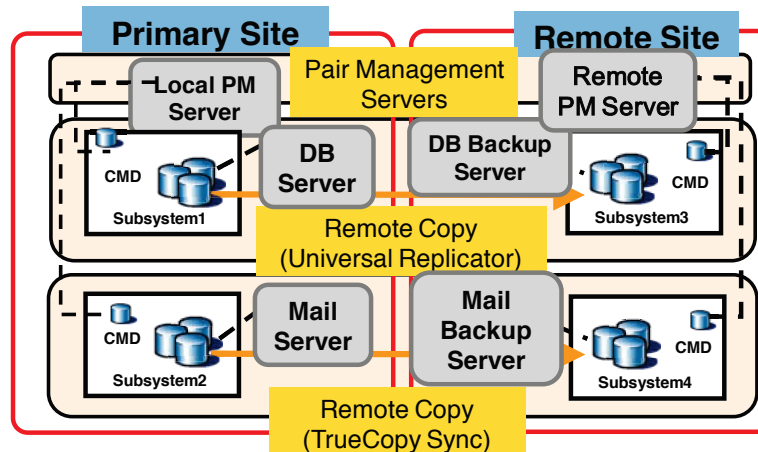


26

In the diagram and following pages, CMD stands for Command Device.

■ Objective

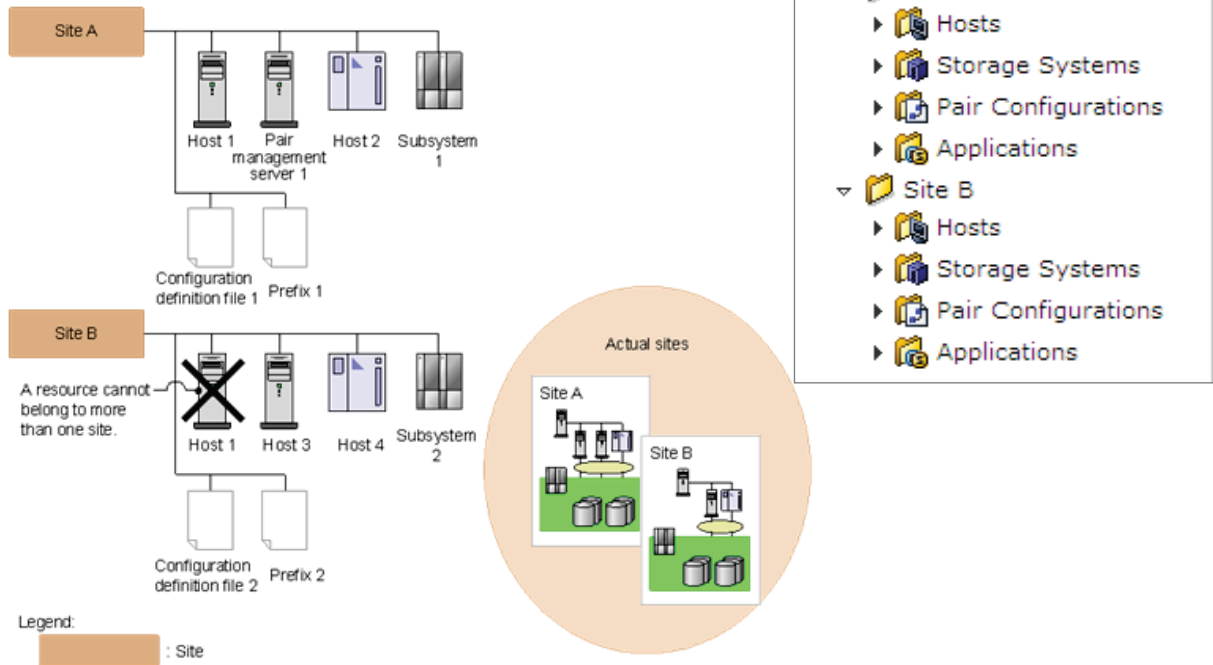
- Easily perform the pair management operation on the **Site** menu with structured resources.
- Easily find the target volumes or Pair Management servers with site structure.
- Pair Configuration Wizard provides the filtering function with site.



27

Site Example

■ Example of Sites



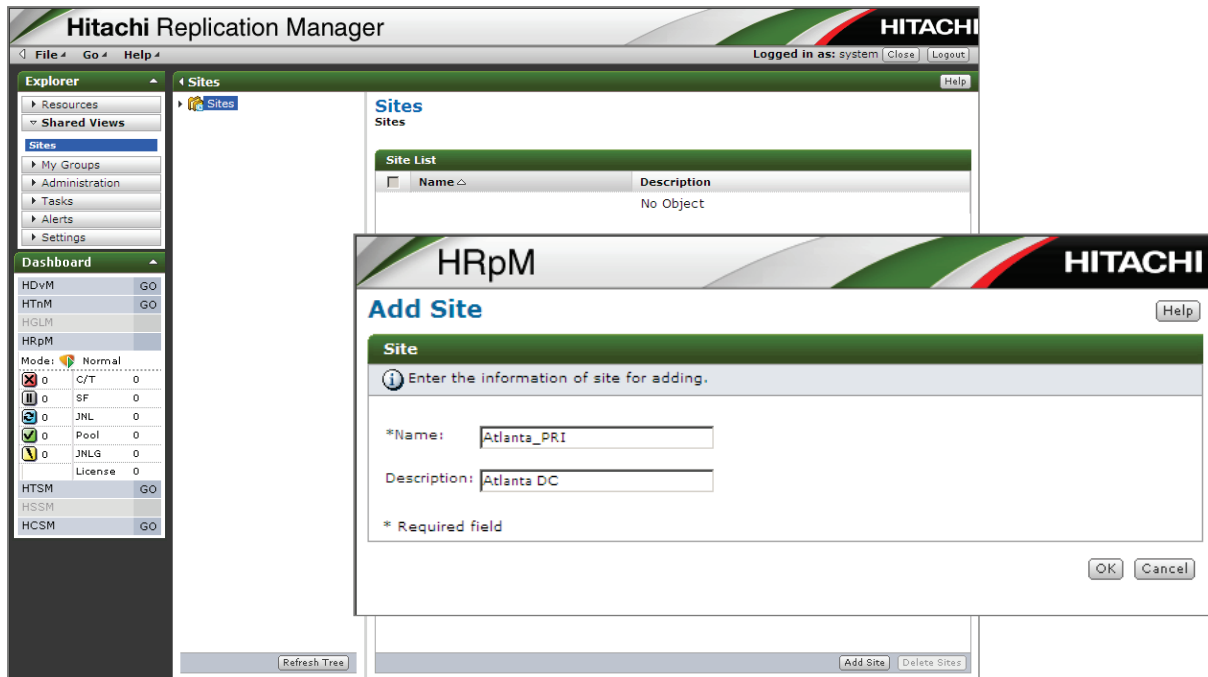
28

Site Properties

- Site structure is shared by all users.
 - Only the Admin user can configure the site.
 - All the users can see the resources under the sites (within the resources controlled by Resource Group).
- One resource belongs to only one site.
 - Exclusive registration where only one storage system can belong to one site
- There is no hierarchical structure.

Setting Up Sites

■ Adding a Site



30

- In the **Explorer** menu, click the **Shared Views** drawer to select the **Sites** option.
- Click **Add Site** to display the Add Site dialog box.
- Enter the site name in the **Name** field and then click **OK**.

■ Sites – Adding Hosts

The screenshot displays the Hitachi Replication Manager interface. In the background, the 'Sites' tree on the left shows 'Atlanta_PRI' selected, with 'Hosts' highlighted under it. The main pane shows the 'Hosts' tab with a table that is currently empty, displaying 'No Object'. In the foreground, the 'Add Hosts' dialog box is open. It features a title bar with 'HRpM' and 'HITACHI' logos. Below the title bar, it says 'Add Hosts' and 'Select hosts to be added in the site "Atlanta_PRI"'. A table lists four hosts: WLAB0K, WLAB0L, WLAB0P, and WLAB0Q. The 'Host' column has checkboxes, with WLAB0K and WLAB0P checked. The 'IP Address' column shows 10.74.65.95, 10.74.65.56, 10.74.65.59, and 10.74.65.60 respectively. The 'Information Source' column shows 'local HDvM' for all. The dialog also includes a 'Rows/Page' dropdown set to 100, a 'Page 1 of 1' indicator, and 'OK' and 'Cancel' buttons at the bottom right.

Host	IP Address	Information Source
☒ WLAB0K	10.74.65.95	local HDvM
☐ WLAB0L	10.74.65.56	local HDvM
☒ WLAB0P	10.74.65.59	local HDvM
☐ WLAB0Q	10.74.65.60	local HDvM

31

■ Sites – Adding Storage System

Storage Systems

Select storage systems to be added in the site "Atlanta_PRI".

Storage System	Storage System Type	Licensed Copy Type
☒ USP_V@10.74.64.24 (10152)	USP_V	SI
☐ USP_V@10.74.64.25 (10043)	USP_V	SI

Rows/Page: 100 Page 1 of 1

OK Cancel

32

■ Adding Pair Configurations and Applications (Hosts)

Hosts

Host	IP Address	Information Source
☐ WLAB0K	10.74.65.95	local HDvM
☐ WLAB0P	10.74.65.59	local HDvM

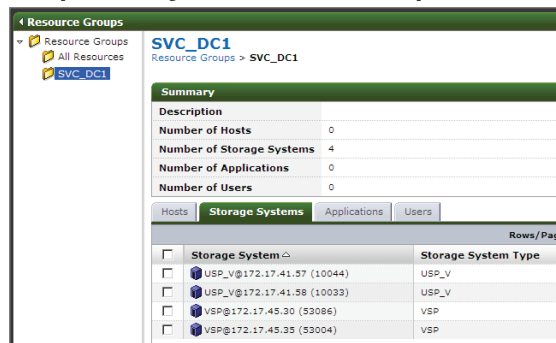
Rows/Page: 100 Page 1 of 1

33

Resource Groups

Resource Groups Overview

- Provide access control functionality.
- Are a collection of hosts, storage systems and applications grouped by purpose and associated with a user for controlled access by the user.
- Large environments require security management for resources such as controlling who can access this storage system. An administrator is assigned to hosts and systems that are grouped by a site or department.

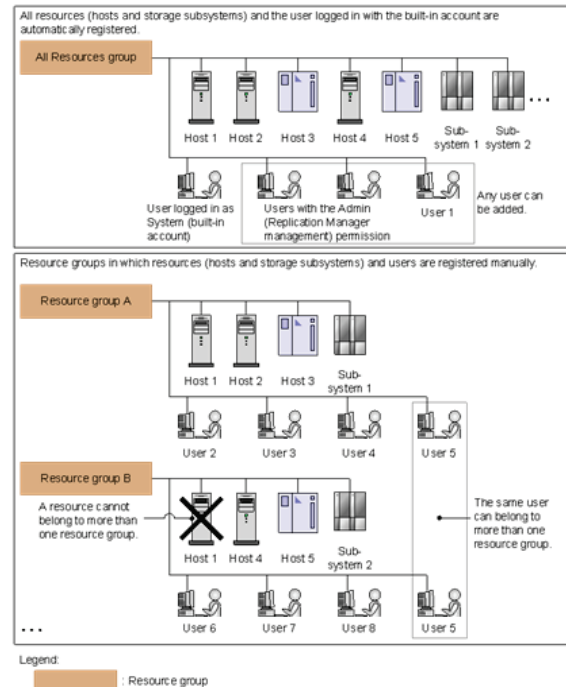


35

Rules for setting up resource groups:

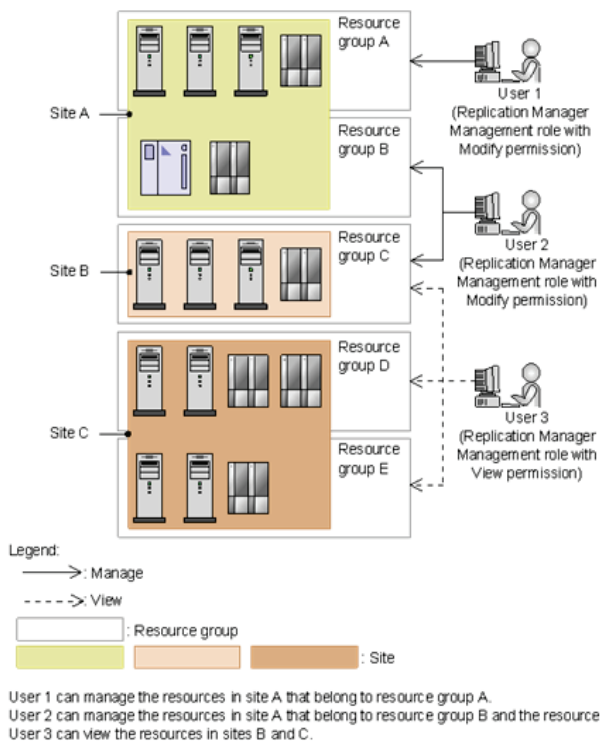
- Multiple resources can be registered in each resource group, but each resource can be registered in only one resource group.
- A user can be granted access permissions for multiple resource groups (that is, the user can be associated with more than one resource group).
- The default group All Resources cannot be deleted or renamed. A new resource group named All Resources cannot be added.
- All resources are automatically registered in the All Resources group.
- Because a user logged in with the built-in account System is permitted to access all resources, the user is automatically registered in the All Resources group.
- Any user can be added to the All Resources group if they do not belong to another resource group.
- Except for users logged in as System (the built-in account), users with the Admin (user management) permission can belong to resource groups only when they also have the Admin, Modify, or View (Replication Manager management) permission.

- **Types of resource groups:**
 - **All Resources**
 - System-defined, containing all the resources in the storage system
 - **User-Defined**
 - Users with administrative privileges can define a Resource Group and add resources, such as hosts and storage systems.
- **Users can only see the allocated resources on the GUI.**
- **A user can be associated with multiple resource groups to increase the range of operations.**

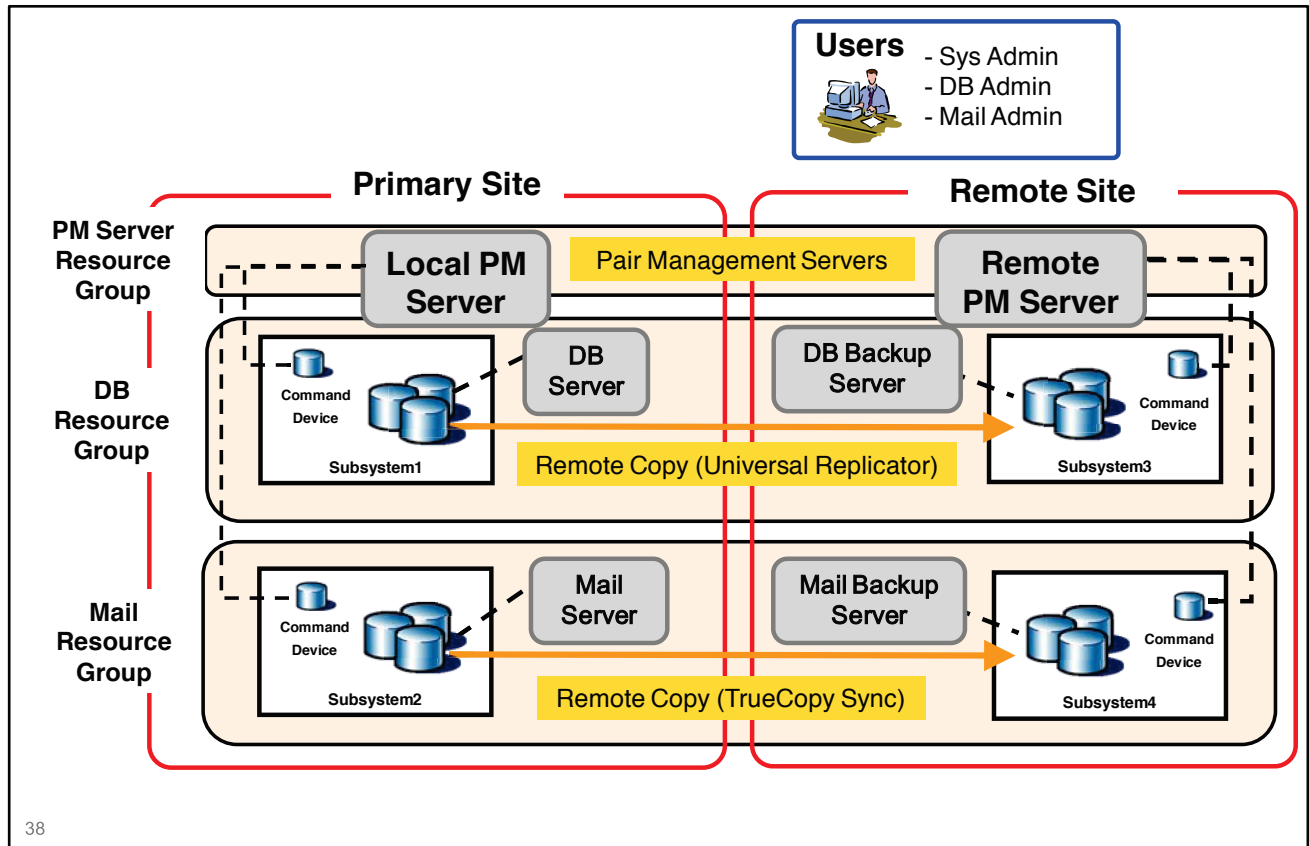


Sites and Resource Group Relationship

- Use the GUI to define logical sites just as you would define actual physical sites (actual data centers).
- Users can view the resources that belong to the sites in the resource groups with which the users have been associated.



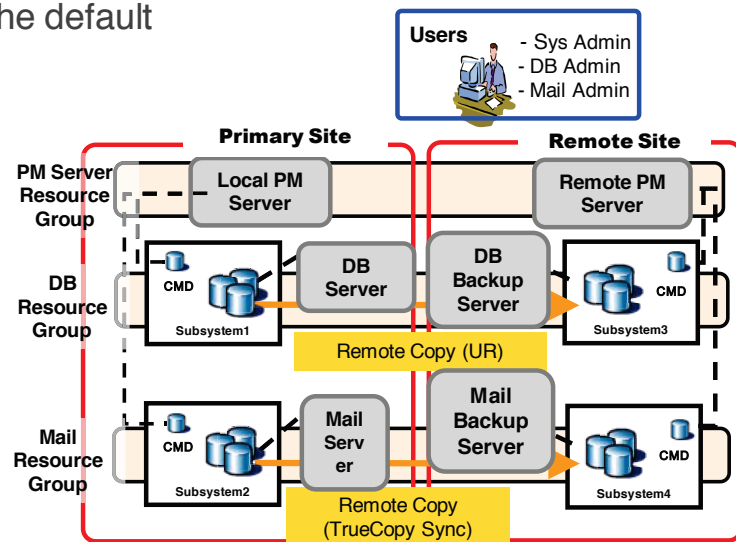
Example of Two Data Centers — Use Case



This is the same use case presented for Sites. This shows how to create resource groups and how users are given control to particular resources in Primary Site and Remote Site so that they can execute the volume copy operations.

- Resource Group Configuration

- All resources are automatically registered in All Resources group.
- The default group All Resources cannot be deleted or renamed.
- **Sys Admin** belongs to the default All Resources group.
- Assign **Mail Admin** to **Mail Resource Group**.
- Assign **DB Admin** to DB Resource Group.

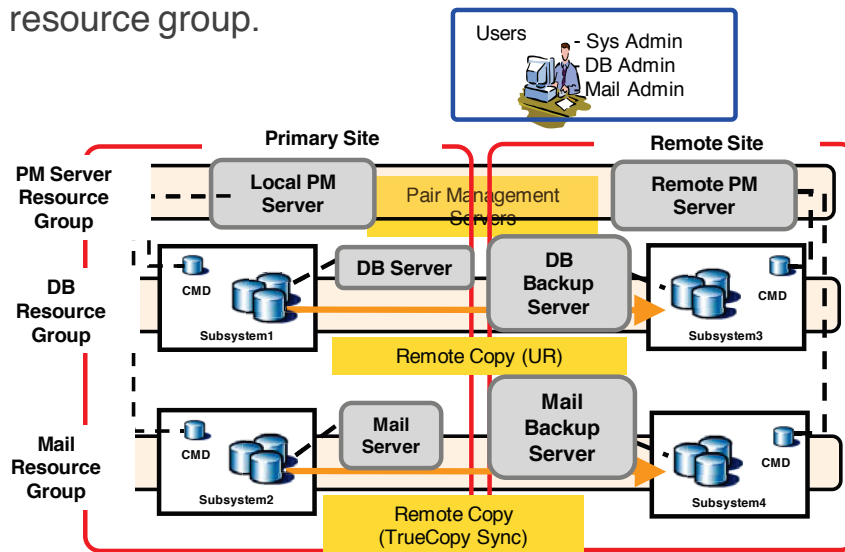


39

In this diagram and the following slides, UR stands for Hitachi Universal Replicator software.

■ Objective

- Prevent the malicious activity or operational errors by dividing the access scope.
- Mail Admin can monitor the Copy Pairs within the assigned resource group.



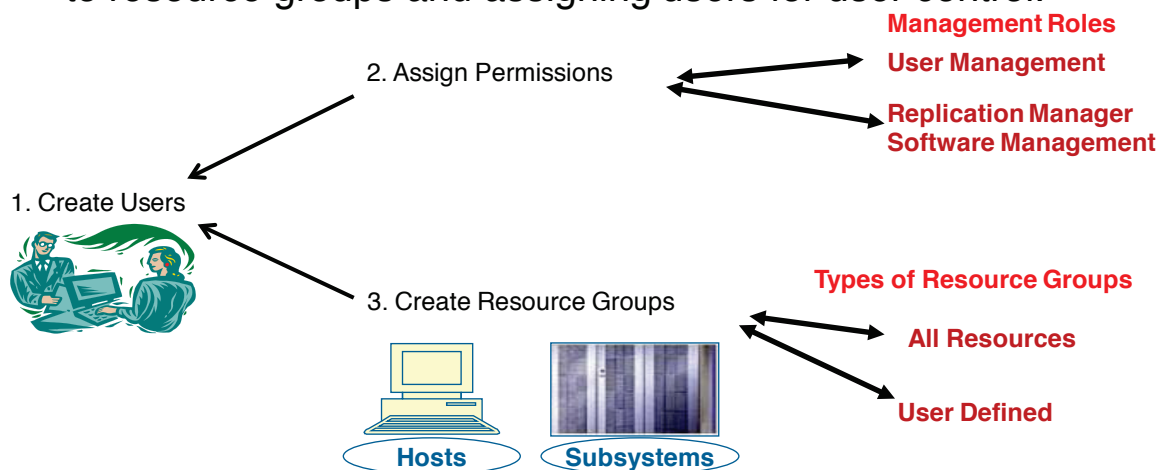
40

In the above diagram:

- The **Primary site** contains: Local PM Server, DB Server, Mail Server, Subsystem1 and Subsystem2.
- The **Remote site** contains: Remote PM Server, DB Backup Server, Mail Backup Server, Subsystem3 and Subsystem4.
- There are **three** resource groups: PM Server Resource Group, DB Resource Group, and Mail Resource Group.
- The user, **Sys Admin**, belongs to the default All Resources Group, therefore has access to all resources on the Primary site and Remote site and can manage all copy pairs.
- The user, **DB Admin**, belongs to DB Resource Group, therefore has access only to the DB Server, DB Backup Server, Subsystem1 and Subsystem3.
- The user, **Mail Admin**, belongs to Mail Resource Group, therefore has access only to the Mail Server, Mail Backup Server, Subsystem2 and Subsystem4.

Resource Group Function

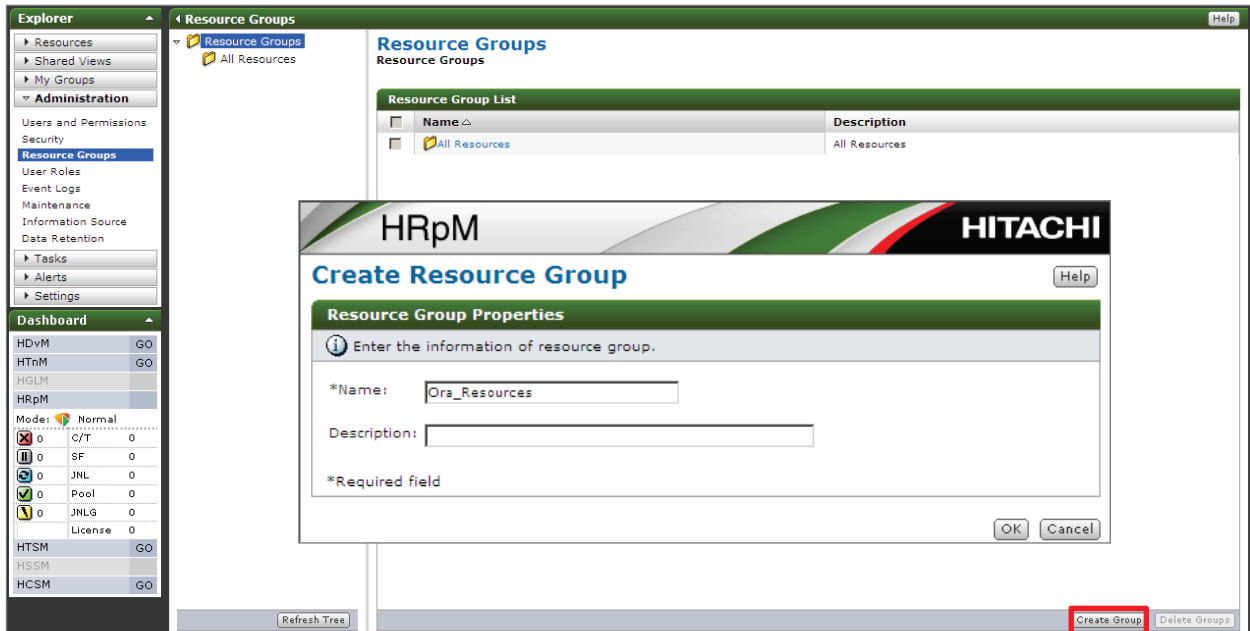
- Resource groups allow the addition of resources (hosts, storage systems and applications) to a user-defined group and assign user access control thus implementing enterprise security.
- Create users and assign permissions before adding resources to resource groups and assigning users for user control.



- Create users.
- Assign permissions to the users based on whether they will be managing Replication Manager or they will also be creating other users.
- Create resource groups – All Resource group is default.
- Add host and storage systems to user-defined resource group.
- Assign users to user defined resource group for accessibility control.

Resource Groups

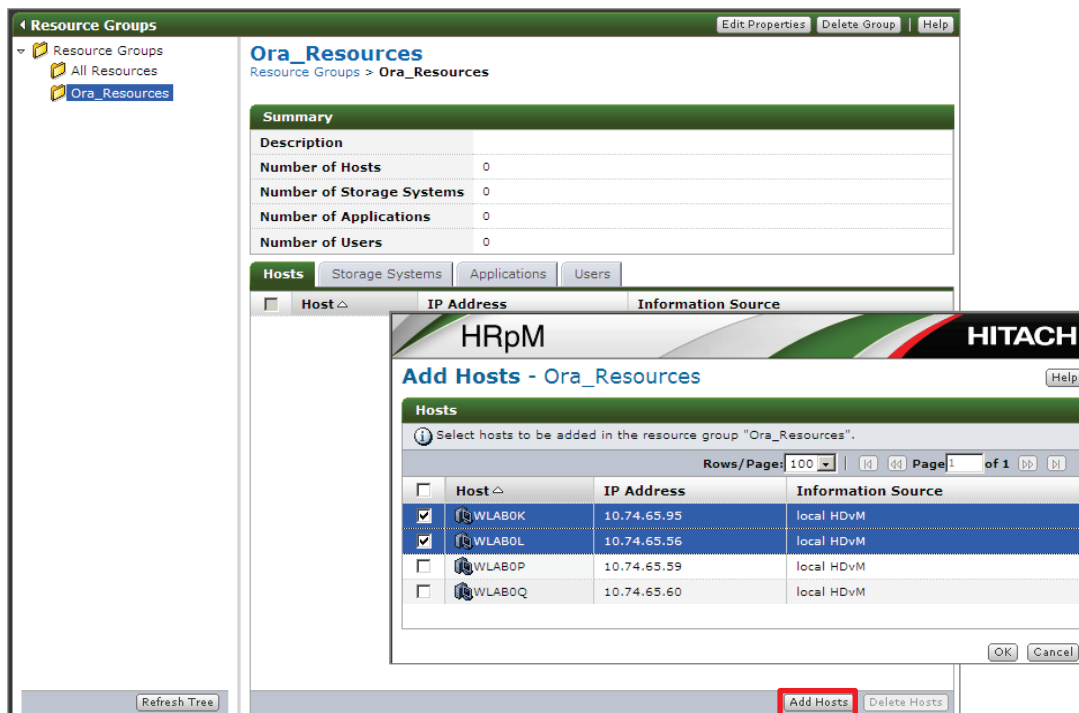
■ Create Resource Group



42

- In the **Explorer** menu, click the **Administration** drawer and then select the **Resource Groups** option.
- Click **Create Group** to display Create Resource Group dialog box.
- Enter a name in the **Name** field and then click **OK**.

■ Add Hosts



43

Assign Hosts — To assign hosts to a user-defined resource group:

- Select the user-defined resource group in the Navigation area.
- Click the **Hosts** tab in the Application area.
- Click **Add Hosts** on the bottom-right of Application area. The Add Hosts dialog box appears.
- Select the host's checkboxes to add those hosts and then click **OK**.

■ Add Storage Systems and Applications

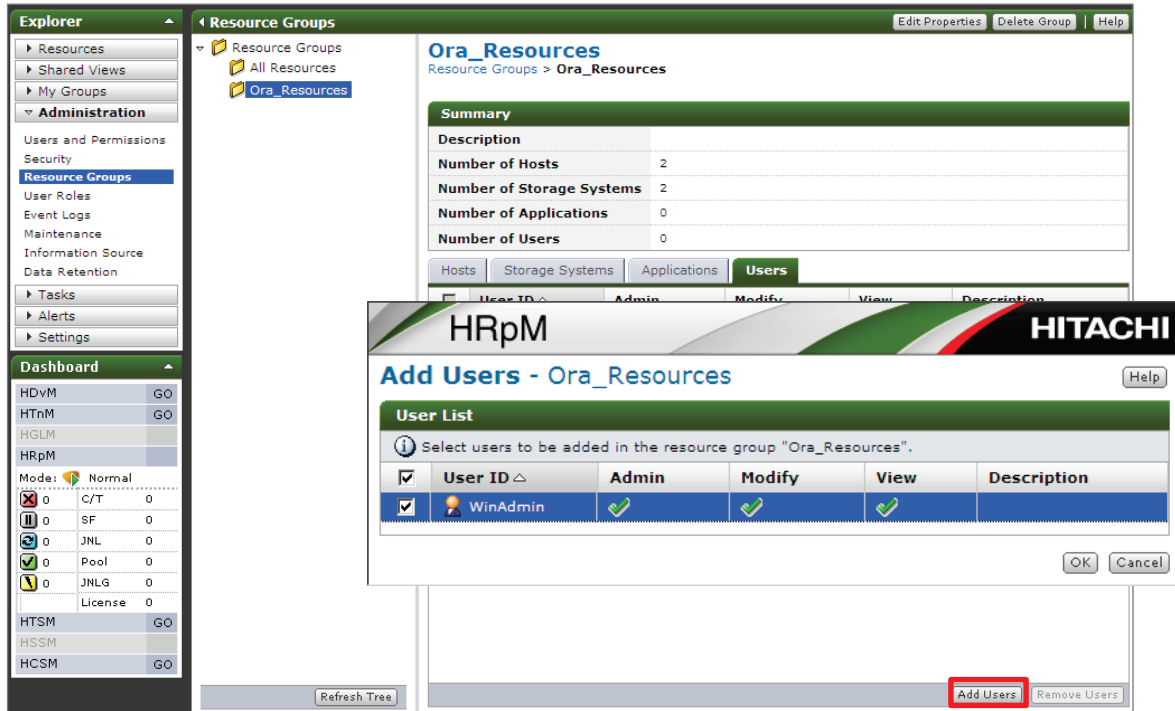


44

Add Resources — To add a storage system to a user-defined resource group:

- Select the user-defined resource group in the Navigation area.
- Click the **Storage systems** tab in the Application area.
- Click **Add Storage systems** on the bottom-right of Application area.
The Add Storage system dialog box appears.
- Select the storage system checkbox to add that system and then click **OK**.

■ Add Users



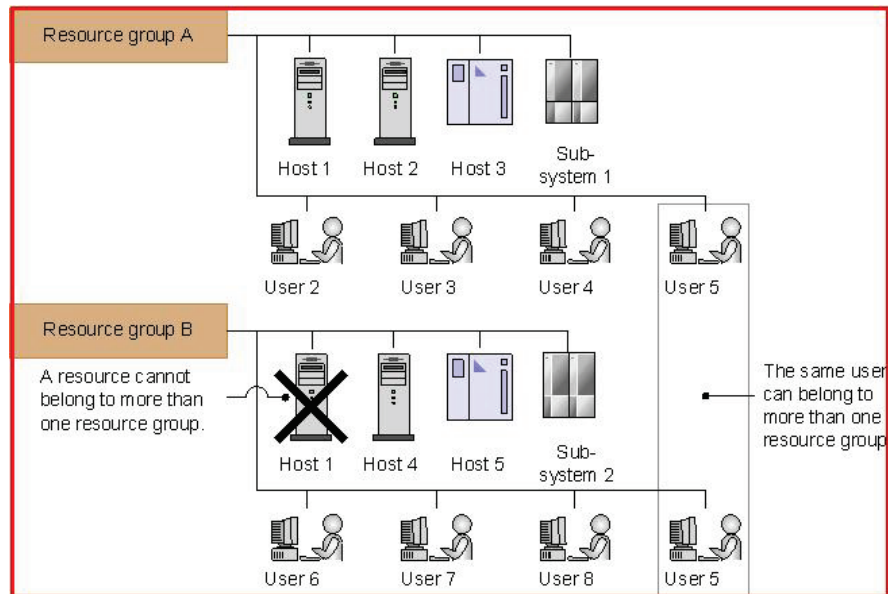
45

Assign Users — To assign users to a user-defined resource group:

- Select the user-defined resource group in the Navigation area.
- Click the **Users** tab in the Application area.
- Click **Add Users** on the bottom-right of Application area. The Add Users dialog box appears.
- Select the user's checkboxes to add those users and then click **OK**.

Resource Group Properties

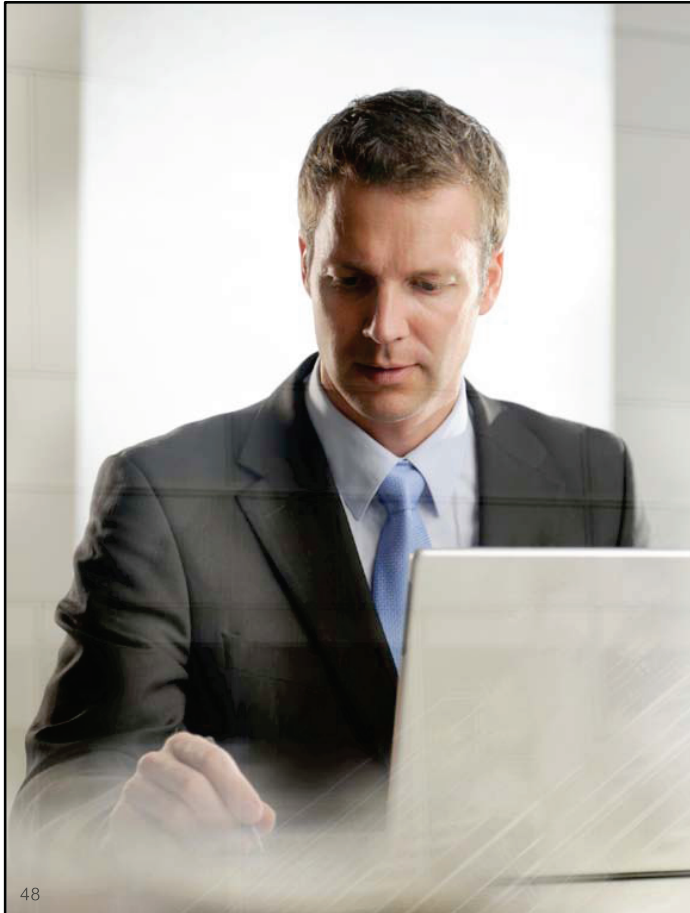
- Multiple resources can be registered in each resource group, but each resource can be registered to only one resource group (exclusive registration).



46

- Newly created users do not belong to any resource group.
- Users can be granted access permissions for multiple resource groups.
- All resources are automatically registered in the All Resources group.
- The default group, All Resources, cannot be deleted or renamed. A new resource group named All Resources cannot be added.
- The built-in admin account, System, is automatically registered in the All Resources group.
- There is no hierarchical structure.

Instructor Demonstration — Initial Setup



48

Instructor Demonstration

- Initial Setup
 - Users and Permissions
 - Refresh Settings
 - Sites
 - Resource Groups



Module Summary

- This module
 - Listed the prerequisites for Replication Manager
 - Described the steps for performing initial setup
 - Described the purpose of using Sites
 - Listed the steps for creating and using the Site function
 - Described the purpose of using Resource Groups
 - Listed the steps for creating and using Resource Groups

Module Review

1. List the initial setup tasks.
2. What information is registered for a Site and a Resource Group?
3. What is the difference between Sites and Resource Groups?

3. Hitachi Replication Products Overview

Module Objectives

- Upon completion of this module, you should be able to:
 - Identify the various replication program products available
 - List the benefits and features of in-system and remote replication products
 - List the basic replication operations for managing replication pairs

2

Hitachi Replication Program Products

Hitachi Replication Products

In-System Replication	Remote Replication
Hitachi ShadowImage Replication	Hitachi TrueCopy Synchronous Remote Replication
Hitachi Copy-On-Write Snapshot	Hitachi Universal Replicator

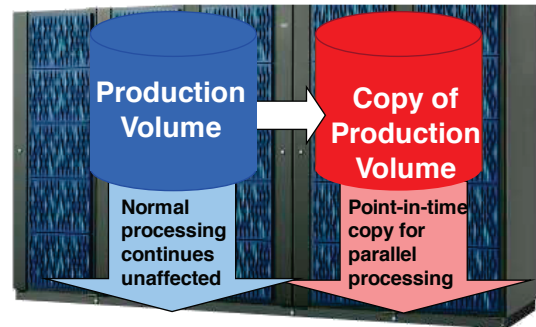
■ Hitachi ShadowImage Replication

– Features

- Full physical copy of a volume at a point in time
- Immediately available for concurrent use by other applications
- No host processing cycles required
- No dependence on operating system, file system or database
- All copies are additionally RAID protected
- Up to 9 copies for a source volume (Enterprise Storage)

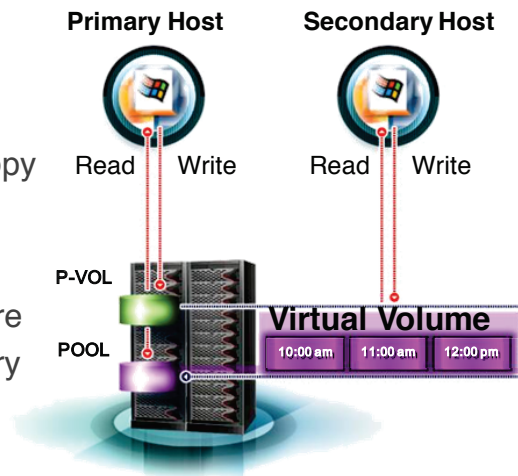
– Benefits

- Protects data availability
- Simplifies and increases disaster recovery testing
- Eliminates the backup window
- Reduces testing and development cycles
- Enables nondisruptive sharing of critical information



■ Hitachi Copy-on-Write Snapshot

- Features
 - Provides nondisruptive, volume “snapshots”
 - Uses less space than ShadowImage
 - Allows multiple frequent, cost-effective, point-in-time copies
 - Immediate read/write access to virtual copy
 - Nearly instant restore from any copy
- Benefits
 - Protects data availability with rapid restore
 - Simplifies and increases disaster recovery testing
 - Eliminates the backup window
 - Reduces testing and development cycles
 - Enables nondisruptive sharing of critical information



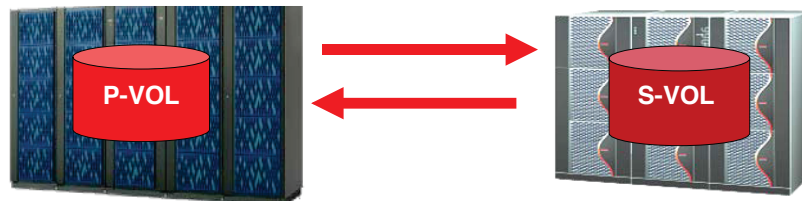
Hitachi TrueCopy Remote Replication

■ Features

- Synchronous support
- Support for mainframe and Open environments
- The remote copy is always a “mirror” image.
- Provides fast recovery with no data loss
- Installed in the highest profile DR sites around the world

■ Benefits

- Complete data protection solution over any distance enables more frequent disaster recovery testing
- Improves customer service by reducing downtime of customer-facing applications
- Increases the availability of revenue producing applications
- Improves competitiveness by distributing time-critical information anywhere and anytime



7

In the diagram and following slides,

P-VOL stands for primary volume.

S-VOL stands for secondary volume.

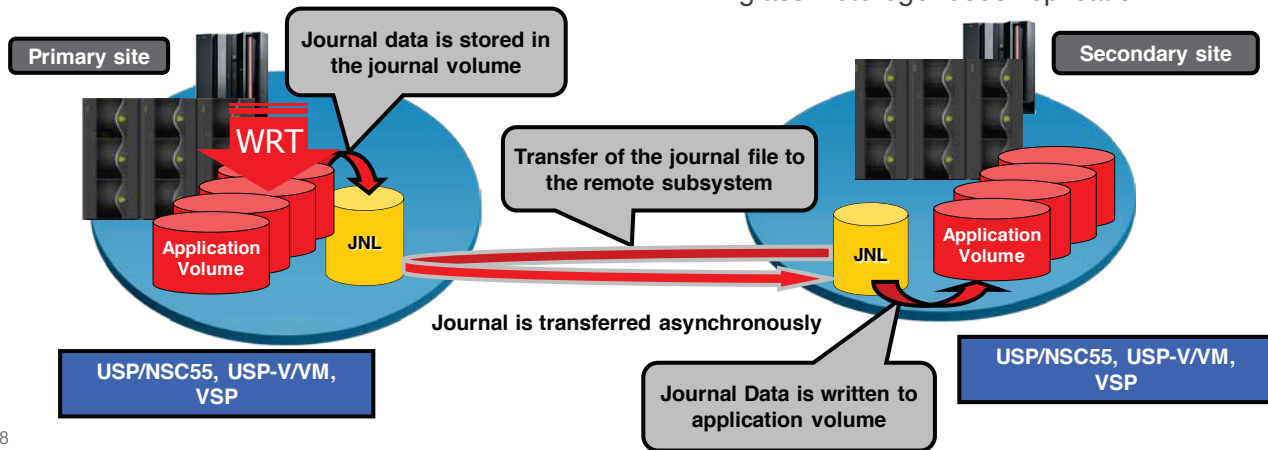
Hitachi Universal Replicator

■ Features

- Asynchronous replication
- Leverages Virtual Storage Platform
- Performance-optimized disk-based journaling
- Resource-optimized processes
- Advanced 3 Data Center capabilities
- Mainframe and Open Systems support

■ Benefits

- Resource optimization
- Mitigation of network problems and significantly reduced network costs
- Enhanced disaster recovery capabilities through 3 Data Center solutions
- Reduced costs due to 'single pane of glass' heterogeneous replication



The following describes the basic technology behind the disk-optimized journals.

- I/O is initiated by the application and sent to the storage system.
- It is captured in cache and sent to the disk journal, at which point it is written to disk.
- The "I/O complete" message is released to the application.
- The remote system pulls the data and writes it to its own journals and then to the replicated application volumes.

Universal Replicator sorts the I/Os at the remote site by sequence and time stamp (mainframe) and guaranteed data integrity.

Note that Universal Replicator offers full support for consistency groups through the journal mechanism (journal groups).

Tools Used for Setting Up Replication

- Graphical User Interface
 - Hitachi Storage Navigator program
 - Storage Centric
 - Hitachi Device Manager
 - Data Center view of resources, limited or no monitoring options, primary focus is provisioning
 - Hitachi Replication Manager
 - Geographically spread Data Center and Site views, enhanced monitoring and alerting features, primary focus is replication
- Command Line Interface
 - Used to script replication process
 - RAID Manager/CCI
 - HORCM configuration files
 - Command device

9

Requirements for All Replication Products

- Any volumes involved in replication operations (source and destination) should be:
 - Same size (in blocks).
 - Must be mapped to a FED (CHA) port.
 - Source can be online and in use.
 - Destination must not be in use/mounted.
 - Same emulation type (Open-3 with Open-3, Open-V with Open-V).
 - Intermix of RAID levels and drive type is supported.
 - Capacity based licensing:
 - You must purchase the license and make sure that there is enough licensed capacity according to the capacity of pairs you are going to create.
 - Source, destination, and reserved volumes require licenses for volume capacity and management.

10

If source is a LUSE volume, then destination must be an identical LUSE volume with same size and structure.

- This will reduce the number of copy pairs possible.

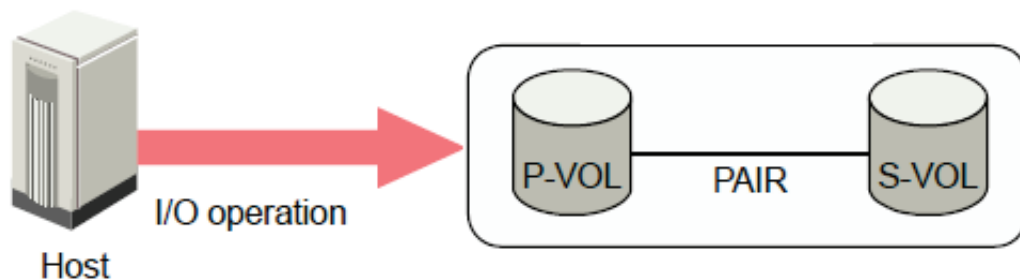
Basic Operations

Replication Operations

- Basic operations when working with replication products:
 - **Paircreate, Pairsplit, Pairresync**
- Commands are consistent across products (in-system or remote replication), but implementation varies depending on the product.
 - In-system: All operations with LDEVs pairings within the same frame
 - Remote: All operations with LDEVs pairings across frames
 - Use manual to identify product specific operations with above commands.

12

- A volume that has source data is called a **Primary Volume (P-VOL)**, and a volume to which the data is copied is called a **Secondary Volume (S-VOL)**.
- The pairing of P-VOL and S-VOL is called a **copy pair**.



13

A copy pair is a pair of volumes linked by the storage system's volume replication functionality (such as ShadowImage and TrueCopy). Copy pairs are also called paired volumes.

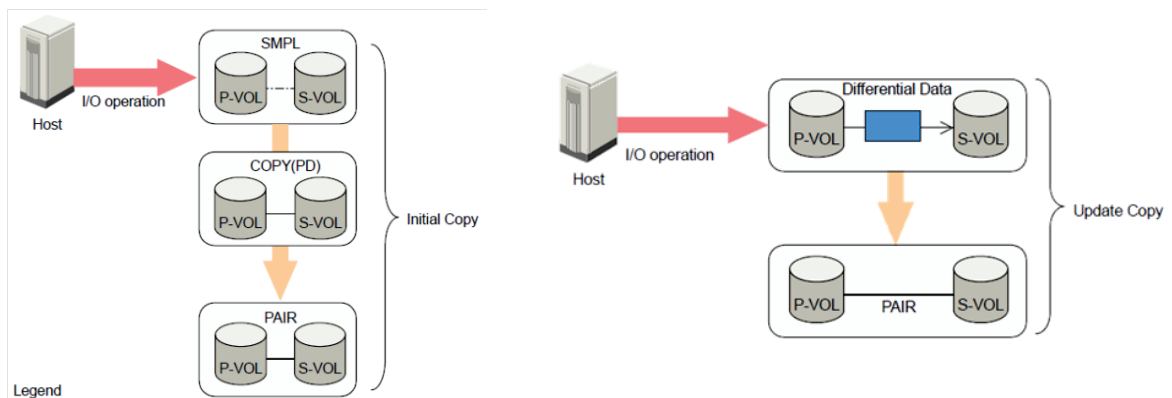
The following types of volumes make up a copy pair:

- Primary volume (P-VOL): The copy source volume.
- Secondary volume (S-VOL): The destination volume to which the contents of the primary volume are copied.

Copy Operations

■ Data Copy Operations

- Initial copy
 - Results in all data being copied from P-VOL to S-VOL
 - Copies everything including empty blocks
- Update copy
 - Only differentials are copied.



14

Replication Operations

■ **paircreate**

1. Select a volume and issue **paircreate**.
2. Initial copy (full copy) takes place. Track by track copy of P-VOL to S-VOL happens regardless of the amount of data in P-VOL.
3. Volume status changes from SMPL to PAIR.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	SMPL	R/W	SMPL	R/W OR R
During	COPY(PD)	R/W	COPY(PD)	R
After	PAIR	R/W	PAIR	R

15

The **paircreate** command generates a new volume pair from two unpaired volumes. The **paircreate** command can create either a paired logical volume or a group of paired volumes.

When issuing **paircreate**, you can select the pace for the initial copy operation. The pace can be specified in terms of number of tracks to copy at a time (1-15). Less number of tracks minimizes the impact of software operations on system I/O performance, while higher number of tracks completes the initial copy operation as quickly as possible. The best timing is based on the amount of write activity on the P-VOL and the amount of time elapsed between update copies.

Simplex (SMPL) status of a volume indicates that the volume is not used in any replication operation.

▪ **pairsplit**

- Update copy takes place to flush all pending changes.
- Volume status changes to PSUS.
- S-VOL is the PiT copy and now available to applications for read/write.
- Differential bitmaps track changes to P-VOL and S-VOL while pair is split.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PAIR	R/W	PAIR	R
During	COPY(SP)	R/W	COPY(SP)	R
After	PSUS	R/W	SSUS	R/W

16

The **pairsplit** command stops updates to the secondary volume of a pair and can either maintain (status = PSUS) or delete (status = SMPL) the pairing status of the volumes. It can be applied to a paired logical volume or a group of paired volumes. The **pairsplit** command allows read access or read/write access to the secondary volume, depending on the selected options.

■ **pairresync**

- S-VOL is no longer available to host.
- S-VOL and P-VOL differential bitmaps are merged.
- Changed tracks are marked and written from P-VOL to S-VOL.
- Volume status changes to pair.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PSUS	R/W	SSUS	R/W
During	COPY(RS)	R/W	COPY(RS)	R
After	PAIR	R/W	PAIR	R

17

Replication software allows you to perform **pairresync** operations on split and suspended pairs.

Pairresync for split pair. When a **pairresync** operation is performed on a split pair (status = PSUS), the system merges the S-VOL track map into the P-VOL track map and then copies all flagged tracks from the P-VOL to the S-VOL. This also greatly reduces the time needed to resynchronize the pair.

Pairresync for suspended pair. When a **pairresync** operation is performed on a suspended pair (status = PSUE), the storage system copies all data on the P-VOL to the S-VOL, since all P-VOL tracks were flagged as difference data when the pair was suspended. The pairresync operation for suspended pairs is equivalent to and takes as long as the ShadowImage initial copy operation.

▪ pairsplit -S (delete)

- Delete the pair and stop replication operations for the pair
- Immediate access to S-VOL
 - No update copy (pending changes are lost, ignored)
- Changes volume status back to simplex

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PAIR	R/W	PAIR	R
After	SMPL	R/W	SMPL	R/W

18

The **pairsplit -S** operation (delete pair) stops the copy operations to the S-VOL of the pair and changes the pair status of both volumes to SMPL.

When a pair is deleted, the pending update copy operations for the pair are discarded, and the status of the P-VOL and S-VOL is changed to SMPL.

Instructor Demonstration — Hi-Track

A man in a dark suit, light blue shirt, and blue tie is looking down at a laptop screen. The background is a bright, out-of-focus office interior.

19

Instructor Demonstration

- Hi-Track
 - Installation
 - Configuration

The logo consists of a stylized letter 'D' inside a square frame. The frame has a blue border on the left and right sides, and a red border on the top and bottom sides. The 'D' is white with a blue outline.

Module Summary

- In this module, you learned how to:
 - Identify the various replication program products available
 - List the benefits and features of in-system and remote replication products
 - List the basic replication operations for managing replication pairs

20

Module Review

1. List the In-System and Remote replication products.
2. What is the difference between Initial Copy and Update Copy?
3. List the basic operations for replication.

4. Hitachi

ShadowImage

Operations with

Replication Manager

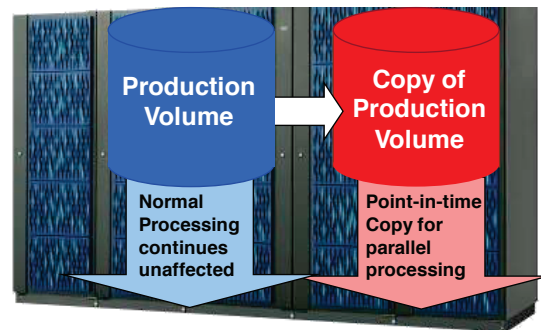
Module Objectives

- Upon completion of this module, you should be able to:
 - Describe licensing considerations for Hitachi ShadowImage® Replication
 - Describe the key features
 - Perform ShadowImage operations through Replication Manager

ShadowImage In-System Replication Features

■ ShadowImage Replication

- Full physical copy of a volume at a point in time
- Immediately available for concurrent use by other applications
- No host processing cycles required
- No dependence on operating system, file system, or database
- All copies are additionally RAID protected
- Up to 9 copies for a source volume (Enterprise Storage)



3

Hitachi ShadowImage® In-System Replication bundle is a nondisruptive, host-independent data replication solution for creating copies of any customer-accessible data within a single Hitachi storage system. ShadowImage also increases the availability of revenue-producing applications by enabling backups to run concurrently with production.

ShadowImage copies:

- Are RAID protected to ensure the highest data availability.
- Can provide immediate access and sharing of information for decision support, testing and development.
- Offer nearly instant recovery from data corruption (disk-based copies).

Licensing Considerations

- A license key is required.
 - A separate license key is required for each storage system.
 - Licenses are purchased in capacity increments.
- License capacity is required for ShadowImage primary volumes, secondary volumes and reserved volumes.
- Additional license capacity is required for P-VOLs and pool volumes that are used by Hitachi Copy-on-Write Snapshot.

4

P-VOL — primary volume

S-VOL — secondary volume

If Hitachi Dynamic Provisioning volumes are used as P-VOLs or S-VOLs on enterprise storage:

- The capacity of the pool used by the Dynamic Provisioning volume will affect the license capacity.
- Include the Dynamic Provisioning pool capacity when determining the ShadowImage license capacity.
- If the amount of data exceeds the license capacity, you can use the volumes for additional 30 days. Once 30 days have passed, you cannot do any operations except suspending or deleting pairs.

Key ShadowImage Features

- Replicates information within Hitachi enterprise storage systems without disrupting operations
- Once copied, data can be used for:
 - Data warehousing and data mining applications
 - Backup and recovery
 - Application development
- Supports the creation of up to 9 system-protected copies from each source volume
- High performance achieved through asynchronous copy facility to secondary volumes
- Up to 128 concurrent copies

5

Enterprise platforms that support ShadowImage Heterogeneous Replication:

- Hitachi Virtual Storage Platform
- Hitachi Universal Storage Platform V
- Hitachi Universal Storage Platform VM
- Hitachi Universal Storage Platform
- Hitachi Network Storage Controller
- Hitachi Lightning 9900™ V Series enterprise storage system
- Hitachi Lightning 9900™ Series enterprise storage system

Key Features

■ Restrictions

- The following volumes cannot be used for creating pairs:
 - Hitachi Universal Replicator journal volumes
 - Virtual volumes (except Dynamic Provisioning volumes)
 - Copy-on-Write pool volumes
 - Network attached storage (NAS) system volumes cannot be S-VOLs
 - Any data retention volume set as “S-VOL DISABLE”

6

Data Retention Utility allows you to assign the S-VOL Disable attribute. This could be used for production volumes to protect them from accidental overwriting due to a copy operation.

Operations and Commands

- **paircreate**: Establishes a pair
- **pairsplit**: Splits so that S-VOL can be accessed by an application.
- **pairresync**: Re-establishes the pair
 - Normal, Quick, Restore, Quick Restore
- **Suspend (pairsplit -E)**: Forces a split. No updates are sent
- **Delete (pairsplit -S)**: Deletes a pair. No updates are sent

7

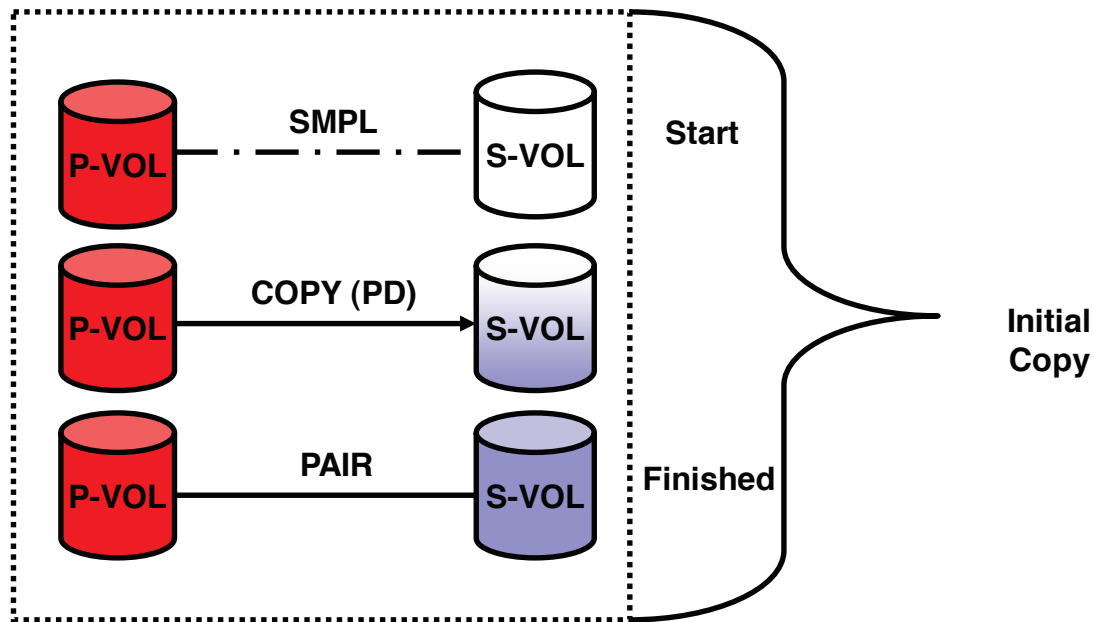
When issuing **paircreate**, you can select the pace for the initial copy operation:

- Slower
- Medium
- Faster

The slower pace minimizes the impact of operations on system I/O performance, while the faster pace completes the initial copy operation as quickly as possible. The best timing is based on the amount of write activity on the P-VOL and the amount of time elapsed between update copies.

Paircreate

■ Initial Copy Operation



8

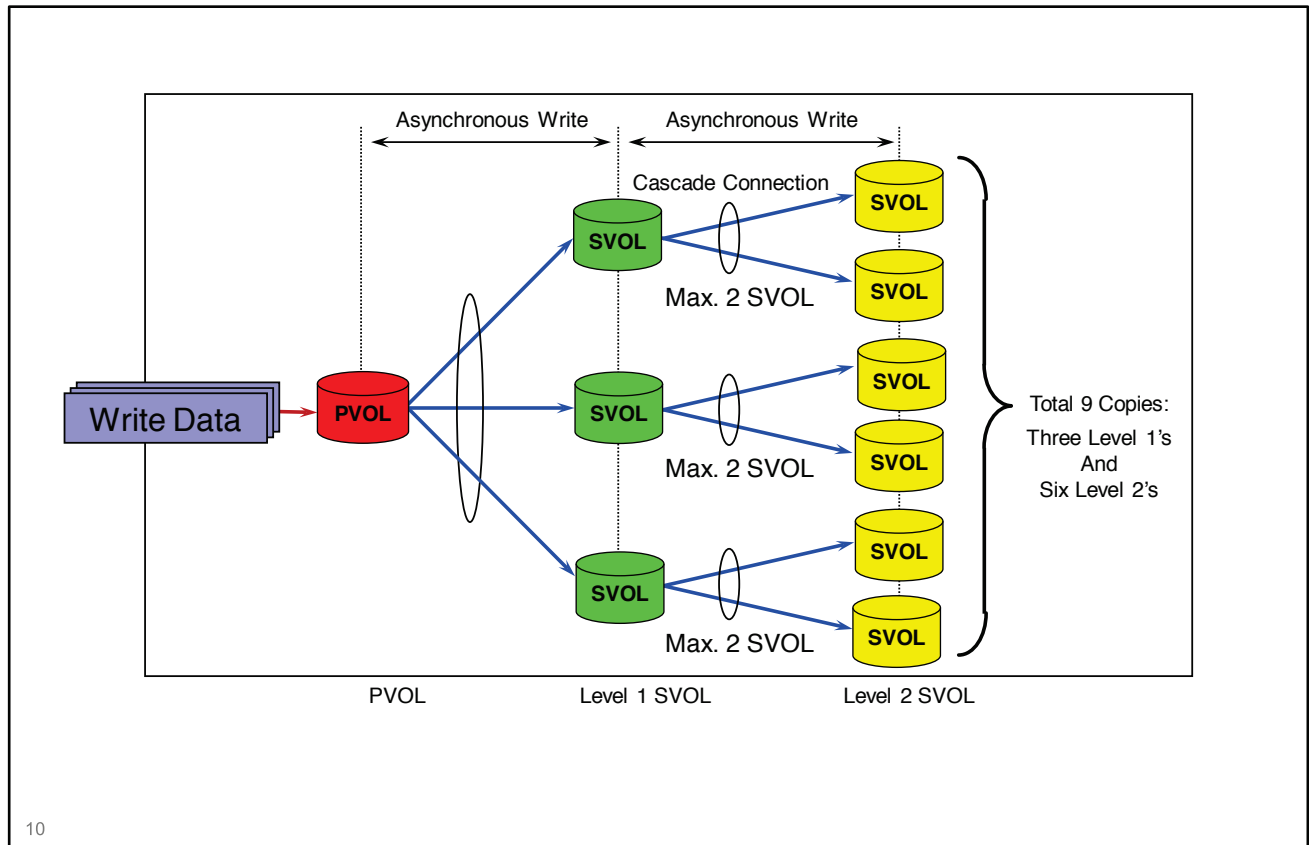
Initial Copy operation takes place when you create a new volume pair. The initial copy operation copies all data on the P-VOL to the associated S-VOL. The P-VOL remains available to all hosts for read and write I/Os throughout the initial copy operation. Write operations performed on the P-VOL during the initial copy operation will be duplicated at the S-VOL by update copy operations after the initial copy is complete. The status of the pair is COPY(PD) (PD = pending) while the initial copy operation is in progress. The status changes to PAIR when the initial copy is complete.

- **Initial Copy Rules**

- Two logical devices (LDEVs) that compose a paired volume must be the same emulation type (and size, if LUSE volumes are used).
- Supports LUSE volumes (VOLs), VLL* and Flash Access VOLs.
- In case of LUN Expansion and VLL, two LDEVs must be the same capacity and same emulation type.
- Neither RAID levels nor HDD types have to match.

9

- VLL stands for Virtual Logical LUN, the method used to create custom volume sizes.
- LUSE – Logical Unit that consists of multiple LDEVs.



ShadowImage Heterogeneous Replication enables you to maintain system-internal copies of all user data for purposes such as data backup or duplication. The RAID protected duplicate volumes are created within the same system as the primary volume at hardware speeds. ShadowImage Heterogeneous Replication is used for UNIX-based and PC server data. It can provide up to nine duplicates of one primary volume for UNIX-based and PC server data only.

ShadowImage Heterogeneous Replication software for IBM z/OS protects mainframe data in the same manner. For mainframes, ShadowImage Heterogeneous Replication can provide up to three duplicates of one primary volume.

In Storage Navigator the **Paircreate** command creates the first Level 1 "S" volume. The **set** command can be used to create a second and third Level 1 "S" volume. And the **cascade** command can be used to create the Level 2 "S" volumes off the Level 1 "S" volumes.

- **Differential Bitmap Function**

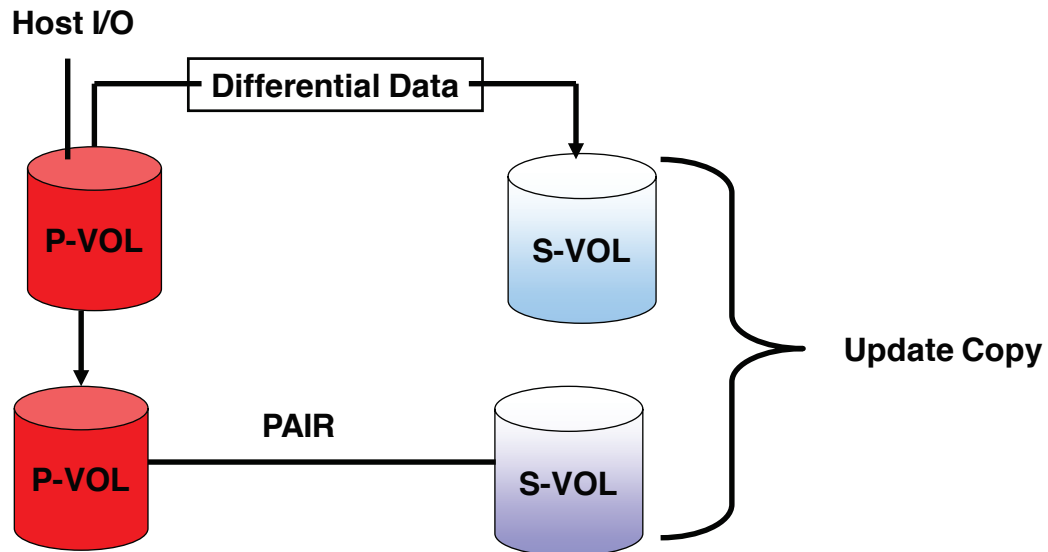
- *Differential bitmaps* are maintained in shared/control memory for each ShadowImage data volume.
- Differential bitmaps designate changes to primary data volumes during *Initial Copy* and to both primary and secondary volumes while *pairs* are *split*.
- When data volumes are *resynchronized*, differential bitmaps for the two volumes are *merged* and *all changed tracks* are sent from primary to secondary volumes (Normal Resync).
- **Differential Bitmap** is also known as **Changed Track Mapping**.

11

The differential data (updated by write I/Os during split or suspension) between the primary data volume and the secondary data volume is stored in each track bitmap. When a split or suspended pair is resumed (pairresync), the primary storage system merges the primary data volume and secondary data volume bitmaps, and the differential data is copied to the secondary data volume.

Update

■ Update Copy Operations

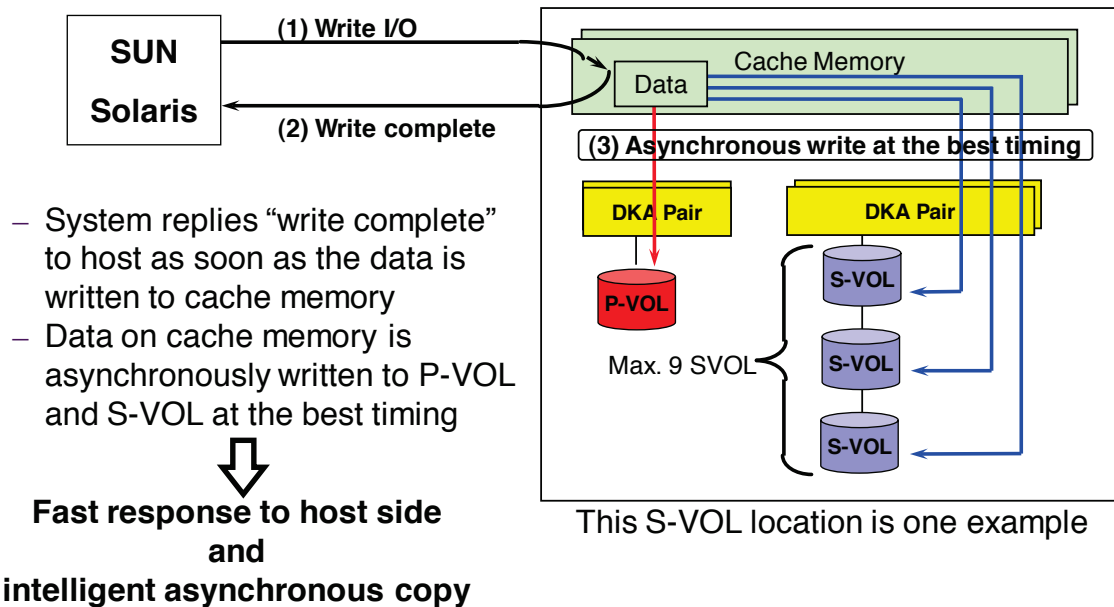


12

The Update Copy operation sends changed data to the S-VOL of a pair after the Initial Copy operation is complete. Update Copy operations take place only for duplex pairs (status = PAIR).

As write I/Os are performed on a duplex P-VOL, the system stores a map of the P-VOL differential data, and then performs update copy operations periodically based on the amount of differential data present on the P-VOL as well as the elapsed time between update copy operations.

■ High Performance by Asynchronous Access to Secondary Volumes



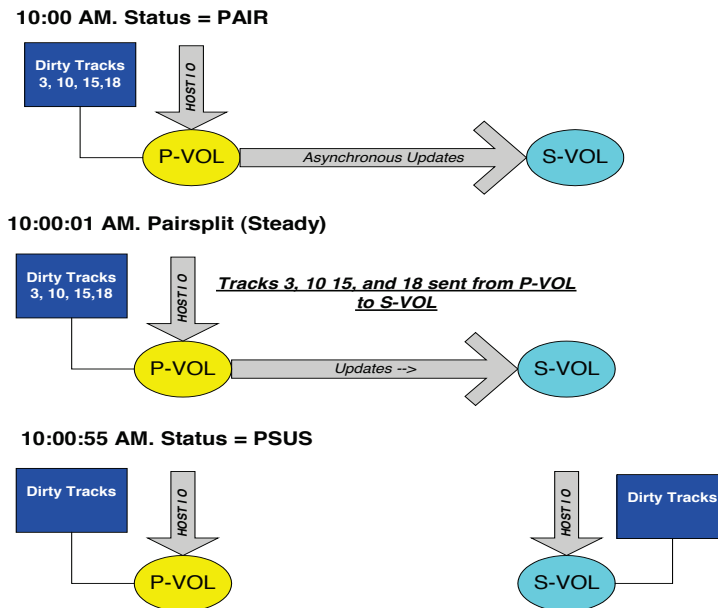
13

The Update Copy operations are not performed for pairs with the following status:

- COPY(PD) (pending duplex)
- COPY(SP) (steady split pending)
- PSUS(SP) (quick split pending)
- PSUS (split)
- COPY(RS) (resync)
- COPY(RS-R) (resync-reverse)
- PSUE (suspended)

Pairsplit

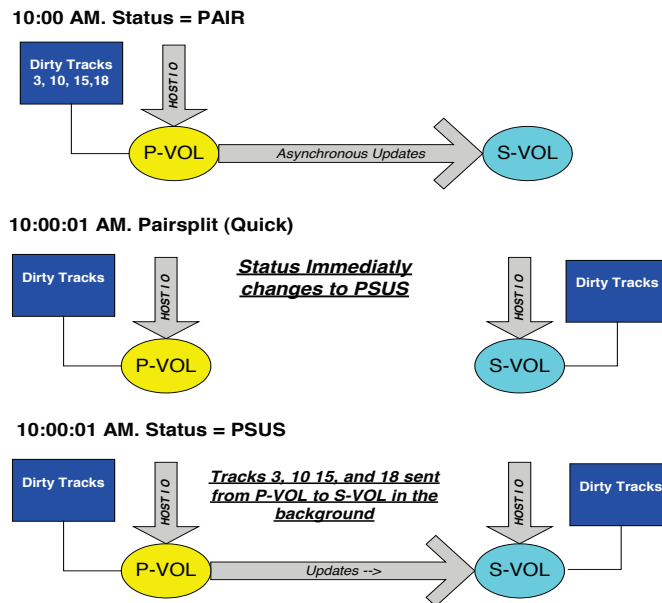
■ Steady Split Illustration



14

- The P-VOL and S-VOL are in PAIR status as of 10:00 AM. P-VOL Tracks 3, 10, 15 and 18 are marked as dirty because of Host I/O.
- At 10:00:01 AM, a **pairsplit** (Steady) command is issued. Tracks 3, 10, 15 and 18 are sent across to the S-VOL from the P-VOL.
- When the update operation in step 2 is complete, the status of the P-VOL and S-VOL is changed to PSUS. During this state, there are track bitmaps attached to both the P-VOL and the S-VOL. These bitmaps keep track of changes on both the P-VOL and the S-VOL.

■ Quick Split Illustration



15

- The P-VOL and S-VOL are in PAIR status as of 10:00 AM. P-VOL Tracks 3, 10, 15 and 18 are marked as dirty because of Host I/O.
- The status of the P-VOL and the S-VOL is changed instantly to PSUS and the S-VOL is immediately available for reads and writes.
- Tracks 3, 10, 15 and 18 are sent across to the S-VOL from the P-VOL in the background.
 - ♦ If during this Update Copy operation there is any I/O to tracks 3, 10, 15, or 18 on the S-VOL, then the system fetches the data from the P-VOL.
 - ♦ During the PSUS state, there are track bitmaps attached to both the P-VOL and the S-VOL. These bitmaps keep track of changes on both the P-VOL and the S-VOL.

- Differential Bitmap Function

- While pairs are split, both P-VOL and S-VOL differential bitmaps may be active.

- Changed Tracks on P-VOL

PVOL | X | X | | | X | X | | | | |

- S-VOL mounted with Write Enabled.

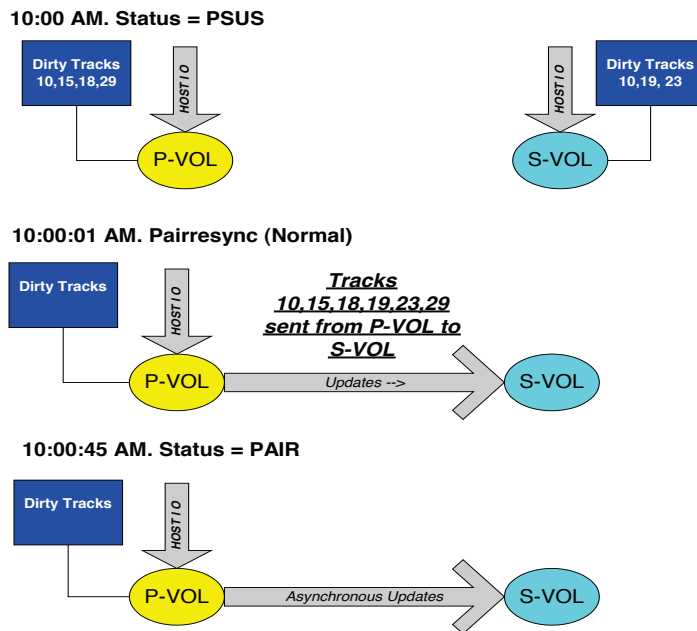
SVOL | X | X | | | | | | | | X | |

16

This diagram illustrates the usage of differential bitmaps after a pair is suspended. While suspended, updates can occur to P-VOL. Changes can also occur on S-VOL if it is mounted with Write Enabled. The bitmaps denote any changed tracks while the pair is suspended.

Pairresync

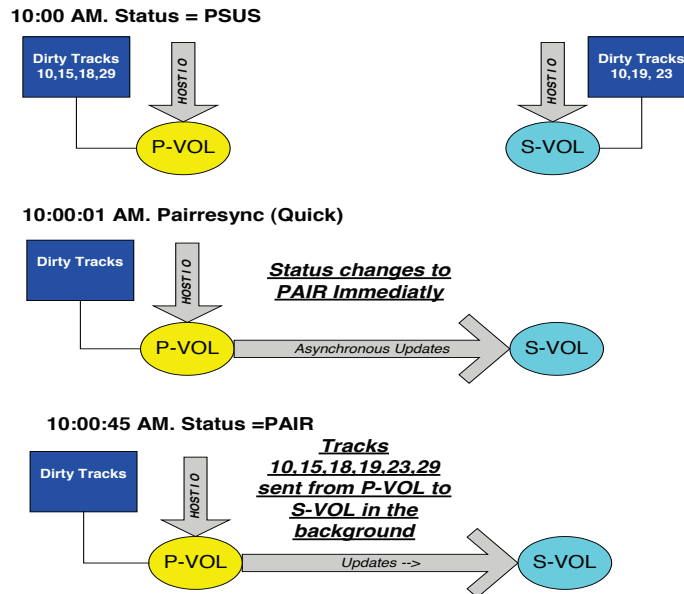
■ Normal **resync** illustration



17

- The status of the P-VOL and the S-VOL is PSUS as of 10:00 AM. P-VOL Tracks 10, 15, 18 and 19 are marked as dirty.
- Tracks 10, 19 and 23 are marked as dirty on the track bitmap for the S-VOL.
- At 10:00 AM, a **pairresync** (Normal) command is issued. The track bitmaps for the P-VOL and S-VOL are merged. The resulting track bitmap has tracks 10, 15, 18, 19, 23 and 29 marked as dirty. These tracks are sent from the P-VOL to the S-VOL as part of an Update Copy operation.
- When the Update Copy operation in step 2 is complete, the P-VOL and S-VOL are declared as a PAIR.

■ Quick **resync** illustration

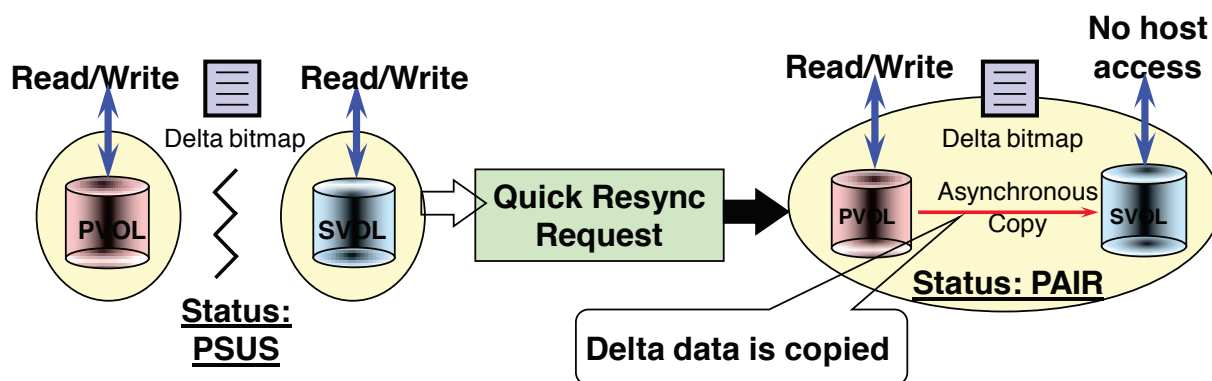


18

- The status of the P-VOL and the S-VOL is PSUS as of 10:00 AM. Tracks 10, 15, 18 and 19 are marked as dirty on the track bitmap for the P-VOL. Tracks 10, 19 and 23 are marked as dirty on the track bitmap for the S-VOL.
- At 10:00 AM, a **pairresync** (Normal) command is issued. The status of the P-VOL and the S-VOL changes instantly to PAIR.
- The track bitmaps for the P-VOL and S-VOL are merged. The resulting track bitmap has tracks 10, 15, 18, 19, 23 and 29 marked as dirty. These tracks are sent from the P-VOL to the S-VOL as part of an update copy operation in the background.

■ Quick resync

- Command completed in less than one sec/pair
- Copies only delta bitmap
- Delta data will be copied during PAIR status
- Command by RAID Manager



19

■ Differential bitmap function

- Changes that have occurred while pair is split

P-VOL | X | X | | | X | X | | | |

S-VOL | X | | X | | | | | | X | | | | . . .

- Merge



- P-VOL differential bitmap after 'OR' operation

P-VOL | X | X | X | | | X | X | X | | |

20

This diagram illustrates the use of differential bitmaps, after a pair is resynchronized.

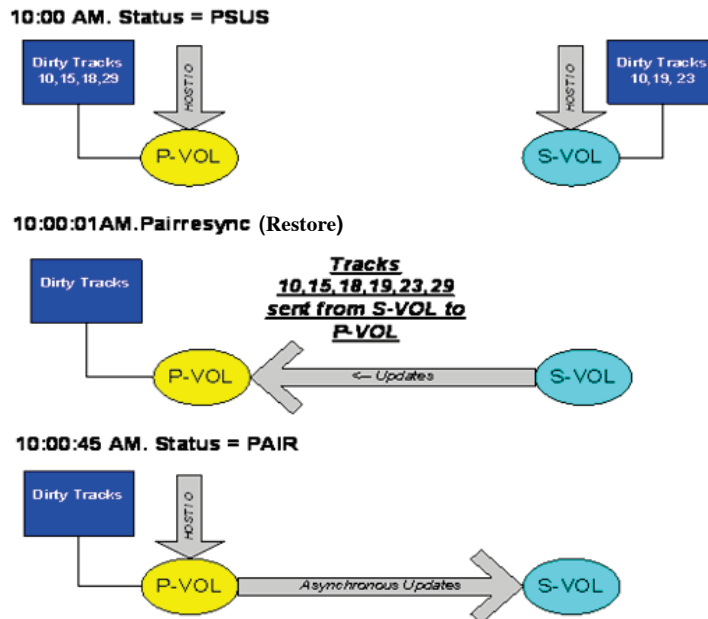
While suspended, updates may occur to both primary and secondary volumes. The bitmaps denote any changed tracks while the pair is suspended.

When the **resync** command is issued, the S-VOL differential bitmaps are merged into the P-VOL differential bitmaps. Then all of the changed tracks are copied from the P-VOL to the S-VOL. This process results in overwrites for any changed S-VOL data.

For a resync restore operation, P-VOL bitmaps are merged into the S-VOL bitmaps and all changed tracks are written from the S-VOL to the P-VOL, thus overwriting production data.

Universal Replicator, TrueCopy Synchronous/Asynchronous, and ShadowImage Heterogeneous Replication all use differential bitmaps in exactly the same way.

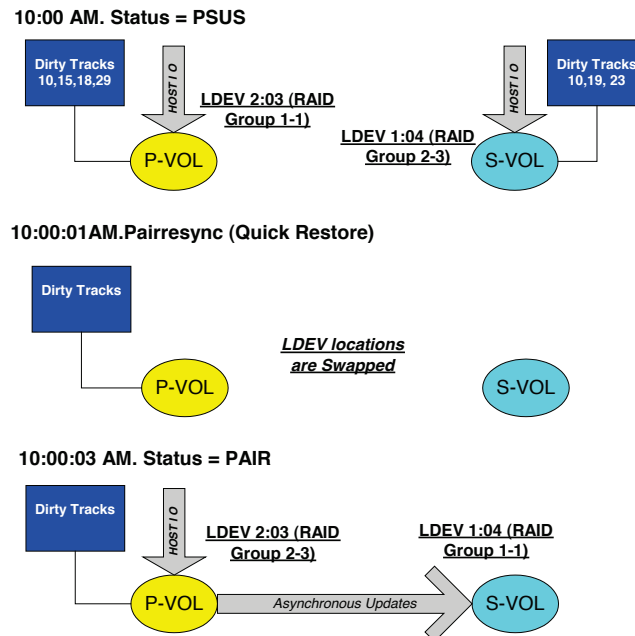
■ Resync restore illustration



21

- The status of the P-VOL and the S-VOL is PSUS as of 10:00 AM. Tracks 10, 15, 18 and 19 are marked as dirty on the track bitmap for the P-VOL. Tracks 10, 19 and 23 are marked as dirty on the track bitmap for the S-VOL.
- At 10:00 AM, a **pairresync** (restore) command is issued. The track bitmaps for the P-VOL and S-VOL are merged. The resulting track bitmap has tracks 10, 15, 18, 19, 23 and 29 marked as dirty. These tracks are sent from the S-VOL to the P-VOL as part of an Update Copy operation.
- When the Update Copy operation in step 2 is complete, the P-VOL and S-VOL are declared as a PAIR.

■ Quick restore illustration



22

- The status of the P-VOL and the S-VOL is PSUS as of 10:00 AM. Tracks 10, 15, 18 and 19 are marked as dirty on the track bitmap for the P-VOL. Tracks 10, 19 and 23 are marked as dirty on the track bitmap for the S-VOL. The P-VOL LDEV ID is 2:03 and the RAID Group that the PVOL belongs to is 1-1. The S-VOL LDEV ID is 1:04 and the RAID Group that the S-VOL belongs to is 2-3.
- At 10:00:01, a **Quick Restore** command is issued. The LDEV locations are swapped so that the P-VOL now belongs to RAID Group 2-3 and the S-VOL now belongs to RAID Group 1-1.
- At 10:00:03, after the SWAP operation is complete the P-VOL and S-VOL are declared as a PAIR.
- If you want to swap back, just do a new pairresync restore (quick) at a later point in time.

- **Quick Restore**
 - Extremely fast recovery of P-VOL from an S-VOL
- **Quick Resync**
 - Rapid resynchronization of an S-VOL from a P-VOL
- **Quick Split**
 - Ability to rapidly suspend mirroring operation and provide availability to an S-VOL

Commands

▪ **paircreate**

1. Select a volume and issue **paircreate**.
2. Initial copy takes place.
3. Volume status changes to PAIR.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	SMPL	R/W	SMPL	R/W OR R
During	COPY(PD)	R/W	COPY(PD)	NA
After	PAIR	R/W	PAIR	NA

24

The **paircreate** command generates a new volume pair from two unpaired volumes. It can create either a paired logical volume or a group of paired volumes.

▪ **pairsplit** – Steady

1. Update copy takes place.
2. Volume status changes to PSUS.
3. S-VOL is now available.
4. Differential bitmaps track changes to P-VOL and S-VOL while pair is split

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PAIR	R/W	PAIR	NA
During	COPY(SP)	R/W	COPY(SP)	NA
After	PSUS	R/W	SSUS	R/W

25

The **pairsplit** command stops updates to the secondary volume of a pair and can either maintain (status = PSUS) or delete (status = SMPL) the pairing status of the volumes. It can be applied to a paired logical volume or a group of paired volumes. The **pairsplit** command allows read access or read/write access to the secondary volume, depending on the selected options. You can create and split ShadowImage pairs simultaneously using the **-split** option of the **paircreate** command.

▪ pairsplit – Quick

1. Volume status changes to PSUS.
2. Update copy takes place in background.
3. S-VOL is available instantly.
4. Differential bitmaps track changes to P-VOL and S-VOL while pair is split.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PAIR	R/W	PAIR	NA
During	COPY(SP)	R/W	SSUS	R/W
After	PSUS	R/W	SSUS	R/W

26

The pairresync Quick operation speeds up the normal **pairresync** operation by copying the P-VOL differential data map, only without copying the P-VOL data to the S-VOL. The P-VOL and the S-VOL are resynchronized when Update Copy operations are performed for duplex pairs (status = PAIR). The pair status during a quick pairresync is COPY(RS) until the differential map is copied, and the P-VOL remains accessible to all hosts for both read and write operations. The S-VOL becomes inaccessible to all hosts during a quick pairresync.

▪ **pairresync** – Normal

1. The data on S-VOL becomes no longer available.
2. S-VOL and P-VOL differential bitmaps are merged.
3. Changed tracks are marked and written from P-VOL to S-VOL.
4. Volume status changes to PAIR.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PSUS	R/W	SSUS	R/W
During	COPY(RS)	R/W	COPY(RS)	NA
After	PAIR	R/W	PAIR	NA

27

ShadowImage Heterogeneous Replication software allows you to perform normal/quick pairresync operations on split and suspended pairs, but reverse/quick and restore pairresync operations can only be performed on split pairs.

pairresync for split pair: When a normal/quick pairresync operation is performed on a split pair (status = PSUS), the system merges the S-VOL track map into the P-VOL track map and then copies all flagged tracks from the P-VOL to the S-VOL. When a reverse or quick restore pairresync operation is performed on a split pair, the system merges the P-VOL track map into the S-VOL track map and then copies all flagged tracks from the S-VOL to the P-VOL. This ensures that the P-VOL and S-VOL are properly resynchronized in the desired direction. This also greatly reduces the time needed to resynchronize the pair.

pairresync for suspended pair: When a normal/quick pairresync operation is performed on a suspended pair (status = PSUE), the subsystem copies all data on the P-VOL to the S-VOL, since all P-VOL tracks were flagged as difference data when the pair was suspended. Reverse and quick restore pairresync operations cannot be performed on suspended pairs. The normal pairresync operation for suspended pairs is equivalent to and takes as long as the ShadowImage Initial Copy operation.

▪ pairresync – Quick

1. S-VOL is no longer available to host.
2. Volume status changes to PAIR.
3. S-VOL and P-VOL differential bitmaps are merged.
4. Changed tracks are marked and written from P-VOL to S-VOL in background.

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PSUS	R/W	SSUS	R/W
During	PAIR	R/W	COPY(RS)	NA
After	PAIR	R/W	PAIR	NA

28

▪ **pairresync** – Restore

1. S-VOL is no longer available to host.
2. S-VOL and P-VOL differential bitmaps are merged.
3. Changed tracks are marked and written from S-VOL to P-VOL.
4. Volume status changes to PAIR.
 - *Can only be done from L1 to P-VOL*

	P-VOL		S-VOL	
Time frame	VOL Status	Host Access	VOL Status	Host Access
Before	PSUS	R/W	SSUS	R/W
During	COPY(RS-R)	NA	COPY(RS-R)	R
After	PAIR	R/W	PAIR	NA

29

The **restore pairresync** operation synchronizes the P-VOL with the S-VOL. The copy direction for a reverse **pairresync** operation is S-VOL to P-VOL.

The pair status during a restore resync operation is COPY(RS-R), and the P-VOL and S-VOL become inaccessible to all hosts for write operations. As soon as the reverse pairresync operation is complete, the P-VOL becomes accessible. The **restore pairresync** operation can only be performed on split pairs, not on suspended pairs. The restore pairresync operation cannot be performed on L2 cascade pairs.

The P-VOL remains read-enabled during the restore pairresync operation only to enable the volume to be recognized by the host. The data on the P-VOL is not guaranteed until the restore pairresync operation is complete and the status changes to PAIR.

▪ **pairresync** – Quick Restore

1. Swap of LDEV ID takes place.
 - Can only be done from L1 to P-VOL.
 - Swap and freeze option available.

Time frame	PVOL		SVOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PSUS	R/W	SSUS	R/W
During	COPY(RS-R)	NA	COPY(RS-R)	R
After	PAIR	R/W	PAIR	NA

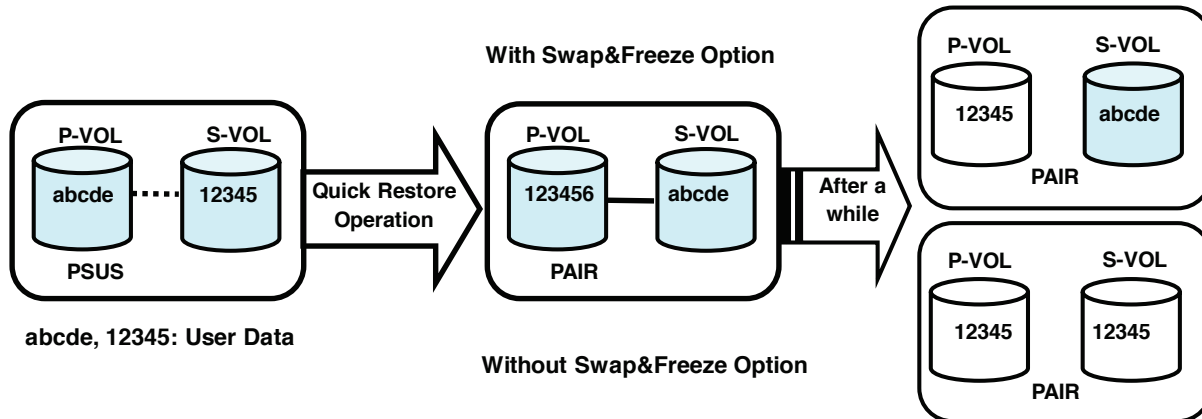
30

The Quick Restore operation speeds up the reverse resync operation by changing the volume map in the Hitachi Lightning 9900™ Series enterprise storage system/9900-1 Lightning 9900 V Series/Universal Storage Platform to swap the contents of the P-VOL and S-VOL without copying the S-VOL data to the P-VOL. P-VOL and S-VOL are resynchronized when update copy operations are performed for pairs in the PAIR status. The pair status during a Quick Restore operation is COPY(RS-R) until the volume map change is complete. P-VOL and S-VOL become inaccessible to all hosts for write operations during a quick restore operation. Quick restore cannot be performed on L2 cascade pairs.

The P-VOL remains read-enabled during the Quick Restore operation only to enable the volume to be recognized by the host. The data on the P-VOL is not guaranteed until the Quick Restore operation is complete and the status changes to PAIR.

■ Quick Restore with or without Swap and Freeze option

The P-VOL **remains unchanged** after the quick restore operation, because the Swap&Freeze option suppresses Update Copy operations.



The P-VOL and S-VOL are resynchronized when ordinary Update Copy operations are performed after the Quick Restore operation.

31

The **Swap&Freeze** option allows the S-VOLs of a ShadowImage pair to remain unchanged after the Quick Restore operation. If the Quick Restore operation is performed on a ShadowImage pair with the Swap&Freeze option, Update Copy operations are suppressed, and are thus not performed for pairs in the PAIR status after the Quick Restore operation. If the Quick Restore operation is performed without the Swap&Freeze option, the P-VOL and S-VOL are resynchronized when Update Copy operations are performed for pairs in the PAIR status.

Note: Make sure that the Swap&Freeze option remains in effect until the pair status changes to PAIR after the quick restore operation. The Quick Restore is done from CCI but the Swap&Freeze option is set from Storage Navigator.

▪ pairsplit – E (Suspend)

- Immediate access to S-VOL
 - No update copy
- Forces an initial copy on resync
 - Marks the entire P-VOL as dirty

Time frame	P-VOL		S-VOL	
	VOL Status	Host Access	VOL Status	Host Access
Before	PAIR	R/W	PAIR	NA
After	PSUE	R/W	SSUE	R/W

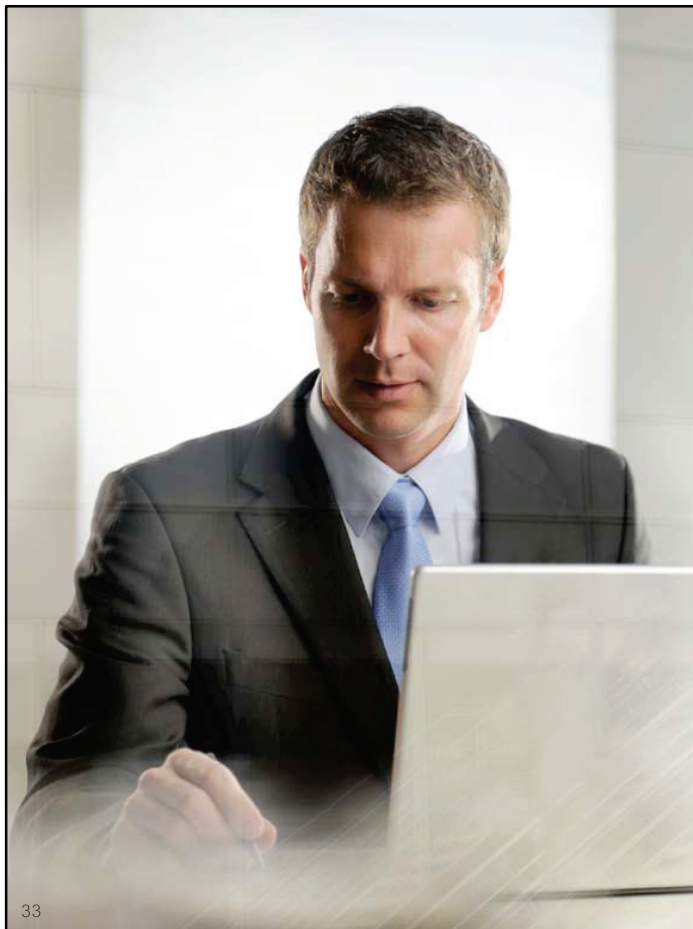
32

The ShadowImage Pairsplit-E operation suspends the ShadowImage copy operations to the S-VOL of the pair. A user can suspend a ShadowImage pair at any time. When a ShadowImage pair is suspended (status = PSUE), the system stops performing ShadowImage. Copy operations to the S-VOL, continue accepting write I/O operations to the P-VOL, and mark the entire P-VOL track map as difference data. When a pairresync operation is performed on a suspended pair, the entire P-VOL is copied to the S-VOL. The reverse and quick restore pairresync operations cannot be performed on suspended pairs.

The subsystem will automatically suspend a ShadowImage pair when it cannot keep the pair mirrored for any reason. When the subsystem suspends a pair, sense information is generated to notify the host. The subsystem will automatically suspend a pair under the following conditions:

- When the ShadowImage volume pair has been suspended or deleted from the UNIX/PC server host using CCI.
- When the storage system detects an error condition related to an update copy operation
- When the P-VOL and/or S-VOL track map in shared memory is lost (for example, due to offline microprogram exchange). This applies to COPY(SP) and PSUS(SP) pairs only. For PAIR, PSUS, COPY(RS), or COPY(RS-R) pairs, the pair is not suspended, but the entire P-VOL (S-VOL for reverse or quick restore pairresync) is marked as difference data.

Instructor Demonstration — ShadowImage



Instructor Demonstration

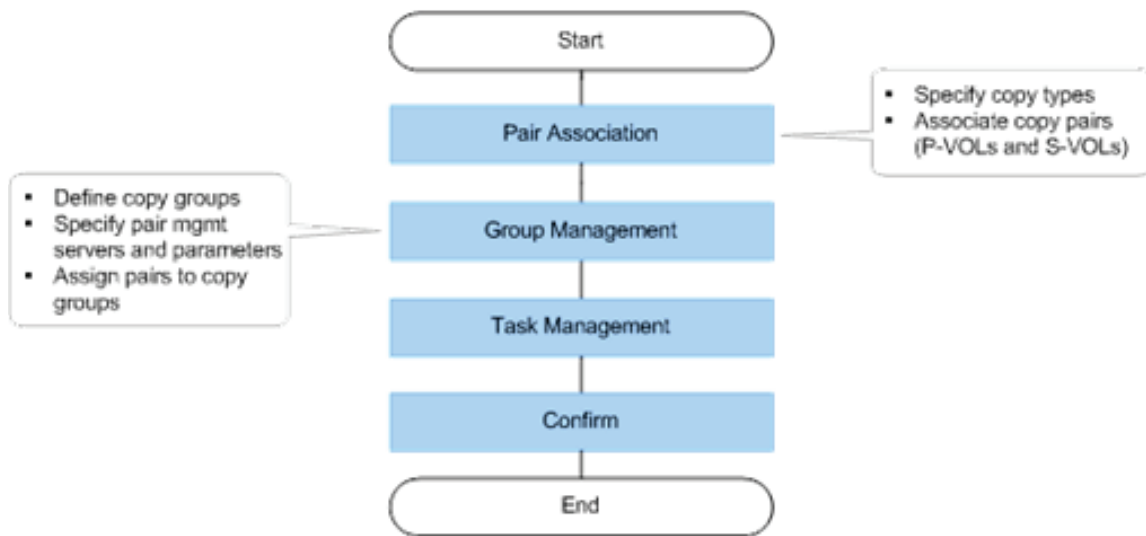
- ShadowImage
 - Create Pair
 - Split Pair
 - Resync Pair
 - Delete Pair



33

Launching ShadowImage Operations

- Perform the following tasks before starting ShadowImage operations
 - Identify the volumes to be used in copy pairs.
 - Ensure that the secondary volumes are not in use.
 - Plan for the naming of pairs and groups



34

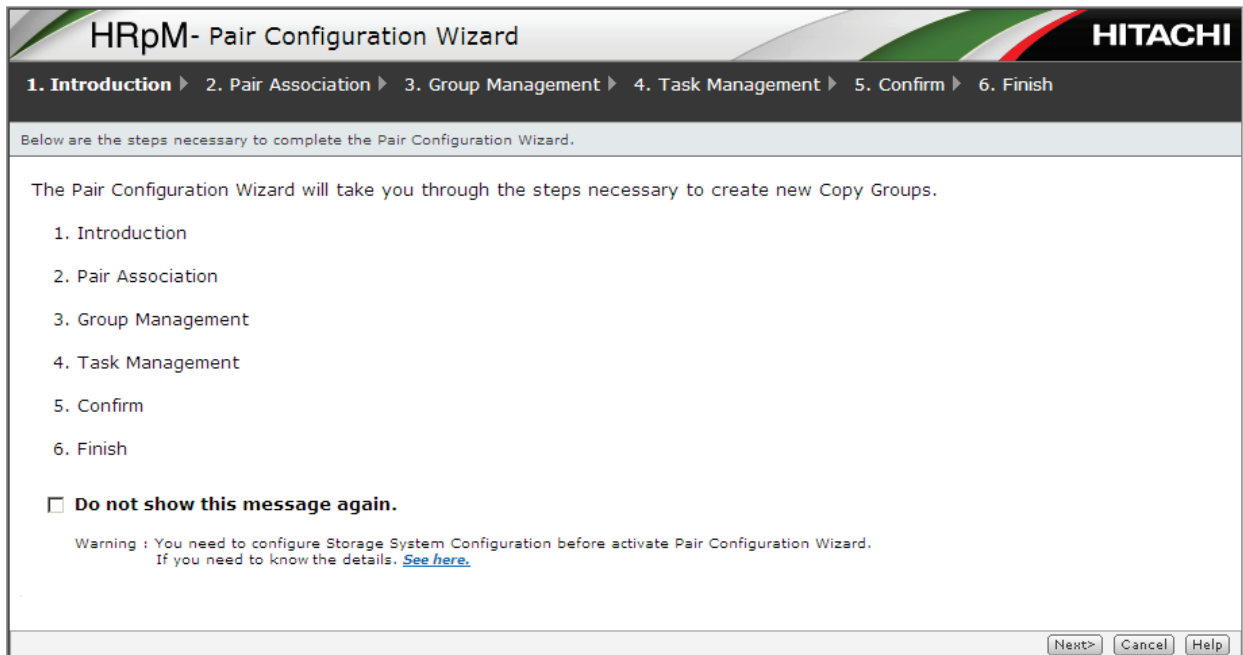
■ Launching Pair Management Operations

The screenshot displays the 'Open Storage System Summary' window. The left sidebar shows a tree view with 'Hosts' and 'Storage Systems'. The main area shows the 'Open Storage System Summary' for 'USP_V@10.74.64.24 (10152)'. The summary includes 'RAW Capacity' (2.25 TB) and 'Allocated Capacity' (28.00 GB). Below this is a table of LUNs with columns: Port/Host Group/LUN, LDEV, Label, Capacity, SLPR, CLPR, and Volume Attribute. The table lists various LUNs, including CL1-A/WLAB0K/01 through CL2-B/WLAB0P/02. The 'Pair Management' button is highlighted in red at the bottom of the table.

Port/Host Group/LUN	LDEV	Label	Capacity	SLPR	CLPR	Volume Attribute
CL1-A/WLAB0K/01	1:00		4.00 GB	0	0	CVS
CL1-A/WLAB0K/02	0:00		2.00 GB	0	0	CVS
CL1-A/WLAB0K/03	0:20	CMD_DEV	2.00 GB	0	0	CVS
CL1-B/WLAB0P/01	4:01		4.00 GB	0	0	CVS
CL1-B/WLAB0P/02	3:01		2.00 GB	0	0	CVS
CL1-B/WLAB0P/03	4:02		4.00 GB	0	0	CVS
CL1-B/WLAB0P/04	3:02		2.00 GB	0	0	CVS
CL1-B/WLAB0P/05	4:03		4.00 GB	0	0	CVS
CL1-B/WLAB0P/06	3:03		2.00 GB	0	0	CVS
CL1-B/WLAB0P/07	0:21	CMD_DEV	2.00 GB	0	0	CVS
CL2-A/WLAB0K/01	1:00		4.00 GB	0	0	CVS
CL2-A/WLAB0K/02	0:00		2.00 GB	0	0	CVS
CL2-A/WLAB0K/03	0:20	CMD_DEV	2.00 GB	0	0	CVS
CL2-B/WLAB0P/01	4:01		4.00 GB	0	0	CVS
CL2-B/WLAB0P/02	3:01		2.00 GB	0	0	CVS

Pair Management operations can be launched from either the **Host** view or the **Storage System** view.

■ Pair Configuration Wizard — Management

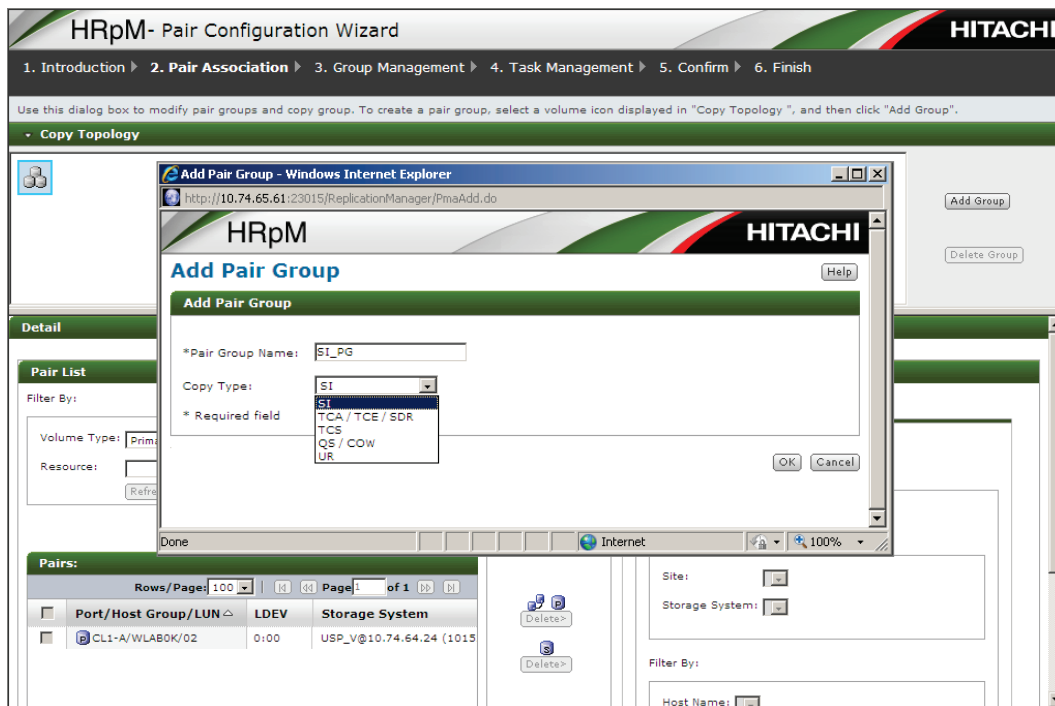


36

To define copy pair configurations, you should first register a new pair group and define a list of volume pairs to assign to the pair groups. Pair groups can be created on the 2. Pair Association page of the Pair Configuration Wizard.

Specifying Copy Type

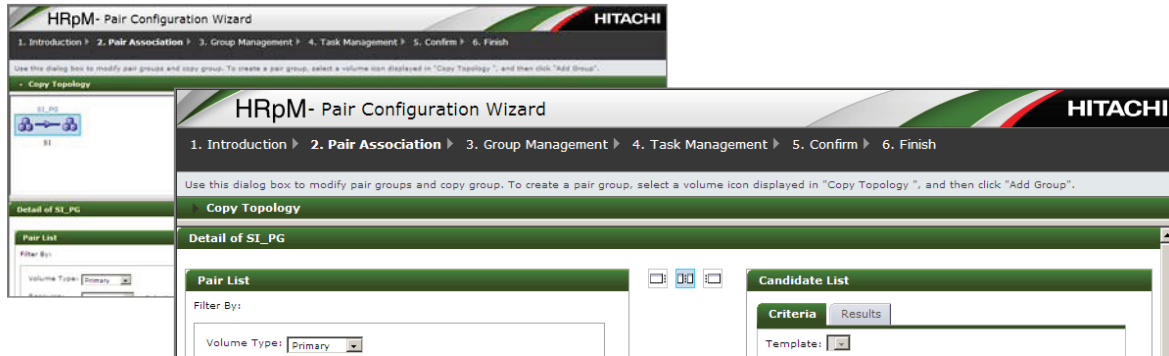
■ Add Pair Group — Specify Copy Topology



37

Specify Pair Volumes (Source and Destination)

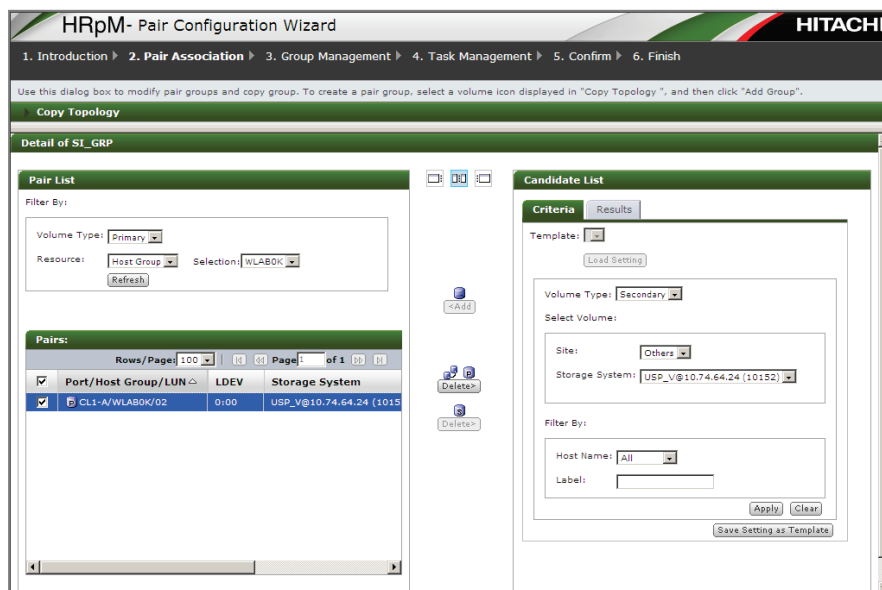
■ Detail Window



Icon	Description
	From the Pair Configuration Wizard 2. Pair Association, you can use this icon to increase the display range of Pair List.
	From the Pair Configuration Wizard 2. Pair Association, you can use this icon to increase the display range of all areas in Detail of pair-group-name and the displayed buttons.
	From the Pair Configuration Wizard 2. Pair Association, you can use this icon to increase the display range of Volume Selection.

38

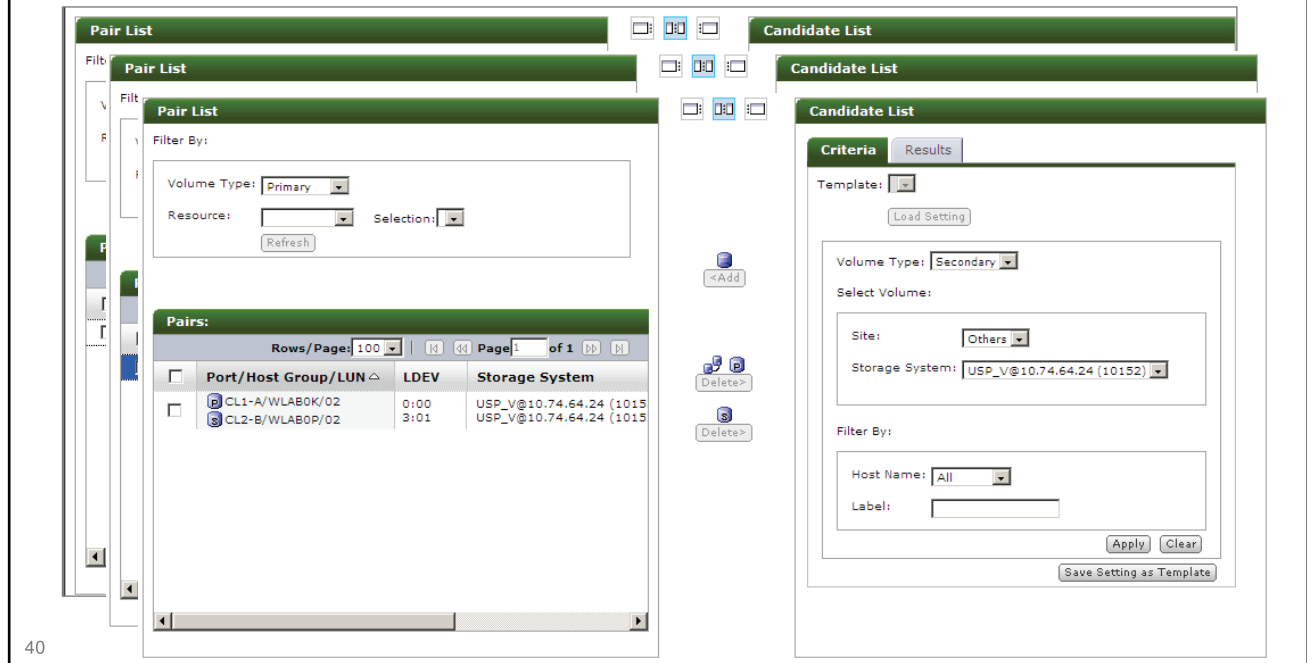
- Pair List (left area)
 - Allows you to filter volumes listed on left side
 - Shows the pair volumes (P-VOL and S-VOL)



39

Specifying Pair Volumes (Source and Destination)

- **Candidate List (right area)**
 - Select Primary or Secondary volumes to add to Pair List

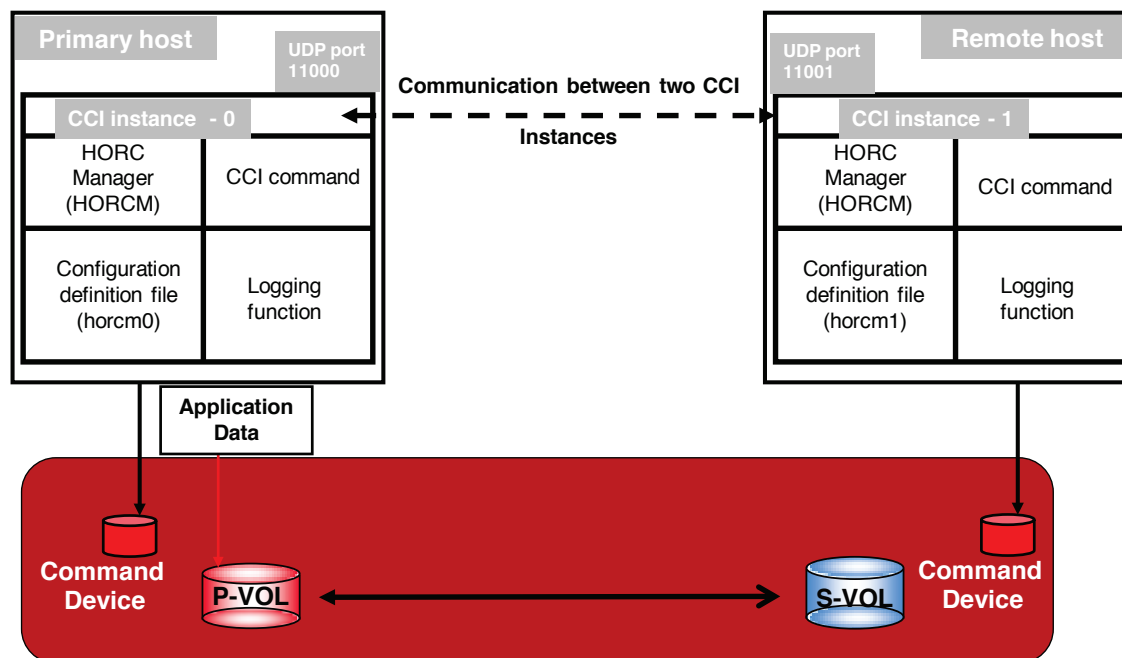


To define a copy pair:

- In the **Pairs** pane under **Detail** of pair-group-name pane, select a primary volume.
- In the **Criteria** tab under the **Candidate List** pane, specify the volume type and optional filtering criteria for obtaining a list of candidate volumes.
- Click **Apply**. The filtered list of candidate volumes is displayed on the **Result** tab.
- From the displayed tree structure on the **Results** tab, select the candidate volumes that you want to assign as the primary volume or secondary volumes for the new copy pairs.
- You can select multiple volumes on the **Result** tab.
- Click **Add**.
- The selected volumes are assigned as secondary volumes and the defined copy pair is displayed in the Pair List pane. Repeat this operation for each pair group you create.
- You can click the icon or the icon to expand the **Candidate List** and **Pair List** panes.
- Click **Next** to continue creating the copy pair configuration definition or click **Save** to temporarily save the workflow.
- The primary and secondary volumes must be configured in a one-to-one correspondence before you can continue pair configuration

Pair Configuration Wizard — Group Management

■ Understanding Create Group Parameters

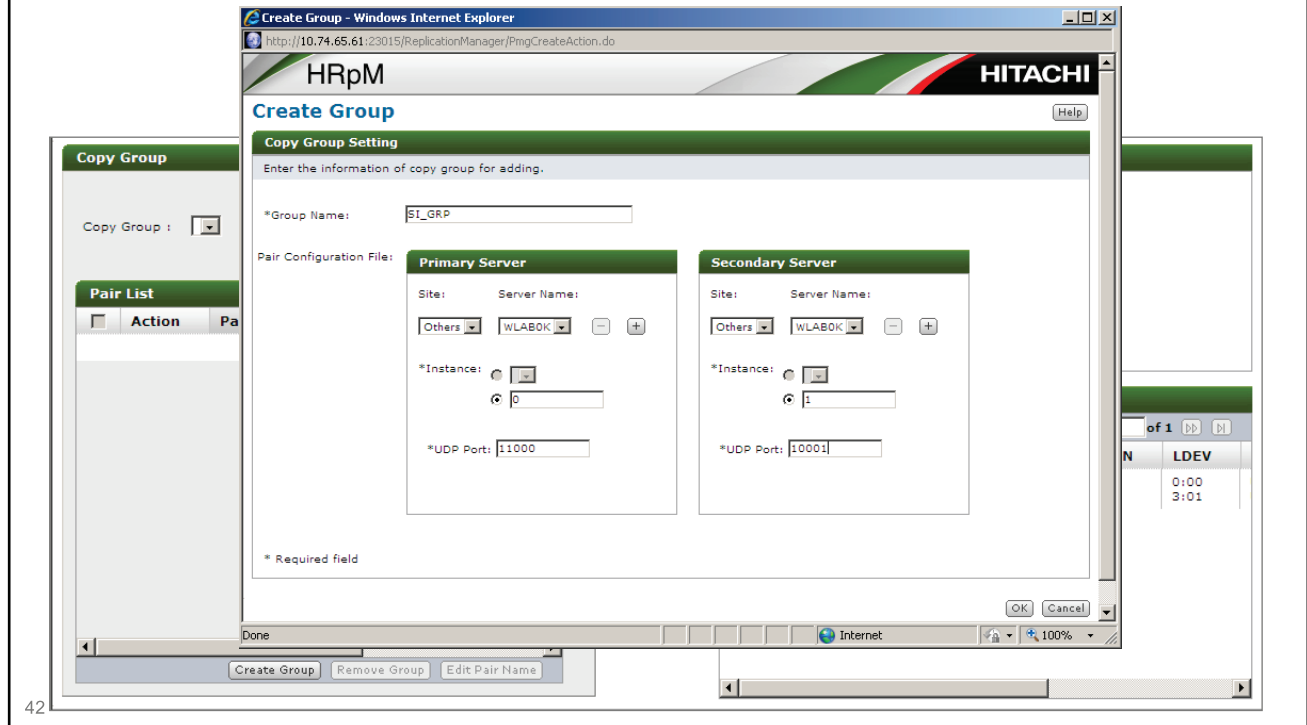


41

The next screen accepts the copy group parameters.

Specifying Copy Group

■ Create Group — Creating a Copy Group



A copy group consists of a number of copy pairs that have been grouped for management purposes. By grouping the copy pairs of volumes that are used for the same operations and purposes, you can perform batch operations on all the copy pairs in that copy group. For example, by performing an operation such as changing the copy pair status on a copy group, you can change the copy pair status of all copy pairs in the copy group in a single operation.

Specify Copy Group name and CCI configuration definition file related information (instance number and communication port number).

The CCI configuration file can be placed separately for the primary and secondary volume instances.

■ Assigning Pair to Copy Group

Copy Group : SI_GRP

Pair List

Rows/Page	100	Page	1	of 1
☒	Action	Pair Name	Port/Host Group/LUN	
☒	Created	P_000-301_0001	CL1-A/WLAB0K/02 CL2-B/WLAB0P/02	

<Apply
Release>

Pair Group

SI_GRP

Assigned

SI
+1/0/-0

Pair List

Action	Pair Name	Port/Host Group/LUN	LDEV	Sto
No Object				

Pair Type displays: +1/0/-0
of newly added pair instances
of originally existing pair instances
of deleted pair instances

43

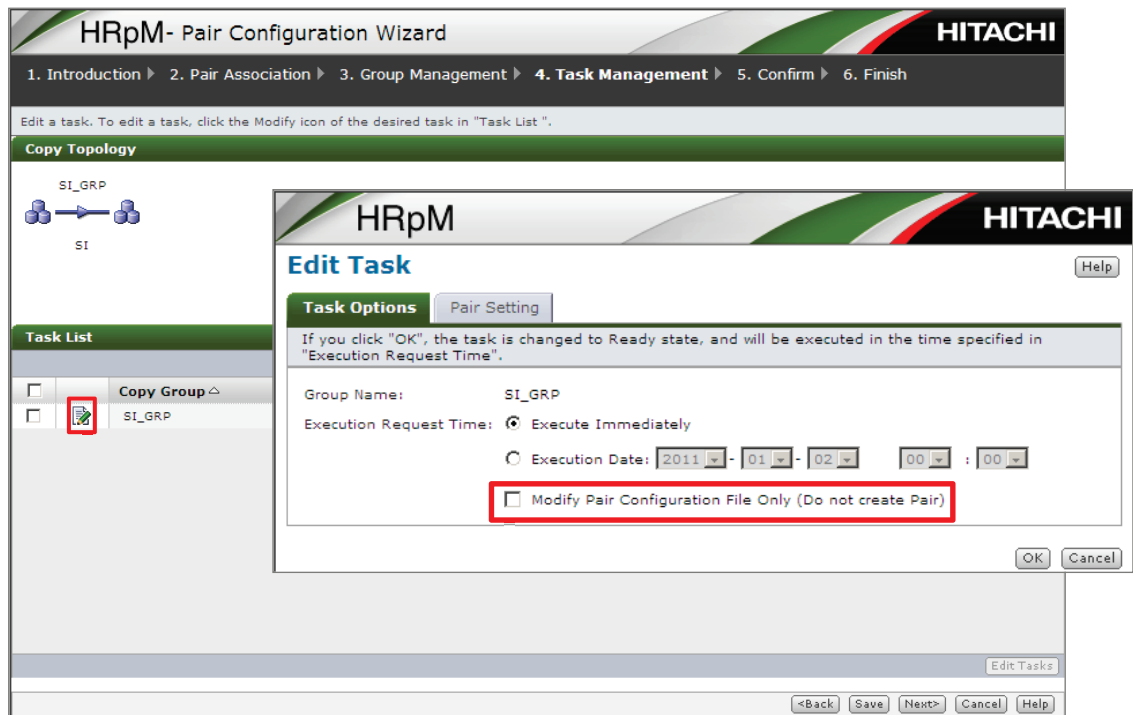
Initially the topology view displays Copy Group attribute as Unassigned.

Select the checkbox for the pair and click **Apply** to add the Pair Group instance to the newly created Copy Group instance.

After this step the topology view displays Copy Group attribute as Assigned.

Configuring Task Management Options

4. Task Management — Set Task Options — Schedule



44

Select whether to execute the tasks immediately, or at a specified date and time.

Execute Immediately - If you want to execute the task immediately, select this radio button. The task will start when the Pair Configuration Wizard ends.

Execution Date - Select this radio button to execute the task at the specific date and time that you select from the drop-down list.

Modify Pair Configuration File Only (Do not create Pair) -

Select this check box if you do not want the task to create a copy pair. When the check box is selected, the task only modifies the CCI configuration definition file. This item is displayed when the task type is Create.

■ Setting Additional Pair Settings

HRpM- Pair Configuration Wizard

1. Introduction ▶ 2. Pair Association ▶ 3. Group

Edit a task. To edit a task, click the Modify icon of the d

Copy Topology

SI_GRP

SI

Task List

	Copy Group ▲	Copy Type
☐	SI_GRP	SI

Edit Task

Task Options | **Pair Setting**

If you click "OK", the task is changed to Ready state, and will be executed in the time specified in "Execution Request Time".

Pair Operation

Operation : create

Copy Pace: 3

Split: ☐ On

Quick Split: ☐ On

Read disable (secondary): ☐ On

Assign CTG for At-Time Split: ☐ On

Pair List

	Pair Name ▲	Port/Host Group/LUN	LDEV	Storage System	Capacity
☒	P_000-301_0002	CL1-A/WLAB0K/02 CL2-B/WLAB0P/02	0:00 3:01	USP_V@10.74.64.24 (10152) USP_V@10.74.64.24 (10152)	2.00 GB 2.00 GB

OK Cancel

45

<Back Save Next> Cancel Help

Pair Configuration Task Confirmation

5. Confirm — Final Confirmation

HRpM- Pair Configuration Wizard **HITACHI**

1. Introduction > 2. Pair Association > 3. Group Management > 4. Task Management > **5. Confirm** > 6. Finish

Check the settings for copy pair configuration.
Carefully review the summary below, and then click "Confirm" to apply all the changes.

Are you sure you want to configure pairs listed below?

Copy Topology

1. Intr SI_GRP

SI

Task List

Copy Group	Copy Type	Pairs	Pair Operations	Execution Request Time
SI_GRP	SI	1	modify file + create	Immediately

☒ Yes, I have confirmed the above information and wish to create pair configuration.

[<Back](#) [Confirm](#) [Cancel](#) [Help](#)

46

Checking Task Status

■ Tasks — Check Status of Task

The screenshot shows the Hitachi ShadowImage Replication Manager interface. On the left is the 'Explorer' sidebar with a tree view containing 'Resources', 'Shared Views', 'My Groups', 'Administration', and 'Tasks'. The 'Tasks' item is selected and highlighted with a red box. Below the sidebar is the 'Dashboard' section with various monitoring widgets. The main area is titled 'Tasks' and contains a 'Task List' table. The table has columns: Task ID, Workflow, MF/ Open, Host, Target, Copy Type, Task Type, Status, and Creation. A single task, TASK0001, is listed with a status of 'Success', which is highlighted with a red box. At the bottom of the table are buttons: 'Refresh Tasks', 'Edit Tasks', 'Delete Tasks', 'Cancel Tasks', and 'Execute Task'.

Task ID	Workflow	MF/ Open	Host	Target	Copy Type	Task Type	Status	Creation
TASK0001		Open	WLAB0K	SI_GRP	SI	modify file + create	Success	2011-01-0

47

Task Status displays the execution status of the task as one of the following:

- Ready: Indicates that the task is waiting to execute.
- Executing: Indicates that the task is executing.
- Cancel: Indicates that the task was cancelled.
- Failure: Indicates that the task failed. When you select Failure, an error window appears. Read the message in the error window.
- Success: Indicates that the task was successful.
- Warning: Indicates that the system timed out waiting for the task to finish processing. When you select Warning, an error window appears. Read the message in the error window.

Checking Pair Status

Hosts View

The screenshot shows the 'Hosts View' for the 'SI_GRP' group. The left sidebar contains a 'Resources' section with 'Hosts' selected, and a 'Dashboard' section with various metrics. The main content area displays the 'Copy Group Summary' for 'SI_GRP' and a table of 'Copy Pairs'.

Copy Group Summary									
C/T Delta		SI		✓					
Side File / Journal Usage		TCA / TCE / SDR							
Primary	Server	WLAB0K		TCS					
	Config File	horcm0.conf		QS / COW					
Secondary	Server	WLAB0K		UR					
	Config File	horcm1.conf		Visible / Total		1 / 1			
CTGID									

Copy Pairs									
Copy Pair	Copy Type	Pair Status	Copy Progress		Primary			Storage Sy	
			Active	Inactive	Pair State	LDEV			
P_000-301_0002	SI	✓	100%		Pair (PAIR)	0:00	USP_V@10		

Operations Supported

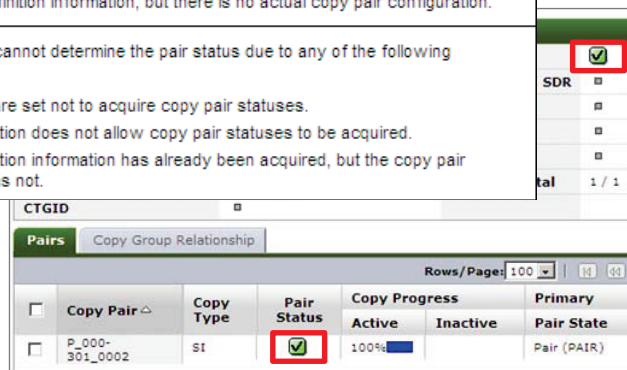
48

Once a pair is created you can view the copy progress status from any of the following views:

- Host view
- Storage System view
- Pair Configurations view

Pair Status Icons

Icon	Copy pair status	Description
	error	An error has occurred in the copy pair.
	suspend	The copy pair is in the split status.
	copying	The copy pair is under forward or backward copy processing.
	sync	The copy pair is synchronized.
	simplex	There is copy pair definition information, but there is no actual copy pair configuration.
	unknown	Replication Manager cannot determine the pair status due to any of the following reasons: - The settings are set not to acquire copy pair statuses. - The configuration does not allow copy pair statuses to be acquired. - The configuration information has already been acquired, but the copy pair information has not.



CTGID	Copy Group Relationship	Rows/ Pages	100	1	1
Copy Pair	Copy Type	Pair Status	Copy Progress	Primary	
Active	Inactive	Pair State			
P_000-301_0002	SI		100%		Pair (PAIR)

49

Hosts View



Copy Group Summary

C/T Delta	SI	
Side File / Journal Usage	TCA / TCE / SDR	
Primary	Server	WLAB0K
Config File	horcm0.conf	
Secondary	Server	WLAB0K
Config File	horcm1.conf	
Visible / Total	1 / 1	

Copy Group Relationship

Copy Group Configuration	Summary Status for Copy Group	Copy			
SI	TCA / TCE / SDR	TCS	QS / COW	UR	
					SI

Operations Supported



Create Alerts Pair Management Refresh Copy Groups

50

■ Storage Systems View

CL1-A/WLAB0K/02
Storage Systems > USP_V@10.74.64.24 (10152) > Open > CL1-A/WLAB0K/02

LUN Summary			
Mount Point	e:	Capacity	2.00 GB
LDEV	0:00	Volume Attribute	CVS

Pair Relationship						
Rows/Page: 100 Page 1 of 1						
	Pair Configuration	Copy Pair	Copy Type	Pair Status	Copy Progress	
					Active	Inactive
☐		P_000-301_0002	SI		100%	

■ Operations Supported

51

■ Pair Configurations View

SI_GRP
Pair Configurations > WLAB0K > horcm0.conf > SI_GRP

Copy Group Summary			
C/T Delta	☐	SI	
Side File / Journal Usage	☐	TCA / TCE / SDR	☐
Primary	Server	WLAB0K	TCS
	Config File	horcm0.conf	QS / COW
Secondary	Server	WLAB0K	UR
	Config File	horcm1.conf	Visible / Total
			1 / 1
CTGID	☐		

Pairs						
Copy Group Relationship						
Rows/Page: 100 Page 1 of 1						
	Copy Pair	Copy Type	Pair Status	Copy Progress		Primary
				Active	Inactive	Pair State
						LDEV
☐	P_000-301_0002	SI		100%		Pair (PAIR)
						0:00

■ Operations Supported

52

■ Pair Configurations View

Explorer

- Resources
 - Hosts
 - Storage Systems
 - Pair Configurations**
 - Applications
 - Shared Views
 - My Groups
 - Administration
 - Tasks
 - Alerts
 - Settings
- Dashboard
 - HDvM GO
 - HTnM
 - HGLM
 - HRpM
 - Mode: Normal
 - 0 C/T 0

Pair Configurations

- Pair Configurations
 - WLAB0K
 - horcm0.conf
 - SI_GRP**
 - horcm1.conf
 - WLAB0L
 - WLAB0P
 - WLAB0Q

SI_GRP
Pair Configurations > WLAB0K > horcm0.conf > SI_GRP

Copy Group Summary

C/T Delta	SI	✓
Side File / Journal Usage	TCA / TCE / SDR	□
Primary	Server	WLAB0K
Config File	horcm0.conf	QS / COW
Secondary	Server	WLAB0K
Config File	horcm1.conf	UR
CTGID	Visible / Total	1 / 1

Copy Group Relationship

Rows/Page: 100 Page 1 of 1

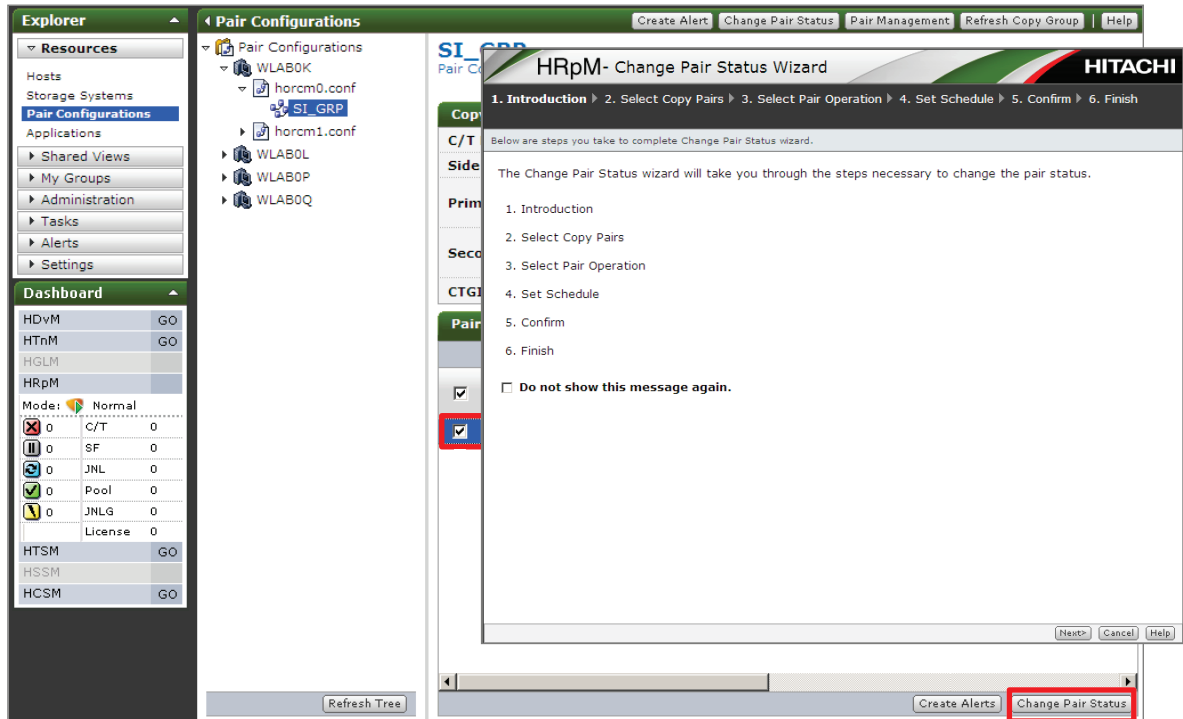
Copy Group Configuration	SI	TCA / TCE / SDR	TCS	QS / COW
✓	✓	□	□	□

■ Operations Supported

Create Alerts Pair Management Refresh Copy Groups

Changing Pair Status

1. Introduction — Launching Change Pair Status



54

Selecting Pairs

2. Select Copy Pairs — Changing Status

HRpM- Change Pair Status Wizard

HITACHI

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Select the copy pair(s) you want to operate.
The copy pair list below is made up of the copy groups to which the selected copy pairs belong. Select the copy pair(s) for which you want to change the pair status, and then, to define the pair operation, click "Next>".
If the copy type is TCA, TCE, SDR or UR, in order to perform the operation which affects all the pairs in the copy group, all the displayed pairs should be checked.

Pair List

Rows/ Pages: 100

Page 1 of 1

☒	Copy Pair ^	Copy Type	Primary			Secondary		
			Pair State	LDEV	Storage System	Pair State	LDEV	Storage System
☒	P_000-301_0002	SI	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	3:01	USP_V@10.74.64.24 (10152)

<Back
Next>
Cancel
Help

55

Selecting Pair Operation

3. Select Pair Operation and Additional Options

HRpM- Change Pair Status Wizard

HITACHI

1. Introduction ▶ 2. Select Copy Pairs ▶ **3. Select Pair Operation** ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Select "Basic" for usual copy pair operation or select "Advanced" for the copy pair operation that relates to takeover or takeback, then click "Next>" to continue.

Pair Operation

Operation:

Basic

split

split

resync

restore

delete

Options:

Copy Pace: 3

Quick Split: ☐ On

Pair List

Rows/Page: 100

14 44

Page: 1 of 1

Copy Pair ^	Copy Type	Primary			Secondary		
		Pair State	LDEV	Storage System	Pair State	LDEV	Storage System
P_000-301_0002	SI	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	3:01	USP_V@10.74.64.24 (10152)

56

3. Select Pair Operations — Specifying Resync and Quick Resync Options

HRpM- Change Pair Status Wizard

HITACHI

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Select "Basic" for usual copy pair operation or select "Advanced" for the copy pair operation that relates to takeover or takeback, then click "Next>" to continue.

Pair Operation

Operations:

Basic

resync

Advanced

Options:

Copy Pace: 3

Quick Resync: On

Pair List

Rows/ Page: 100
Page 1 of 1

Copy Pair	Copy Type	Primary			Secondary		
		Pair State	LDEV	Storage System	Pair State	LDEV	Storage System
P_121-123_0001	SI	Pair (PAIR)	1:21	USP_V@172.17.41.64 (10069)	Pair (PAIR)	1:23	USP_V@172.17.41.64 (10069)
P_122-124_0002	SI	Pair (PAIR)	1:22	USP_V@172.17.41.64 (10069)	Pair (PAIR)	1:24	USP_V@172.17.41.64 (10069)

57

Selecting Schedule

4. Set Schedule — Scheduling the Operation

HRpM- Change Pair Status Wizard **HITACHI**

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ **4. Set Schedule** ▶ 5. Confirm ▶ 6. Finish

When task has to be executed immediately, please select "Execute Immediately".
When task has to be executed recursively, please select "Execute on schedule" and specify execution interval in "Interval". Moreover, when "-" is specified in "Interval", it is executed only once.
Click "Next>" to continue.

☒ Execute Immediately
☐ Execute on Schedule

Interval: hour(s)

Execution Date: - - :

Confirming Pair Change Operation

5. Confirm

HRpM- Change Pair Status Wizard

HITACHI

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Check the settings for pair operation.
Carefully review the summary below, and then click "Confirm" to apply all the changes.

⚠ Make sure that previous Change Pair Status tasks for the same copy group are complete before performing new Change Pair Status operations.

⚠ Check the settings for pair operation.

During I/O processing of the primary volume, this processing might result in incomplete data in the secondary volume. Make sure that I/O processing for the primary volume is not being performed.

Execution Mode: Execute Immediately

Pair Operation

Operation: Basic / split

Options:

Copy Pace: 3
Quick Split: off

Pair List

Rows/Page: 100
Page 1 of 1

Copy Pair	Copy Type	Primary			Secondary		
		Pair State	LDEV	Storage System	Pair State	LDEV	Storage System
P_000-301_0002	SI	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	3:01	USP_V@10.74.64.24 (10152)

☒ Yes, I have confirmed the above information and wish to change pair status.

<Back Confirm Cancel Help

59

Module Summary

- In this module, you learned how to:
 - Describe the licensing considerations for Hitachi ShadowImage Replication
 - Describe the key features
 - List the steps for performing ShadowImage operations through Replication Manager

Module Review

1. How many ShadowImage level one copies can be created for a give P-VOL?
2. What's information is tracked through the bitmaps?
3. What is the difference between Quick and Normal functions?

5. Hitachi Copy-on-Write Operations with Replication Manager

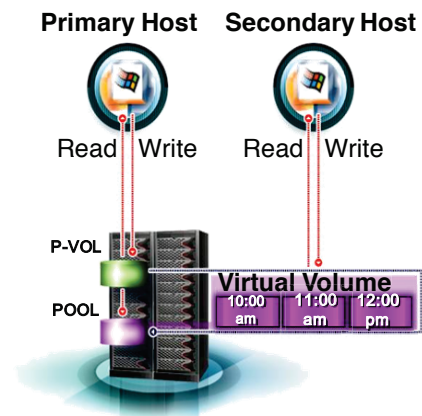
Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the purpose of Hitachi Copy-on-Write® Snapshot
 - Compare the functionality of Copy-on-Write Snapshot to Hitachi ShadowImage Heterogeneous Replication
 - Describe typical Copy-on-Write Snapshot operations
 - Perform Copy-On-Write operations using Replication Manager

Hitachi Replication Products

■ Copy-on-Write Snapshot

- Provides non-disruptive, volume *snapshots*
- Uses less space than ShadowImage
- Allows multiple frequent, cost-effective, point-in-time copies
- Immediate read/write access to virtual copy
- Nearly instant restore from any copy



3

Copy-on-Write Snapshot

- Rapidly creates point-in-time snapshot copies of any data volume within Hitachi storage systems, without impacting host service or performance levels.
- Realizes significant savings compared to full cloning methods because these snapshots store only the changed data blocks in the Copy-on-Write Snapshot storage pool
- Requires substantially smaller storage capacity for each snapshot copy than the source volume.

Copy-on-Write Snapshot Purposes

- Allows you to retain a logical duplicate of the primary volume data internally
- Restores data during the snapshot instruction if a logical error occurs in the primary volume
- Creates a duplicated volume consisting of physical data stored in the primary volume and differential data stored in the data pool
- Can create up to **64** snapshot images (V-VOLs) per primary volume
- Requires ShadowImage Heterogeneous Replication license to be installed

4

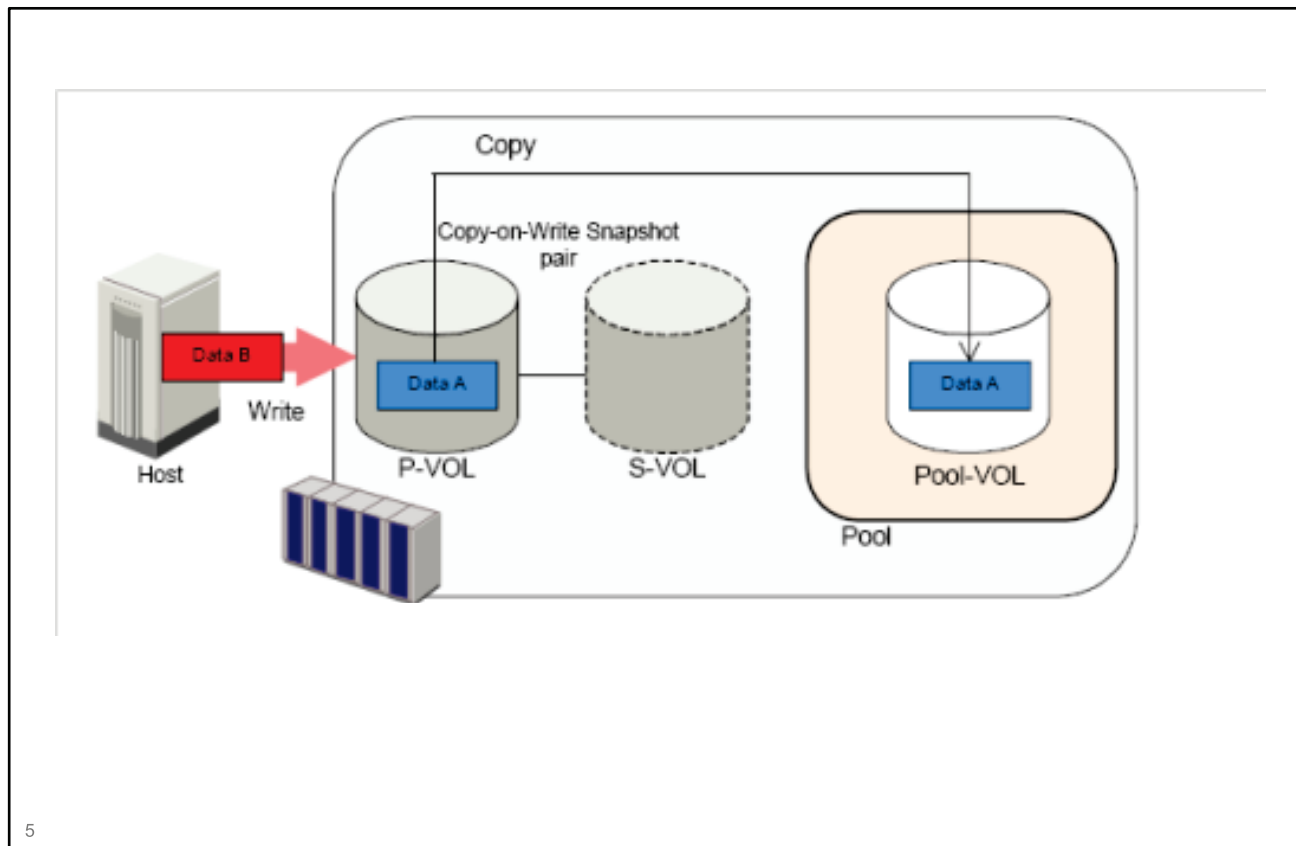
The duplicated volume of the Copy-on-Write Snapshot function consists of physical data stored in the primary volume and differential data stored in the data pool. This differs from the ShadowImage function where all the data is retained in the secondary volume.

Although the capacity of the used data pool is smaller than that of the primary volume, a duplicated volume can be created logically when the snapshot instruction is given. The data pool can share two or more primary volumes and the differential data of two or more duplicated volumes.

Copy-on-Write Snapshot requires ShadowImage Heterogeneous Replication license to be installed.

- Capacity used will be subtracted from the license capacity for ShadowImage. Therefore, you must ensure that the license capacity for ShadowImage is larger than the capacity to be used by both ShadowImage and Copy-on-Write Snapshot.

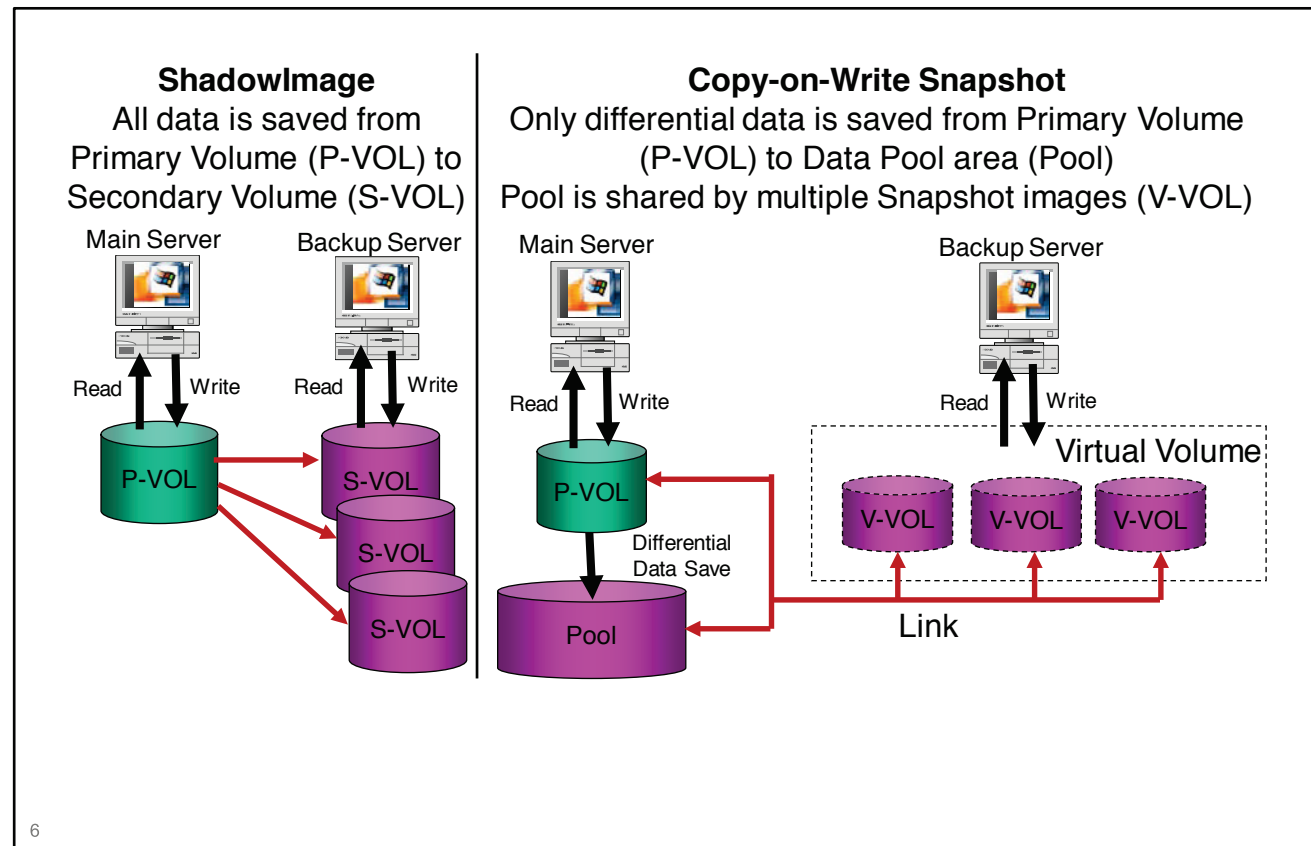
Copy-on-Write Snapshot Overview



The Copy-on-Write Snapshot configuration includes a P-VOL, a number of V-VOLs, a data pool (POOL).

- Data Pool: Volumes in which only differential data is stored (POOL)
- Snapshot Image: A virtual replica volume for the primary volume (V-VOL); this is an internal volume that is held for restoration purposes.

Contrasting ShadowImage and Copy-on-Write Snapshot



Copy-on-Write Snapshot requires ShadowImage Heterogeneous Replication in order to function. They are similar in that both program products create pairs.

However, Copy-on-Write Snapshot uses V-VOLs as a secondary volume which reduces disk storage system capacity requirements. Additionally, only the updated data of the P-VOL is copied to the V-VOL and the differential data is stored in the pool. Therefore, the replicated volume created by Copy-on-Write Snapshot comprises of differential data stored in the pool and physical data from the primary volume (P-VOL). ShadowImage, which creates pairs from physical volumes, copies all of the data in the P-VOL to the S-VOL. This copy process requires more time but provides increased data security.

Caution: Copy-on-Write Snapshot copies only the updated data in a P-VOL to the V-VOL. Therefore, data in the V-VOL is not guaranteed in the following cases:

- When physical failure occurs in a P-VOL
- When a POOL is blocked

Size of Physical Volume

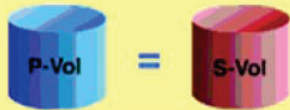
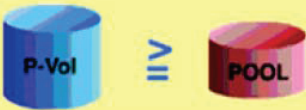
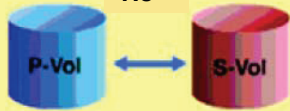
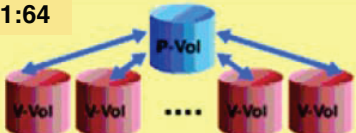
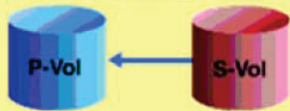
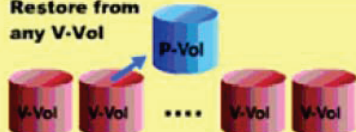
The P-VOL and the S-VOL have exactly the same size in ShadowImage

Heterogeneous Replication. In Copy-on-Write Snapshot, less disk space is required for building a V-VOL image since only part of the V-VOL is on the Pool and the rest is still on the primary volume.

Pair Configuration

Up to 9 copies can be created for every P-VOL in ShadowImage Heterogeneous Replication. In Copy-on-Write Snapshot there can be up to 64 V-VOLs per primary volume.

- ShadowImage copies and produces physically separate copies of the data. Copy-on-Write Snapshot produces a virtual S-VOL (V-VOL).

	ShadowImage	Snapshot
Size of Physical Volume	P-Vol = S-Vol 	P-Vol $\geq$ Pool for one V-Vol 
Pair Configuration	1:3 	1:64 
Restore	P-Vol can be restored from S-Vol 	Restore from any V-Vol 

7

	Copy-on-Write Virtual Volume	ShadowImage Clone
Features	Provides a very quick copy because it is a virtual volume	Superior protection because it is a complete copy Immediate restore if P-VOL becomes corrupted
Time to Create	Instantaneous	From minutes to hours, depending on the size of the P-VOL
Disk Space Used	Size will vary depending upon rate of data change but will be far less than the P-VOL	Same amount as P-VOL
Data Recovery Time After P-VOL is corrupted	Two stage restore: 1. V-VOL verify, data not available to host 2. Copy back, data available	Instantaneous

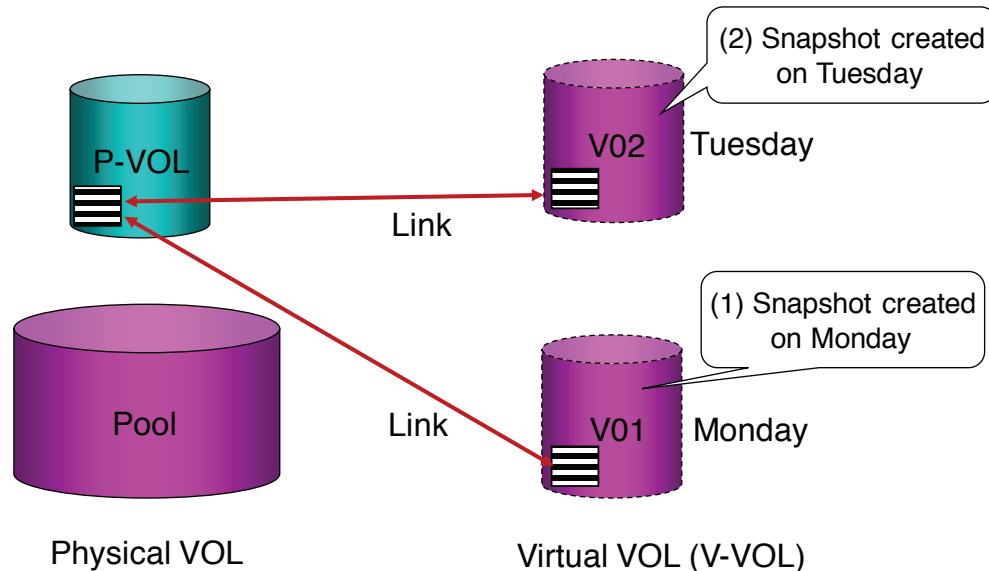
8

The capacity of a pool is equal to the total capacity of registered pool-VOLs in the pool. If the usage rate of the pool exceeds its capacity, the status of the Copy-on-Write Snapshot pair changes to PSUE (Pair Suspended Error — status when failure occurred).

If this happens, snapshot data cannot be stored in the pool and the Copy-on-Write Snapshot pair must be deleted. When a Copy-on-Write Snapshot pair is deleted, the snapshot data stored in the pool is deleted and the P-VOL and V-VOL relationship is released.

Copy-on-Write Snapshot Operations

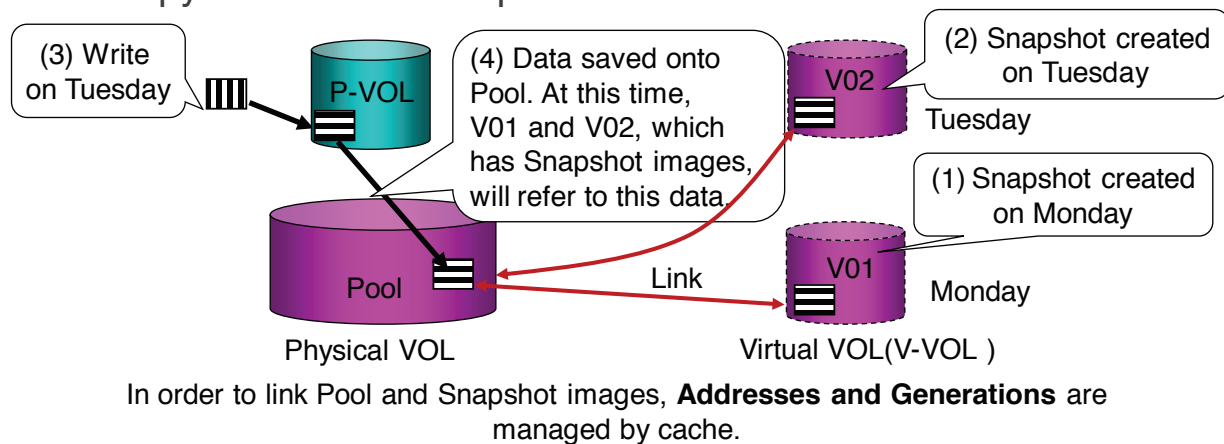
- Before modifying the data block on P-VOL with Copy-On-Write Snapshot, V-VOL will get the data from P-VOL.



This diagram shows a situation where two snapshots have been taken. The highlighted data block in the snapshots is available on the primary volume and a request for this block through the V-VOL would be physically taken from the P-VOL. This situation will last as long as the corresponding block on the P-VOL is not altered.

■ After writing to the data block on P-VOL:

- When there is a write after having created a snapshot, that data is saved on the data pool area (pool) first.
- This saved data in pool is from now on used by the V-VOLs.
- Pool can be shared by multiple V-VOLs; therefore only one copy of the data is required.

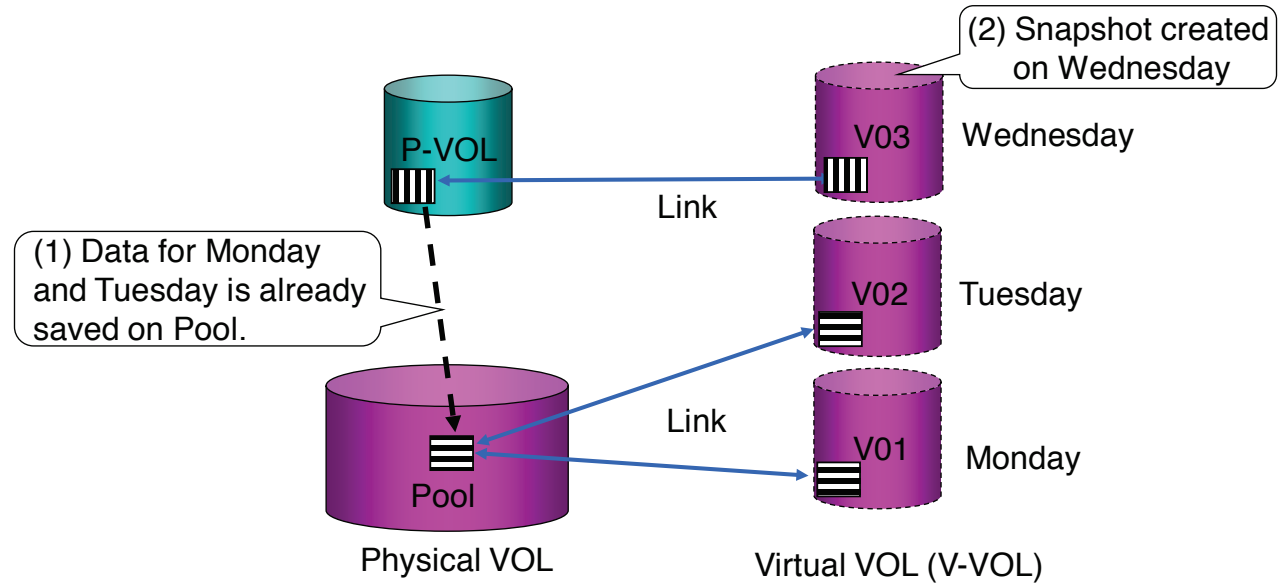


10

Now the data block on the P-VOL needs to be written. However, before the actual write is executed, the block is copied to the Pool area. The set of pointers that actually represent the V-VOL will be updated and if there is a request now for the original block through a V-VOL, the block is physically taken from Pool.

From the host's perspective, the V-VOL (Snapshot Image) has not changed, which was the plan.

- On Wednesday a new snapshot image is created.
 - The new snapshot image refers to the data on P-VOL.

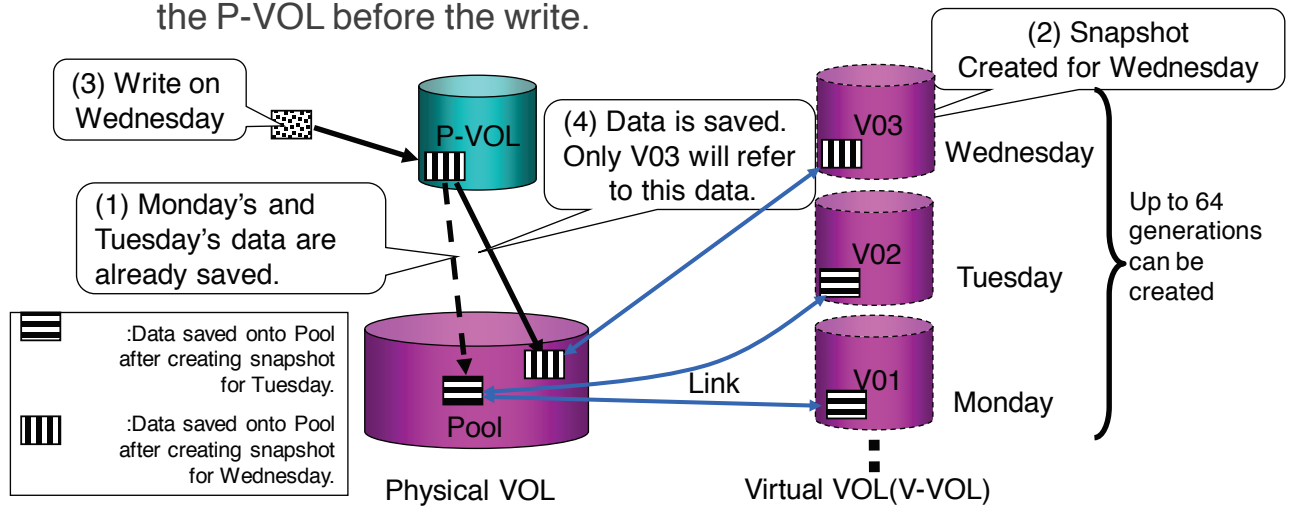


11

On Wednesday, another snapshot image has been created. The situation now is that the data block, as it was before, the write will physically be taken from the Pool area and the block as it is after the write from the primary volume (P-VOL).

If there is a request for that block through a V-VOL, the data will physically be read from the Pool area or from the P-VOL depending on what snapshot image is being referred to.

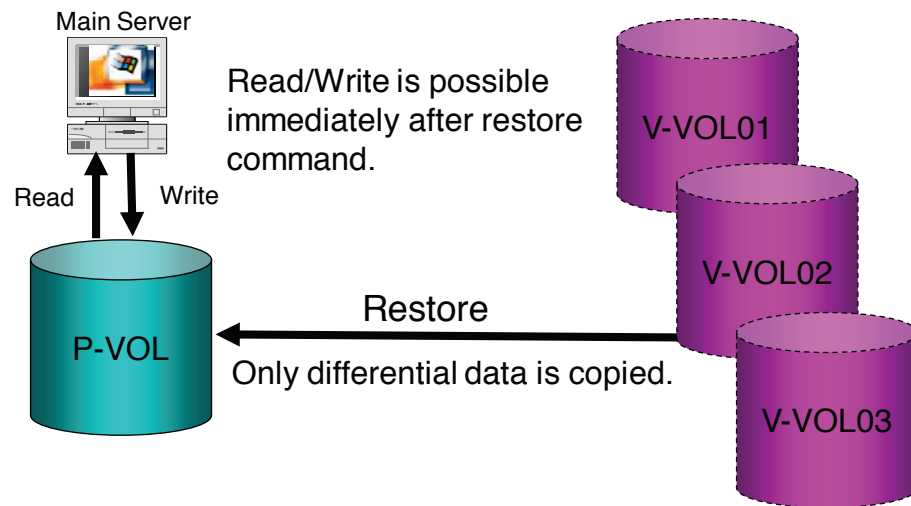
- **Write command to the same data block again.**
 - When there is another write to the same area, before actually writing, the data is additionally saved on the Data Pool area (Pool).
 - This saved data in Pool is viewed by the V-VOL that was linked to the P-VOL before the write.



12

One more write to the same data block on the P-VOL. Again, before executing the write, the block is copied to the pool area, the pointers that make up the V-VOL are updated and upon a request for that data block through a V-VOL the data will physically be taken from the pool.

- Restore is possible from any Hitachi snapshot image (V-VOL).
 - To the host, it appears as if the restore was done instantly.
 - Actual data copying from V-VOL to P-VOL is done in background.



13

- Restoring a primary volume can be done instantly from any V-VOL. It can be done instantly because it does not involve immediate moving of data from Pool to P-VOL. Only pointers must be modified.
- The background data will then be copied from the pool to P-VOL.
- If the P-VOL becomes physically damaged, all V-VOLs would be destroyed as well and a restore is not possible.

Setting Up Copy-on-Write

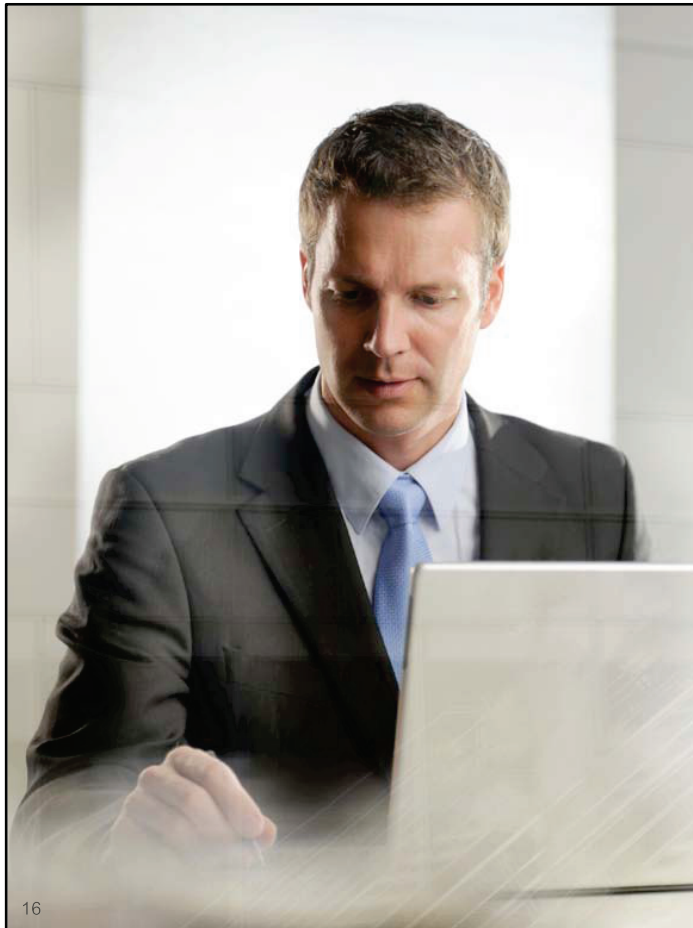
- Overview of Copy-on-Write Snapshot Setup and Configuration
 - Install additional shared memory for differential tables (if required).
 - Install additional shared memory for the V-VOL management area.
 - Install ShadowImage license keys if not already installed. ShadowImage is required for Copy-on-Write Snapshot.
 - Install Copy-on-Write Snapshot license key.

14

Operating Copy-on-Write

- Operation Steps
 - Set up Copy-On-Write Pool
 - Set up Virtual Volumes for Copy-On-Write operations
 - Manage Pairs
 - Create Pairs
 - Change Pair Status

Instructor Demonstration — Copy-on-Write



Instructor Demonstration

- Copy-On-Write
 - Create Pool/V-VOLs
 - Create Pair
 - Split Pair
 - Resync Pair
 - Delete Pair



16

Setting Up the Data Pool

■ Creating the Data Pool — 1. Select Pool ID

The screenshot displays the Hitachi Replication Manager (HRpM) interface. On the left is the 'Explorer' pane with a tree view showing 'Resources' > 'Storage Systems'. The main pane shows the 'Open Storage System Summary' for a selected storage system. Below this, the 'Pools' tab is active, showing a table with columns: Pool, Used by, Status, Pool Usage, Total Capacity, Number of Associated Pairs, and Last Up. The table is currently empty, showing 'No Object'. Overlaid on the bottom half of the screen is the 'HRpM- Create Pool Wizard' dialog box. The wizard has a progress bar with five steps: 1. Select Pool ID, 2. Select Pool Volumes, 3. Set Option, 4. Confirm, and 5. Finish. Step 1 is currently selected. The wizard prompts the user to 'Select a number that is assigned to new pool, and click "Next>"'. A 'Pool ID' dropdown menu is visible, showing '0'. At the bottom of the wizard, there are 'Next>', 'Cancel', and 'Help' buttons. Below the wizard, a toolbar contains buttons for 'Refresh Tree', 'Create Pool' (highlighted with a red box), 'Delete Pools', 'Create Alerts', 'Export History', and 'Refresh Pool Info'.

17

1. From the **Explorer** menu, choose **Resources** and then **Storage Systems**. The Storage Systems subwindow appears.
2. Expand the object tree, and then select a storage system under **Storage Systems**. The storage-system-name subwindow appears.
3. Click the **Open** link. The **Open** subwindow appears.
4. On the Pools page, click **Create Pool**. The **Create Pool Wizard** starts.

- Adding Capacity – **2. Select Pool Volumes** to add to the data pool.

HRpM- Create Pool Wizard **HITACHI**

1. Select Pool ID ▶ 2. **Select Pool Volumes** ▶ 3. Set Option ▶ 4. Confirm ▶ 5. Finish

Select volumes you want to register as pool volumes.
Perform following to select volumes:
1. Select filtering parameters ("CU" and "Capacity" and "Parity Group"), and click "Refresh".
2. On "Free Volumes", mark the checkbox beside volumes that you want to register as pool volume, and click "Add>".
For canceling registering of pool volumes, perform following.
On "Pool Volumes", mark the checkbox beside volumes that you want to unregister, and click "<Delete".
Click "Next>" when the selection has been finished.

Filters for Free Volumes:
CU: Capacity: Parity Group:
Label:

LDEV Total Capacity: 805.21 GB

Free Volumes

Candidate volumes for registering pool volumes

☐	LDEV	Label	Operation	Capacity	Parity Group	En Ty
☐	2:00		Add	805.21 GB	1-3-1	OF
☐	5:00		-	805.21 GB	2-2-1	OF
☐	9:00		-	10.00 GB	2-3-1	OF
☐	9:01		-	10.00 GB	2-3-1	OF
☐	9:02		-	10.00 GB	2-3-1	OF
☐	9:03		-	10.00 GB	2-3-1	OF
☐	9:04		-	10.00 GB	2-3-1	OF

Pool Volumes

Pool volumes to be registered to new pool

☐	LDEV	Label	Operation	Capacity	Parity Group	En Ty
☒	2:00		Add	805.21 GB	1-3-1	OF

18

■ Specifying Capacity Alert Threshold (20% – 95% @ 5% increments) — 3. Set Option

HRpM- Create Pool Wizard

1. Select Pool ID ▶ 2. Select Pool Volumes ▶ 3. Set Option ▶ 4. Confirm ▶ 5. Finish

Set pool option and click "Next>".

Pool Option

*Threshold for warning status: %

* Required field

<Back Next> Cancel Help

19

■ Confirming Pool Creation — 4. Confirm

HRpM- Create Pool Wizard

1. Select Pool ID ▶ 2. Select Pool Volumes ▶ 3. Set Option ▶ 4. Confirm ▶ 5. Finish

Check the setting of pool to be created.
Carefully review the summary below, and then click "Confirm" to create pool.
This operation might take several minutes to finish.

Pool ID: 0
LDEV Total Capacity: 805.21 GB

Pool Volumes

LDEV	Label	Operation	Capacity	Parity Group	Emulation Type	SLPR	CLPR	RAID Level	Volume Attribute
2:00		Add	805.21 GB	1-3-1	OPEN-V	0	0	RAID5(3D+1P)	

Pool Option

Threshold for warning status: 80%

☒ Yes, I have confirmed the above information and wish to create pool

<Back Confirm Cancel Help

20

■ Changing Data Pool Capacity and Options

The screenshot displays the Hitachi Replication Manager (HRpM) interface. The main window shows the 'Open Storage System Summary' for a storage system with RAW Capacity of 2.26 TB and Allocated Capacity of 32.00 GB. The 'Pools' tab is selected, showing a table of pool volumes. A red box highlights the 'Pool' column header. Below this, the 'Edit Pool Setting - 0' dialog is open, showing the 'Pool Volume Setting' and 'Pool Option Setting' tabs. The 'Pool Volume Setting' tab is active, showing a table of free volumes. A red box highlights the 'Pool Option Setting' tab. The 'Pool Option Setting' tab is also active, showing a 'Set pool option' section with a 'Threshold for warning status' set to 80%.

Open Storage System Summary

RAW Capacity	2.26 TB
Allocated Capacity	32.00 GB

Pools

Pool	Used by	Status	Pool Usage	Total Capacity	Number of Associated Pairs	Last
0	QS / COW	Normal	0%	801.11 GB	0	201

Edit Pool Setting - 0

Pool Volume Setting

For adding pool volumes, perform following:
1. Select filtering parameters ("CU" and "Capacity" and "Parity Group"), and click "OK".
2. On "Free volumes", mark the checkboxes beside volumes that you want to register.
For removing pool volumes, perform following:
On "Pool volumes", mark the checkboxes beside volumes that you want to unregister.
When the all operations for "Edit Pool Setting" has been finished, click "OK". Then

Pool Option Setting

Set pool option.
Click "OK" when the all changes of "Edit Pool Setting" has been finished.

* Threshold for warning status: 80 %

* Required field

Free Volumes

LDEV	Label	Operation	Capacity	Parity Group
5:00	-	-	805.31 GB	2-3-1
5:01	-	-	10.00 GB	2-3-1
5:02	-	-	10.00 GB	2-3-1

Pool Volumes

LDEV	Label	Operation	Capacity	Parity Group
2:00	-	-	800.21 GB	2-3-1

The new pool usage threshold has to be set higher than the existing pool usage.

Creating Virtual Volumes

■ Create V-VOL Wizard — Setup V-VOL Group

The screenshot displays the Hitachi Replication Manager (HRpM) interface. On the left is the 'Explorer' pane with a tree view of 'Storage Systems' and a 'Dashboard' section. The main area shows the 'Open Storage System Summary' for a specific storage system, including 'RAW Capacity' (2.25 TB) and 'Allocated Capacity' (28.00 GB). Overlaid on this is the 'HRpM- Create V-VOL Wizard' dialog box. The wizard is at step 1, 'Setup V-VOL Group', and shows options to 'Create New Group' (with a value of -1) or 'Select Existing Group'. The 'Emulation Type' is set to 'OPEN-V' and 'CLPR' is set to 0. The wizard has 'Next', 'Cancel', and 'Help' buttons at the bottom.

22

Replication Manager supports creation of V-VOLs on storage system configurations. After creating V-VOLs, it is necessary to assign LUNs to them in order to create copy pairs. Assignment of LUNs should be done using Device Manager. Replication Manager provides a wizard for creating V-VOLs and associating them with volume pools.

2. Select Primary LDEVs (Volumes)

HRpM- Create V-VOL Wizard **HITACHI**

1. Setup V-VOL Group ▶ **2. Select Primary LDEVs** ▶ 3. Setup V-VOLs ▶ 4. Confirm ▶ 5. Finish

Select primary LDEVs to be replicated with V-VOLs, and click "Add >".
The wizard will create exactly the same size of V-VOLs.
When creating multiple V-VOLs for the LDEVs, select "Count of Snapshot" tab.

Target LDEVs Count of Snapshot

Filters for Candidate LDEVs:
CU: All Capacity: All
Label: Refresh

☐	LDEV ^	Label	Capacity	Volume Attribute
☐	0:00		2.00 GB	CVS
☐	1:00		4.00 GB	CVS
☐	3:01		2.00 GB	CVS
☐	3:02		2.00 GB	CVS
☐	3:03		2.00 GB	CVS
☐	4:01		4.00 GB	CVS
☐	4:02		4.00 GB	CVS
☐	4:03		4.00 GB	CVS

Add> <Delete

Target LDEVs

☐	LDEV ^	Label	Capacity	Volume Attribute
☐	0:00		2.00 GB	CVS

Count of Snapshot

Count of Snapshot for each LDEV:

<Back Next> Cancel Help

23

The primary volume capacity is used for defining the capacity of the new V-VOLs.

3. Setup V-VOLs — Specifying Address — Assign starting CU:LDEV address for new volume (optional).

HRpM- Create V-VOL Wizard

1. Setup V-VOL Group ▶ 2. Select Primary LDEVs ▶ 3. Setup V-VOLs ▶ 4. Confirm ▶ 5. Finish

The CU:LDEV of the V-VOLs will be automatically assigned during the creation.
To specify the starting number of CU:LDEV, Select "Specify start number of V-VOL(s)" checkbox, and then select CU and LDEV.

☒ Specify start number of V-VOL(s)

CU: 0A LDEV Start Number: 00

LDEV	Capacity	Emulation Type
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V

<Back Next> Cancel Help

24

In case you do not specify the starting address, the first available address will be assigned. The address for new volumes will be displayed on successful creation of the V-VOLs.

4. Confirm — Task Summary screen

HRpM- Create V-VOL Wizard **HITACHI**

1. Setup V-VOL Group ▶ 2. Select Primary LDEVs ▶ 3. Setup V-VOLs ▶ **4. Confirm** ▶ 5. Finish

Carefully review the summary below, and click "Confirm" to create V-VOLs.
This operation might take several minutes to finish.

V-VOL Group ID: V1-1
 Emulation Type: OPEN-V
 CLPR: 0
 CU:LDEV Start Number: 0A:00

V-VOL List

LDEV	Capacity	Emulation Type
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V
Auto	2.00 GB	OPEN-V

☒ Yes, I have confirmed the above information and wish to create V-VOLs.

25

- Review the setup and note the LDEV addresses.

HRpM- Create V-VOL Wizard **HITACHI**

1. Setup V-VOL Group ▶ 2. Select Primary LDEVs ▶ 3. Setup V-VOLs ▶ 4. Confirm ▶ **5. Finish**

Processing to create the V-VOLs has ended. Click "Finish" to finish the wizard.

i Processing to create the V-VOLs has ended.
The newly created V-VOLs will be displayed in the following "V-VOL List".

V-VOL Group ID: V1-1
 Emulation Type: OPEN-V
 CLPR: 0
 CU:LDEV Start Number: 0A:00

V-VOL List

Result	LDEV	Capacity	Emulation Type	Message ID
Success	A:00	2.00 GB	OPEN-V	
Success	A:01	2.00 GB	OPEN-V	
Success	A:02	2.00 GB	OPEN-V	
Success	A:03	2.00 GB	OPEN-V	
Success	A:04	2.00 GB	OPEN-V	

26

Managing Pairs

- Creating Pair with Copy Type — CoW.

1. Introduction ▶ 2. Pair Association ▶ 3. Group Management ▶ 4. Task Management ▶ 5. Confirm ▶ 6. Finish

Use this dialog box to modify pair groups and copy group. To create a pair group, select a volume icon displayed in "Copy Topology", and then click "Add Group".

Copy Topology

COW_Grp

Q5 / COW

Add Group

Delete Group

Detail of COW_Grp

Pair List

Filter By:

Volume Type: Primary

Resource: Selection:

Refresh

Pairs:

Rows/Page: 100 Page 1 of 1

Port/Host Group/LUN	LDEV	Storage System
CL1-A/WLAB0K/02	0:00	USP_V@10.74.64.24 (1015)
CL1-A/WLAB0K/05	A:00	USP_V@10.74.64.24 (1015)

Add

Delete>

Candidate List

Criteria Results

Template:

Load Setting

Volume Type: Secondary

Select Volume:

Site: Others

Storage System: USP_V@10.74.64.24 (10152)

Filter By:

27

■ Specifying Additional Settings for Pair

HRpM- Pair Configuration Wizard

1. Introduction ▸ 2. Pair Association ▸ 3. Group Management ▸ 4. Task Management ▸ 5. Confirm ▸ 6. Finish

HRpM

Copy Topology

COW_Grp

QS / COW

Task List

☐	Copy Group ▾	Copy Type
☐	COW_Grp	QS / COW

Edit Task

Task Options

Pair Setting

Pair Operation

Operation :

create

Pool ID

0 ▾

Split:

☒ On

Assign CTG for At-Time Split:

☐ On

Pair List

Rows/Page: 100 ▾

Page 1 of 1

☒	Pair Name ▾	Port/Host Group/LUN	LDEV	Storage System	Capacity
☒	P_000-A00_0003	CL1-A/WLAB0K/02 CL1-A/WLAB0K/05	0:00 A:00	USP_V@10.74.64.24 (10152) USP_V@10.74.64.24 (10152)	2.00 GB 2.00 GB

<Back

Save

Next>

Cancel

Help

28

Module Summary

- In this module, you learned how to:
 - Describe the purpose of Hitachi Copy-on-Write Snapshot
 - Compare the functionality of Copy-on-Write Snapshot to Hitachi ShadowImage Heterogeneous Replication
 - Describe typical Copy-on-Write Snapshot operations
 - Perform Copy-On-Write operations using Replication Manager

Module Review

1. How many copies of a volume can be created with Copy-On-Write?
2. Can a S-VOL be used for restoring the data in case of P-VOL failure?
3. Which option can be recommended for a customer who wants to maintain a copy of the primary volume with minimum investment in additional capacity?

6. Hitachi TrueCopy Operations with Replication Manager

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe Hitachi TrueCopy® key benefits and features
 - Describe TrueCopy remote replication solutions
 - Describe TrueCopy internal operations
 - Describe how TrueCopy and Hitachi ShadowImage Replication work together
 - Perform TrueCopy operations with Hitachi Replication Manager

2

Hitachi TrueCopy Remote Replication bundle includes synchronous and asynchronous capability.

Hitachi TrueCopy Benefits

- **Storage System-based Replication**
 - Host independent
 - Applications not involved
- **Multiple Management Options**
 - Storage Navigator
 - Manual operation of single replication
 - Replication Manager
 - Semi-automated operation of multiple replications
 - Command Line Interface (CLI)
 - Fully automated replication using scripts
- **Open Systems and Mainframe Compatible**
- **Synchronous and Asynchronous Versions Available**
 - Unlimited distance capabilities (asynchronous)

3

TrueCopy Remote Replication

- ♦ Provides vital recovery management capabilities that safeguard information up to the point of an outage in the event a primary site is damaged. As a result, TrueCopy Synchronous/ Asynchronous helps minimize the impact of business downtime. Data recovery processes traditionally span several days and involve many administrators. Using a service-based implementation, TrueCopy Synchronous/ Asynchronous replaces these manual and time-consuming methods with automated copy processes. Consequently, recovery time is significantly reduced, enabling normal business operations to resume in a matter of minutes, not days.
- ♦ Provides host-independent, vital recovery management capabilities that minimize the impact of downtime and ensure nonstop access to your information in the event of a disaster or during scheduled downtime. TrueCopy replicates data locally between Hitachi storage systems – within the same data center or remotely, between geographically dispersed locations.
- ♦ Is available in synchronous and asynchronous versions.
- ♦ Is a remote data replication solution for both mainframe and open systems environments. TrueCopy Synchronous/ Asynchronous replication is

accomplished by continuously sending data copies between one or more primary Hitachi storage systems to one or more secondary systems, located either in the same data center or at a remote site.

- TrueCopy Asynchronous extension broadens this functionality by providing a solution that crosses long distances and can be deployed for wide area disaster recovery (DR) scenarios.
- TrueCopy Synchronous is typically used for applications with the most stringent recovery-point objectives where loss of data cannot be tolerated. TrueCopy Synchronous is normally deployed over distances of less than 60 kilometers, although it may be possible to extend that distance to 300 kilometers.

- **Business Continuity**

- Local and remote data replication
- Reduce frequency and duration of planned outages
- Disaster recovery testing
- Rapid recovery versus tape restore
- Government regulation compliance

- **Productivity and Process Improvements**

- Reduces application downtime for backups
- Resource optimization
- Non-disruptive LAN-free backups
- Tested maintenance operations applied to production environments
- Provide production data for offline data mining

4

Business Continuity

- Safeguards critical data by providing sophisticated point-in-time copies, up to the point of an outage, in the event your primary site is damaged.
- Mitigates disaster risks by replicating data locally, or to geographically dispersed remote sites.
- Replaces slow, labor-intensive and expensive tape-based replication and retrievals with rapid, automated processes.
- For selected industries, TrueCopy Synchronous/ Asynchronous allows conformance with government mandates or regulations for disaster tolerance.

Productivity and Process Improvements

- Improves service levels by reducing planned and unplanned downtime of customer-facing applications.
- Optimizes resource utilization by offloading processing and data to alternate systems that can be located anywhere.
- Performs backups on a secondary system while your business operates at full capacity.
- Simplifies site maintenance and application development operations by replicating your environment at a local or remote site without impacting production data.
- Fully leverages data warehousing/ data mining investments by replicating production information, either locally or at a remote site.

Hitachi TrueCopy Synchronous Benefits

- Data Migration Between Storage Systems Using TrueCopy Synchronous
 - Minimal impact to host applications:
 - To load data onto new or scratch volumes (for example, a new or upgraded storage system)
 - To temporarily move data to accommodate other activities (for example, repair)
 - To relocate LUs to balance workloads and distribute I/O activity evenly within and across storage systems to improve performance

5

LU – logical unit

- Data Migration Between Storage Systems Using TrueCopy Synchronous (*continued*)
 - Initial copy operation copies the entire contents of the primary volume (P-VOL) to the secondary volume (S-VOL) with minimal impact to host I/O.
 - 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 pair is then deleted to change the device state to SMPL (Simplex), and host high-availability (HA) software can then be used to complete the data migration non-disruptively.
 - To support host-based application automation, manage data migration with Command Control Interface (CCI).

Remote Replication Solutions

- **Hardware Synchronous Remote Copy**
 - TrueCopy Synchronous
 - Host writes to remote cache, thus automatically maintaining data consistency.
 - Optional Consistency Groups (from CCI) to get Time Consistent Split.
 - Remote delay inserted at end of channel program by microcode. Only one turnaround required.
 - Exclude temporary data.
 - Turnaround times become unacceptable at longer distances.
 - Appreciable delay at zero distance:
 - 500 to 700 μ sec delay within control unit
 - Total around 900 μ sec at zero distance
 - RPO near zero, RTO near zero.

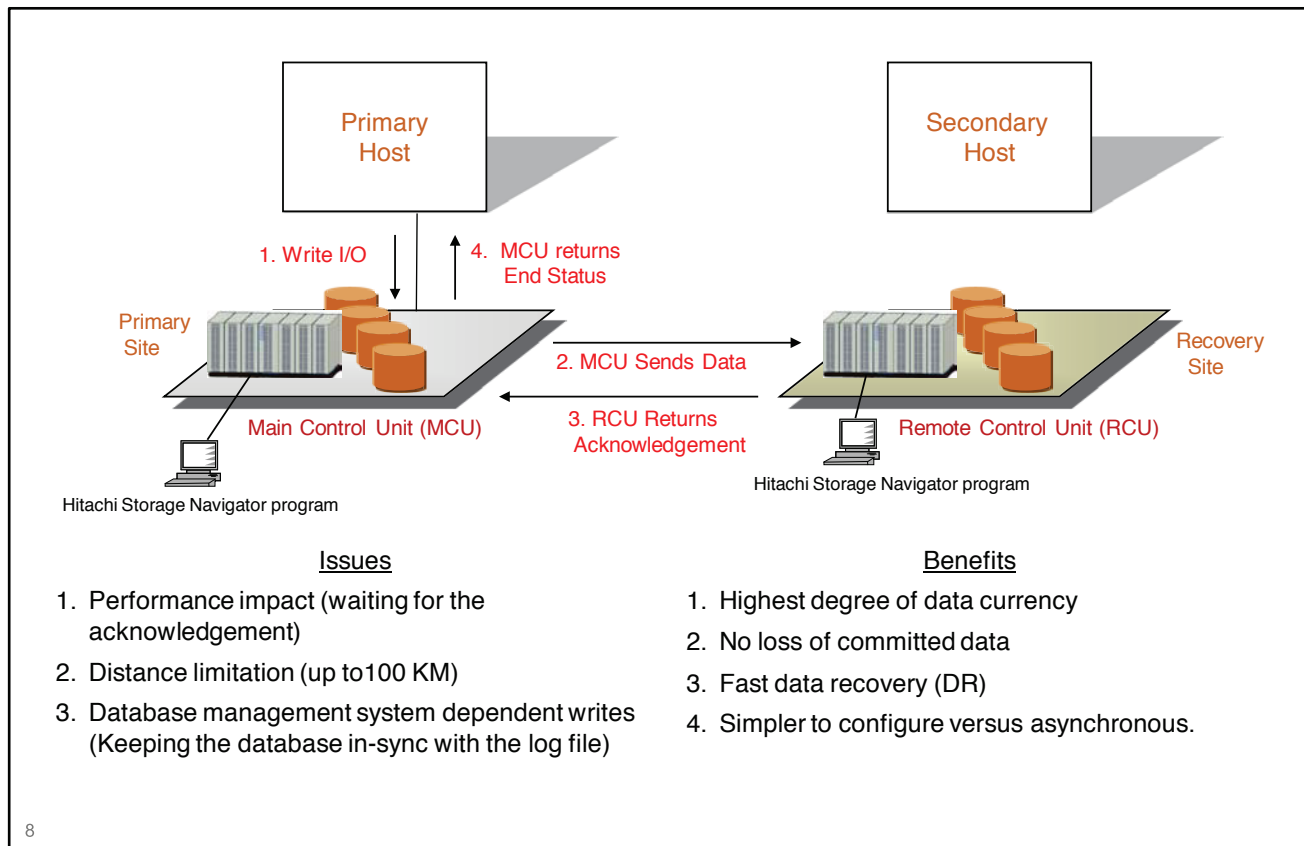
7

CCI – Command Control Interface

RPO – Recovery Point Objective

RTO – Recovery Time Objective

Internal Operations of Synchronous Replication



This type of remote copy solution is implemented entirely in the Hitachi enterprise storage systems microprogram and hardware. It is transparent to the host applications.

Operation

- The primary host server issues a write I/O to the primary control unit.
- The primary control unit sends the data to the secondary control unit.
- The secondary control unit sends an acknowledgement back to the primary control unit.
- The primary control unit sends status end to the host server. The application continues execution.

Pros

- Hardware solution is transparent for operating systems and applications.
- No data loss.
- Data on primary and secondary volumes are synchronized.
- Relatively simple implementation.
- Makes for fast disaster recovery.

Cons

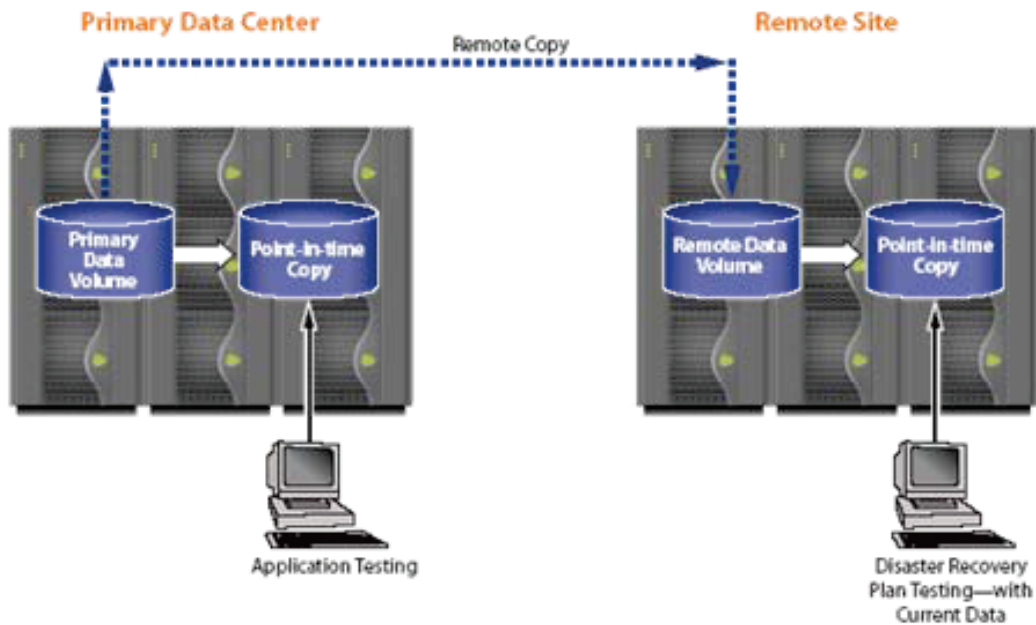
- Short distances.
- Performance loss – Each write takes more time.
- Inability to handle “time-dependent” writes – therefore there is the potential data integrity risk.

This type of solution provides a guarantee that each transaction was written to disk, but the performance of the user’s application may decrease as the distance to the remote device increases. Depending upon the application, this could impair those that are transaction intense. Since the user application waits for a confirmation that each transaction has been written to disk, as the distance to the storage device increases, the time to receive a response also increases.

The risk in this situation is that although the confidence factor is high that the remote storage device has data that is *consistent*, it is probable that the number of transactions that can be processed per second will decrease. The rate of decrease will depend directly on the distance to the remote location and how fast the device can turn around an acknowledgement.

Remote Replication Configurations

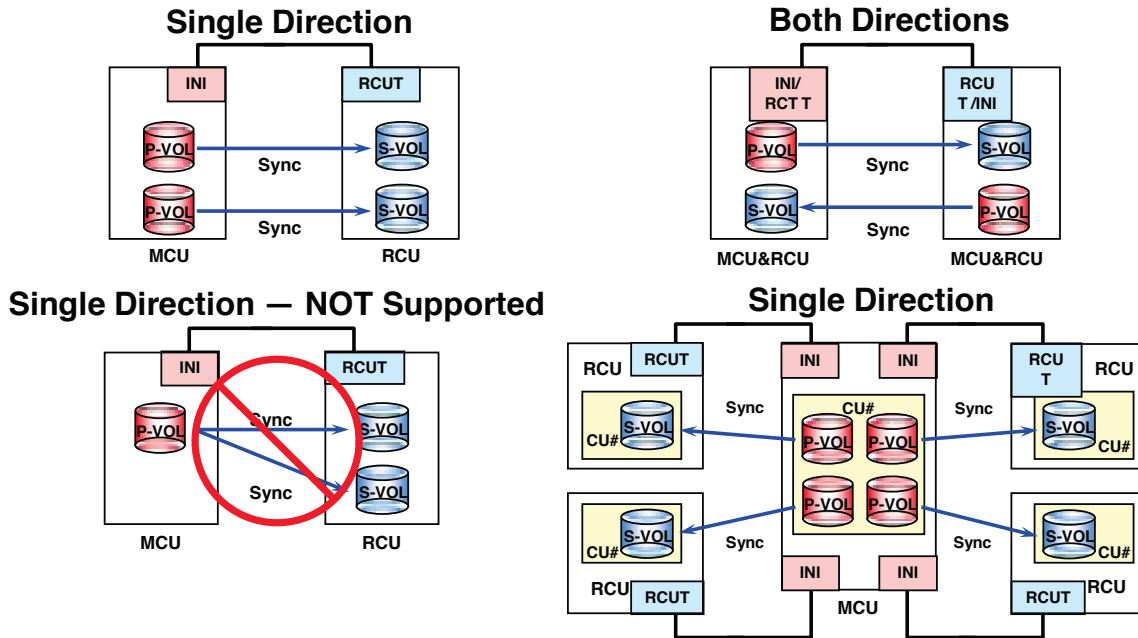
- Two Data Center Configuration



9

Hitachi offers powerful solutions for business continuity as well as for disaster recovery testing while maintaining complete disaster recovery protection. The example above illustrates a typical configuration that uses TrueCopy to maintain an exact, I/O consistent data volume at the remote site. It also uses Hitachi ShadowImage Heterogeneous Replication to create a separate copy for disaster recovery testing. This enables the organization to test its disaster recovery plan with current data.

TrueCopy Synchronous Configurations



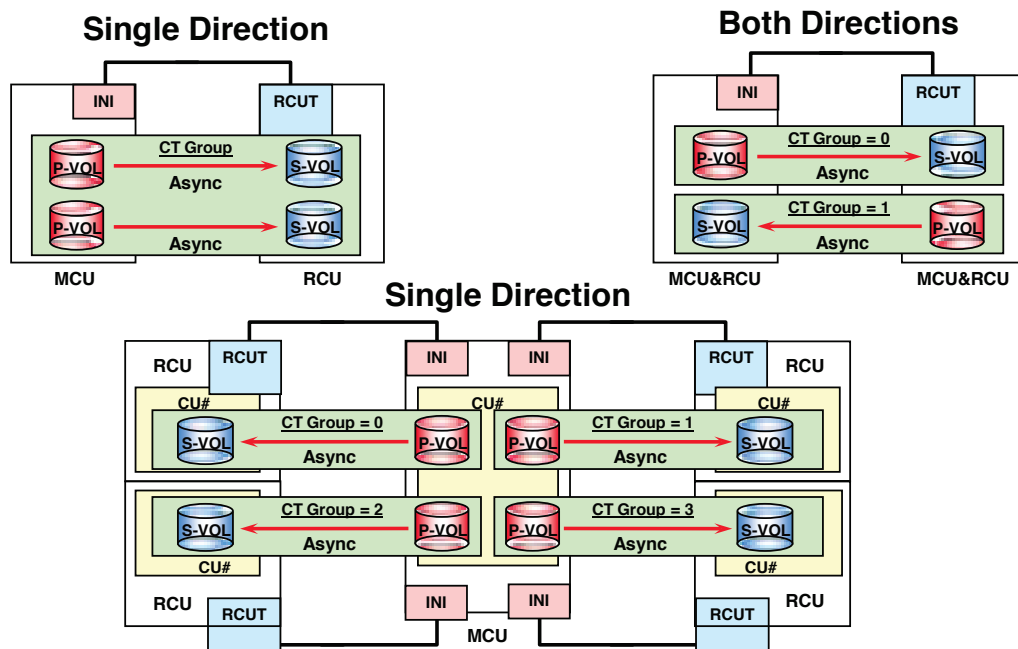
10

Note that TrueCopy Synchronous has no inherent grouping capability. Pair operations occur individually.

P-VOL – Primary volume

S-VOL – Secondary volume

TrueCopy Asynchronous Configurations

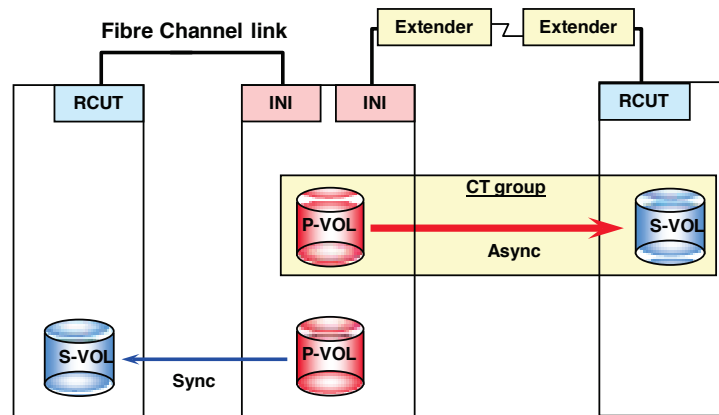


11

TrueCopy Asynchronous has inherent consistency grouping. Pairs operate at either the group or volume level.

- TrueCopy Configurations

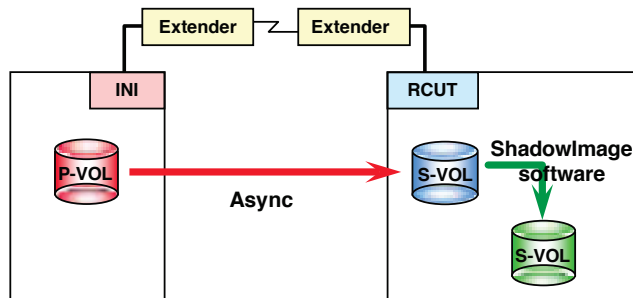
- Synchronous and asynchronous volumes can coexist in the same system



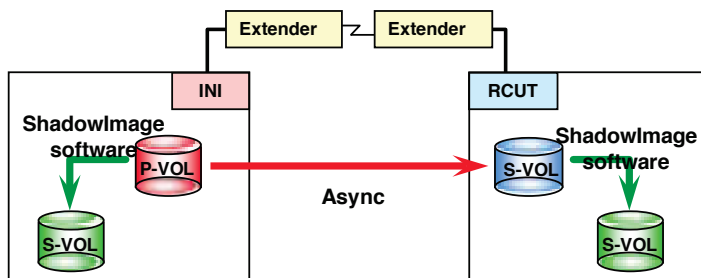
12

Note that while synchronous and asynchronous volumes can coexist in the same storage system, they cannot replicate the same data.

■ TrueCopy and ShadowImage Replication Configurations



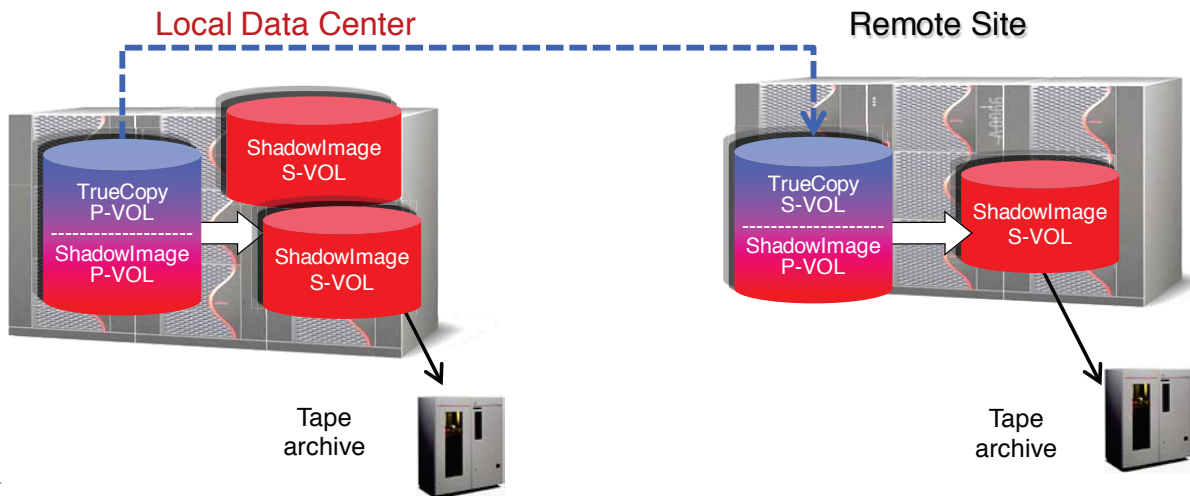
- ShadowImage provides backup copies of a TrueCopy P-VOL at a remote site.



- ShadowImage provides backup copies of a TrueCopy P-VOL at local and remote sites.

TrueCopy and ShadowImage Together

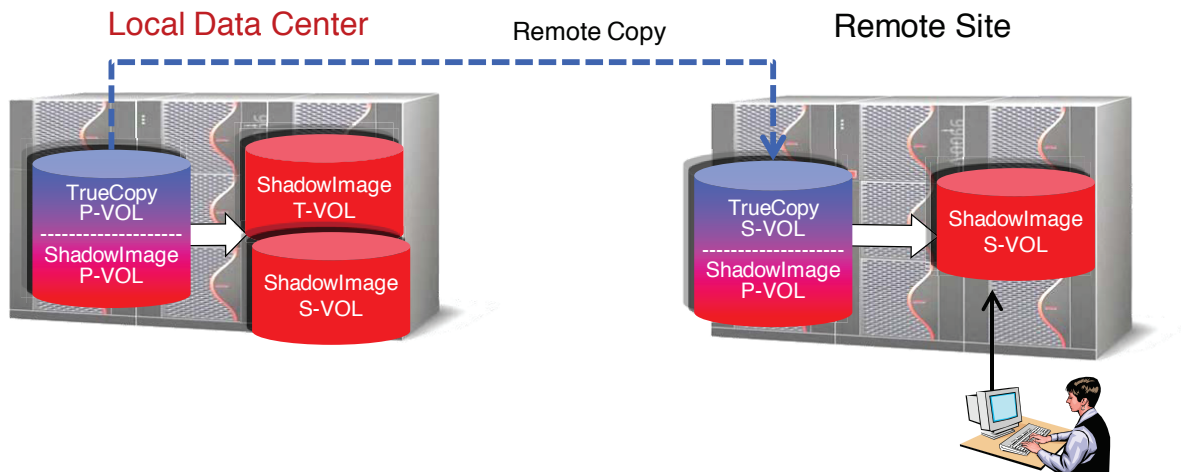
- Primary and Remote Site Backups
 - ShadowImage Replication provides on-site backup copies for rapid recovery, split-mirror backup, decision support, and testing and development.
 - TrueCopy implementation provides a remote disaster restart and recovery capability.



14

■ Disaster Recovery

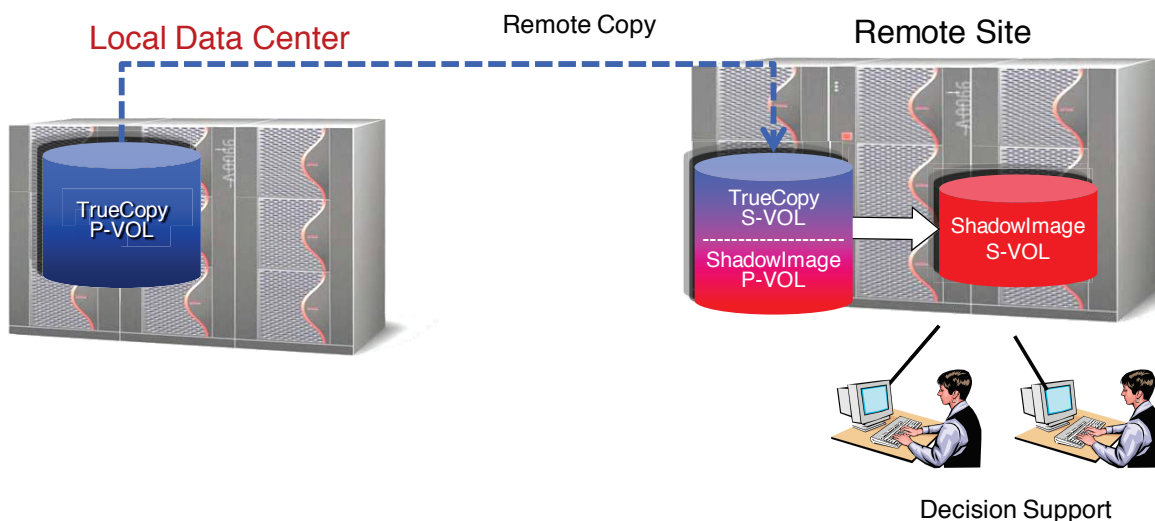
- Test your remote disaster recovery plan nondisruptively with current production data.



15

■ Data Distribution and Migration

- TrueCopy and ShadowImage create and distribute multiple remote copies.
- This provides immediate access to time-critical information.



16

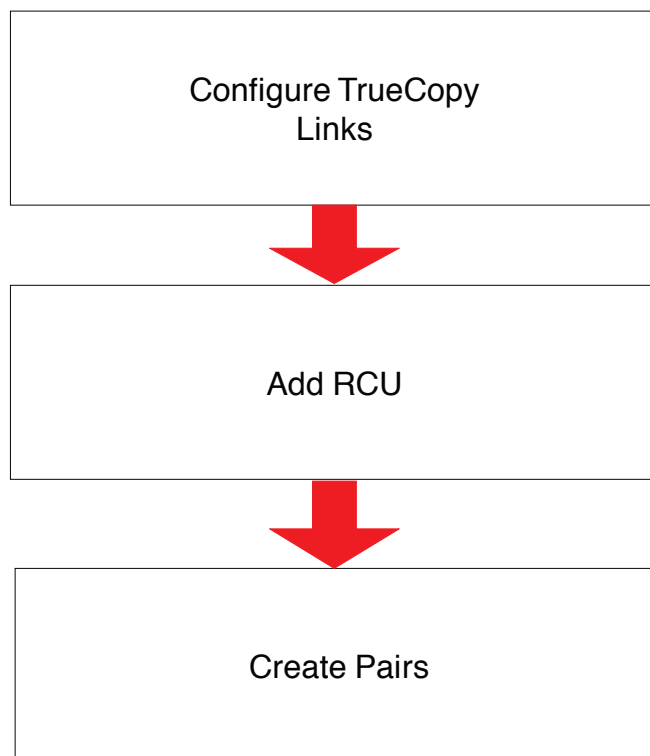
TrueCopy Specifications

- TrueCopy supports external devices, logical unit number expansion (LUSE), Virtual LVI / logical unit number (LUN) and the Cache Residency Manager feature.
- Two LDEVs that comprise a TrueCopy Synchronous volume pair must be the same emulation type and same capacity.
 - LUSE volumes must be same emulation, size, and structure.
 - Example OPEN-V*6 to OPEN-V*6
- Not dependent on RAID levels and HDD types (different levels or types can coexist).

17

TrueCopy defines the MCU and RCU relationship at the LCU level. Each LCU must have a unique four digit identifier called the storage system ID (SSID). The SSIDs are assigned at installation.

TrueCopy Configuration Checklist

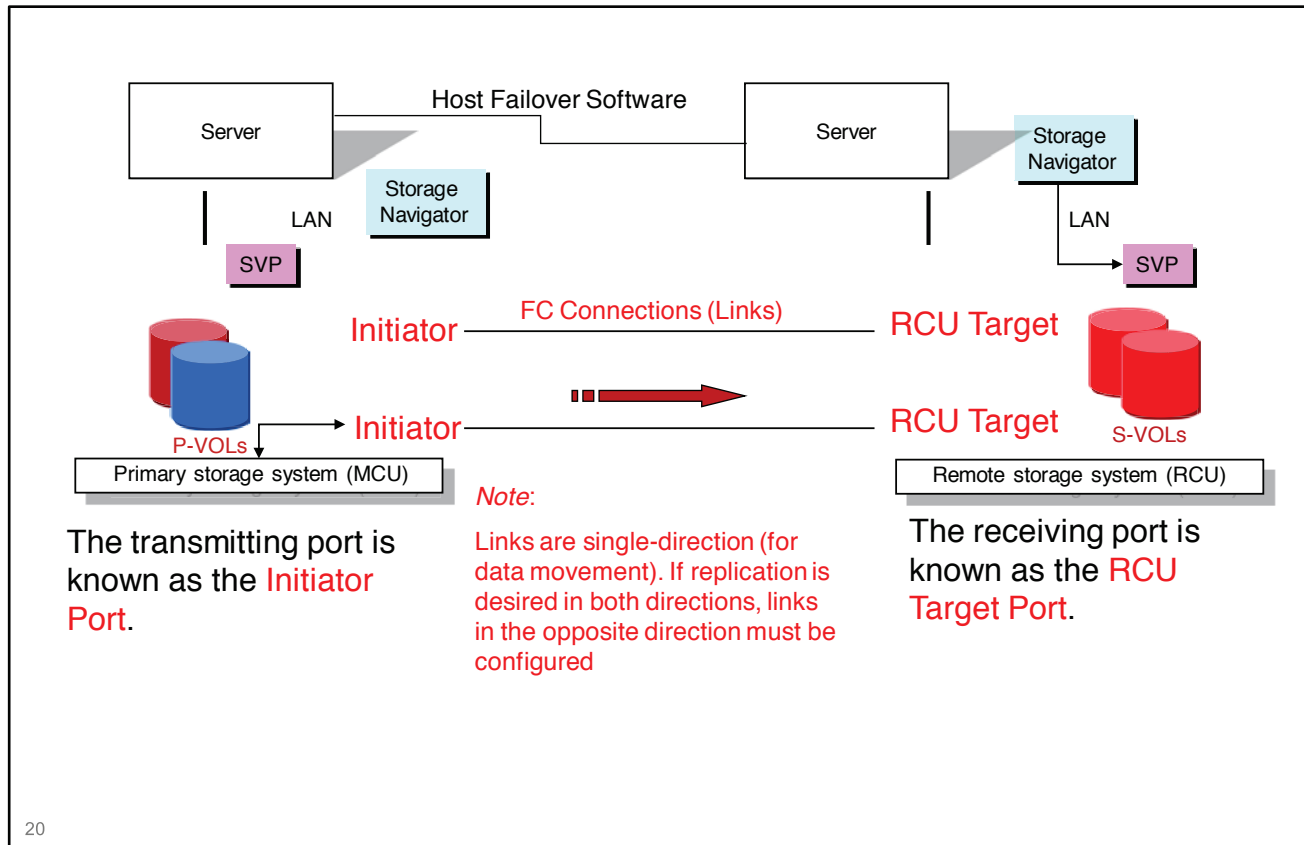


18

Fibre Channel Links

- TrueCopy over Fibre Channel can be configured for the following types of connections:
 - Direct Connection
 - Two systems are directly connected.
 - Switch Connection
 - Two systems are connected using switches.
 - Initiator ports cannot be connected to a host. Hard-zone switches can be added, if necessary, to prevent the hosts from accessing initiator ports.
 - While RCU-target ports can be connected to hosts via a Fibre Channel switch, it is not recommended.
 - Extended Connection
 - Two systems are connected using channel extenders and switches for long distance solution support.
- Other restrictions:
 - LUNs cannot be mapped to initiator ports.
 - Hosts cannot access the initiator ports.
 - The topology for the Initiator and RCU target ports must be the same.
For example, if the initiator port is set for Fabric=OFF, Fibre Channel Arbitrated Loop (FC-AL), then the RCU target should also be set to FABRIC=OFF, FC-AL.

19



The major components of a TrueCopy operation using Fibre Channel interface connections are:

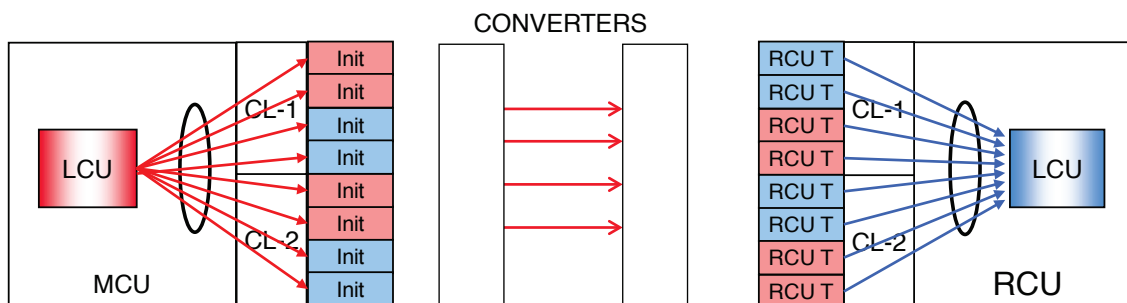
- TrueCopy running on the storage system at the *primary* (production) site and on the storage system at the *secondary* (recovery) site
 - ♦ Storage system at primary site – Main Control Unit (MCU)
 - ♦ Storage system at secondary site – Remote Control Unit (RCU)
- TrueCopy Synchronous/ Asynchronous Volume Pairs
 - ♦ P-VOLs (production volumes) at primary site. The MCUs contain the P-VOLs, containing the original data, and are *online* to hosts.
 - ♦ S-VOLs (secondary volumes) at secondary site. The RCUs contain the S-VOLs, which are the synchronous and asynchronous copies of the P-VOLs. S-VOLs can be online to hosts only when pairs are *SPLIT*, *SUSPENDED*, or *DELETED*.

MCU – RCU Configuration

- TrueCopy Synchronous supports one to N and N to one remote copy connections (N is less than or equal to 4). One MCU can be connected to as many as four RCUs, and one RCU can be connected to as many as four MCUs.
- TrueCopy Asynchronous supports one to one remote copy connections with the same Consistency Group (will be discussed later).

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.

- TrueCopy Synchronous supports up to 8 Fibre Channel links per logical CU.
- MCU-RCU relationships are at the logical CU level.

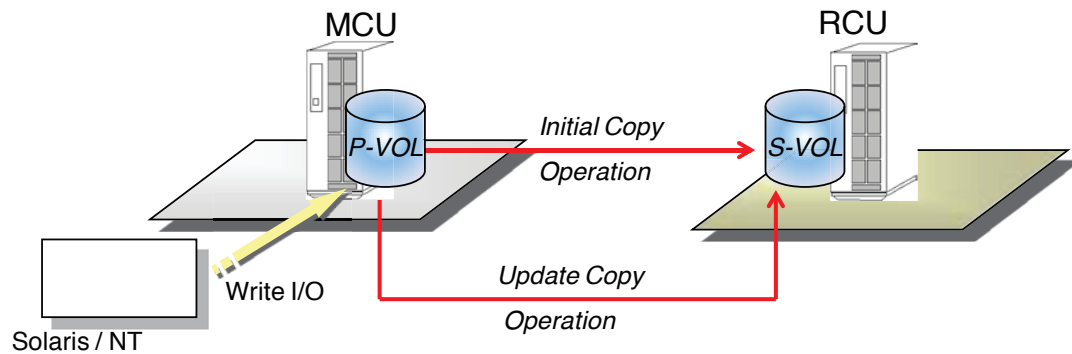


Up to 8 **initiator** ports **per RCU** can be defined in the MCU. Up to 4 RCUs can be attached to each MCU for a total of 32 links per storage system.

Up to 8 **RCU Target** Ports **per MCU** can be defined in the RCU. Up to 4 MCUs can be attached to each RCU for a total of 32 links.

Pair Operations

■ Remote Copy Operation Types



■ Initial Copy Operations

- Syncs P-VOL and S-VOL independently of Host I/O
- Add a pair (Paircreate), Resume and Split Pair

■ Update Copy Operations

- Host issues Write I/O to P-VOL
- Sync Mode: P-VOL and S-VOL kept in sync

22

TrueCopy Synchronous operations involve the primary (main) systems and the secondary (remote) systems (MCUs and RCUs). 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 Synchronous secondary volumes (S-VOLs), which are the synchronous copies of the P-VOLs.

There are two types of copy operations:

- **Initial Copy:** All the content from the primary volume is copied to the secondary volume. As soon as the initial copy starts, the secondary volume becomes unavailable for any type of host I/O.
- **Update Copy.**

Differential Bitmap Function

- TrueCopy Differential Bitmap Function
 - **Differential bitmaps** designate changes to **primary data** volumes during **initial copy**, and to **both primary** and **secondary** volumes while **pairs are split**.
 - Differential bitmaps are maintained in shared memory for each pair.
 - Differential bitmaps operate at either **track or cylinder** level.
 - Denote changed tracks if volume size is less than 10,019 cylinders
 - Denote changed cylinders if volume size is 10,019 cylinders or greater
 - When data volumes are **resynchronized**, differential bitmaps for the two volumes are **merged** and **all changed tracks and cylinders** are sent from primary to secondary volumes.
 - Operating at cylinder level slows resynchronization of split pair (more data has to be sent for any given change).

23

The differential data (updated by write I/Os during split or suspension) between the primary data volume and the secondary data volume is stored in each bitmap. When a split/suspended pair is resumed (pairresync), the primary storage system merges the primary data volume and secondary data volume bitmaps, and the differential data is copied to the secondary data volume.

- During Initial Copy

- Initial State

P-VOL | | | | | | | | | | | | | | | |



- Host write I/Os can change tracks during initial copy

P-VOL | X | X | X | | | X | | X | | | X | | | |



- Changed tracks sent to S-VOL after initial copy completes

S-VOL | X | X | X | | | X | | X | | | X | | | |

24

This diagram illustrates the usage of differential bitmaps, after a **paircreate** command is issued. While Initial Copy is operating, updates can occur to primary volumes. The P-VOL bitmaps denote any changed tracks/cylinders that occur.

Differential Bitmapping for Universal Replicator, TrueCopy Remote Replication, ShadowImage Replication, and Hitachi Copy-on-Write Snapshot work in exactly the same way.

▪ **Pairsplit** Command

- While pairs are split, both P-VOL and S-VOL differential bitmaps may be active.
- Changed Tracks on P-VOL

P-VOL | X | X | | | | X | X | | | | |

- S-VOL mounted with Write Enabled

S-VOL | X | X | | | | | | | X | | |

25

This diagram illustrates the usage of differential bitmaps after a pair is suspended. While suspended, updates can occur to the P-VOL. Changes can also occur on S-VOL if it is mounted as Write Enabled. The bitmaps denote any changed tracks/cylinders while the pair is suspended.

- Resynchronization

- Changes that have occurred while pair is split

P-VOL | X | | X | | | X | | X | | | | |

S-VOL | X | | | X | | | | | | X | | | | | . . .



- Merge

P-VOL | X | | X | X | | | X | | X | | X | | | | |

- P-VOL differential bitmap after OR operation

26

This diagram illustrates the usage of differential bitmaps after a pair is resynchronized.

While suspended, updates may occur to both primary and secondary volumes. The bitmaps denote any changed tracks/cylinders while the pair is suspended.

When the **resync** command is issued, the S-VOL differential bitmaps are merged into the P-VOL differential bitmaps. Then all of the changed data are copied from the P-VOL to the S-VOL. This process results in overwrites for any changed S-VOL data.

Advanced Pair Operations and Recovery Scenarios

- **Takeover**

- If a primary site is damaged and operation cannot continue, the takeover operation is used to immediately continue operations at a secondary site.

- **Takeback**

- When the damaged primary site is recovered, the takeback operation is used to immediately switch operations from the secondary site back to the primary site.

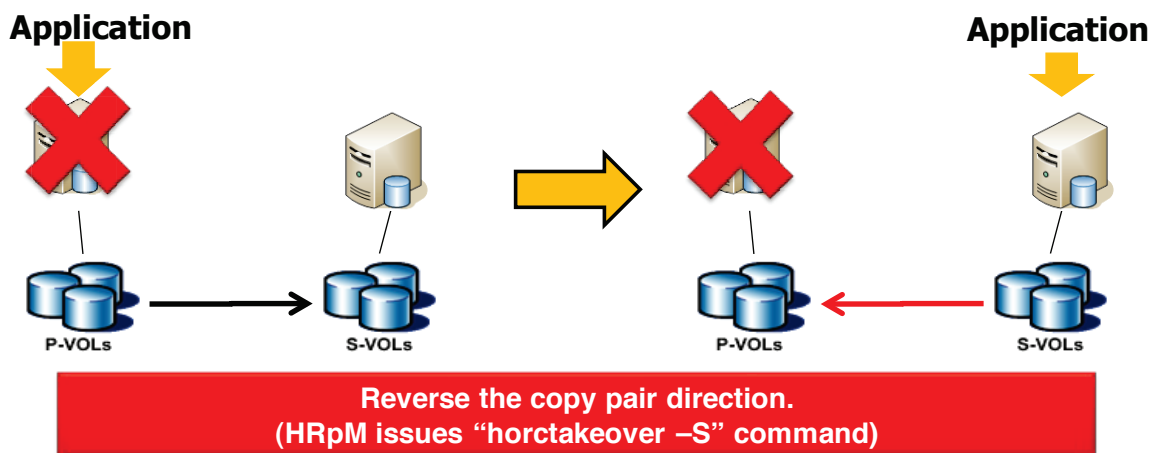
27

In addition to the basic pair operations (such as split and resync), the Change Pair Status Wizard supports several advanced operations for open system pairs. The relationship between the basic and advanced operations can be understood in terms of two scenarios:

- Takeover (the pair is split apart or swapped)
- Takeback (the pair is recovered)

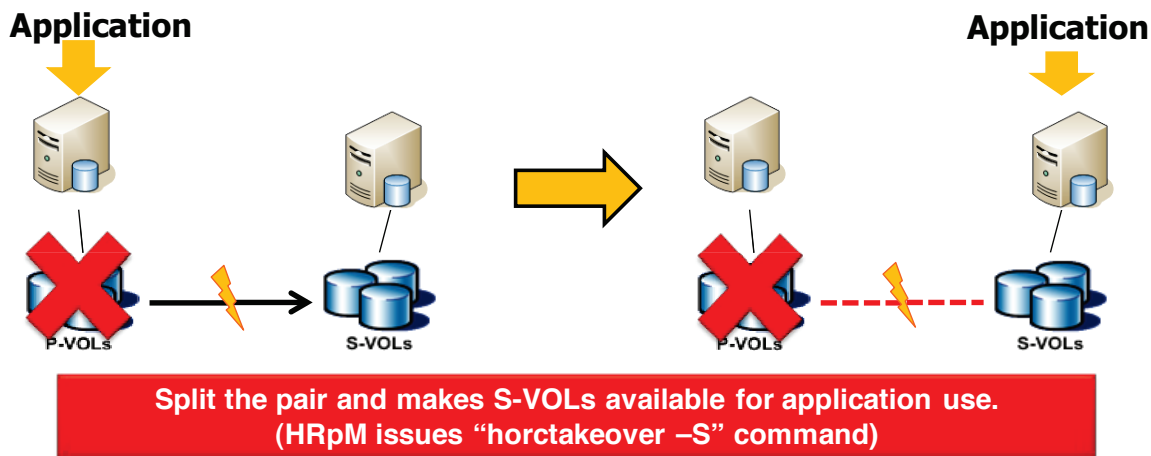
Hitachi Open Remove Copy (HORC) Takeover Support

- Takeover — Server Failure
 - User can perform **takeover** for operating the application at remote site during failure.
 - Automatically performs either of the following depending on failure type.



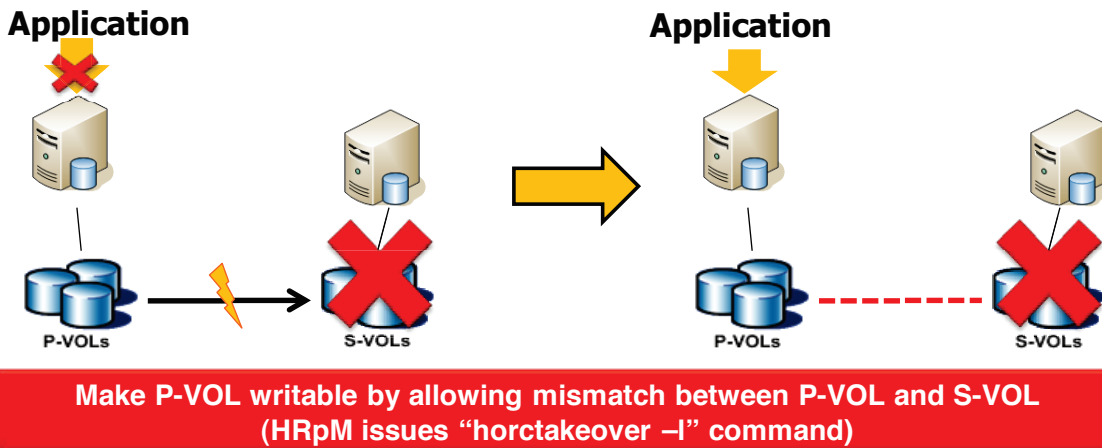
28

- Takeover — Storage Failure or Remote Failure
 - User can perform **takeover** for operating the application in remote site during the failure.
 - It automatically performs either of the following depending on the failure type.



29

- **Force-Split — Remote Path or Secondary Site Failure**
 - User can perform **force-split** for recovering application I/O to P-VOL when it is suspended due to Fence Level option of TrueCopy Sync pairs.
 - It makes P-VOL available even though P-VOL and S-VOL becomes not identical.

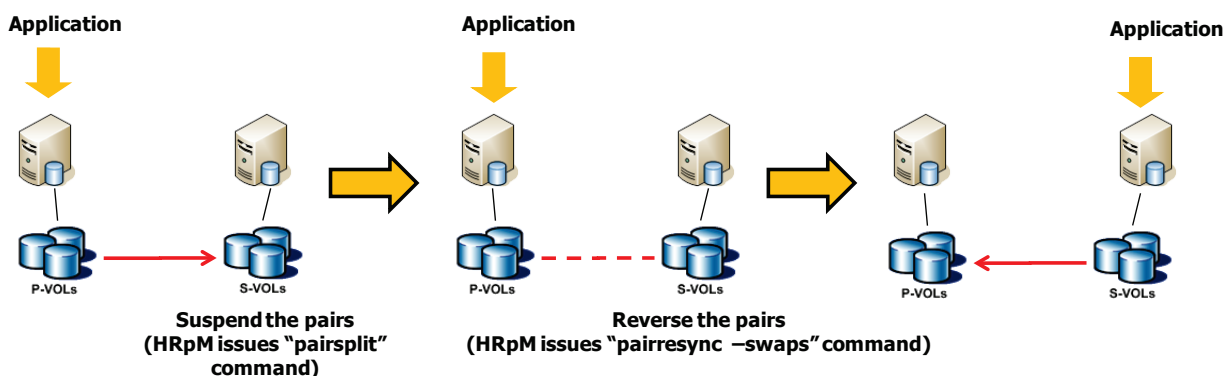


30

- Fence Level (data or status) option can be specified when creating pairs. This option is used for guaranteeing the same data on P-VOL and S-VOL even when a failure has occurred.
- If this option was enabled, Application I/O to P-VOL returns error if storage system fails writing to S-VOLs.

■ Swap

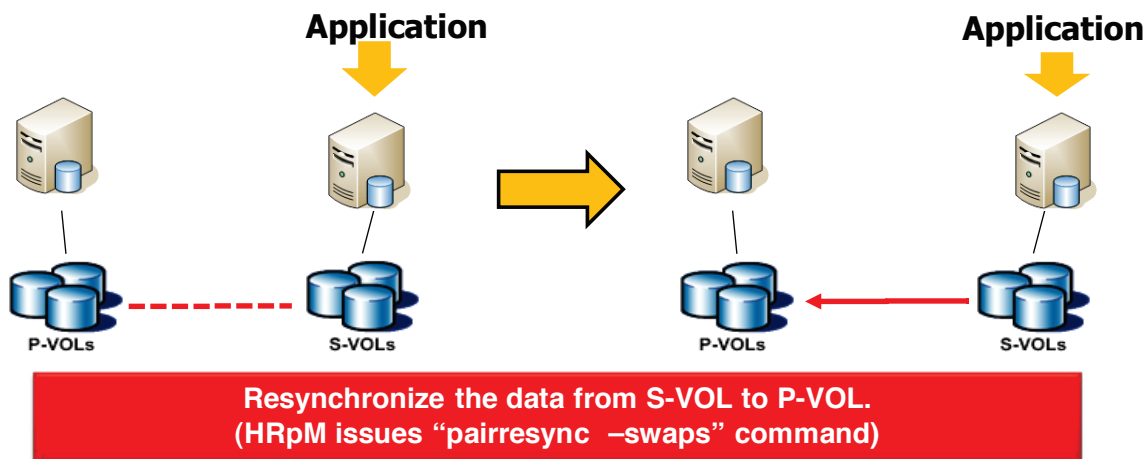
- User can perform **swap** for maintenance of primary site or remote path.
- **swap** is also used for failback (restore the copy pair back to P-VOL > S-VOL direction).



31

- Swap operation performs two steps (suspend and reverse). If P-VOLs have any issues, this operation fails at first **suspend** step and keeps the pair status as PAIR.
- In maintenance scenario, keeping the PAIR status is preferable rather than forcefully making S-VOLs available to applications. (**Takeover** operation forcefully split pairs when there is an error on P-VOL for making S-VOLs available.)

- **Takeover-Recovery** — Pair is not lost during the failure.
 - Pair status is other than SMPL.
 - User can perform **takeover-recover** for restoring data to primary site.
 - Depending on the pair status, user specifies whether to resynchronize or recreate pairs.



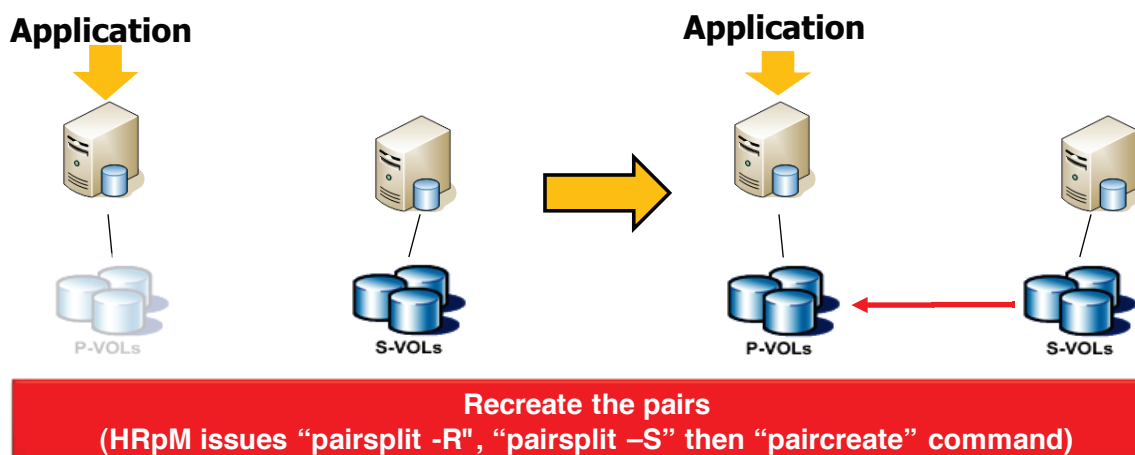
32

There are two types of takeover-recovery operations:

- takeover-recovery (resync)
- takeover-recovery (recreate)

A takeover-recovery operation is used as a recovery procedure when a user performs a takeover operation and the secondary volume changes to Split (SSWS). The details of the executed takeover-recovery operation depend on the options specified, so you must check the copy pair status and select the options accordingly.

- Takeover-Recovery — Pair is lost during the failure.
 - Pair status is SMPL.
 - User can perform **takeover-recover** for restoring data to primary site.
 - Depending on the pair status, users specifies whether to resynchronize or recreate pairs.



33

■ Select Pair Operation — Basic and Advanced options

HRpM- Change Pair Status Wizard

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Select "Basic" for usual copy pair operation or select "Advanced" for the copy pair operation that relates to takeover or takeback, then click "Next>" to continue.

Pair Operation

Operation: ☒ Basic

split
split
resync
restore
delete

Options:

Secondary Mode:

Force Suspend: ☐ On

Pair List

Rows/Page: 100 | Page: 1 of 1

Copy Pair	Copy Type	Primary	Secondary
		Pair State	Pair State
		LDEV	LDEV
		Storage System	Storage System
P_000-302_0004	TCS	Pair (PAIR)	Pair (PAIR)
		0:00	3:02
		USP_V@10.74.64.24 (10152)	USP_V@10.74.64.25 (10043)

34

- **Advanced** option for performing operations (takeover, swap, force-split and takeover-recovery).
- Existing pair operations (split, resync, etc.) are categorized in **Basic** operations.

- **Takeover-recovery** operation provides additional parameters for resync and recreating copy pairs.

The screenshot displays a configuration window for Hitachi TrueCopy operations. It is divided into two main sections: 'Operation:' and 'Options:'.
In the 'Operation:' section, there are two radio buttons: 'Basic' and 'Advanced'. The 'Advanced' radio button is selected. Below the radio buttons is a text field containing the command 'swap [pairsplit+pairresync -swaps]'.
In the 'Options:' section, there is a 'Copy Pace' dropdown menu currently set to '15'.

■ Tasks View

The screenshot displays the Hitachi TrueCopy interface. On the left, the 'Explorer' sidebar shows the 'Tasks' section selected. The main window is divided into two panes. The top pane shows the 'URGroup' configuration, including a 'Copy Group Summary' table and a 'Pairs' table. The 'Pairs' table lists a pair with ID 'P_06A-061_0028' in a 'Success' state. The bottom pane shows the 'Task List' table, which contains several tasks. A red box highlights the task with ID 'TASK0101', which is a 'swap' operation. A callout box labeled 'Swap operation example' points to this task.

Task ID	Workflow	MF/Open	Host	Target	Copy Type	Task Type	Status	Create Time
TASK0101		Open	scsat7121	TCSTEST	TCS	swap	Success	2011-11-11 11:11:11
TASK0100		Open	172.17.72.35	TEST	Local	create replica(SQL)	Success	2011-11-11 11:11:11
TASK0099		Open	SCSAW7235	DF800E-EXG	n/a	modify file		
TASK0098		Open	SCSAW7235	DF800E-EXG	SI	delete		
TASK0094		Open	scsat7121	TCSTEST	TCS	modify file + create	Success	2011-11-11 11:11:11
TASK0093		Open	ClusteredSQL	DEFAULT	Local	create replica(SQL)	Success	2011-11-11 11:11:11

The result of **Change Pair Status Wizard** operation is registered as task. User can confirm the status on the task view.

After task is completed, user can confirm the updated configuration or status on the copy group window.

■ **Additional Notes**

- If copy direction is reversed by HORC Takeover operations, the following settings for the original copy groups become unavailable:
 - Alert
 - My Copy Group
 - Scheduled execution of pairs
- If the above settings are required while the copy directions are reversed, please reconfigure these settings.
 - When the reversed copy direction is brought back to the original, the above settings for original copy groups become available again.

37

Pair Operations

- **Paircreate** — P-VOL fence level
 - **Never:** P-VOL will never be fenced.
 - **Data:** P-VOL will be fenced when the MCU cannot successfully execute an update copy operation for any reason.
 - **Status:** 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.

38

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.

▪ **paircreate** – Initial Copy Parameters

- Initial Copy:
 - Entire Volume: Copy all P-VOL data to S-VOL (default).
 - No Copy: Do not copy any P-VOL data to S-VOL.
- Initial Copy Pace:
 - Desired number of tracks to be copied at one time (1 –15) during the initial copy operation.

39

Initial Copy Parameters

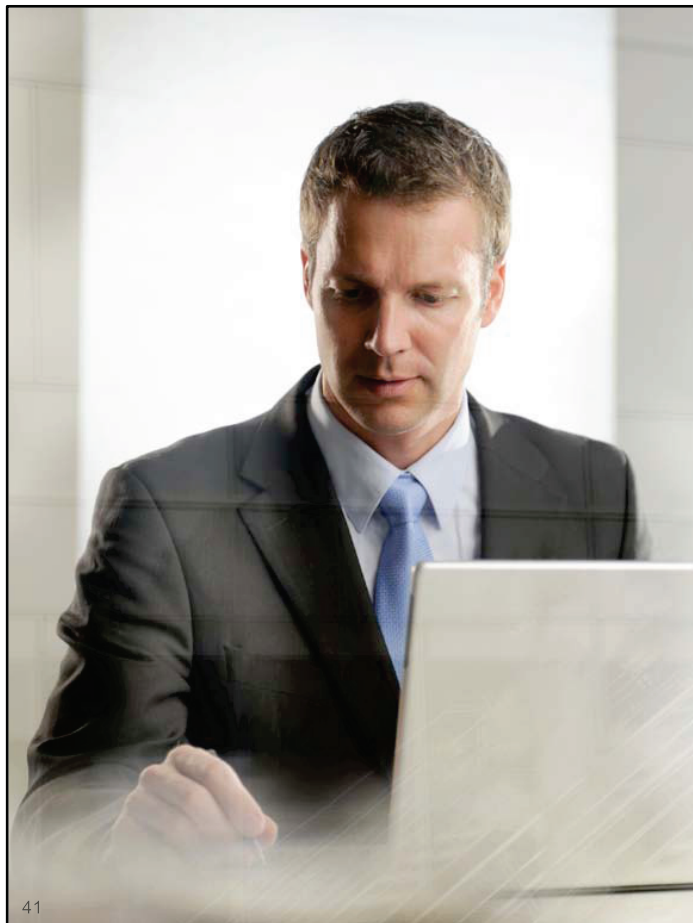
Select the initial copy options for the new pairs. These options cannot be changed after a pair has been added:

- Initial Copy:
 - ♦ Entire – Copy all P-VOL data to S-VOL;
 - ♦ No Copy = do not copy any P-VOL data to S-VOL.
 - ♦ Default = 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. Default = 15.

TrueCopy Operations

- Using Replicator Manager
 - Set up remote paths
 - Manage pairs

Instructor Demonstration — Hitachi TrueCopy



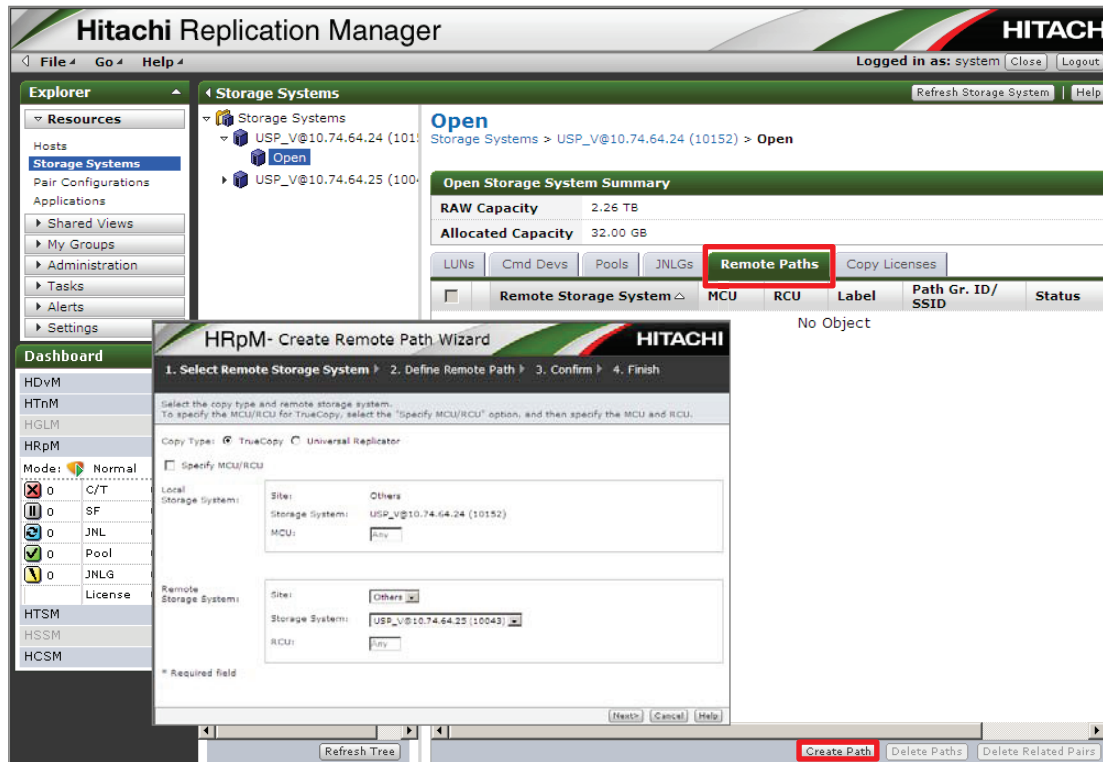
41

Instructor Demonstration

- Hitachi TrueCopy
 - Setup Remote Path
 - Create Pair
 - Split Pair
 - Resync Pair
 - Takeover



Setting Up Remote Paths



42

Remote Paths are port connections between local and remote storage systems. These logical routes are used by remote copy pairs for copying data from a P-VOL to an S-VOL. Replication Manager allows remote path configuration for different replication technologies. You must set up a remote path before you can use any of the following volume replication functions:

TrueCopy

For enterprise-class storage systems: Based on the copy direction, you specify the port for the local storage system CU (MCU) and the port for the remote storage system CU (RCU). Initiator and RCU Target are set automatically as the attributes of the specified ports.

You can specify either CU Free (recommended) (to connect only from the local storage system to a remote storage system via a dynamically assigned MCU-RCU pair) or CU Specific (to connect each path via a specified MCU and RCU).

Universal Replicator

Using CU Free, you can specify the port for the local storage system and the port for the remote storage system. You must set paths for both directions. Initiator and RCU Target are set automatically as the attributes of the specified ports.

- Define Remote Paths — Assign path **Label**, specify local and remote ports

HRpM- Create Remote Path Wizard HITACHI

1. Select Remote Storage System > 2. Define Remote Path > 3. Confirm > 4. Finish

Specify the label, path group ID, local ports, and remote ports.
To define a bi-directional remote path, select "Select reverse direction path", and then enter the parameters in the right pane.

Local Storage System: USP_V@10.74.64.24 (10152)
Remote Storage System: USP_V@10.74.64.25 (10043)

☐ Select reverse direction path

Local -> Remote

Label:

*Path Group ID:

Local Port: ->

Remote Port: ->

Existing Ports	
Local	Remote
Local (Initiator)	Remote (RCU Target)
	No Object

Local -<- Remote

Label:

*Path Group ID:

Local Port: <->

Remote Port: <->

Existing Ports	
Local	Remote
Local (Initiator)	Remote (RCU Target)
	No Object

☒ Select reverse direction path

Local -> Remote

Label:

*Path Group ID:

Local Port: ->

Remote Port: ->

Existing Ports	
Local	Remote
Local (Initiator)	Remote (RCU Target)
	No Object

Local -<- Remote

Label:

*Path Group ID:

Local Port: <->

Remote Port: <->

Existing Ports	
Local	Remote
Local (RCU Target)	Remote (Initiator)
	No Object

43

Select reverse direction path checkbox should be checked only if reverse links are set up between the two sites.

■ Reviewing and Confirming the Task

1. Select Remote Storage System ▶ 2. Define Remote Path ▶ 3. Confirm ▶ 4. Finish

Check the remote path settings.
Carefully review the summary below, and then click "Confirm" to create the remote path.
This operation might take several minutes to finish.

Initiators/RCU Targets

⚠ This operation will change the attribute of ports listed below.
Note that the attributes of the ports associated with the selected ports will also be changed.
After changing the attributes, these ports will be dedicated for remote copying, and will not be available for host-storage connection.

Storage System	Selected Port	Associated Port	Attribute (Current)	Attribute (After the op.)
USP_V@10.74.64.24 (10152)	CL3-E	CL7-E	Target	Initiator
USP_V@10.74.64.24 (10152)	CL4-E	CL8-E	Target	RCU Target
USP_V@10.74.64.25 (10043)	CL4-E	CL8-E	Target	RCU Target
USP_V@10.74.64.25 (10043)	CL3-E	CL7-E	Target	Initiator

Local Storage System: Site: Others
Storage System: USP_V@10.74.64.24 (10152)
MCU: Any

Remote Storage System: Site: Others
Storage System: USP_V@10.74.64.25 (10043)
RCU: Any

Remote Path:

Local -> Remote

Label: Path_M_R

Path Group ID: Default

Local Port: CL3-E Remote Port: CL4-E

Local <- Remote

Label: Path_R_M

Path Group ID: Default

Local Port: CL4-E Remote Port: CL3-E

☒ Yes, I have confirmed the above information and wish to create a remote path.

<Back Confirm Cancel Help

44

■ Task Summary

HRpM- Create Remote Path Wizard **HITACHI**

1. Select Remote Storage System ▶ 2. Define Remote Path ▶ 3. Confirm ▶ 4. Finish

"Create Remote Path" completed successfully. Click "Finish" to finish the wizard.

Information "Create Remote Path" completed successfully. Click "Finish" to finish the wizard.
The newly created remote path will be displayed in the "Remote Paths".

Initiators/RCU Targets

⚠ This operation changed the attribute of the following ports.
Note that the attributes of the ports associated with the selected ports were also changed.

Storage System	Selected Port	Associated Port	Attribute
USP_V@10.74.64.24 (10152)	CL3-E	CL7-E	Initiator
USP_V@10.74.64.24 (10152)	CL4-E	CL8-E	RCU Target
USP_V@10.74.64.25 (10043)	CL4-E	CL8-E	RCU Target
USP_V@10.74.64.25 (10043)	CL3-E	CL7-E	Initiator

45

Remote Paths

Storage Systems Refresh Storage System Help

Storage Systems > USP_V@10.74.64.24 (10152) > Open

Open Storage System Summary

RAW Capacity 2.26 TB
Allocated Capacity 32.00 GB

LUNs Cmd Devs Pools JNLGs **Remote Paths** Copy Licenses

Rows/Page: 100 Page 1 of 1

	Remote Storage System	MCU	RCU	Label	Path Gr. ID/SSID	Status	Num of Paths
☐	USP_V@10.74.64.25 (10043)	Any	Any	Path_M_R	Default	Normal	1

Storage Systems Refresh Storage System Help

Storage Systems > USP_V@10.74.64.25 (10043) > Open

Open Storage System Summary

RAW Capacity 2.25 TB
Allocated Capacity 28.00 GB

LUNs Cmd Devs Pools JNLGs **Remote Paths** Copy Licenses

Rows/Page: 100 Page 1 of 1

	Remote Storage System	MCU	RCU	Label	Path Gr. ID/SSID	Status	Num of Paths
☐	USP_V@10.74.64.24 (10152)	Any	Any	Path_R_M	Default	Normal	1

Adding or Deleting Ports to Remote Path

HRpM Hitachi

Edit Remote Path Help

Operation Type: ☒ Add Ports ☐ Delete Ports

Remote Path Summary

Path Gr. ID/SSID Default
Local Storage System USP_V@10.74.64.24 (10152)
MCU Any
Remote Storage System USP_V@10.74.64.25 (10043)
RCU Any

Remote Path Setting

Label: Path_M_R

Local Port: CL3-E
Remote Port: CL4-E

Existing Ports

Local (Initiator)	Remote (RCU Target)
CL3-E	CL4-E
CL7-E	CL8-E

HRpM Hitachi

Edit Remote Path Help

Operation Type: ☐ Add Ports ☒ Delete Ports

Remote Path Summary

Path Gr. ID/SSID Default
Local Storage System USP_V@10.74.64.24 (10152)
MCU Any
Remote Storage System USP_V@10.74.64.25 (10043)
RCU Any

Remote Path Setting

Label: Path_M_R

Local Port: CL3-E
Remote Port: CL4-E

Existing Ports

Local (Initiator)	Remote (RCU Target)
CL3-E	CL4-E
CL7-E	CL8-E

46

47

Managing Pairs

- Setting up Copy Type as TCS (TrueCopy Sync)
 - Select P-VOL or S-VOL

HRpM- Pair Configuration Wizard

1. Introduction ▶ 2. **Pair Association** ▶ 3. Group Management ▶ 4. Task Management ▶ 5. Confirm ▶ 6. Finish

Use this dialog box to modify pair groups and copy group. To create a pair group, select a volume icon displayed in "Copy Topology", and then click "Add Group".

Copy Topology

TC_Grp

TCS

Buttons: Add Group, Delete Group

Detail of TC_Grp

Pair List

Filter By:

Volume Type: Primary

Resource: Selection:

Refresh

Pairs:

Port/Host Group/LUN	LDEV	Storage System	Capacity	Label	Volume Attribute
CL1-A/WLAB0K/02	0:00	USP_V@10.74.64.24 (10152)	2.00 GB		CVS
CL2-B/WLAB0Q/04	3:02	USP_V@10.74.64.25 (10043)	2.00 GB		CVS

Rows/Page: 100 Page 1 of 1

Buttons: <Add, Delete>

48

■ Specifying Copy Group Attributes

HRpM- Pair Configuration Wizard

1. Introduction ▶ 2. Pair Association ▶ **3. Group Management** ▶ 4. Task Management ▶ 5. Confirm ▶ 6. Finish

Associate a pair group with a new or existing copy group. To select a pair group, click the arrow icon displayed in "Pair Group".

Copy Group

Copy Group :

Pair List

Action	Pair Name	Port/Hos

HRpM Create Group

Copy Group Setting

Enter the information of copy group for adding.

*Group Name:

Pair Configuration File:

Primary Server		Secondary Server	
Site:	Server Name:	Site:	Server Name:
Others	WLAB0K	Others	WLAB0L
*Instance:	0	*Instance:	1
*UDP Port:	11000	*UDP Port:	11001

* Required field

OK Cancel

Create Group Remove Group Edit Pair Name

49

Note that most of the scenarios require a pair management server on the primary as well as secondary site.

■ Pair Configurations View

Pair Configurations
Pair Configurations

Pair Management Servers

Pair Management Server	IP Address	Information Source
WLAB0K	10.74.65.95	local HDvM
WLAB0L	10.74.65.56	local HDvM
WLAB0P	10.74.65.59	local HDvM
WLAB0Q	10.74.65.60	local HDvM

50

■ Specifying Additional Settings

HRpM- Pair Configuration Wizard

1. Introduction ▶ 2. Pair Association ▶ 3. Group Management ▶ **4. Task Management** ▶ 5. Confirm ▶ 6. Finish

Edit a task. To edit a task, click the Modify icon of the desired task in "Task List".

Copy Topology

TC_Grp
TCS

Task List

☐	Copy Group △	Copy Type
☐	TC_Grp	TCS

HRpM Edit Task

Task Options | **Pair Setting**

If you click "OK", the task is changed to Ready state, and will be executed in the time specified in "Execution Request Time".

Pair Operation

Operation : create
Copy Pace: 15
Fence Level: never
No Copy: never
Assign CTG: data status

Pair List

☒	Pair Name △	Port/Host Group/LUN	LDEV	Storage System	Capacity
☒	P_000-302_0004	CL1-A/WLAB0K/02 CL2-B/WLAB0Q/04	0:00 3:02	USP_V@10.74.64.24 (10152) USP_V@10.74.64.25 (10043)	2.00 GB 2.00 GB

OK Cancel

51

■ Pair Status

The screenshot displays the Hitachi TrueCopy Replication Manager interface. On the left is the 'Explorer' pane with a tree view of resources including Hosts, Storage Systems, Pair Configurations, and Applications. The 'Pair Configurations' section is expanded, showing a hierarchy of WLAB0K, horcm0.conf, SI_GRP, TC_Grp, horcm1.conf, WLAB0L, WLAB0P, and WLAB0Q. The main pane shows the 'TC_Grp' configuration page. It includes a 'Copy Group Summary' table and a 'Pairs' table.

Copy Group Summary

C/T Delta	SI
Side File / Journal Usage	TCA / TCE / SDR
Primary Server	WLAB0K
Primary Config File	horcm0.conf
Secondary Server	WLAB0L
Secondary Config File	horcm1.conf
CTGID	
Visible / Total	1 / 1
Mainframe Consistency Group	

Pairs

Copy Pair	Copy Type	Pair Status	Copy Progress		Primary Pair State	LDEV
			Active	Inactive		
P_000-302_0004	TCS		74%		Copying (COPY)	0:00

52

■ Pair Status Change

The screenshot shows the 'HRpM- Change Pair Status Wizard' in the Hitachi TrueCopy Replication Manager. The wizard is at step 3, 'Select Pair Operation'. It provides instructions to select 'Basic' for usual copy pair operation or 'Advanced' for takeover or takeback. The 'Pair Operation' section shows the 'Basic' operation selected, with a dropdown menu showing options: split, resync, restore, and delete. The 'Options' section shows 'Secondary Mode' set to 'Read Only' and 'Force Suspend' set to 'On'. The 'Pair List' table at the bottom shows the current state of the copy pair.

HRpM- Change Pair Status Wizard

1. Introduction ▶ 2. Select Copy Pairs ▶ 3. Select Pair Operation ▶ 4. Set Schedule ▶ 5. Confirm ▶ 6. Finish

Select "Basic" for usual copy pair operation or select "Advanced" for the copy pair operation that relates to takeover or takeback; then click "Next>" to continue.

Pair Operation

Operation: ☒ Basic

Options: Secondary Mode: Force Suspend: ☐ On

Pair List

Copy Pair	Copy Type	Primary Pair State	LDEV	Storage System	Secondary Pair State	LDEV	Storage System
P_000-302_0004	TCS	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	3:02	USP_V@10.74.64.25 (10043)

53

Module Summary

- In this module, you learned how to:
 - Describe TrueCopy key benefits and features
 - Describe TrueCopy remote replication solutions
 - Describe TrueCopy internal operations
 - Describe how TrueCopy and ShadowImage Replication work together
 - List the steps to perform TrueCopy operations with Replication Manager

Module Review

1. What are the pre-requisites for performing TrueCopy operations from Hitachi Replication Manager?
2. What is the minimum number of paths required to set up TrueCopy operations from Site A to Site B?
3. What are takeover operations?
4. What is the default value for Fence Level?

7. Hitachi Universal Replicator Operations with Replication Manager

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the features of the Hitachi Universal Replicator
 - List the benefits
 - List the specifications
 - Describe the supported configurations
 - Perform Hitachi Universal Replicator operations with Hitachi Replication Manager

Hitachi Universal Replicator Overview

- Hitachi Universal Replicator (HUR) is an asynchronous, continuous, nondisruptive, host-independent remote data replication solution for disaster recovery (DR) or data migration over long distances.
- HUR and ShadowImage can be used together in the same storage system and on the same volumes to provide multiple copies of data at the primary and remote sites.
- TrueCopy Synchronous and HUR can be combined to allow advanced three data center (3DC) configurations for optimal data protection.

3

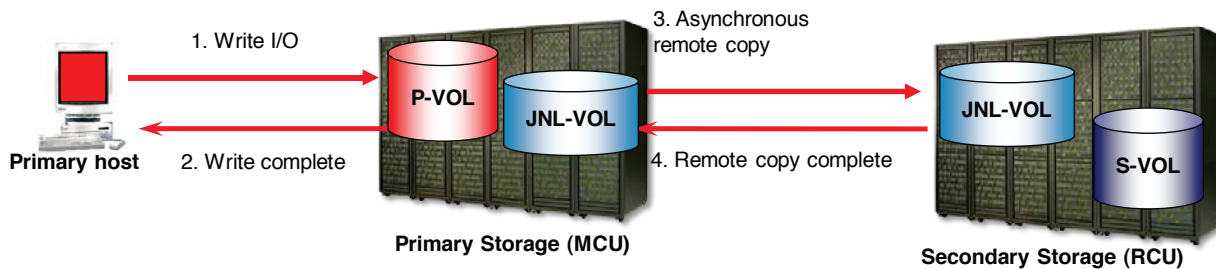
Hitachi Universal Replicator delivers simplified asynchronous data replication across internal and external storage attached to Hitachi Universal Storage Platform® family. Universal Replicator is designed for organizations with demanding heterogeneous data replication needs for business continuity or improved IT operations. HUR delivers enterprise-class performance associated with storage system-based replication while providing resilient business continuity without the need for redundant servers or replication appliances.

■ **HUR Benefits**

- Ensures Business Continuity
- Optimizes resource use (lowers the cache and resource consumption on production and primary storage systems)
- Improves bandwidth utilization and simplifies bandwidth planning
- Improves operational efficiency and resiliency (mitigates the impact of link failures between sites)
- Provides more flexibility in trading off between Recovery Point Objective and cost
- Implements advanced multi-data center support more easily
- Moves data among levels of tiered storage systems more easily

4

■ Write I/O Overview



5

The Host I/O process completes immediately after storing write data to the cache memory of primary storage system Main Disk Control Unit (MCU).

- Then the data is asynchronously copied to the secondary storage system Remote Disk Control Unit (RCU).

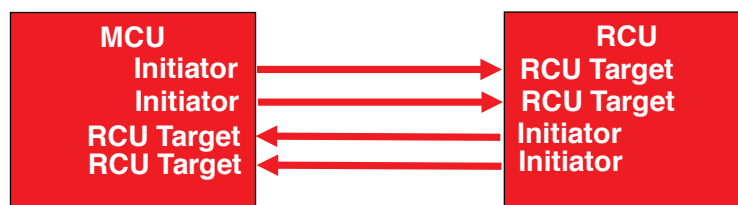
MCU will store data to be transferred in the Journal Cache, to be destaged to Journal Volume in the event of link failure.

Universal Replicator provides consistency of copied data by maintaining write order in copy process.

- To achieve this, HUR attaches write order information to the data in copy process.

Hitachi Universal Replicator Hardware

- Remote Connections (Links)
 - Bidirectional fibre connections to send and receive data between MCU and RCU.
 - Minimum of four initiator ports, two in each system for redundancy.
 - Minimum of four RCU target ports, two (redundancy) in each system.
 - Unlike TrueCopy Remote Replication, Universal Replicator remote copy connections (links) are **not** assigned to control units (CUs).
 - Only Fibre Channel is supported.



6

Two fibre connections enable pathway to send and receive data.

- At least four fiber connections are required:
 - ♦ Fibre connection 1 makes a request to remote site.
 - ♦ Fibre connection 2 reads journal command and journal copy.
- Requires four reserved CHA ports.
 - ♦ Since CHA ports are configured in pairs, a total of 8 CHA ports will be reserved.
- Each site involved in data replication will include:
 - ♦ Initiator → RCU target
 - Two Initiator ports on each system for redundancy
 - ♦ RCU target → Initiator
 - Two RCU target ports on each system for redundancy

Hitachi Universal Replicator Components

- **Main Control Unit (MCU)**
 - MCU is the storage array at the primary site and contains P-VOLs and Master Journal Group.
- **Remote Control Unit (RCU)**
 - RCU is the storage array at the remote site and contains S-VOLs and Restore Journal Group.
- **Journal Group**
 - A journal group consists of Data volumes and Journal volumes.
 - Maintains volume consistency by operating on multiple data volumes with one command.
 - Master Journal Group in the MCU contains P-VOLs and master journal volumes.
 - Restore Journal Group in the RCU contains S-VOLs and restore journal volumes.
- **Journal Volumes**
 - A journal volume stores differential data.

Hitachi Universal Replicator Specifications

- Primary Volume (P-VOL) and Secondary Volume (S-VOL)
 - Only OPEN-V emulation type is supported for HUR pair volumes.
 - HUR requires a one-to-one relationship between the volumes of the pairs. P-VOL : S-VOL = 1 : 1
 - Maximum number of pairs supported is 32,768 (one less with Command Control Interface (CCI)).
 - If the HUR pairs include the Logical Unit Size Expansion (LUSE) pairs, the maximum number of pairs decreases because a LUSE volume consists of multiple logical devices (LDEVs).
 - Supports external devices, LUSE volumes, Dynamic Provisioning volumes (DP-VOLs).

8

■ **Journal Group and Journal Volume**

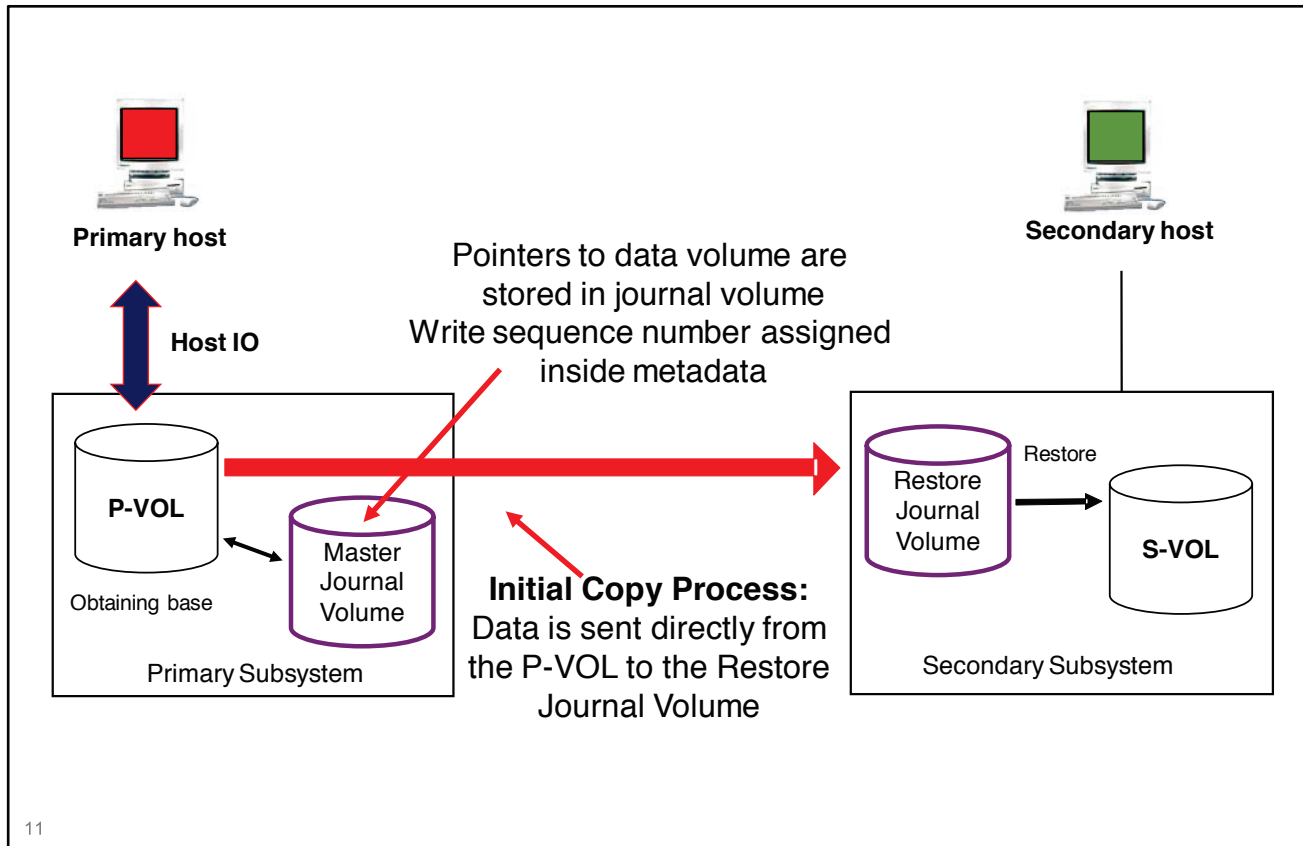
- A maximum of 256 Journal Groups per storage system.
- A maximum of 8192 data volumes in a journal group.
- A maximum of 64 journal volumes in a journal group.
- Only OPEN-V emulation type is supported for Journal Volumes.
- Journal volumes cannot be a LUSE volume or a DP volume.
- Journal volume must not have a path definition.
- Each of the journal volumes can have different volume sizes and different RAID configurations in a single journal group.
- Journal Volumes can be added to Journal Groups dynamically.

Hitachi Universal Replicator Usage

- Journal volumes are used to store differential data.
- Journal groups are used to maintain volume consistency.
- Pull versus Push:
 - Upon request, the secondary storage array (RCU) pulls data from the primary storage array (MCU).
 - With TrueCopy Remote Replication bundle, the MCU pushes data to the RCU.
 - Three method invocations are used:
 - Journal Obtain
 - Journal Copy
 - Journal Restore
- When paired, asynchronous transfer automatically synchronizes secondary data volumes.

10

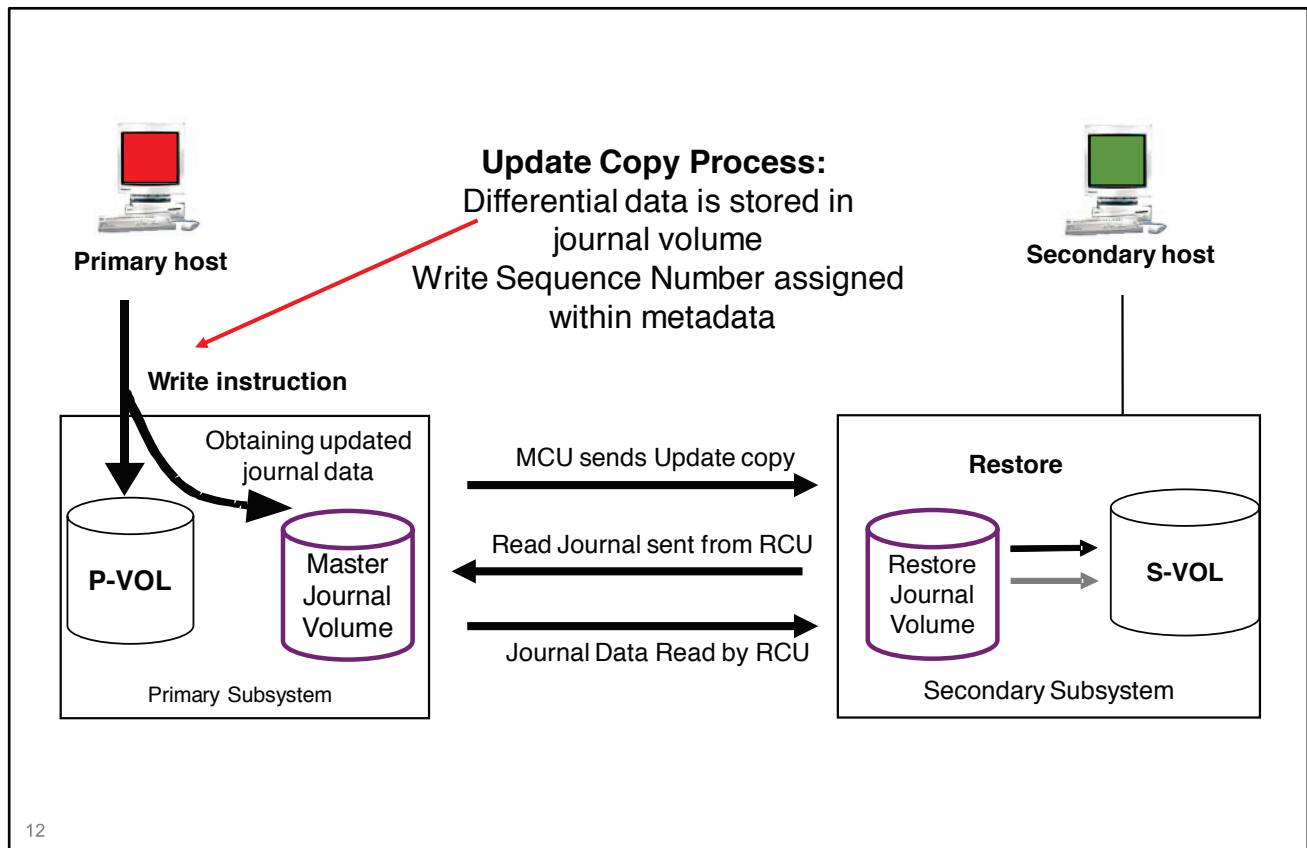
Base Journal (Initial Copy)



Base Journal – Initial Copy

- Upon initiation or the **paircreate**, the primary site stores pointers to the data in the P-VOL (primary data volume) as a base journal.
 - ♦ For the Base Journal, only metadata is stored in the journal volume. The data in the P-VOL is not copied to the Master Journal Volume.
- The base journal data is obtained by the RCU repeatedly sending read commands to the MCU.
- The data in the secondary data volume synchronizes with the data in the primary data volume via pointers.
- This operation is the same as Initial Copy in TrueCopy Remote Replication.
- Initial Copy is complete when the MCU informs the RCU that the highest sequence number has been sent.

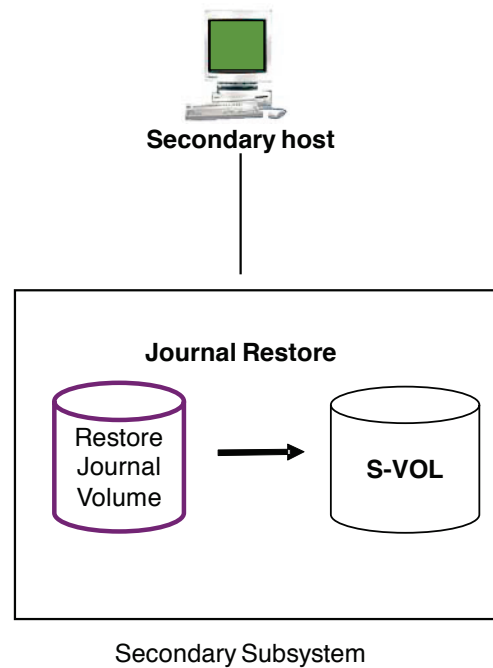
Update Journal (Update Copy)



Journal copy is the function to copy the data in the primary journal volumes (M-JNL) in the MCU to the secondary journal volumes (R-JNL) in the secondary site. The secondary storage system issues the read journal command to the primary storage system to request the transfer of the journal data that is stored in the primary journal volumes after the pair create or pair resync operation from the MCU. The MCU transfers the journal data in the journal volumes to the RCU if it has the journal data that has been not sent. If primary storage system does not have the journal data, the information (indicating that MCU does not have such journal data) is sent. The RCU stores the journal volume data that is transferred from the MCU in the secondary journal volumes in RCU. The read journal commands are issued repeatedly and regularly from the RCU to the MCU. After the data are restored, the highest journal sequence number is informed from the RCU to the MCU when the read journal command is issued. According to this information, the journal data is discarded in the MCU.

Journal Restore

- Data is copied from the Master Journal Volume to the Restore Journal Volume.
- Data is sorted in the Restore Journal Volume by sequence number.
- As data is received in sequence is “restored” to the S-VOL



13

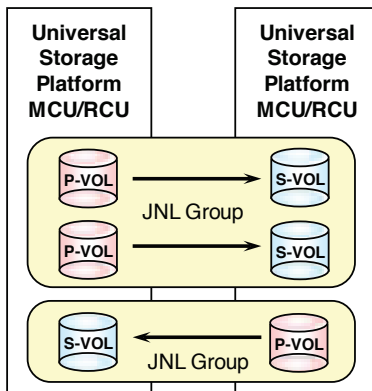
Journal restore is the function of copying the data in the restore/secondary journal volume to the S-VOL at the secondary site. The data in the restore/secondary journal volume is copied to the secondary data volume according to the write sequence number. This ensures the write sequence consistency between the primary and secondary data volumes. After the journal data is restored to the secondary data volume, the journal data is discarded at the secondary site.

Hitachi Universal Replicator Configurations

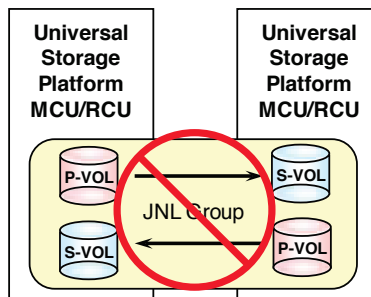
■ Allowable Configurations



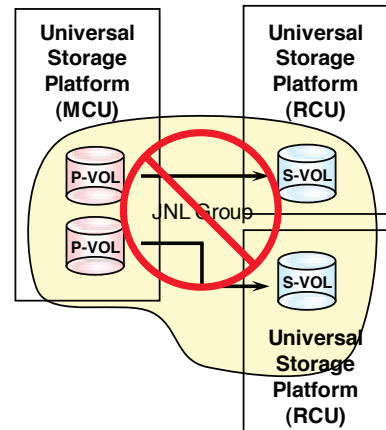
Allowed



Not allowed

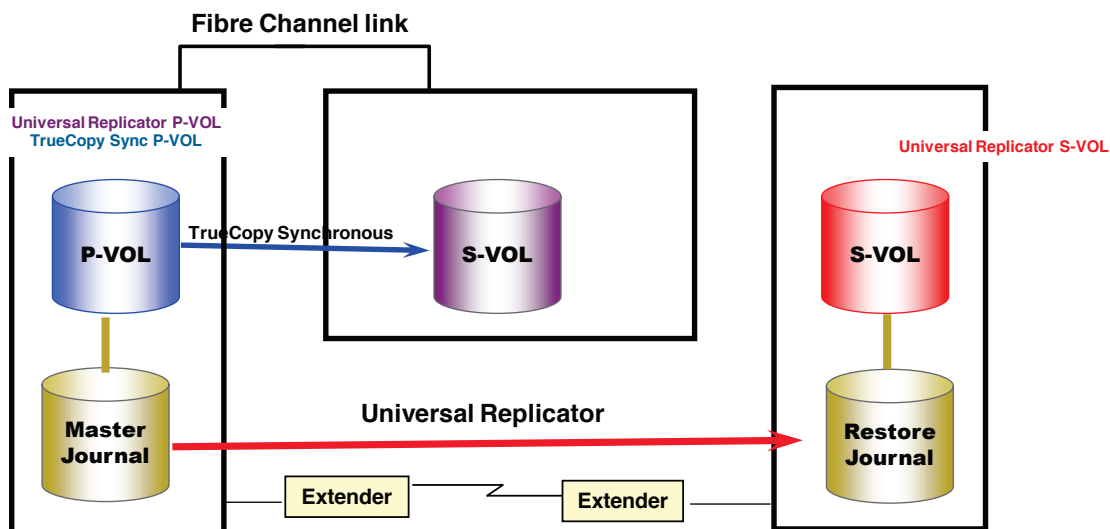


Not allowed



Three Data Center Configuration

- TrueCopy Remote Replication Synchronous and Universal Replicator can be combined into a three data center (3DC) configuration.
- This is a 3DC multi-target illustration.



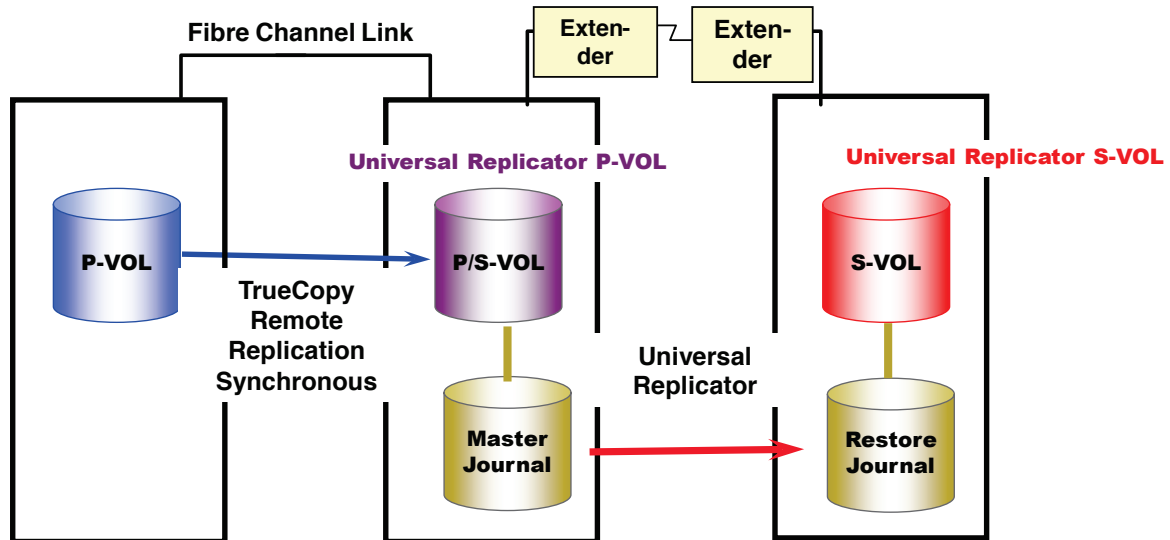
15

Three data center strategies combine in-region and out-of-region replication to provide the strongest protection: fast recovery and data currency for local site failures, combined with good protection from regional disasters. However, multiple data centers and data copies increase costs, so robust 3DC strategies have typically been limited to large organizations with extremely critical business continuity needs.

The above figure illustrates a 3DC multi-target configuration, in which data is replicated to two remote sites in parallel. TrueCopy synchronous replication maintains a current copy of the production data at an in-region recovery data center. At the same time, the Universal Storage Platform at the primary site replicates the data to an out-of-region recovery site, using Universal Replicator asynchronous replication across a separate replication network.

In case of production site failure, processing can resume at the in-region recovery site, using a current TrueCopy replica of production data. The in-region hot site can also support planned failover when needed for maintenance, upgrades, or business continuity testing. Meanwhile, Universal Replicator provides ongoing replication to the out-of-region site, maintaining robust business continuity protection. In case of a regional disaster, the out-of-region data center can recover rapidly with a slightly older but fully consistent copy of production data.

- This is a 3DC Cascade illustration.



16

The above figure illustrates a 3DC cascade configuration that uses synchronous TrueCopy Remote Replication to maintain a current copy of the production data at an in-region data center. As noted earlier, 3DC cascade configurations make sense when the in-region hot site provides processing capabilities for recovery.

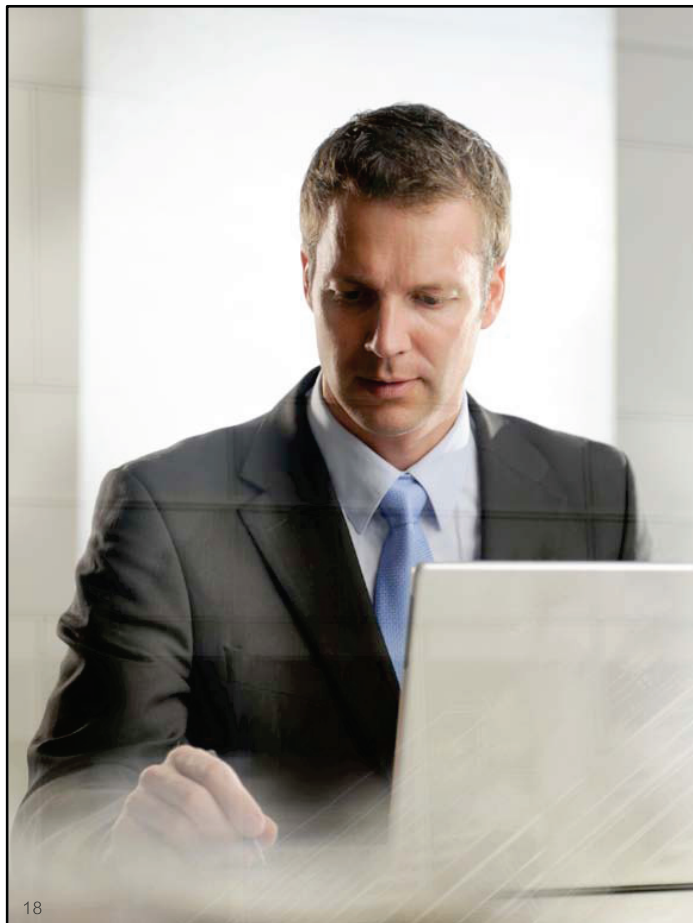
The storage system at the in-region site also cascades the data to an out-of-region recovery site, using Universal Replicator asynchronous replication. In comparison with other asynchronous replication technologies, Universal Replicator does not require an additional point-in-time copy of the data volume at the intermediate site. Universal Replicator stages the data to the journal disk, which is relatively small compared with a complete data copy. This feature saves physical disk space and reduces the cost of the 3DC configuration.

Hitachi Universal Replicator Operations

- Setting Up Remote Paths
- Setting Up Journal Groups
- Managing Pairs

17

Instructor Demonstration — Hitachi Universal Replicator



18

Instructor Demonstration

- Hitachi Universal Replicator
 - Setting Up Ports
 - Setting Up Journals
 - Managing Pair



Setting Up Remote Paths

■ Creating a Remote Path

The screenshot displays the Hitachi Replication Manager (HRpM) interface. On the left, the 'Explorer' pane shows the 'Storage Systems' tree with two entries: 'USP_V@10.74.64.24 (10152)' and 'USP_V@10.74.64.25 (10043)'. The 'Dashboard' pane shows various system status indicators. The main window displays the 'HRpM- Create Remote Path Wizard' dialog box, which is currently at step 1: 'Select Remote Storage System'. The wizard has four steps: 1. Select Remote Storage System, 2. Define Remote Path, 3. Confirm, and 4. Finish. The 'Copy Type' is set to 'Universal Replicator'. The 'Local Storage System' is 'Atlanta_PRI' and the 'Remote Storage System' is 'USP_V@10.74.64.25 (10043)'. The 'Site' for the remote system is 'Dallas_SEC'. The 'Storage System' for the remote system is 'USP_V@10.74.64.25 (10043)'. The 'MCU' and 'RCU' are both set to 'Any'. The 'Specify MCU/RCU' checkbox is unchecked. The 'Next' button is visible at the bottom right of the wizard.

19

- Defining Remote Paths
 - Reverse Path

HRpM- Create Remote Path Wizard **HITACHI**

1. Select Remote Storage System ▶ **2. Define Remote Path** ▶ 3. Confirm ▶ 4. Finish

Specify the label, path group ID, local ports, and remote ports.
To define a bi-directional remote path, select "Select reverse direction path", and then enter the parameters in the right pane.

Local Storage System: USP_V@10.74.64.24 (10152)
Remote Storage System: USP_V@10.74.64.25 (10043)

☒ Select reverse direction path

Local -> Remote

Label:

Path Group ID:

Local Port		Remote Port
CL1-F	->	CL2-F
CL3-F	->	CL4-F

Existing Ports

Local (Initiator)	Remote (RCU Target)
No Object	

Local <- Remote

Label:

Path Group ID:

Local Port		Remote Port
CL3-A	<-	CL4-A
CL3-B	<-	CL4-B

Existing Ports

Local (RCU Target)	Remote (Initiator)
No Object	

20

Note that **Select reverse direction path** is grayed out. The reverse link configuration is mandatory for Universal Replicator.

■ Confirming the Settings

1. Select Remote Storage System ▶ 2. Define Remote Path ▶ 3. **Confirm** ▶ 4. Finish

Check the remote path settings.
Carefully review the summary below, and then click "Confirm" to create the remote path.
This operation might take several minutes to finish.

Initiators/RCU Targets

⚠ This operation will change the attribute of ports listed below.
Note that the attributes of the ports associated with the selected ports will also be changed.
After changing the attributes, these ports will be dedicated for remote copying, and will not be available for host-storage connection.

Storage System	Selected Port	Associated Port	Attribute (Current)	Attrit
USP_V@10.74.64.24 (10152)	CL1-F	CL5-F	Target	Initiat
USP_V@10.74.64.24 (10152)	CL3-F	CL7-F	Target	Initiat
USP_V@10.74.64.24 (10152)	CL3-A	CL7-A	Target	RCU 1

Local Storage System:

Site: Atlanta_PRI
Storage System: USP_V@10.74.64.24 (10152)
MCU: Any

Remote Storage System:

Site: Dallas_SEC
Storage System: USP_V@10.74.64.25 (10043)
RCU: Any

Remote Path:

Local -> Remote

Label: Path_M_R
Path Group ID: Default

Local Port	Remote Port
CL1-F	CL2-F
CL3-F	CL4-F

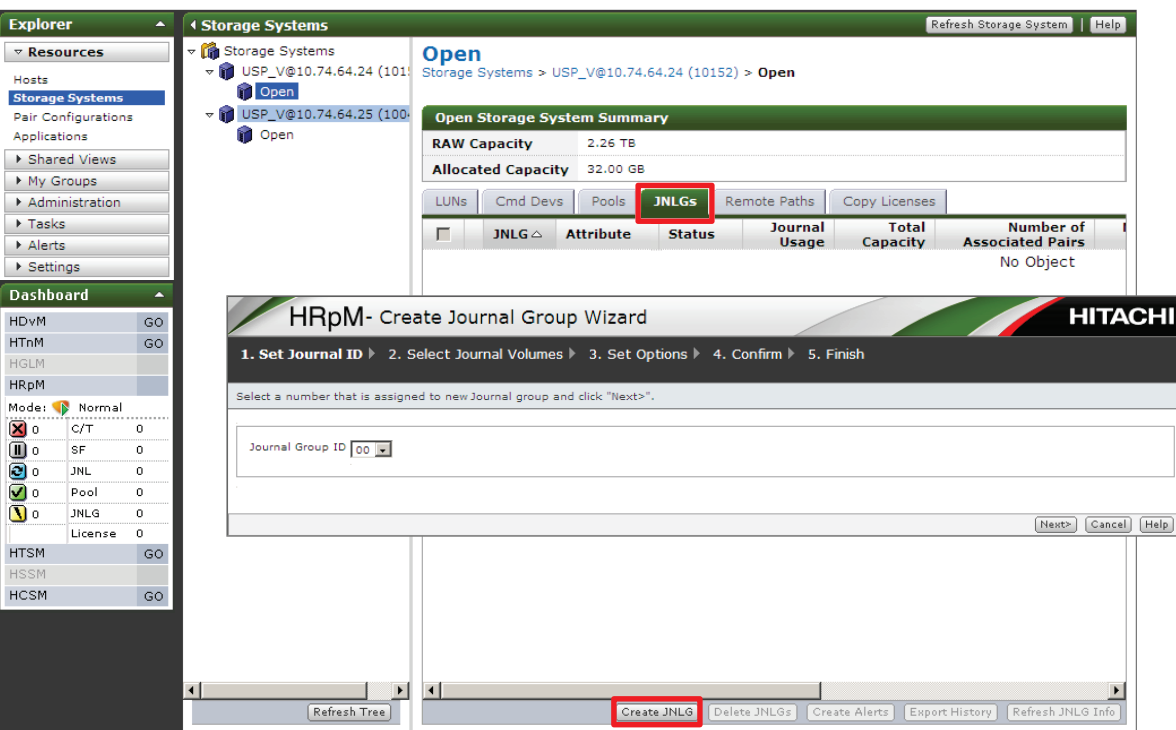
Local <- Remote

Label: Path_R_M
Path Group ID: Default

Local Port	Remote Port
CL3-A	CL4-A
CL3-B	CL4-B

☐ Yes, I have confirmed the above information and wish to create a remote path.

<Back Confirm Cancel Help



Universal Replicator uses journal volumes as volume copy buffers. You must set up journal groups before creating Universal Replicator volume pairs. Journal groups are used to keep the journal data for asynchronous data transfer. Journal groups must be set in each storage system on both the primary and secondary side. The journal volume for the primary site and the primary volume, and the journal volume for the secondary site and the secondary volume, are defined as journal groups.

■ Selecting Journal Volumes

HRpM- Create Journal Group Wizard **HITACHI**

1. Set Journal ID ▶ 2. **Select Journal Volumes** ▶ 3. Set Options ▶ 4. Confirm ▶ 5. Finish

Select volumes you want to register as journal volumes.
Perform following to select volumes:
1. Select filtering parameters ("CU" and "Capacity" and "Parity Group"), and click "Refresh".
2. On "Free Volumes", mark the checkbox beside volumes that you want to register as journal volumes, and click "Add>".
For canceling registration of journal volumes, perform following:
On "Journal Volumes", mark the checkbox beside volumes that you want to cancel the registration, and click "<Delete".
Click "Next>" when the selection has been finished.

Filters for Free Volumes:
CU: Capacity: Parity Group:
Label:

Free Volumes
Candidate volumes for registering journal volumes

☐	LDEV	Label	Operation	Capacity	Parity Group	Em Ty
☐	0:01	-	-	2.00 GB	1-1-1	OPE
☐	0:02	-	-	2.00 GB	1-1-1	OPE
☐	0:03	-	-	2.00 GB	1-1-1	OPE
☐	0:04	-	-	2.00 GB	1-1-1	OPE
☐	0:05	-	-	2.00 GB	1-1-1	OPE
☐	0:06	-	-	2.00 GB	1-1-1	OPE
☐	0:07	-	-	2.00 GB	1-1-1	OPE
☐	0:08	-	-	2.00 GB	1-1-1	OPE

LDEV Total Capacity: 30.00 GB

Journal Volumes
Journal volumes to be registered to new journal group

☐	LDEV	Label	Operation	Capacity	Parity Group	Em Ty
☐	9:00	-	Add	10.00 GB	2-3-1	OP
☐	9:01	-	Add	10.00 GB	2-3-1	OP
☐	9:02	-	Add	10.00 GB	2-3-1	OP

<Back Next> Cancel Help

23

■ Setting Journal Options

24

- **Inflow Control:** Allows you to specify whether to restrict inflow of update I/Os to the journal volume (in other words, whether to delay response to the hosts).
 - ♦ **Yes** indicates inflow will be restricted. **No** indicates inflow will not be restricted.
 - ♦ *Note:* If **Yes** is selected and the metadata or the journal data is full, the update I/Os may stop. (Journal Groups suspended)
- **Data Overflow Watch:** Allows you to specify the time (in seconds) for monitoring whether metadata and journal data are full. This value must be within the range of 0 to 600 seconds.
 - ♦ *Note:* If **Inflow Control** is **No**, **Data Overflow Watch** does not take effect and does not display anything.
- **Path Watch Time:** Allows you to specify the interval from when a path gets blocked to when a mirror gets split (suspended). This value must be within the range of 1 to 60 minutes.
 - ♦ **Note:** Make sure that the same interval is set to both the master and restore journal groups in the same mirror, unless otherwise required. If the interval differs between the master and restore journal groups, these journal groups will not be suspended simultaneously. For example, if the interval for the master journal group is 5 minutes and the interval for the restore journal group is 60 minutes, the master journal group will be suspended in 5 minutes

after a path gets blocked, and the restore journal group will be suspended in 60 minutes after a path gets blocked.

- ♦ **Caution:** By default, the factory enables (turns ON) SVP mode 449, disabling the path watch time option. If you'd like to enable the path watch time option, please disable mode 449 (turn it OFF).
- **Note:** If you want to split a mirror (suspend) immediately after a path becomes blocked, please disable SVP modes 448 and 449 (turn OFF).
- **Forward Path Watch Time:** Allows you to specify whether to forward the Path Watch Time value of the master journal group to the restore journal group. If the Path Watch Time value is forwarded, the two journal groups will have the same Path Watch Time value.
 - ♦ **Yes:** The Path Watch Time value will be forwarded to the restore journal group.
 - ♦ **No:** The Path Watch Time value will not be forwarded to the restore journal group. No is the default.
 - ♦ **Blank:** The current setting of **Forward Path Watch Time** will remain unchanged.
 - ♦ **Caution:** This option cannot be specified in the remote site.
- **Use of Cache:** Allows you to specify whether to store journal data in the restore journal group into the cache.
 - ♦ **Use:** Journal data will be stored into the cache.
 - **Note:** When there is insufficient space in the cache, journal data will also be stored into the journal volume.
 - ♦ **Not Use:** Journal data will not be stored into the cache.
 - ♦ **Blank:** The current setting of **Use of Cache** will remain unchanged.
 - ♦ **Caution:** This setting does not take effect on master journal groups. However, if the **horctakeover** option is used to change a master journal group into a restore journal group, this setting will take effect on the journal group.
- **Speed of Line:** Allows you to specify the line speed of data transfer. The unit is Mbps (megabits per second).
 - ♦ You can specify one of the following: **256**, **100**, or **10**.
 - ♦ **Caution:** This setting does not take effect on master journal groups. However, if the **horctakeover** option is used to change a master journal group into a restore journal group, this setting will take effect on the journal group.
- **Delta resync Failure:** Allows you to specify the processing that would take place when delta resync operation cannot be performed.
 - ♦ **Entire:** All the data in primary data volume will be copied to remote data volume when delta resync operation cannot be performed. The default is Entire.

- ♦ **None:** No processing will take place when delta resync operation cannot be performed. Therefore, the remote data volume will not be updated. If Delta Resync pairs are desired, they will have to be created manually.
- ♦ **Caution:** – This option cannot be specified in the remote site.

■ Confirming Settings

HRpM- Create Journal Group Wizard **HITACHI**

1. Set Journal ID ▶ 2. Select Journal Volumes ▶ 3. Set Options ▶ **4. Confirm** ▶ 5. Finish

Check the journal group setting.
Carefully review the summary below, and then click "Confirm" to create journal group.
This operation might take several minutes to finish.

Journal Group ID: 00
LDEV Total Capacity: 30.00 GB

Journal Volumes									
LDEV	Label	Operation	Capacity	Parity Group	Emulation Type	SLPR	CLPR	RAID Level	Volume Attribute
9:00		Add	10.00 GB	2-3-1	OPEN-V	0	0	RAID5(3D+1P)	CVS
9:01		Add	10.00 GB	2-3-1	OPEN-V	0	0	RAID5(3D+1P)	CVS
9:02		Add	10.00 GB	2-3-1	OPEN-V	0	0	RAID5(3D+1P)	CVS

Journal Group Options

Inflow Control: Data Overflow Watch Time: 60 sec

Path Watch Time: 5 min
Forward Path Watch Time: No
Use of Cache: Use
Speed of Line: 256 Mbps
Delta resync Failure: Entire

☒ Yes, I have confirmed the above information and wish to create journal group.

<Back Confirm Cancel Help

25

■ Viewing Journal Group Status

Storage Systems Refresh Storage System Help

Storage Systems > USP_V@10.74.64.24 (10152) > Open

Open Storage System Summary

RAW Capacity: 2.26 TB
Allocated Capacity: 32.00 GB

LUNs Cmd Devs Pools **JNLGs** Remote Paths Copy Licenses

JNLG	Attribute	Status	Journal Usage	Total Capacity	Number of Associated Pairs
00	Initial	Initial	0%	30.00 GB	0

Storage Systems > USP_V@10.74.64.25 (10043) > Open

Open Storage System Summary

RAW Capacity: 2.25 TB
Allocated Capacity: 28.00 GB

LUNs Cmd Devs Pools **JNLGs** Remote Paths Copy Licenses

JNLG	Attribute	Status	Journal Usage	Total Capacity	Number of Associated Pairs
01	Initial	Initial	0%	30.00 GB	0

26

HRpM- Pair Configuration Wizard

1. Introduction ▶ 2. Pair Association ▶ 3. Group Management ▶ 4. Task Management ▶ 5. Confirm ▶ 6. Finish

Use this dialog box to modify pair groups and copy group. To create a pair group, select a volume icon displayed in "Copy Topology", and then click "Add Group".

Copy Topology

UR_Grp

UR

Add Group

Delete Group

Detail of UR_Grp

Pair List

Filter By:

Volume Type: Primary

Resource:

Selection:

Refresh

Pairs:

Rows/ Pages: 100

Page: 1 of 1

	Port/Host Group/LUN	LDEV	Storage System	Capacity	Label	Volume Attribute
☐	CL1-A/WLAB0K/02	0:00	USP_V@10.74.64.24 (10152)	2.00 GB		CVS
☐	CL1-A/WLAB0L/02	0:00	USP_V@10.74.64.25 (10049)	2.00 GB		CVS

<Add

Delete

Delete

27

Hitachi Data Systems

HDS Confidential: For distribution only to authorized parties.

Page 7-27

Managing Pairs

■ Defining Pair Settings

1. Introduction ▶ 2. Pair Association ▶ 3. Group Management ▶ 4. Task Management ▶ 5. Confirm ▶ 6. Finish

Edit a task. To edit a task, click the Modify icon of the desired task in "Task List".

Copy Topology

UR_Grp

UR

Task List

☐	Copy Group ^	Copy Type
☐	UR_Grp	UR

HRpM

Edit Task Help

Task Options: **Pair Setting**

If you click "OK", the task is changed to Ready state, and will be executed in the time specified in "Execution Request Time".

Pair Operation

Operation : create

Copy Pace: 15

Fence Level: Async

JNLG ID(P): 00

JNLG ID(S): 01

No Copy: ☐ On

Pair List

Rows/Page: 100 Page 1 of 1

☒	Pair Name ^	Port/Host Group/LUN	LDEV	Storage System	Capacity
☒	P_000-000_0005	CL1-A/WLAB0K/02	0:00	USP_V@10.74.64.24 (10152)	2.00 GB
		CL1-A/WLAB0L/02	0:00	USP_V@10.74.64.25 (10043)	2.00 GB

OK Cancel

JNLG ID(P) - Select the journal group ID of the primary volume of the copy pair.
This list displays from 0 to 255 (unused) journal group IDs.

JNLG ID(S) - Select the journal group ID of the secondary volume of the copy pair.
This list displays from 0 to 255 (unused) journal group IDs.

■ Viewing Pair Status

Pair Configurations

UR_Grp
Pair Configurations > WLAB0K > horcm0.conf > UR_Grp

Copy Group Summary

C/T Delta	n/a	SI	
Side File / Journal Usage	0%	TCA / TCE / SDR	
Primary Server	WLAB0K	TCS	
Primary Config File	horcm0.conf	QS / COW	
Secondary Server	WLAB0L	UR	☒
Secondary Config File	horcm1.conf	Visible / Total	1 / 1
CTGID	00		

Pairs Copy Group Relationship

Rows/Page: 100 Page 1 of 1

Copy Pair	Copy Type	Pair Status	Copy Progress		Primary	
			Active	Inactive	Pair State	LDEV
P_000-000_0005	UR	☒			Pair (PAIR)	0:00

29

■ Viewing Advanced Options on Pair Operations

HRpM- Change Pair Status Wizard HITACHI

1. Introduction > 2. Select Copy Pairs > 3. Select Pair Operation > 4. Set Schedule > 5. Confirm > 6. Finish

Select "Basic" for usual copy pair operation or select "Advanced" for the copy pair operation that relates to takeover or takeback, then click "Next>" to continue.

Pair Operation

Operation: ☐ Basic ☒ Advanced

takeover (horctakeover -S)

Options: *Timeout for data transfer: 300 second(s)

* Required field

Pair List

Rows/Page: 100 Page 1 of 1

Copy Pair	Copy Type	Primary			Secondary		
		Pair State	LDEV	Storage System	Pair State	LDEV	Storage System
P_000-000_0005	UR	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	0:00	USP_V@

30

Module Summary

- In this module you learned how to:
 - Describe the features of the Hitachi Universal Replicator
 - List the benefits
 - List the specifications
 - Describe the supported configurations
 - Perform Universal Replicator operations with Replication Manager

Module Review

1. List the components of a Hitachi Universal Replicator configuration.
2. What is the minimum number of links used for a redundant configuration?
3. What is the advantage of using Journal Volumes in the replication process?
4. List the steps for setting up Universal Replicator copy pair operations.

8. Replication Manager Monitoring Operations

Module Objectives

- Upon completion of this module, you should be able to:
 - List the pair monitoring options available in Hitachi Replication Manager (HRpM)
 - Describe the process for setting up alerts
 - Manage alerts

Monitoring Copy Operations

- Operations Monitored by Replication Manager

- Configuration information
- Pair status
- Performance of remote copies
- Status of application replicas
- Resource utilization

HRpM			
Mode:		Normal	
	0	C/T	0
	0	SF	0
	0	JNL	0
	2	Pool	0
	0	JNLG	0
		License	0

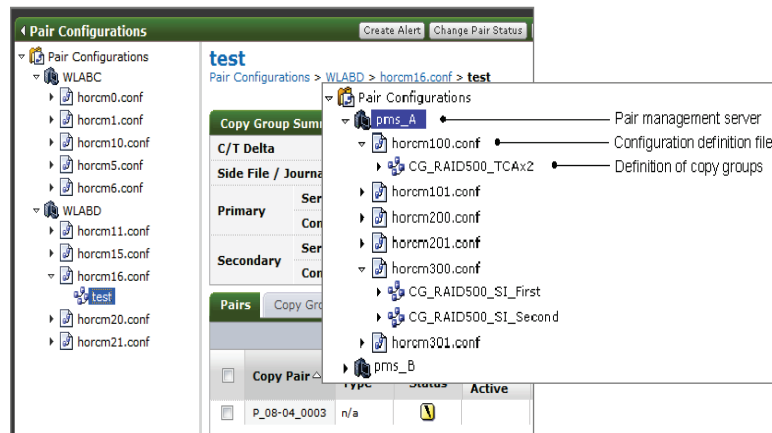
- Alerts can be generated when a monitored target, such as a copy pair or buffer, satisfies a preset condition.
- You can specify a maximum of 1,000 conditions.

3

Alert notifications are useful for enabling a quick response to a hardware failure or for determining the cause of degradation in transfer performance. They are also useful for preventing errors due to buffer overflow and insufficient copy licenses, thereby facilitating the continuity of normal operation. Because you can receive alerts by email or SNMP traps, you can also monitor the replication environment while you are logged out of Replication Manager.

■ Monitoring Pair Configuration Information

- For specific volume
- For specific copy group
- Configuration files
- Configuration files definition



4

You can monitor copy pair configurations in multiple ways using Replication Manager. You can use a tree view to check the configuration definition file for CCI that is created by Replication Manager or other products, or to check the copy group definition file for Business Continuity Manager or Mainframe Agent. You can limit the range of copy pairs being monitored to those of a host or storage system, and also check the configuration of related copy pairs. You can also check copy pair configurations from a copy group perspective.

- **Monitoring Pair Status**

- Using alerts
 - Alerts are generated upon a change in status
- Using My Copy Groups
 - To focus on specific copy groups when monitoring copy groups
- Using refresh settings
 - Click **Refresh** in the Application area.

5

You can configure pair status monitoring for hosts, storage systems, copy groups, or copy pairs to detect an unexpected pair status. When a pair status for which you require notification is detected, Replication Manager can be configured to alert you with an email message or an SNMP trap. Replication Manager also detects pair statuses based on the periodic monitoring of pair statuses.

- **Monitoring Performance of Remote Copies**
 - Viewing Copy Progress
 - **My Copy Group or Pair Configurations**
 - Checking Buffer Usage (Side Files and Journal Volumes)
 - **Copy Group Summary**
 - Checking Write Delay Time (C/T Delta) for Each Copy Group
 - **My Group, Copy Group Summary**

6

You can configure threshold monitoring for asynchronous remote copy metrics to detect an unexpected overflow of preset thresholds. You can display the transfer delay state between the primary and secondary volumes for each copy group. This feature of Replication Manager is used to monitor asynchronous remote copying by using Hitachi TrueCopy Asynchronous, Hitachi TrueCopy Extended Distance, and Hitachi Universal Replicator. The transfer delay state of remote copies displays these types of information:

- Usage of side file/journal
- Write delay time (C/T delta)
- Usage rate of pool capacity

- **Monitoring Status of Application Replicas**

- Data Protection Status
- Microsoft® Exchange and MS SQL Server®

Status	Icon	Description
Normal		The latest replica is current (the last scheduled replica was successful).
Warning		The latest replica is older than expected (the last scheduled replica was unsuccessful).
Critical		No replica is available due to task failures.
Unknown		No replica is available as the task has not yet been created/executed.
Excluded		The object has been excluded from monitoring. Only displayed at the lowest level (information stores). When an object is excluded, the status of the object is not aggregated to the upper layer.

7

Monitoring the Status of Application Replicas

You can monitor the progress of replica creation using the summary displayed in the Applications and Servers subwindows. You can receive notification through email or SNMP traps on replica monitoring parameters.

■ Monitoring Resource Utilization

- Usage ratio of pools and journal groups
- Alert functionality to send notifications to avoid overflow and maintain data consistency

Storage Systems Refresh Storage System Help

Open
Storage Systems > USP_V@10.74.64.25 (10043) > Open

Open Storage System Summary

RAW Capacity	2.62 TB
Allocated Capacity	51.53 GB

LUNs Cmd Devs **Pools** JNLGs Remote Paths Copy Licenses

Pools V-VOLs

Rows/Page: 100 1 2 3 4 5 6 7 8 9 10 Page 1 of 1 1 2 3 4 5 6 7 8 9 10

	Pool	Used by	Status	Pool Usage	Total Capacity	Number of Associated Pairs	Last Update
☐	10	DP	-	-	-	-	2011-02-02 17:35:59

LUNs Cmd Devs Pools **JNLGs** Remote Paths Copy Licenses

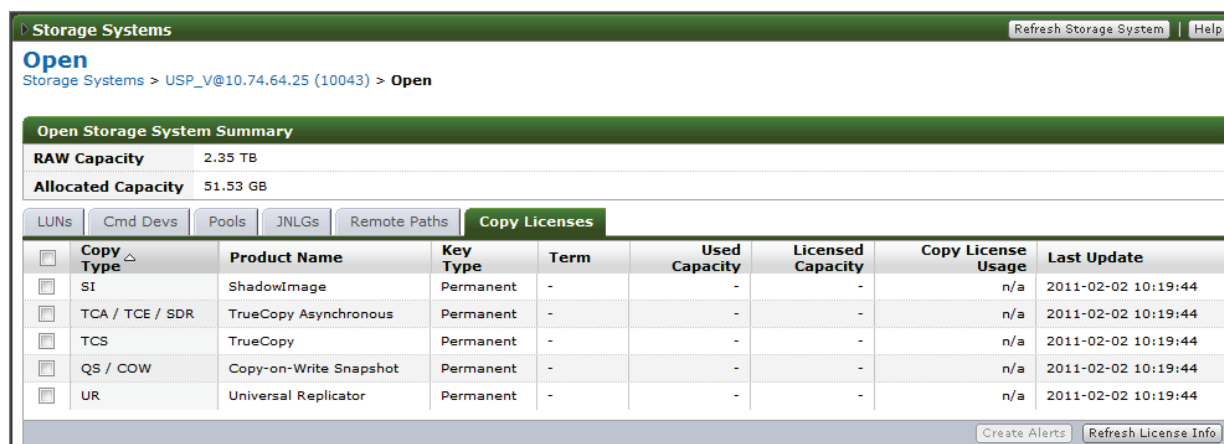
	JNLG	Attribute	Status	Journal Usage	Total Capacity	Number of Associated Pairs	Mirror ID	Remote Storage System	Pair JNLG	CTG
☐	00	Initial	Initial	0%	8.00 GB	0				

8

You can monitor the usage ratio of buffers (pools and journal groups) and receive alert notification. You can get notification by way of email or SNMP traps, based on the predefined thresholds. If you are an administrator, you can add volumes to the buffers using Replication Manager.

■ Monitoring Copy License Use

- View and monitor the used capacity and copy license consumption percentage for each copy product to prevent license expiry.
- Configure alerts to get notifications when copy license consumption reaches a particular threshold or exceeds the licensed capacity.



The screenshot shows the 'Storage Systems' interface with the 'Open' storage system selected. The 'Open Storage System Summary' section displays 'RAW Capacity' as 2.35 TB and 'Allocated Capacity' as 51.53 GB. The 'Copy Licenses' tab is active, showing a table of license information.

Copy Type	Product Name	Key Type	Term	Used Capacity	Licensed Capacity	Copy License Usage	Last Update
SI	ShadowImage	Permanent	-	-	-	n/a	2011-02-02 10:19:44
TCA / TCE / SDR	TrueCopy Asynchronous	Permanent	-	-	-	n/a	2011-02-02 10:19:44
TCS	TrueCopy	Permanent	-	-	-	n/a	2011-02-02 10:19:44
QS / COW	Copy-on-Write Snapshot	Permanent	-	-	-	n/a	2011-02-02 10:19:44
UR	Universal Replicator	Permanent	-	-	-	n/a	2011-02-02 10:19:44

9

You can monitor the used capacity and copy license usage percentage for each copy product in complex replication environments. You can configure alerts to send notifications when copy license usage reaches a particular threshold or the licensed capacity has been reached.

Setting Up Alerts

■ Create Alerts — Host > Copy Groups

The screenshot shows the Hitachi Replication Manager web interface. The left sidebar contains a navigation menu with options like Resources, Hosts, Storage Systems, and Alerts. The main content area displays the 'Host Summary' for 'WLABD' and a table of 'Copy Groups'. The table has columns for Copy Group, SI, TCA / TCE / SDR, TCS, QS / COW, UR, and Last. The first row, 'SI', is highlighted with a red box. At the bottom right, the 'Create Alerts' button is also highlighted with a red box.

Copy Group	SI	TCA / TCE / SDR	TCS	QS / COW	UR	Last
SI						
TC1						2011-
test						2011-

10

■ Create Alerts — Host > (specific volume)

Hitachi Replication Manager

Logged in as: system | Close | Logout

Explorer

- Resources
 - Hosts
 - Storage Systems
 - Pair Configurations
 - Applications
 - Shared Views
 - My Groups
 - Administration
 - Tasks
 - Alerts
 - Settings
- Dashboard
 - HDvM GO
 - HTnM GO
 - HGLM
 - HRpM
 - Mode: Normal
 - 0 C/T 0
 - 0 SF 0
 - 0 JNL 0
 - 0 Pool 0
 - 0 JNLG 0
 - License 0
 - HTSM GO
 - HSSM
 - HCSM GO

Hosts

- WLABC
- WLABD

CTL0-A/Mihai/01
Hosts > WLABD > CTL0-A/Mihai/01

LUN Summary

Mount Point	e:
LDEV	01
Capacity	1.00 GB
Volume Attribute	

Pair Relationship

Pair Configuration	Copy Pair	Copy Type	Pair Status	Copy Progress
Pair1	Pair1	TCA / TCE / SDR	Active	Ina
Pair1	Pair1	QS / COW	Active	20%

Create Alerts | Pair Management | Refresh Copy Pairs

11

■ Create Alerts — Storage System > Open > Copy Licenses

Storage Systems

- AMS2300@10.17.104.65 ()
- AMS2300@10.17.104.67 ()
- USP_V@10.74.64.25 (10043)
 - Open

Open
Storage Systems > USP_V@10.74.64.25 (10043) > Open

Open Storage System Summary

RAW Capacity	2.35 TB
Allocated Capacity	51.53 GB

Copy Licenses

Copy Type	Product Name	Key Type	Term	Used Capacity	Licensed Capacity	Copy License Usage	La
SI	ShadowImage	Permanent	-	-	-	n/a	20:
TCA / TCE / SDR	TrueCopy Asynchronous	Permanent	-	-	-	n/a	20:
TCS	TrueCopy	Permanent	-	-	-	n/a	20:
QS / COW	Copy-on-Write Snapshot	Permanent	-	-	-	n/a	20:
UR	Universal Replicator	Permanent	-	-	-	n/a	20:

Create Alerts | Refresh License Info

12

■ Create Alerts — Storage System > Open > Pools

The screenshot shows the 'Open' storage system summary and the 'Pools' tab. The 'Open Storage System Summary' section displays the following information:

- RAW Capacity: 7.89 TB
- Allocated Capacity: 7.82 TB
- Distributed Mode: ☐

The 'Pools' tab is active, showing a table with the following data:

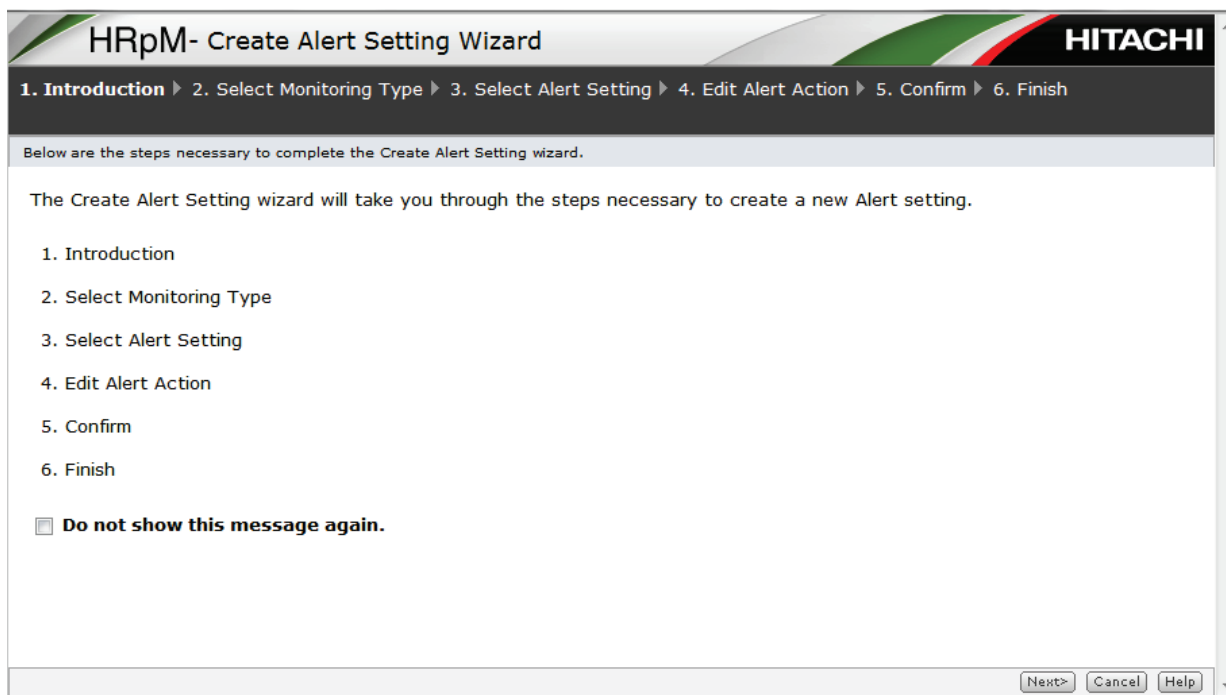
Pool	Status	Pool Usage	Total Capacity	Number of Associated Pairs	Last Update
0	Normal	4%	25.00 GB	2	2011-02-02 15:48:19

The 'Create Alerts' button is highlighted in the bottom right corner of the interface.

13

Create Alert Setting Wizard

■ Creating Alerts — 1. Introduction



14

■ Creating Alerts — 2. Select Monitoring Type

HRpM- Create Alert Setting Wizard **HITACHI**

1. Introduction ▶ 2. **Select Monitoring Type** ▶ 3. Select Alert Setting ▶ 4. Edit Alert Action ▶ 5. Confirm ▶ 6. Finish

Click "Next>" to Select Alert Setting.
'Performance Monitoring' is selectable only for the following conditions.
Resource type of monitoring targets is copy group, and the targets consist of only TCA pairs or only TCE pairs or only SDR pairs or only UR pairs.

Select Monitoring Type

☒ Pair Status Monitoring

☐ Performance Monitoring

☐ Copy License Usage Monitoring

<Back Next> Cancel Help

15

■ Creating Alerts — 3. Alert Setting

HRpM- Create Alert Setting Wizard **HITACHI**

1. Introduction ▶ 2. Select Monitoring Type ▶ 3. **Select Alert Setting** ▶ 4. Edit Alert Action ▶ 5. Confirm ▶ 6. Finish

Select an alert setting you want to define.
Perform either of the following:
a. Creating New Alert Setting - To create a new alert setting, select "Create New Alert Setting", and then click "Next>" to define the alert setting.
b. Selecting Existing Alert Setting - To select an existing alert setting, select "Select Existing Alert Setting", and then click "Next>" to edit the alert setting.

Select Alert Creation Mode:

☒ Create New Alert Setting

☐ Select Existing Alert Setting

Alert Setting List: Status_Change

<Back Next> Cancel Help

16

■ Creating Alerts — 4. Edit Alert Action

*Alert Name:

Available Template:

*Monitoring Pair Status: ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒

☒ Alert with Email

Mail Server:

To:

From:

Subject:

Message:

☐ Enable SMTP Authentication

User ID:

Password:

☐ Alert with SNMP Trap

Host:

Community:

Message:

* Required field

<Back Next> Cancel Help

17

■ Creating Alerts — 5. Confirm and 6. Finish

HRpM- Create Alert Setting Wizard

HITACHI

1. Introduction ▶ 2. Select Monitoring Type ▶ 3. Select Alert Setting ▶ 4. Edit Alert Action ▶ 5. Confirm ▶ 6. Finish

Check the alert setting.
Carefully review the summary below, and then click "Confirm" to apply all the changes.
This operation might take several minutes to finish.

Alert Name:

Monitoring Pair Status: ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒

☒ Alert with Email

Mail Server:

To:

From:

Subject:

Message:

☐ Enable SMTP Authentication

User ID:

Password:

☐ Alert with SNMP Trap

Host:

Community:

Message:

Resource List:

☒ Yes, I have confirmed the above information and wish to create alert setting.

<Back Confirm Cancel Help

18

Alert Status

■ Exporting Alerts from Alert List

The screenshot displays the 'Alerts' section of the Replication Manager interface. On the left is a navigation pane with 'Alerts' selected. The main area shows an 'Alert Summary' with 'Marking Type' set to 'Auto'. Below this is the 'Alert List' tab, which contains a table of alerts. The table has columns for Date / Time, Alert Name, Resource, Completed / Not Completed, Alert Action (Email, SNMP), and Detected (Metrics, Value). There are four rows of alert data shown.

Date / Time	Alert Name	Resource	Completed / Not Completed	Alert Action		Detected	
				Email	SNMP	Metrics	Value
2011-02-02 16:13:33	Oracle_Data	Pair1	Not Completed			Pair Status	II
2011-02-02 09:42:56	Status_Change	P_05-06_0001	Not Completed		✓	Pair Status	✓
2011-02-02 09:41:59	Status_Change	P_05-06_0001	Completed		✓	Pair Status	✓
2011-02-02 09:41:02	Status_Change	P_05-06_0001	Completed		✓	Pair Status	✓

At the bottom right of the table area, there is an 'Export Alerts' button.

19

■ Editing or Deleting Alerts

The screenshot shows the 'Alerts' management page. At the top, there's a green header with 'Alerts' and a 'Help' button. Below it is an 'Alert Summary' section with a 'Marking Type' dropdown set to 'Auto'. There are two tabs: 'Alert List' and 'Alert Setting List', with 'Alert Setting List' being the active tab. The main area contains a table with columns: 'Alert Name', 'Resource Type', 'Enabled / Disabled', 'Alert Action' (with sub-columns 'Email' and 'SNMP'), and 'Monitoring' (with sub-columns 'Metrics' and 'Condition'). The table has two rows: 'Oracle_Data' and 'Status_Change'. The 'Status_Change' row is selected. At the bottom, there are buttons: 'Test Alert', 'Enable Alerts', 'Disable Alerts', and 'Delete Alerts'.

	Alert Name	Resource Type	Enabled / Disabled	Alert Action		Monitoring	
				Email	SNMP	Metrics	Condition
☐	Oracle_Data	Copy Pair	Enabled	☒		Pair Status	☒ ☒ ☒ ☒ ☒
☒	Status_Change	Copy Pair	Enabled	☒	☒	Pair Status	☒ ☒ ☒ ☒ ☒

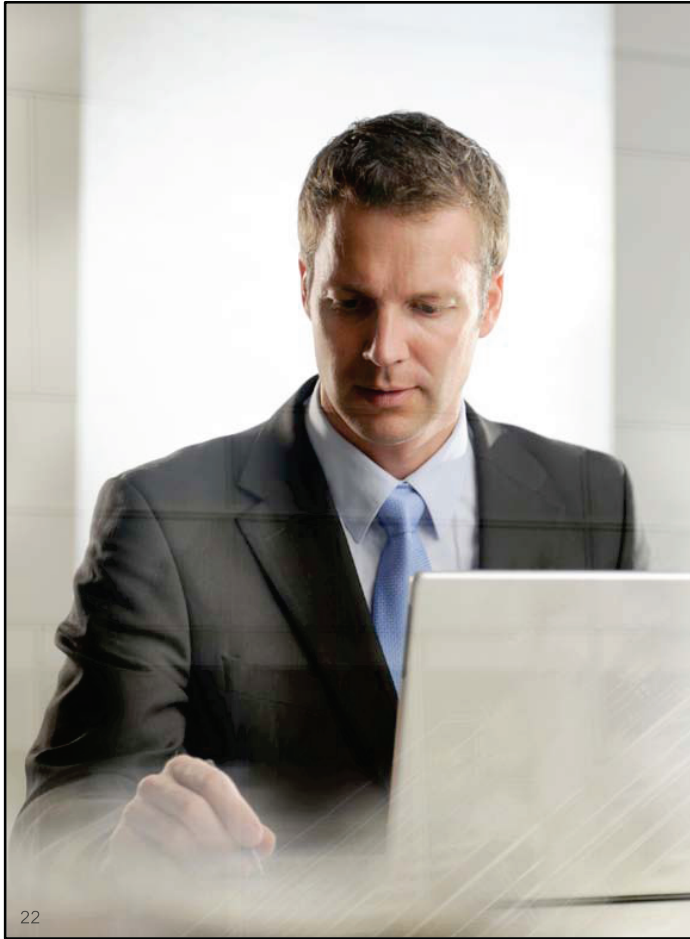
20

■ Editing Alert Setting

The screenshot shows the 'Edit Alert Setting - Oracle_Data' page. It has a green header with 'HRpM' and 'HITACHI' logos. Below the header is a 'Help' button. The main area has a green bar with 'Alert Setting' and instructions: 'If you want to edit an alert action, select the "Alert Action" tab to edit the parameters. To save the modified parameters as a template, click "Save Alert as Template", and then click "OK". If you want to remove a resource from the alert settings, select the resource from "Resource List".' There are two tabs: 'Alert Action' and 'Resource List', with 'Alert Action' being the active tab. The 'Alert Name' field is set to 'Oracle_Data'. Below the tabs, there's an 'Available Template' dropdown and an 'Apply Alert Setting' button. The 'Monitoring Pair Status' section has a row of icons. The 'Alert with Email' section is checked and contains fields for 'Mail Server' (mail.smtp.com), 'To' (orcl@storage.com), 'From' (admin@storage.com), 'Subject' (Replication Manager Alert), and 'Message' (Pair Status changed). There's also an 'Enable SMTP Authentication' checkbox and fields for 'User ID' and 'Password'. The 'Alert with SNMP Trap' section is unchecked and contains fields for 'Host', 'Community', and 'Message'. At the bottom right, there's a 'Save Alert Setting as Template' button.

21

Instructor Demonstration — Monitoring Options



22

Instructor Demonstration

- Monitoring Options
 - Dashboard
 - Copy Pair Status
 - License Status
 - Alerts



Module Summary

- In this module you learned how to:
 - List the pair monitoring options available in Hitachi Replication Manager
 - Describe the process for setting up alerts
 - Describe the alerts management process

Module Review

1. How can you use alerts?
2. **Copy Pair** status can be monitored for what entities?

25

9. Application Replicas

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe how Hitachi Replication Manager (HRpM) supports managing application replicas
 - Identify the components required for setting up an environment for managing application replicas
 - Describe the Application Agent architecture and functions
 - List the steps for handling backup and restores for:
 - Microsoft® Exchange Server (MS-Exchange)
 - Microsoft SQL Server® (MS-SQL)

2

Application Replicas

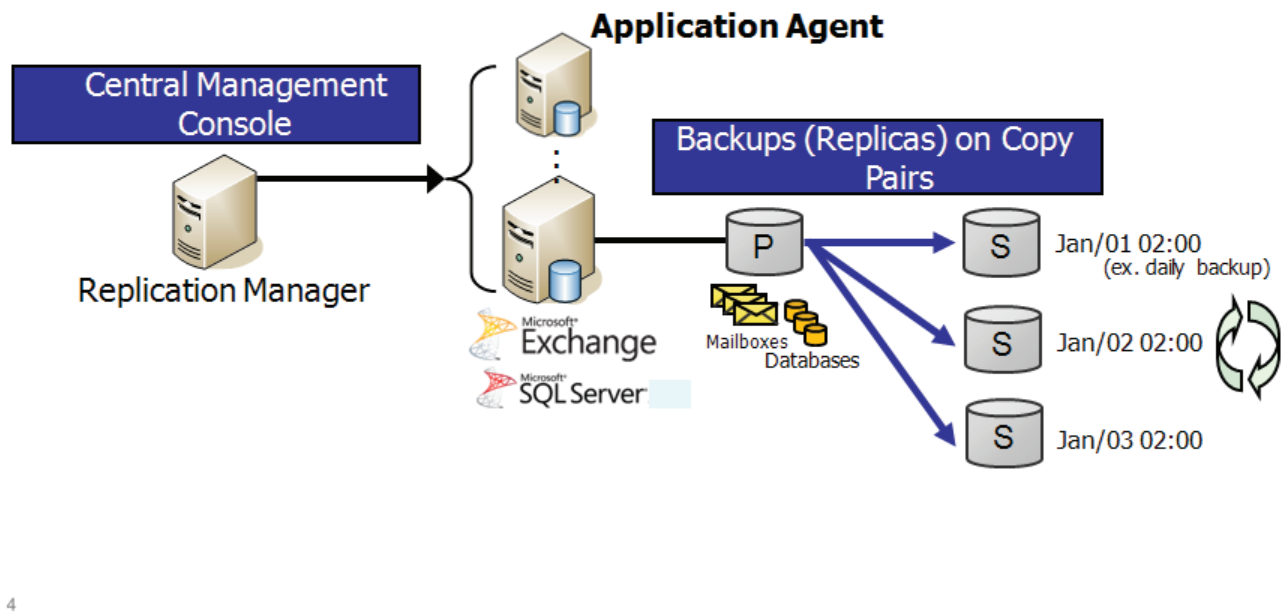
- An **application replica** is a snapshot of an application server that is saved to a series of secondary volumes on an immediate or scheduled basis.
- Requires installation of **Application Agent** on the application server.
- Supported **Applications**:
 - MS-Exchange
 - MS-SQL
- Replication Manager is used to create, manage and manually restore replicas.
 - Support for auto and manual selection of backup targets
 - Targets can be rotated

3

As with copy pair management, the creation and management of application replicas is organized around tasks and storage assets.

Backup and Restore Overview

- Hitachi Replication Manager allows backup and restore of MS-Exchange and MS-SQL databases.



Replication Manager supports creating backups of application data. Known as application replicas, these snapshots are managed as a series of secondary volumes that are rotated on a scheduled basis. Replication Manager manages the relationships between backup objects and their associated logical units within storage devices, the relationships between primary and secondary volumes, and the backup history. Replicas can be mounted and dumped to tape using scripts executed through Replication Manager.

The **Volume Shadow Copy Service (VSS)** can produce consistent shadow copies by coordinating with business applications, file-system services, backup applications, fast-recovery solutions, and storage hardware. Several features in the Windows Server 2003 operating systems use the Volume Shadow Copy Service, including Shadow Copies for Shared Folders and Backup.

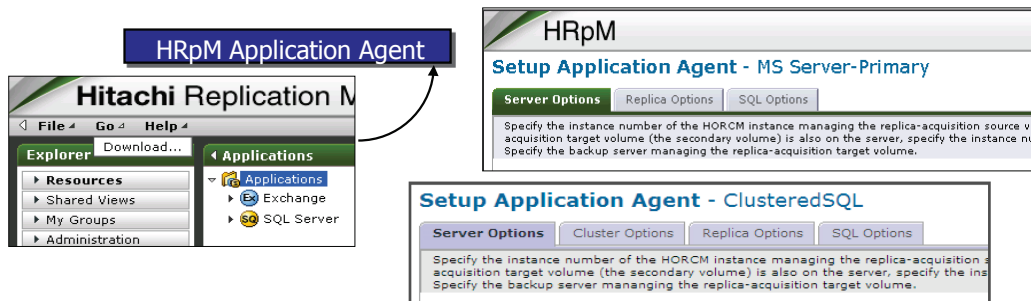
MS-SQL Server provides an API called **Virtual Backup Device Interface (VDI)** that enables independent software vendors to integrate MS-SQL Server into their products for providing support for backup and restore operations. These APIs are engineered to provide maximum reliability and performance, and support the full range of SQL Server backup and restore functionality, including the full range of hot and snapshot backup capabilities.

The Application agent uses VSS for MS-Exchange and VDI for MS-SQL backups and restores.

HRpM provides automatic replica creation based on pre-defined schedule.

Application Backup and Restore Features

- **Simpler Setup**
 - **Simple Deployment**
 - Application Agent Installer deploys the required components for replica management.
 - Application Agent can be easily downloaded from HCS GUI to application servers.
 - **Simple Agent Setup**
 - HRpM hides complex parameters which users normally do not need to know about.



5

■ Consolidated Management

- Multiple Server Management
 - HRpM allows user to manage multiple servers in a single point of view.
- Integration with Pair Management
 - **Pair Management** button easily navigates users to required pair configurations.

The image shows two screenshots from the HRpM interface. The left screenshot displays the 'Applications' view with a tree structure showing 'Exchange', 'MS Server-Primary', 'SQL Server', and 'MS Server-Primary'. A callout box points to this view, stating: 'Shows the list of application servers in a single consolidated view'. The right screenshot shows the 'HRpM - Pair Configuration Wizard' dialog box, specifically the 'Pair Association' step. A 'Pair Management' button is highlighted with a red box, and a callout box points to it, stating: 'Launch Pair Configuration Wizard from Applications View'.

6

■ Enhanced Monitoring

- Data Protection Status
 - Intuitive icon shows the summary status, so user can easily identify the possible issues.
- Email Notification
 - Errors can be notified by email for immediate actions.

The image shows two screenshots from the HRpM interface. The left screenshot displays the 'SQL Server' application view, showing a table of 'Instances' with columns for 'Name', 'Host ID', 'Data Protection Status', and 'Latest Replica'. A callout box points to the 'Data Protection Status' column, stating: 'Protection Status for Hosts and Storage Groups / Instances'. The right screenshot shows the 'Email Options' dialog box, which includes a checkbox for 'Enable Email notification for replica task' and fields for 'Email notification type', 'Mail Server', 'To', 'From', 'Subject(normal)', 'Subject(error)', and 'Message'. A callout box points to this dialog, stating: 'Email notification settings for Application Agent'. Below the screenshots, a legend explains the status icons: a green circle for 'Normal : Latest Replica is available.', a yellow triangle for 'Warning : Only the old replica is available.', a red exclamation mark for 'Critical : No replica is available due to errors.', and a grey circle for 'Unknown : No replica task has been scheduled yet.'

7

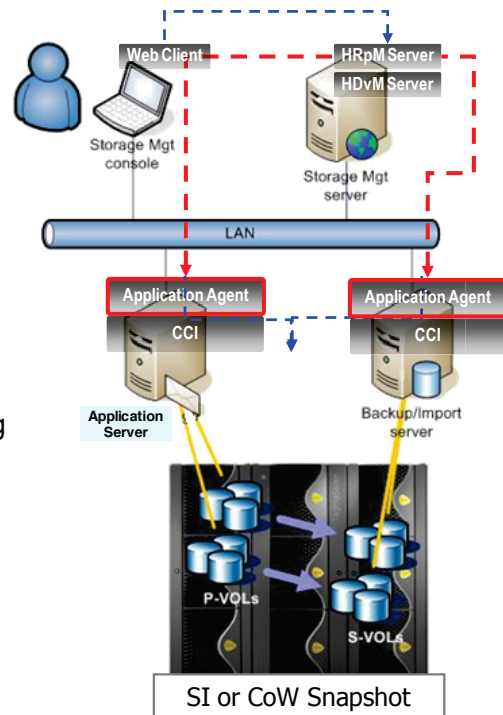
Components

■ Servers

- Storage Management Server
 - Provides management interface
- Application Server
 - Mailbox server of MS-Exchange
 - Database server of MS-SQL Server
- Backup / Import Server
 - Server which mounts S-VOL

■ Software

- Application Agent
 - Executes replica operations by communicating with CCI and MS-SQL/MS-Exchange.
- CCI (+ HDvM Agent)
 - Executes pair operation (resync or split).
 - HDvM Agent is not mandatory for creating replica, but the agent is required for pair configuration.
- HRpM and HDvM Server
 - Manages backup and restore tasks.



8

HDvM – Hitachi Device Manager

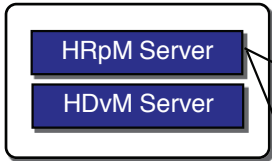
SI – Hitachi ShadowImage Heterogeneous Replication

CoW – Hitachi Copy-on-Write Snapshot

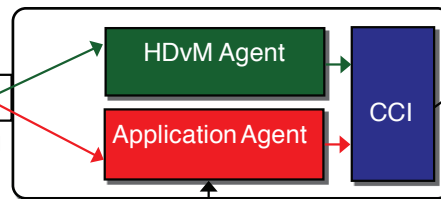
Application Agent

■ Application Agent Architecture

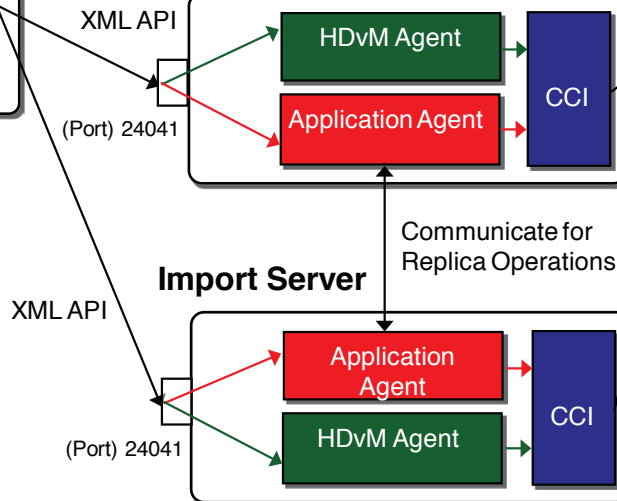
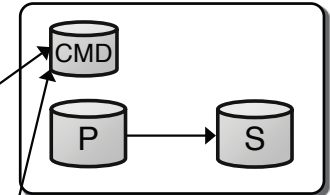
Management Server



Application Server



Storage System

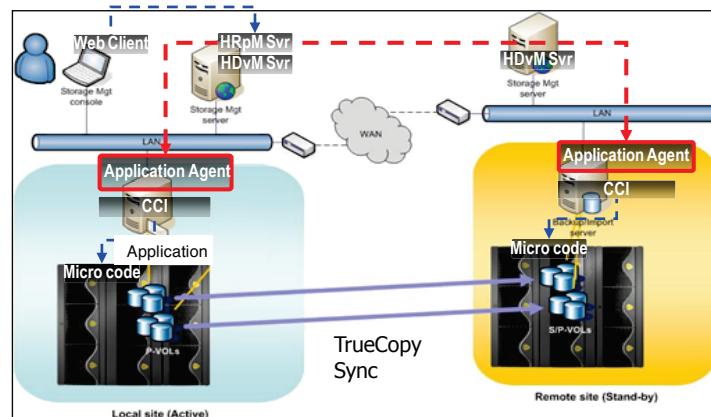


- Pair Operations
(Pair Configuration Wizard, Change Pair Status Wizard)
- Replica Operations and Agent Settings
(Create Replica Wizard, Restore Replica Wizard, Setup Agent Dialog)

9

System Configuration for Remote Copy

- HRpM Application Agent also supports creating a replica to the remote site.
 - Remote Copy Support:
 - Hitachi TrueCopy Synchronous — MS-SQL Server / MS-Exchange
 - Hitachi Universal Replicator — MS-SQL Server
 - Import Server is required on remote site (MS-Exchange Only).



HDvM Server on remote site is not mandatory for replica operation, though it is required for performing pair configuration on remote site.

10

HDvM = Hitachi Device Manager

Backup and Restore Operations

- Features:
 - Discovering Application Agent
 - Creating Replica
 - Restoring Replica
 - Mounting Replica

11

Discovering Application Agent

- Discovery and Configuration of an Agent Through the Intuitive GUI
 - New Application Agent in Information Source view provides the screens for the settings.

Information Source

Application Agent
Information Source > Application Agent

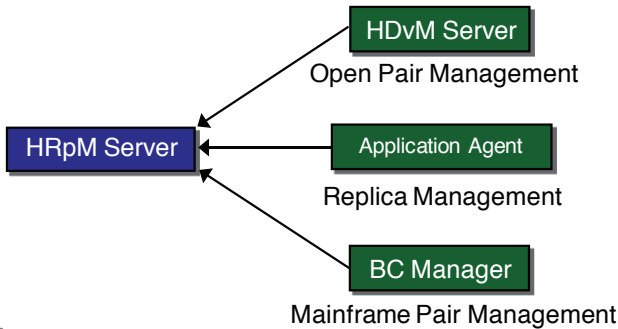
Application Agent Setting

List of Application Agents is displayed.

	Name	Host ID	Port	Host Type	Configuration Type	Component Version		
						Copy Controller	Exchange	SQL Server
☐	MS Server-Backup	10.17.105.2	24041	Backup Server	Physical Host (Stand-Alone)	7.1.0-00	7.1.0-00	7.1.0-00
☐	MS Server-Primary	10.17.105.1	24041	Database Server	Physical Host (Stand-Alone)	7.1.0-00	7.1.0-00	7.1.0-00

Refresh Tree

Add Agent Remove Agents Setup Agent Refresh Agent



HRpM

Add Application Agent

Discover Application Agent by specifying the host information

Application Agent Setting

If you registered the Application Agent without selecting the host information, you must select the host information to acquire the configuration, select (Application Agent) unit, and then execute (Refresh Agent).

Name:

Host ID:

Port:

Host Type: ☒ Database server ☐ Backup server

Configuration Type: ☒ Physical Host (Stand-alone) ☐ Virtual Host (Cluster)

Cluster Settings:

Application Type:

Virtual Host:

Cluster Nodes:

Host ID:

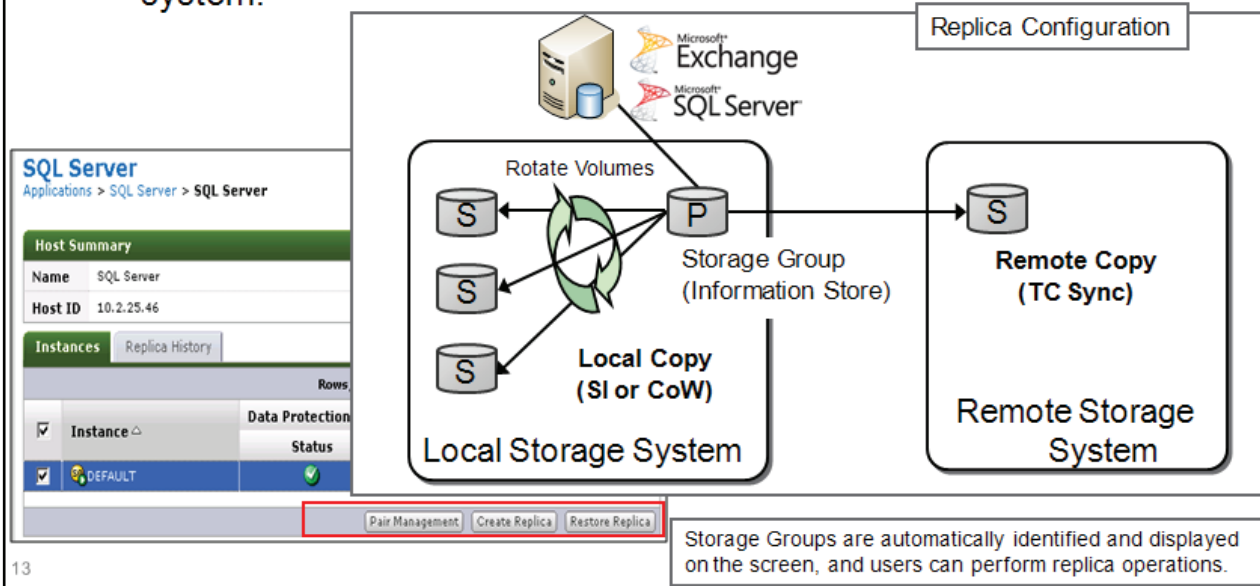
☒ Acquire application configuration managed by the Application Agent during the registration.

* Required field

OK Cancel

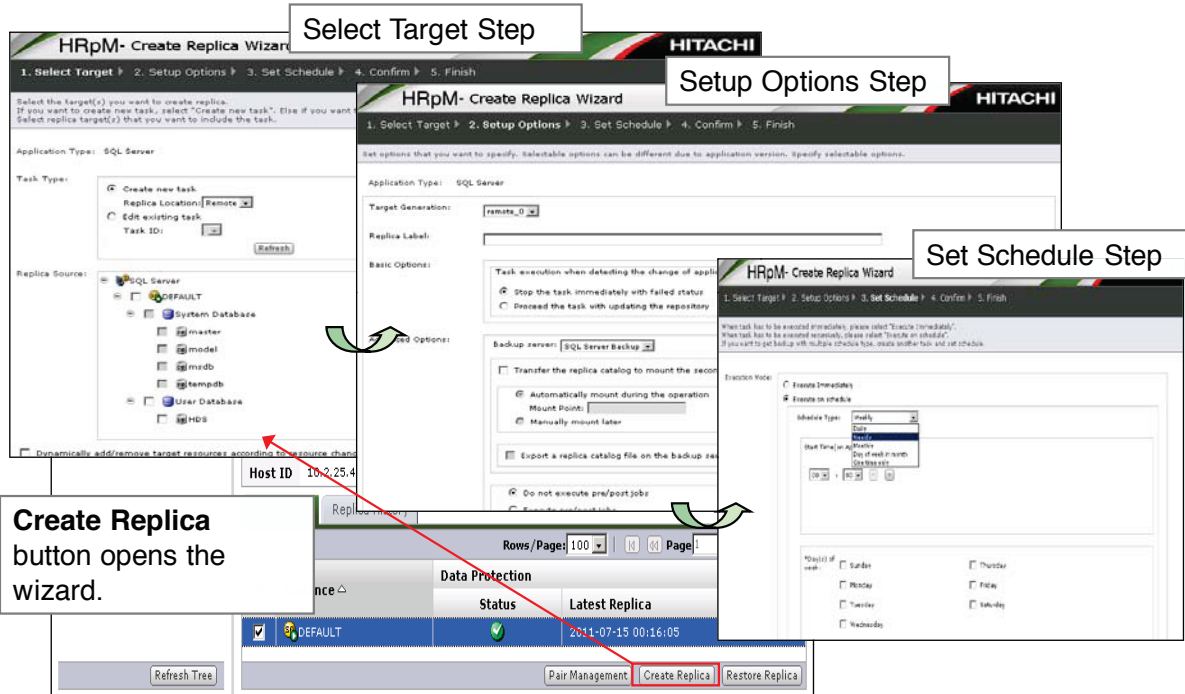
Creating Replicas

- You can create replicas of application databases.
 - HRpM automatically ensures the backup target resources mapping. (Storage Group – Information Store – Copy Pairs)
 - Users can create the replica on either the local or remote storage system.



13

- A wizard helps create replicas.
 - Replicas can be created with recurring schedules.



Create Replica Wizard

- The result of the **Create Replica Wizard** is registered as task and **Task View** provides the detail of the task execution.

The screenshot displays the Hitachi Data Systems Task View interface. The main window shows a 'Task List' table with columns: Task ID, Workflow, MF/Open, Host, Target, Copy Type, and Task Type. Two tasks are listed: TASK0002 (selected) and TASK0001. A red box highlights the 'TASK0002' row, and a red arrow points from it to the 'Edit Task - TASK0002' dialog box. The dialog box has a 'Schedule' tab with options for 'Execute Immediately' and 'Execute on schedule'. A text box explains that 'Execute on schedule' allows for recursive execution and error handling. Another red arrow points from the 'TASK0002' row to the 'Task History - TASK0002' window. This window shows a 'Task Summary' with details like Application (SQL Server), Host (SQL Server), and Task Type (create replica(SQL)). Below the summary is a 'Result List' table showing the task's status as 'Success' and completion time as '00:00:17'.

Edit Task allows to update the execution schedule.

Task History allows to view the history of execution results

15

Restoring Replicas

- The application database can be restored using the replica.
 - Easy to identify the available backups on the GUI screen.
 - Quick recovery of Exchange by using the copy pair reverse-resync operation.

Replica History tab shows the list of created replicas.

SQL Server
Applications > SQL Server > SQL Server

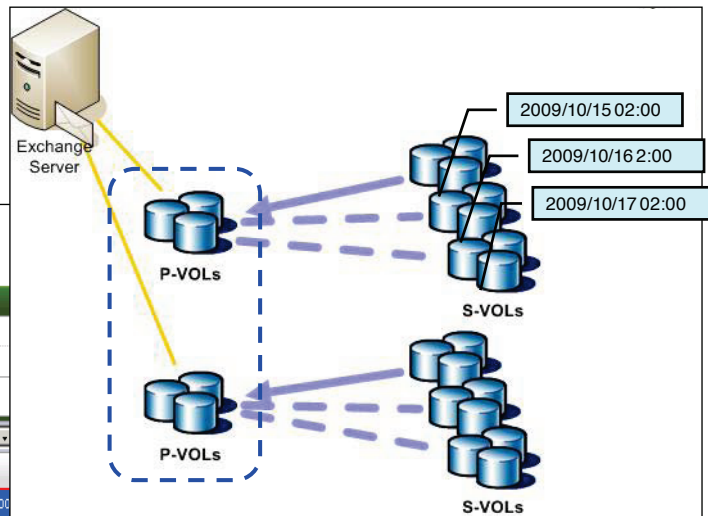
Host Summary

Name SQL Server
Host ID 10.2.25.46

Instances **Replica History**

Creation Time	Target Generation	Instance	Database	Checkpoint LSN
2011-07-15 00:16:05	remote_0	DEFAULT	HDS	190000000452000

Restore Replica Mount Replica Unmount Replica Import Replica Info Delete Replicas



Copy Information from S-VOL to P-VOL

Restoring Replica

- **Restore Replica Wizard** provides a simple restore operation with recovery options.

The screenshot displays the HRpM- Restore Replica Wizard and the main application interface. The wizard is shown in two steps: 'Select Target Step' and 'Setup Options Step'. The 'Select Target Step' shows a 'Replica Summary' with 'Creation Time' 2011-07-15 00:16:05 and 'Replica Location' Remote. The 'Setup Options Step' shows 'Application Type: SQL Server', 'Target Server: This Database server SQL Server', 'Target Instance: Original SQL Instance', and 'Restore Mode: Point-in-time restore'. The main application interface shows a table of replicas with a 'Restore Replica' button highlighted. A red arrow points from the 'Restore Replica' button to the 'Setup Options Step' of the wizard.

Replica Summary

Creation Time	Replica Location
2011-07-15 00:16:05	Remote

Replica History

Creation Time	Target Generation	Instance	Database
2011-07-15 00:16:05	remote_0	DEFAULT	HDS

Restore Replica button highlighted.

17

Mounting or Unmounting Replica

- The replica can be mounted on the import server for purposes other than performing a restore on HRpM (additional purposes include tape backup from S-VOL, etc.).

HRpM HITACHI

Mount Replica

Replica Summary

Creation Time: 2009-10-14 16:30:42

Replica Location: n/a

Storage Group: FIRST STORAGE GROUP

Mount Point Setting

Carefully review the Replica Summary and Secondary Host details. Set the Mount Point and click "OK" to continue.

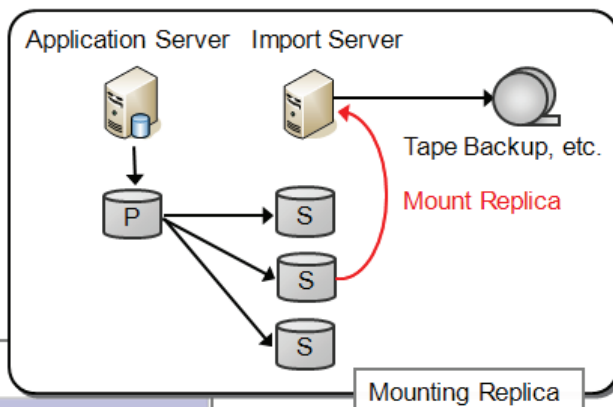
Secondary Host: scsaw6945

*Mount Point: I:

*Required field

OK Cancel

This dialog allows to mount the replica to specified mount point



Host Summary

Name: scsaw6945

Host ID: 172.17.69.45

Storage Groups Replica History

Creation Time	Replica Location	Storage Group	Label	Secondary Host
2009-10-14 16:10:10	Local	FIRST STORAGE GROUP	Test from HRpM for Mount	
2009-10-14 16:30:42	n/a	FIRST STORAGE GROUP	HRpM for Mount H Drive	scsaw6945
2009-10-15 12:32:05	Local	FIRST STORAGE GROUP SECOND STORAGE GROUP	2 storage groups	

Restore Replica Mount Replica Unmount Replica

Note: Refresh Hosts in Applications view is required before mounting the replica.

Module Summary

- In this module, you learned how to:
 - Describe how Hitachi Replication Manager supports managing application replicas
 - Identify the components for setting up environment for managing application replicas
 - Describe the Application Agent architecture and functions
 - List the steps for handling backup and restores for applications

Module Review

1. Where can you download the Application Agents?
2. What applications are supported for Application Replicas?
3. What functions are supported for Application Replica management?

Your Next Steps

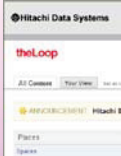




Validate your knowledge and skills with certification



Check your progress in the learning paths



Collaborate and share with fellow HDS colleagues



Review the course description for supplemental courses



Register, enroll and view additional course offerings

Check your personalized learning path



Get the latest course and Academy updates

Hitachi Data Systems Academy Open @HDS Academy



Get practical advice and insight with HDS white papers

3

Learning Center: <http://learningcenter.hds.com>

LinkedIn:

http://www.linkedin.com/groups?home=&gid=3044480&trk=anet_ug_hm&goback=%2Emyg%2Eanb_3044480_*2

Twitter: <http://twitter.com/#!/HDSAcademy>

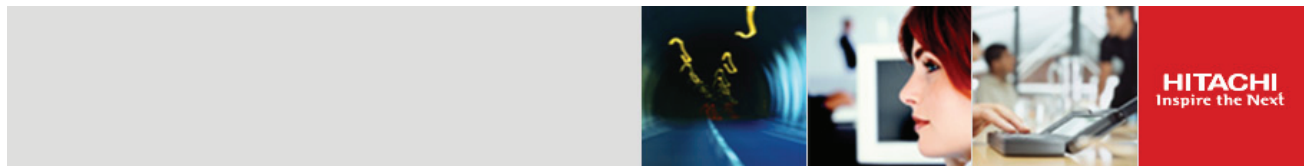
White Papers: <http://www.hds.com/corporate/resources/>

Certification: <http://www.hds.com/services/education/certification>

Learning Paths:

- APAC: http://www.hds.com/services/education/apac/?_p=v#GlobalTabNavi
- Americas: <http://www.hds.com/services/education/north-america/?tab=LocationContent1#GlobalTabNavi>
- EMEA: <http://www.hds.com/services/education/emea/#GlobalTabNavi>

theLoop: <http://loop.hds.com/index.jspa> — HDS internal only



Training Course Glossary

[A](#) [B](#) [C](#) [D](#) [E](#) [F](#) [G](#) [H](#) [I](#) [J](#) [K](#) [L](#) [M](#) [N](#) [O](#) [P](#) [Q](#) [R](#) [S](#) [T](#) [U](#) [V](#) [W](#) [X](#) [Y](#) [Z](#)

—A—

ACC — Action Code. A SIM System Information Message. Will produce an ACC, which requires an engineer to the correct fix procedures in the ACC directory in the MM (Maintenance Manual).

ACE — Access Control Entry. Stores access rights for a single user or group within the Windows security model

ACL — Access Control List. Stores a set of ACEs, so that it describes the complete set of access rights for a file system object within the Microsoft Windows security model

ACP — Array Control Processor. Microprocessor mounted on the disk adapter circuit board (DKA) that controls the drives in a specific disk array. Considered part of the back end; it controls data transfer between cache and the hard drives.

ACP Domain — Also Array Domain. All of the array-groups controlled by the same pair of DKA boards, or the HDDs managed by one ACP PAIR (also called BED).

ACP PAIR — Physical disk access control logic. Each ACP consists of two DKA PCBs. To provide eight loop paths to the real HDDs

Actuator (arm) — Read/write heads are attached to a single head actuator, or actuator arm, that moves the heads around the platters.

AD — Active Directory

ADC — Accelerated Data Copy

Address — A location of data, usually in main memory or on a disk. A name or token that identifies a network component. In local area networks (LANs), for example, every node has a unique address.

ADP — Adapter

ADS — Active Directory Service

AIX — IBM UNIX

AL — Arbitrated Loop. A network in which nodes contend to send data, and only one node at a time is able to send data.

AL-PA — Arbitrated Loop Physical Address

AMS — Adaptable Modular Storage

APAR — Authorized Program Analysis Reports

APF — Authorized Program Facility. In IBM z/OS and OS/390 environments, a facility that permits the identification of programs that are authorized to use restricted functions.

API — Application Programming Interface

APID — An ID to identify a command device

Application Management — The processes that manage the capacity and performance of applications.

ARB — Arbitration or request

ARM — Automated Restart Manager

Array Domain — Also ACP Domain. All functions, paths, and disk drives controlled by a single ACP pair. An array domain can contain a variety of LVI or LU configurations.

Array Group — Also called a parity group, is a group of hard disk drives (HDDs) that form the basic unit of storage in a subsystem. All HDDs in a parity group must have the same physical capacity.

Array Unit — A group of Hard Disk Drives in one RAID structure. Same as Parity Group.

ASIC — Application specific integrated circuit

ASSY — Assembly

Asymmetric virtualization — See Out-of-band virtualization.

Asynchronous — An I/O operation whose initiator does not await its completion before proceeding with other work. Asynchronous I/O operations enable an initiator to have multiple concurrent I/O operations in progress. Also called Out-of-band virtualization.

ATA — Advanced Technology Attachment. A disk drive implementation that integrates the controller on the disk drive itself. Also known as IDE (Integrated Drive Electronics) Advanced Technology Attachment.

Authentication — The process of identifying an individual, usually based on a username and password.

AUX — Auxiliary Storage Manager

Availability — Consistent direct access to information over time

[-back to top-](#)

—B—

B4 — A group of four HDU boxes that are used to contain 128 HDDs

Back end — In client/server applications, the client part of the program is often called the front end and the server part is called the back end.

Backup image—Data saved during an archive operation. It includes all the associated files, directories, and catalog information of the backup operation.

BADM — Basic Direct Access Method

BASM — Basic Sequential Access Method

BATCTR — Battery Control PCB

BC — Business Class (in contrast with EC, Enterprise Class)

BCP — Base Control Program

BCPii — Base Control Program internal interface

BDW — Block Descriptor Word

BED — Back End director. Controls the paths to the HDDs.

BIOS — Basic Input/Output System. A chip located on all computer motherboards that governs how a system boots and operates.

BLKSIZE — Block size

BPAM — Basic Partitioned Access Method

BPM — Business Process Management

BST — Binary Search Tree

BSTP — Blade Server Test Program

BTU — British Thermal Unit

Business Continuity Plan — Describes how an organization will resume partially or completely interrupted critical functions within a predetermined time after a disruption or a disaster. Sometimes also called a Disaster Recovery Plan.

[-back to top-](#)

—C—

CA — Continuous Access software (see HORC) or Continuous Availability (or Computer Associates)

Cache — Cache Memory. Intermediate buffer between the channels and drives. It has a maximum capacity of 64GB (32GB x 2 areas). It is available and controlled as two areas of cache (cache A and cache B). It is fully battery-backed (48 hours).

Cache hit rate — When data is found in the cache, it is called a cache hit, and the effectiveness of a cache is judged by its hit rate.

Cache partitioning — Storage management software that allows the virtual partitioning of cache and allocation of it to different applications.

CAD — Computer-Aided Design

Capacity — Capacity is the amount of data that a drive can store after formatting. Most data storage companies, including HDS, calculate capacity based on the assumption that 1KB = 1,024 bytes, 1MB = 1,024 kilobytes, 1GB = 1,024 megabytes, and 1TB = 1,024 gigabytes.

CAPEX — Capital expenditure — the cost of developing or providing non-consumable parts for the product or system. For example, the purchase of a photocopier is the CAPEX, and the annual paper and toner cost is the OPEX. (See OPEX).

CAS — Column address strobe is a signal sent to a dynamic random access memory (DRAM) that tells it that an associated address is a column address. CAS-column address strobe

sent by the processor to a DRAM circuit to activate a column address.	CIFS protocol – Common internet file system is a platform-independent file sharing system. A network file system accesses protocol primarily used by Windows clients to communicate file access requests to Windows servers.
CBU – Capacity Backup	CIM – Common Information Model
CCHH – Common designation for Cylinder and Head	CKD – Count-key Data. A format for encoding data on hard disk drives; typically used in the mainframe environment.
CCI – Command Control Interface	CKPT – Check Point
CDP – Continuous Data Protection	CL – See Cluster
CDWP – Cumulative disk write throughput	CLI – Command Line Interface
CE – Customer Engineer	CLPR – Cache Logical Partition. Cache can be divided into multiple virtual cache memories to lessen I/O contention.
CEC – Central Electronics Complex	Cluster – A collection of computers that are interconnected (typically at high-speeds) for the purpose of improving reliability, availability, serviceability or performance (via load balancing). Often, clustered computers have access to a common pool of storage, and run special software to coordinate the component computers' activities.
CentOS – Community Enterprise Operating System	CM – Cache Memory, Cache Memory Module. Intermediate buffer between the channels and drives. It has a maximum of 64GB (32GB x 2 areas) of capacity. It is available and controlled as two areas of cache (cache A and cache B). It is fully battery-backed (48 hours).
Centralized management – Storage data management, capacity management, access security management, and path management functions accomplished by software.	CM DIR – Cache Memory Directory
CF – Coupling Facility	CM-HSN – Control Memory Hierarchical Star Network
CFCC – Coupling Facility Control Code	CM PATH – Cache Memory Access Path. Access Path from the processors of CHA, DKA PCB to Cache Memory.
CFW – Cache Fast Write	CM POK – Cache Memory Package
CH – Channel	CM/SM – Cache Memory/Shared Memory
CHS – Channel SCSI	CMA – Cache Memory Adapter
CHA – Channel Adapter. Provides the channel interface control functions and internal cache data transfer functions. It is used to convert the data format between CKD and FBA. The CHA contains an internal processor and 128 bytes of edit buffer memory.	CMD – Command
CHA/DKA – Channel Adapter/Disk Adapter	CMG – Cache Memory Group
CHAP – Challenge-Handshake Authentication Protocol	CNAME – Canonical NAME
CHF – Channel Fibre	CNS – Cluster Name Space or Clustered Name Space
CHIP – Client-Host Interface Processor. Microprocessors on the CHA boards that process the channel commands from the hosts and manage host access to cache.	CNT – Cumulative network throughput
CHK – Check	
CHN – Channel adapter NAS	
CHP – Channel Processor or Channel Path	
CHPID – Channel Path Identifier	
CHSN or C-HSN – Cache Memory Hierarchical Star Network	
CHT – Channel tachyon, a Fibre Channel protocol controller	
CICS – Customer Information Control System	

CoD – Capacity on Demand

Concatenation – A logical joining of two series of data, usually represented by the symbol “|”. In data communications, two or more data are often concatenated to provide a unique name or reference (e.g., S_ID | X_ID). Volume managers concatenate disk address spaces to present a single larger address spaces.

Connectivity technology – a program or device's ability to link with other programs and devices. Connectivity technology allows programs on a given computer to run routines or access objects on another remote computer.

Controller – A device that controls the transfer of data from a computer to a peripheral device (including a storage system) and vice versa.

Controller-based Virtualization – Driven by the physical controller at the hardware microcode level versus at the application software layer and integrates into the infrastructure to allow virtualization across heterogeneous storage and third party products.

Corporate governance – Organizational compliance with government-mandated regulations

CP – Central Processor (also called Processing Unit or PU)

CPC – Central Processor Complex

CPM – Cache Partition Manager. Allows for partitioning of the cache and assigns a partition to a LU; this enables tuning of the system's performance.

CPS – Cache Port Slave

CPU – Central Processing Unit

CRM – Customer Relationship Management

CSS – Channel Subsystem

CS&S – Customer Service and Support

CSTOR – Central Storage or Processor Main Memory

C-Suite – The C-suite is considered the most important and influential group of individuals at a company. Referred to as “the C-Suite within a Healthcare provider.”

CSV – Comma Separated Value or Cluster Shared Volume

CSW – Cache Switch PCB. The cache switch (CSW) connects the channel adapter or disk adapter to the cache. Each of them is connected to the cache by the Cache Memory Hierarchical Star Net (C-HSN) method. Each cluster is provided with the two CSWs, and each CSW can connect four caches. The CSW switches any of the cache paths to which the channel adapter or disk adapter is to be connected through arbitration.

CTG – Consistency Group

CTN – Coordinated Timing Network

CU – Control Unit (refers to a storage subsystem. The hexadecimal number to which 256 LDEVs may be assigned.

CUDG – Control Unit Diagnostics. Internal system tests.

CUoD – Capacity Upgrade on Demand

CV – Custom Volume

CVS – Customizable Volume Size. Software used to create custom volume sizes. Marketed under the name Virtual LVI (VLVI) and Virtual LUN (VLUN).

CWDM – Course Wavelength Division Multiplexing

CXRC – Coupled z/OS Global Mirror

[-back to top-](#)

—D—

DA – Device Adapter

DACL – Discretionary access control list (ACL). The part of a security descriptor that stores access rights for users and groups.

DAD – Device Address Domain. Indicates a site of the same device number automation support function. If several hosts on the same site have the same device number system, they have the same name.

DAMP – Disk Array Management Program. Renamed to Storage Navigator Modular (SNM).

DAS – Direct Attached Storage

DASD – Direct Access Storage Device

Data Blocks – A fixed-size unit of data that is transferred together. For example, the X-modem protocol transfers blocks of 128 bytes. In general, the larger the block size, the faster the data transfer rate.

Data Duplication — Software duplicates data, as in remote copy or PiT snapshots. Maintains two copies of data.

Data Integrity — Assurance that information will be protected from modification and corruption.

Data Lifecycle Management — An approach to information and storage management. The policies, processes, practices, services and tools used to align the business value of data with the most appropriate and cost-effective storage infrastructure from the time data is created through its final disposition. Data is aligned with business requirements through management policies and service levels associated with performance, availability, recoverability, cost, and what ever parameters the organization defines as critical to its operations.

Data Migration — The process of moving data from one storage device to another. In this context, data migration is the same as Hierarchical Storage Management (HSM).

Data Migrator — Software allows for using existing storage resources more efficiently by overseeing the migration of data to less expensive secondary storage. This includes file system data from a Microsoft® Windows® or UNIX host. By shrinking the size of your primary storage, Data Migrator reduces the backup window and prevents over-capacity. Also referred to as Hierarchical Storage Management (HSM).

Data Pipe or Data Stream — The connection set up between the MediaAgent, source or destination server is called a *Data Pipe* or more commonly a *Data Stream*.

Data Pool — A volume containing differential data only.

Data Stream — CommVault's patented high performance data mover used to move data back and forth between a data source and a MediaAgent or between two MediaAgents.

Data Striping — Disk array data mapping technique in which fixed-length sequences of virtual disk data addresses are mapped to sequences of member disk addresses in a regular rotating pattern.

Data Transfer Rate (DTR) — The speed at which data can be transferred. Measured in kilobytes per second for a CD-ROM drive, in bits per

second for a modem, and in megabytes per second for a hard drive. Also, often called data rate.

DBMS — Data Base Management System

DCA — Data Cache Adapter

DDL — Database Definition Language

DDM — Disk Drive Module

DDNS — Dynamic DNS

DE — Data Exchange Software

Device Management — Processes that configure and manage storage systems

DFS — Microsoft Distributed File System

DFSMS — Data Facility Storage Management Subsystem

DFSMSDM — Data Facility Storage Management Subsystem System Data Mover

DFSMSdfp — Data Facility Storage Management Subsystem Data Facility Product

DFSMSdss — Data Facility Storage Management Subsystem Data Set Services

DFSMSHsm — Data Facility Storage Management Subsystem Hierarchical Storage Manager

DFSMSRmm — Data Facility Storage Management Subsystem Removable Media Manager

DFSMSStvs — Data Facility Storage Management Subsystem Transactional VSAM Services

DFW — DASD Fast Write

DICOM — Digital Imaging and Communications in Medicine

DIMM — Dual In-line Memory Module

Direct Access Storage Device — A type of storage device, in which bits of data are stored at precise locations, enabling the computer to retrieve information directly without having to scan a series of records.

Direct Attached Storage — Storage that is directly attached to the application or file server. No other device on the network can access the stored data.

Director class switches — Larger switches often used as the core of large switched fabrics

Disaster Recovery Plan (DRP) — A plan that describes how an organization will deal with potential disasters. It may include the precautions taken to either maintain or quickly resume mission-critical functions. Sometimes also referred to as a Business Continuity Plan.

Disk Administrator — An administrative tool that displays the actual LU storage configuration.

Disk Array — A linked group of one or more physical independent hard disk drives generally used to replace larger, single disk drive systems. The most common disk arrays are in daisy chain configuration or implement RAID (Redundant Array of Independent Disks) technology.

A disk array may contain several disk drive trays, and is structured to improve speed and increase protection against loss of data. Disk arrays organize their data storage into Logical Units (LUs), which appear as linear block paces to their clients. A small disk array, with a few disks, might support up to eight LUs; a large one, with hundreds of disk drives, can support thousands.

DKA — Disk Adapter. Also called an array control processor (ACP); it provides the control functions for data transfer between drives and cache. The DKA contains DRR (Data Recover and Reconstruct), a parity generator circuit. It supports four fibre channel paths and offers 32KB of buffer for each fibre channel path.

DKC — Disk Controller Unit. In a multi-frame configuration, the frame that contains the front end (control and memory components).

DKCMN — Disk Controller Monitor. Monitors temperature and power status throughout the machine.

DKF — Fibre disk adapter. Another term for a DKA.

DKU — Disk Array Frame or Disk Unit. In a multi-frame configuration, a frame that contains hard disk units (HDUs).

DKUPS — Disk Unit Power Supply

DLIBs — Distribution Libraries

DKUP — Disk Unit Power Supply

DLM — Data Lifecycle Management

DMA — Direct Memory Access

DM-LU — Differential Management Logical Unit.
DM-LU is used for saving management information of the copy functions in the cache.

DMP — Disk Master Program

DNS — Domain Name System

DOC — Deal Operations Center

Domain — A number of related storage array groups

DOO — Degraded Operations Objective

DP — Dynamic Provisioning (pool)

DP-VOL — Dynamic Provisioning Virtual Volume

DR — Disaster Recovery

DRAC — Dell Remote Access Controller

DRAM — Dynamic random access memory

DRP — Disaster Recovery Plan

DRR — Data Recover and Reconstruct. Data Parity Generator chip on DKA.

DRV — Dynamic Reallocation Volume

DSB — Dynamic Super Block

DSF — Device Support Facility

DSF INIT — Device Support Facility Initialization (for DASD)

DSP — Disk Slave Program

DTA — Data adapter and path to cache-switches

DTR — Data Transfer Rate

DVE — Dynamic Volume Expansion

DW — Duplex Write

DWDM — Dense Wavelength Division Multiplexing

DWL — Duplex Write Line or Dynamic Workspace Linking

[-back to top-](#)

—E—

EAV — Extended Address Volume

EC — Enterprise Class (in contrast with BC, Business Class)

ECC — Error Checking and Correction

ECC.DDR SDRAM — Error Correction Code Double Data Rate Synchronous Dynamic RAM Memory

ECM — Extended Control Memory

ECN — Engineering Change Notice

E-COPY — Serverless or LAN free backup

EFI — Extensible Firmware Interface. EFI is a specification that defines a software interface between an operating system and platform firmware. EFI runs on top of BIOS when a LPAR is activated.

EMIF — ESCON Multiple Image Facility

ENC — Enclosure or Enclosure Controller. The units that connect the controllers in the DF700 with the Fibre Channel disks. They also allow for online extending a system by adding RKAs.

EOF — End of Field

EOL — End of Life

EPO — Emergency Power Off

EREP — Error REPorting and Printing

ERP — Enterprise Resource Management

ESA — Enterprise Systems Architecture

ESB — Enterprise Service Bus

ESC — Error Source Code

ESCD — ESCON Director

ESCON — Enterprise Systems Connection. An input/output (I/O) interface for mainframe computer connections to storage devices developed by IBM.

ESD — Enterprise Systems Division

ESDS — Entry Sequence Data Set

ESS — Enterprise Storage Server

ESW — Express Switch or E Switch. Also referred to as the Grid Switch (GSW).

Ethernet — A local area network (LAN) architecture that supports clients and servers and uses twisted pair cables for connectivity.

ETR — External Time Reference (device)

EVS — Enterprise Virtual Server

EXCP — Execute Channel Program

ExSA — Extended Serial Adapter

[-back to top-](#)

—F—

Fabric — The hardware that connects workstations and servers to storage devices in a SAN is referred to as a "fabric." The SAN fabric enables any-server-to-any-storage device connectivity through the use of Fibre Channel switching technology.

Failback — The restoration of a failed system share of a load to a replacement component. For example, when a failed controller in a redundant configuration is replaced, the devices that were originally controlled by the failed controller are usually failed back to the replacement controller to restore the I/O balance, and to restore failure tolerance. Similarly, when a defective fan or power supply is replaced, its load, previously borne

by a redundant component, can be failed back to the replacement part.

Failed over — A mode of operation for failure tolerant systems in which a component has failed and its function has been assumed by a redundant component. A system that protects against single failures operating in failed over mode is not failure tolerant, since failure of the redundant component may render the system unable to function. Some systems (e.g., clusters) are able to tolerate more than one failure; these remain failure tolerant until no redundant component is available to protect against further failures.

Failover — A backup operation that automatically switches to a standby database server or network if the primary system fails, or is temporarily shut down for servicing. Failover is an important fault tolerance function of mission-critical systems that rely on constant accessibility. Failover automatically and transparently to the user redirects requests from the failed or down system to the backup system that mimics the operations of the primary system. Also called path failover.

Failure tolerance — The ability of a system to continue to perform its function or at a reduced performance level, when one or more of its components has failed. Failure tolerance in disk subsystems is often achieved by including redundant instances of components whose failure would make the system inoperable, coupled with facilities that allow the redundant components to assume the function of failed ones.

FAIS — Fabric Application Interface Standard

FAL — File Access Library

FAT — File Allocation Table

Fault Tolerant — Describes a computer system or component designed so that, in the event of a component failure, a backup component or procedure can immediately take its place with no loss of service. Fault tolerance can be provided with software, embedded in hardware, or provided by some hybrid combination.

FBA — Fixed-block Architecture. Physical disk sector mapping.

FBA/CKD Conversion — The process of converting open-system data in FBA format to mainframe data in CKD format.

FBUS — Fast I/O Bus

FC — Fibre Channel or Field-Change (microcode update) or Fibre Channel. A technology for transmitting data between computer devices; a set of standards for a serial I/O bus capable of transferring data between two ports

FC RKAJ — Fibre Channel Rack Additional.
Acronym referring to an additional rack unit that houses additional hard drives exceeding the capacity of the core RK unit of the Thunder 9500V/9200 subsystem.

FC-0 — Lowest layer on fibre channel transport.
This layer represents the physical media.

FC-1 — This layer contains the 8b/10b encoding scheme.

FC-2 — This layer handles framing and protocol, frame format, sequence/exchange management and ordered set usage.

FC-3 — This layer contains common services used by multiple N_Ports in a node.

FC-4 — This layer handles standards and profiles for mapping upper level protocols like SCSI an IP onto the Fibre Channel Protocol.

FCA — Fibre Adapter. Fibre interface card.
Controls transmission of fibre packets.

FC-AL — Fibre Channel Arbitrated Loop. A serial data transfer architecture developed by a consortium of computer and mass storage device manufacturers, and is now being standardized by ANSI. FC-AL was designed for new mass storage devices and other peripheral devices that require very high bandwidth. Using optical fiber to connect devices, FC-AL supports full-duplex data transfer rates of 100Mbps. FC-AL is compatible with SCSI for high-performance storage systems.

FCC — Federal Communications Commission

FCIP — Fibre Channel over IP, a network storage technology that combines the features of Fibre Channel and the Internet Protocol (IP) to connect distributed SANs over large distances. FCIP is considered a tunneling protocol, as it makes a transparent point-to-point connection between geographically separated SANs over IP networks. FCIP relies on TCP/IP services to establish connectivity between remote SANs over LANs, MANs, or WANs. An advantage of FCIP is that it can use TCP/IP as the transport while keeping Fibre Channel fabric services intact.

FCP — Fibre Channel Protocol

FC-P2P — Fibre Channel Point-to-Point

FCSE — Flashcopy Space Efficiency

FC-SW — Fibre Channel Switched

FCU — File Conversion Utility

FD — Floppy Disk or Floppy Drive

FDR — Fast Dump/Restore

FE — Field Engineer

FED — (Channel) Front End Director

Fibre Channel — A serial data transfer architecture developed by a consortium of computer and mass storage device manufacturers and now being standardized by ANSI. The most prominent Fibre Channel standard is Fibre Channel Arbitrated Loop (FC-AL).

FICON — Fiber Connectivity. A high-speed input/output (I/O) interface for mainframe computer connections to storage devices. As part of IBM's S/390 server, FICON channels increase I/O capacity through the combination of a new architecture and faster physical link rates to make them up to eight times as efficient as ESCON (Enterprise System Connection), IBM's previous fiber optic channel standard.

FLGFAN — Front Logic Box Fan Assembly

FLOGIC Box — Front Logic Box

FM — Flash Memory. Each microprocessor has FM. FM is non-volatile memory that contains microcode.

FOP — Fibre Optic Processor or fibre open

FPC — Failure Parts Code or Fibre Channel Protocol Chip

FPGA — Field Programmable Gate Array

Frames — An ordered vector of words that is the basic unit of data transmission in a Fibre Channel network.

Front end — In client/server applications, the client part of the program is often called the front end and the server part is called the back end.

FRU — Field Replaceable Unit

FS — File System

FSA — File System Module-A

FSB — File System Module-B

FSM — File System Module

FSW — Fibre Channel Interface Switch PCB. A board that provides the physical interface (cable connectors) between the ACP ports and the disks housed in a given disk drive.

FTP — File Transfer Protocol. A client-server protocol that allows a user on one computer to transfer files to and from another computer over a TCP/IP network.

FWD — Fast Write Differential

[-back to top-](#)

—G—

GARD — General Available Restricted Distribution

Gb — Gigabit

GB — Gigabyte

Gb/sec — Gigabit per second

GB/sec — Gigabyte per second

GbE — Gigabit Ethernet

GBIC — Gigabit Interface Converter

GDG — Generation Data Group

GDPS — Geographically Dispersed Parallel Sysplex

GID — Group Identifier within the Unix security model.

gigE — Gigabit Ethernet

GLM — Gigabyte Link Module

Global Cache — Cache memory is used on demand by multiple applications. Use changes dynamically, as required for READ performance between hosts/applications/LUs.

GPFS — General Parallel File System

GSC — Global Support Center

GSS — Global Solutions Services

GSSD — Global Solutions Strategy and Development

GSW — Grid Switch Adapter. Also known as E Switch (Express Switch).

GUI — Graphical User Interface

GUID — Globally Unique Identifier

GWS — Grid Switch

[-back to top-](#)

—H—

H1F — Essentially the Floor Mounted disk rack (also called Desk Side) equivalent of the RK. (See also: RK, RKA, and H2F).

H2F — Essentially the Floor Mounted disk rack (also called Desk Side) add-on equivalent similar to the RKA. There is a limitation of only one H2F that can be added to the core RK Floor Mounted unit. See also: RK, RKA, and H1F.

HA — High Availability

HBA — Host Bus Adapter — An I/O adapter that sits between the host computer's bus and the Fibre Channel loop and manages the transfer of information between the two channels. In order to minimize the impact on host processor performance, the host bus adapter performs many low-level interface functions automatically or with minimal processor involvement.

HCA — Host Channel Adapter

HCD — Hardware Configuration Definition

HD — Hard Disk

HDA — Head Disk Assembly

HDD — Hard Disk Drive. A spindle of hard disks that make up a hard drive, which is a unit of physical storage within a subsystem.

HDDPWR — Hard Disk Drive Power

HDI Remote — HDI Cloud Storage & Computing

HDU — Hard Disk Unit. A number of hard drives (HDDs) grouped together within a subsystem.

Head — See read/write head

Heterogeneous — The characteristic of containing dissimilar elements. A common use of this word in information technology is to describe a product as able to contain or be part of a "heterogeneous network," consisting of different manufacturers' products that can interoperate.

Heterogeneous networks are made possible by standards-conforming hardware and software interfaces used in common by different products, thus allowing them to communicate with each other. The Internet itself is an example of a heterogeneous network.

Hi Track System — Automatic fault reporting system.

HIS — High Speed Interconnect

HiStar — Multiple point-to-point data paths to cache

HLQ — High-level Qualifier

HLU — Host Logical Unit.

H-LUN — Host Logical Unit Number. See LUN.

HMC — Hardware Management Console

Homogeneous — Of the same or similar kind

Host — Also called a server. Basically a central computer that processes end-user applications or requests.

Host LU — See HLU

Host Storage Domains — Allows host pooling at the LUN level and the priority access feature lets administrator set service levels for applications.

HP — Hewlett-Packard Company or High Performance

HPAV — Hyper Parallel Access Volume (PAV)

HPC — High Performance Computing

HSA — Hardware System Area

HSG — Host Security Group

HSM — Hierarchical Storage Management (see Data Migrator)

HSN — Hierarchical Star Network

HSSDC — High Speed Serial Data Connector

HTTP — Hyper Text Transfer Protocol

HTTPS — Hyper Text Transfer Protocol Secure

Hub — A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets. A switching hub actually reads the destination address of each packet and then forwards the packet to the correct port. Device to which nodes on a multi-point bus or loop are physically connected.

HyperPAV — Hyper Parallel Access Volume (PAV)

[-back to top-](#)



IDE — Integrated Drive Electronics Advanced Technology. A standard designed to connect hard and removable disk drives.

I/F — Interface

iFCP — Internet Fibre Channel Protocol

Index Cache — Provides quick access to indexed data on the media during a browse\restore operation.

I/O — Input/Output. Term used to describe any program, operation, or device that transfers data to or from a computer and to or from a peripheral device.

IBR — Incremental Block-level Replication

IBR — Intelligent Block Replication

ICB — Integrated Cluster Bus

ICF — Integrated Coupling Facility

ID — Identifier

IDR — Incremental Data Replication

iFCP — Internet Fibre Channel Protocol. Allows an organization to extend Fibre Channel storage networks over the Internet by using TCP/IP. TCP is responsible for managing congestion control as well as error detection and recovery services.

iFCP allows an organization to create an IP SAN fabric that minimizes the Fibre Channel fabric component and maximizes use of the company's TCP/IP infrastructure.

IFL — Integrated Facility for LINUX

IID — Initiator ID. Is used to identify LU, whether it is NAS System LU or User LU. If it is 0, that means it is NAS System LU; and if it is 1, then the LU is User LU.

IIS — Internet Information Server

ILM — Information Life Cycle Management

ILO — (Hewlett-Packard) Integrated Lights-Out

IML — Initial Microprogram Load

IMS — Information Management System

In-band virtualization — Refers to the location of the storage network path, between the application host servers in the storage systems. Provides both control and data along the same connection path. Also called symmetric virtualization.

Interface – The physical and logical arrangement supporting the attachment of any device to a connector or to another device.

Internal bus – Another name for an internal data bus. Also, an expansion bus is often referred to as an internal bus.

Internal data bus – A bus that operates only within the internal circuitry of the CPU, communicating among the internal caches of memory that are part of the CPU chip's design. This bus is typically rather quick and is independent of the rest of the computer's operations.

IOCDs – I/O Control Data Set

IODF – I/O Definition file

IOPH – I/O per hour

IOS – I/O Supervisor

IOSQ – Input/Output Subsystem Queue

IP – Internet Protocol

IPL – Initial Program Load

IPSEC – IP security

ISC – Initial shipping condition or Inter-System Communication

iSCSI – Internet SCSI. Pronounced eye skuzzy. An IP-based standard for linking data storage devices over a network and transferring data by carrying SCSI commands over IP networks. iSCSI supports a Gigabit Ethernet interface at the physical layer, which allows systems supporting iSCSI interfaces to connect directly to standard Gigabit Ethernet switches or IP routers. When an operating system receives a request, it generates the SCSI command and then sends an IP packet over an Ethernet connection. At the receiving end, the SCSI commands are separated from the request, and the SCSI commands and data are sent to the SCSI controller and then to the SCSI storage device. iSCSI will also return a response to the request using the same protocol. iSCSI is important to SAN technology because it enables a SAN to be deployed in a LAN, WAN, or MAN.

iSER – iSCSI Extensions for RDMA

ISL – Inter-Switch Link

iSNS – Internet Storage Name Service

ISOE – iSCSI Offload Engine

ISP – Internet service provider

ISPF – Interactive System Productivity Facility

ISPF/PDF – Interactive System Productivity Facility/Program Development Facility

ISV – Independent Software Vendor

[-back to top-](#)

—J—

Java – A widely accepted, open systems programming language. Hitachi's enterprise software products are all accessed using Java applications. This enables storage administrators to access the Hitachi enterprise software products from any PC or workstation that runs a supported thin-client internet browser application and that has TCP/IP network access to the computer on which the software product runs.

Java VM – Java Virtual Machine

JBOD – Just a Bunch of Disks

JCL – Job Control Language

JMP – Jumper. Option setting method

JMS – Java Message Service

JNL – Journal

JNLG – Journal Group

JRE – Java Runtime Environment

JVM – Java Virtual Machine

J-VOL – Journal Volume

[-back to top-](#)

—K—

KSDS – Key Sequence Data Set

kVA – Kilovolt Ampere

KVM – Kernel-based Virtual Machine or Keyboard-Video Display-Mouse

kW – Kilowatt

[-back to top-](#)

—L—

LACP – Link Aggregation Control Protocol

LAG – Link Aggregation Groups

LAN – Local Area Network

LBA – Logical block address. A 28-bit value that maps to a specific cylinder-head-sector address on the disk.

LC – Lucent connector. Fibre Channel connector that is smaller than a simplex connector (SC)

LCDG – Link Processor Control Diagnostics

LCM – Link Control Module

LCP – Link Control Processor. Controls the optical links. LCP is located in the LCM.

LCSS – Logical Channel Subsystems

LCU – Logical Control Unit

LD – Logical Device

LDAP – Lightweight Directory Access Protocol

LDEV – Logical Device or Logical Device (number). A set of physical disk partitions (all or portions of one or more disks) that are combined so that the subsystem sees and treats them as a single area of data storage. Also called a volume. An LDEV has a specific and unique address within a subsystem. LDEVs become LUNs to an open-systems host.

LDKC – Logical Disk Controller or Logical Disk Controller Manual

LDM – Logical Disk Manager

LDS – Linear Data Set

LED – Light Emitting Diode

LFF – Large Form Factor

LIC – Licensed Internal Code

LLQ – Lowest Level Qualifier

LM – Local Memory

LMODs – Load Modules

LNKLST – Link List

Load balancing – The process of distributing processing and communications activity evenly across a computer network so that no single device is overwhelmed. Load balancing is especially important for networks where it is difficult to predict the number of requests that will be issued to a server. If one server starts to be swamped, requests are forwarded to another server with more capacity. Load balancing can also refer to the communications channels themselves.

LOC – Locations section of the Maintenance

Logical DKC (LDKC) – Logical Disk Controller Manual. An internal architecture extension to the Control Unit addressing scheme that

allows more LDEVs to be identified within one Hitachi enterprise storage system.

LPAR – Logical Partition (mode)

LR – Local Router

LRECL – Logical Record Length

LRP – Local Router Processor

LRU – Least Recently Used

LSS – Logical Storage Subsystem (equivalent to LCU)

LU – Logical Unit. Mapping number of an LDEV.

LUN – Logical Unit Number. One or more LDEVs. Used only for open systems.

LUSE – Logical Unit Size Expansion. Feature used to create virtual LUs that are up to 36 times larger than the standard OPEN-x LUs.

LVDS – Low Voltage Differential Signal

LVI – Logical Volume Image. Identifies a similar concept (as LUN) in the mainframe environment.

LVM – Logical Volume Manager

[-back to top-](#)

—M—

MAC – Media Access Control. A MAC address is a unique identifier attached to most forms of networking equipment.

MAID – Massive array of disks

MAN – Metropolitan Area Network

MAPI – Management Application Programming Interface

Mapping – Conversion between two data addressing spaces. For example, mapping refers to the conversion between physical disk block addresses and the block addresses of the virtual disks presented to operating environments by control software.

Mb – Megabits

MB – Megabytes

MBA – Memory Bus Adaptor

MBUS – Multi-CPU Bus

MC – Multi Cabinet

MCU – Main Disk Control Unit. The local CU of a remote copy pair. Main or Master Control Unit.

MCU – Master Control Unit.

MediaAgent – The workhorse for all data movement. MediaAgent facilitates the transfer of data between the data source, the client computer, and the destination storage media.

Metadata – In database management systems, data files are the files that store the database information; whereas other files, such as index files and data dictionaries, store administrative information, known as metadata.

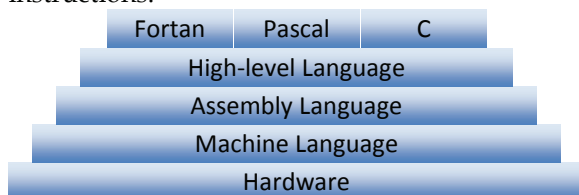
MFC – Main Failure Code

MG – Module Group. Two (DIMM) cache memory modules that work together.

MGC – (3-Site) Metro/Global Mirror

MIB – Management Information Base. A database of objects that can be monitored by a network management system. Both SNMP and RMON use standardized MIB formats that allow any SNMP and RMON tools to monitor any device defined by a MIB.

Microcode – The lowest-level instructions that directly control a microprocessor. A single machine-language instruction typically translates into several microcode instructions.



Microprogram – See Microcode

MIF – Multiple Image Facility

Mirror Cache OFF – Increases cache efficiency over cache data redundancy.

M-JNL – Primary journal volumes.

MM – Maintenance Manual

MMC – Microsoft Management Console

Mode – The state or setting of a program or device. The term mode implies a choice, which is that you can change the setting and put the system in a different mode.

MP – Microprocessor

MPA – Microprocessor adapter

MPIO – Multipath I/O

MPU – Microprocessor Unit

MS/SG – Microsoft Service Guard

MSCS – Microsoft Cluster Server

MSS – Multiple Subchannel Set

MTBF – Mean Time Between Failure

MTS – Multi-Tiered Storage

M-VOL – Main Volume

MVS – Multiple Virtual Storage

[-back to top-](#)

—N—

NAS – Network Attached Storage. A disk array connected to a controller that gives access to a LAN Transport. It handles data at the file level.

NAT – Network Address Translation

NDMP – Network Data Management Protocol is a protocol meant to transport data between NAS devices.

NetBIOS – Network Basic Input/Output System

Network – A computer system that allows sharing of resources, such as files and peripheral hardware devices.

NFS protocol – Network File System is a protocol that allows a computer to access files over a network as easily as if they were on its local disks.

NIM – Network Interface Module

NIS – Network Information Service (originally called the Yellow Pages or YP)

NLS – Native Language Support

Node – An addressable entity connected to an I/O bus or network, used primarily to refer to computers, storage devices, and storage subsystems. The component of a node that connects to the bus or network is a port.

Node name – A Name_Identifier associated with a node

NRO – Network Recovery Objective

NTP – Network Time Protocol

NVS – Non Volatile Storage

[-back to top-](#)

—O—

OEM – Original Equipment Manufacturer

OFC – Open Fibre Control

OID – Object identifier

OLA – Operating Level Agreements

OLTP – On-Line Transaction Processing
 OLTT – Open-loop throughput throttling
 On/Off CoD – On/Off Capacity on Demand
 ONODE – Object node
 OPEX – Operational Expenditure. This is an operating expense, operating expenditure, operational expense, or operational expenditure, which is an ongoing cost for running a product, business, or system. Its counterpart is a capital expenditure (CAPEX).
 ORM – Online Read Margin
 OS – Operating System
 Out-of-band virtualization – Refers to systems where the controller is located outside of the SAN data path. Separates control and data on different connection paths. Also called asymmetric virtualization.

[-back to top-](#)

—P—

PACS – picture archiving and communication systems
 Parity – A technique of checking whether data has been lost or written over when it is moved from one place in storage to another or when it is transmitted between computers.
 Parity Group – Also called an array group. This is a group of hard disk drives (HDDs) that form the basic unit of storage in a subsystem. All HDDs in a parity group must have the same physical capacity.
 Partitioned cache memory – Separate workloads in a “storage consolidated” system by dividing cache into individually managed multiple partitions. Then customize the partition to match the I/O characteristics of assigned LUs
 PAT – Port Address Translation
 PATA – Parallel ATA
 Path – Also referred to as a transmission channel, the path between two nodes of a network that a data communication follows. The term can refer to the physical cabling that connects the nodes on a network, the signal that is communicated over the pathway or a sub-channel in a carrier frequency.
 Path failover – See Failover.
 PAV – Parallel Access Volumes
 PAWS – Protect Against Wrapped Sequences
 PBC – Port By-pass Circuit
 PCB – Printed Circuit Board
 PCHIDS – Physical Channel Path Identifiers
 PCI – Power Control Interface
 PCI CON – Power Control Interface Connector Board
 PCIe – Peripheral Component Interconnect Express
 PD – Product Detail
 PDEV – Physical Device
 PDM – Policy based Data Migration or Primary Data Migrator
 PDS – Partitioned Data Set
 PDSE – Partitioned Data Set Extended
 Performance – Speed of access or the delivery of information
 PFA – Predictive Failure Analysis
 PGR – Persistent Group Reserve
 PI – Product Interval
 PIR – Performance Information Report
 PiT – Point-in-Time
 PK – Package (see PCB)
 PL – Platter. The circular disk on which the magnetic data is stored. Also called motherboard or backplane.
 PM – Package Memory
 Port – In TCP/IP and UDP networks, an endpoint to a logical connection. The port number identifies what type of port it is. For example, port 80 is used for HTTP traffic.
 P-P – Point-to-point; also P2P.
 PPRC – Peer-to-Peer Remote Copy
 PR/SM – Processor Resource/System Manager
 Protocol – A convention or standard that enables the communication between two computing endpoints. In its simplest form, a protocol can be defined as the rules governing the syntax, semantics, and synchronization of communication. Protocols may be implemented by hardware, software, or a combination of the two. At the lowest level,

a protocol defines the behavior of a hardware connection.

Provisioning – The process of allocating storage resources and assigning storage capacity for an application, usually in the form of server disk drive space, in order to optimize the performance of a storage area network (SAN). Traditionally, this has been done by the SAN administrator, and it can be a tedious process. In recent years, automated storage provisioning (also called auto-provisioning) programs have become available. These programs can reduce the time required for the storage provisioning process, and can free the administrator from the often distasteful task of performing this chore manually.

PS – Power Supply

PSA – Partition Storage Administrator

PSSC – Perl Silicon Server Control

PSU – Power Supply Unit

PSUE – pair suspended error

PSUS – pair suspend

PTAM – Pickup Truck Access Method

PTF – Program Temporary Fixes

PTR – Pointer

PU – Processing Unit

P-VOL – Primary Volume

[-back to top-](#)

—Q—

QD – Quorum Device

QoS – Quality of Service. In the field of computer networking, the traffic engineering term quality of service (QoS) refers to resource reservation control mechanisms rather than the achieved service quality. Quality of service is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow.

QSAM – Queued Sequential Access Method

[-back to top-](#)

—R—

RACF – Resource Access Control Facility

RAID – Redundant Array of Independent Disks, or Redundant Array of Inexpensive Disks. A

group of disks that look like a single volume to the server. RAID improves performance by pulling a single stripe of data from multiple disks, and improves fault-tolerance either through mirroring or parity checking and it is a component of a customer's SLA.

RAID-0 – Striped array with no parity

RAID-1 – Mirrored array and duplexing

RAID-3 – Striped array with typically non-rotating parity, optimized for long, single-threaded transfers.

RAID-4 – Striped array with typically non-rotating parity, optimized for short, multi-threaded transfers.

RAID-5 – Striped array with typically rotating parity, optimized for short, multithreaded transfers.

RAID-6 – Similar to RAID-5, but with dual rotating parity physical disks, tolerating two physical disk failures.

RAM – Random Access Memory

RAM DISK – A LUN held entirely in the cache area.

RAS – Reliability, Availability, and Serviceability or Row Address Strobe

RBAC – Role Base Access Control

RC – Reference Code or Remote Control

RCHA – RAID Channel Adapter

RCP – Remote Control Processor

RCU – Remote Control Unit or Remote Disk Control Unit

RD/WR – Read/Write

RDM – Raw Disk Mapped

RDMA – Remote Direct Memory Access

RDP – Remote Desktop Protocol

RDW – Record Descriptor Word

Read/Write Head – Read and write data to the platters, typically there is one head per platter side, and each head is attached to a single actuator shaft.

RECFM – Record Format Redundant. Describes the computer or network system components, such as fans, hard disk drives, servers, operating systems, switches, and telecommunication links that are installed to back up primary resources in case they fail.

A well-known example of a redundant system is the redundant array of independent disks (RAID). Redundancy contributes to the fault tolerance of a system.

Redundancy — Backing up a component to help ensure high availability.

Reliability — Level of assurance that data will not be lost or degraded over time.

Reliability — An attribute of any computer component (software, hardware, or a network) that consistently performs according to its specifications.

REST — Representational State Transfer

REXX — Restructured extended executor

RID — Relative Identifier that uniquely identifies a user or group within a Microsoft Windows domain

RISC — Reduced Instruction Set Computer

R-JNL — Secondary journal volumes.

RKAJAT — Rack Additional SATA disk tray

RLGFAN — Rear Logic Box Fan Assembly

RLOGIC BOX — Rear Logic Box

RMF — Resource Measurement Facility

RMI — Remote Method Invocation. A way that a programmer, using the Java programming language and development environment, can write object-oriented programming in which objects on different computers can interact in a distributed network. RMI is the Java version of what is generally known as a RPC (remote procedure call), but with the ability to pass one or more objects along with the request.

ROA — Return on Asset

RoHS — Restriction of Hazardous Substances (in Electrical and Electronic Equipment)

ROI — Return on Investment

ROM — Read-only memory

Round robin mode — A load balancing technique in which balances power is placed in the DNS server instead of a strictly dedicated machine as other load techniques do. Round robin works on a rotating basis in that one server IP address is handed out, then moves to the back of the list; the next server IP address is handed out, and then it moves to the end of the list; and so on, depending on

the number of servers being used. This works in a looping fashion.

Round robin DNS is usually used for balancing the load of geographically distributed Web servers.

Router — A computer networking device that forwards data packets toward their destinations, through a process known as routing.

RPC — Remote procedure call

RPO — Recovery Point Objective. The point in time that recovered data should match.

RPSFAN — Rear Power Supply Fan Assembly

RRDS — Relative Record Data Set

RS CON — RS232C/RS422 Interface Connector

RSD — RAID Storage Division

R-SIM — Remote Service Information Message

RSM — Real Storage Manager

RTM — Recovery Termination Manager

RTO — Recovery Time Objective. The length of time that can be tolerated between a disaster and recovery of data.

R-VOL — Remote Volume

R/W — Read/Write

[-back to top-](#)

—S—

SA — Storage Administrator

SA z/OS — System Automation for z/OS

SAA — Share Access Authentication. The process of restricting a user's rights to a file system object by combining the security descriptors from both the file system object itself and the share to which the user is connected

SACK — Sequential Acknowledge

SACL — System ACL. The part of a security descriptor that stores system auditing information.

SAN — Storage Area Network. A network linking computing devices to disk or tape arrays and other devices over Fibre Channel. It handles data at the block level.

SAP — System Assist Processor (for I/O Processing)

SARD — System Assurance Registration Document

SAS – (1) SAN Attached Storage. Storage elements that connect directly to a storage area network (SAN) and provide data access services to computer systems. (2) Serial Attached SCSI.

SATA – Serial ATA. Serial Advanced Technology Attachment is a new standard for connecting hard drives into computer systems. SATA is based on serial signaling technology, unlike current IDE (Integrated Drive Electronics) hard drives that use parallel signaling.

SBOD – Switched Bunch of Disks

SBSC – Smart Business Storage Cloud

SBX – Small Box (Small Form Factor)

SC – (1) Simplex connector. Fibre Channel connector that is larger than a Lucent connector (LC). (2) Single Cabinet.

SCM – Supply Chain Management

SCP – Secure Copy

SCSI – Small Computer Systems Interface. A parallel bus architecture and a protocol for transmitting large data blocks up to a distance of 15 to 25 meters.

SD – Software Division

SDM – System Data Mover

SDSF – Spool Display and Search Facility

Sector – A sub-division of a track of a magnetic disk that stores a fixed amount of data.

SEL – System Event Log

Selectable segment size – Can be set per partition.

Selectable Stripe Size – Increases performance by customizing the disk access size.

SENC – Is the SATA (Serial ATA) version of the ENC. ENCs and SENCs are complete microprocessor systems on their own and they occasionally require a firmware upgrade.

Serial Transmission – The transmission of data bits in sequential order over a single line.

Server – A central computer that processes end-user applications or requests, also called a host.

Service-level agreement – SLA. A contract between a network service provider and a customer that specifies, usually in measurable terms, what services the network service provider will furnish. Many Internet

service providers (ISP) provide their customers with a SLA. More recently, IT departments in major enterprises have adopted the idea of writing a service level agreement so that services for their customers (users in other departments within the enterprise) can be measured, justified, and perhaps compared with those of outsourcing network providers.

Some metrics that SLAs may specify include:

- The percentage of the time services will be available
- The number of users that can be served simultaneously
- Specific performance benchmarks to which actual performance will be periodically compared
- The schedule for notification in advance of network changes that may affect users
- Help desk response time for various classes of problems
- Dial-in access availability
- Usage statistics that will be provided

Service-Level Objective – SLO. Individual performance metrics built into an SLA. Each SLO corresponds to a single performance characteristic relevant to the delivery of an overall service. Some examples of SLOs include: system availability, help desk incident resolution time, and application response time.

SES – SCSI Enclosure Services

SFF – Small Form Factor

SFI – Storage Facility Image

SFM – Sysplex Failure Management

SFP – Small Form-Factor Pluggable module Host connector. A specification for a new generation of optical modular transceivers. The devices are designed for use with small form factor (SFF) connectors, offer high speed and physical compactness, and are hot-swappable.

SHSN – Shared memory Hierarchical Star Network

SID – Security Identifier. A user or group identifier within the Microsoft Windows security model.

SIGP – Signal Processor

SIM – Service Information Message. A message reporting an error that contains fix guidance

information. or Storage Interface Module or Subscriber Identity Module

SIM RC – Service (or system) Information Message Reference Code

SIMM – Single In-line Memory Module

SLA – Service Level Agreement

SLO – Service Level Objective

SLPR – Storage administrator Logical PaRtition. Storage can be divided among various users to reduce conflicts with usage.

SLRP – storage logical partitions

SM – Shared Memory or Shared Memory Module. Stores the shared information about the subsystem and the cache control information (director names). This type of information is used for the exclusive control of the subsystem. Like CACHE, shared memory is controlled as two areas of memory and fully non-volatile (sustained for approximately seven days).

SM PATH – Shared Memory Access Path. The Access Path from the processors of CHA, DKA PCB to Shared Memory.

SMB/CIFS – Server Message Block Protocol/Common Internet File System

SMC – Shared Memory Control

SMF – System Management Facility

SMI-S – Storage Management Initiative Specification

SMP – Symmetric Multiprocessing. An IBM-licensed program used to install software and software changes on z/OS systems.

SMP/E – System Modification Program/Extended

SMS – System Managed Storage

SMTP – Simple Mail Transfer Protocol

SMU – System Management Unit

Snapshot Image – A logical duplicated volume (V-VOL) of the primary volume. It is an internal volume intended for restoration.

SNIA – Storage Networking Industry Association. An association of producers and consumers of storage networking products, whose goal is to further storage networking technology and applications.

SNM – Storage Navigator Modular Program

SNM2 – Storage Navigator Modular 2 Program

SNMP – Simple Network Management Protocol. A TCP/IP protocol that was designed for

management of networks over TCP/IP, using agents and stations.

SOA – Service Oriented Architecture

SOAP – Simple object access protocol. A way for a program running in one kind of **operating system** (such as Windows 2000) to communicate with a program in the same or another kind of an operating system (such as LINUX) by using the World Wide Web's Hypertext Transfer Protocol (HTTP) and its Extensible Markup Language (XML) as the mechanisms for information exchange.

Socket – In UNIX and some other operating systems, socket is a software object that connects an application to a network protocol. In UNIX, for example, a program can send and receive TCP/IP messages by opening a socket and reading and writing data to and from the socket. This simplifies program development because the programmer need only worry about manipulating the socket and can rely on the operating system to actually transport messages across the network correctly. Note that a socket in this sense is completely soft; it is a software object, not a physical component.

SOM – System Option Mode

SOSS – Service Oriented Storage Solutions

SPAN – Span is a section between two intermediate supports. See Storage pool

Spare – An object reserved for the purpose of substitution for a like object in case of that object's failure.

SPC – SCSI Protocol Controller

SpecSFS – Standard Performance Evaluation Corporation Shared File system

SPECsfs97 – Standard Performance Evaluation Corporation (SPEC) System File Server (sfs) developed in 1997 (97)

SRDF/A – (EMC) Symmetrix Remote Data Facility Asynchronous

SRDF/S – (EMC) Symmetrix Remote Data Facility Synchronous

SSB – Sense Byte

SSC – SiliconServer Control

SSCH – Start Subchannel

SSD – Solid-state Drive or Solid-State Disk

SSH – Secure Shell

SSID – Storage Subsystem ID or Subsystem Identifier

SSL – Secure Sockets Layer

SSPC – System Storage Productivity Center

SSUE – split suspended error

SSUS – split suspend

SSVP – Sub Service Processor interfaces the SVP to the DKC

SSW – SAS Switch

Sticky Bit – Extended Unix mode bit that prevents objects from being deleted from a directory by anyone other than the object's owner, the directory's owner or the root user

Storage pooling – The ability to consolidate and manage storage resources across storage system enclosures where the consolidation of many appears as a single view.

STP – Server Time Protocol

STR – Storage and Retrieval Systems

Striping – A RAID technique for writing a file to multiple disks on a block-by-block basis, with or without parity.

Subsystem – Hardware or software that performs a specific function within a larger system.

SVC – Supervisor Call Interruption

SVC Interrupts – Supervisor calls

S-VOL – (1) (ShadowImage) Source Volume for In-System Replication, or (2) (Universal Replicator) Secondary Volume

SVP – Service Processor – A laptop computer mounted on the control frame (DKC) and used for monitoring, maintenance and administration of the subsystem.

Switch – A fabric device providing full bandwidth per port and high-speed routing of data via link-level addressing.

SXP – SAS Expander

Symmetric virtualization – See In-band virtualization.

Synchronous – Operations that have a fixed time relationship to each other. Most commonly used to denote I/O operations that occur in time sequence, i.e., a successor operation does not occur until its predecessor is complete.

[-back to top-](#)

–T–

Target – The system component that receives a SCSI I/O command, an open device that operates at the request of the initiator

TCO – Total Cost of Ownership

TCP/IP – Transmission Control Protocol over Internet Protocol

TDCONV – Trace Dump CONVerter. A software program that is used to convert traces taken on the system into readable text. This information is loaded into a special spreadsheet that allows for further investigation of the data. More in-depth failure analysis.

TDMF – Transparent Data Migration Facility

TEP – Tivoli Enterprise Portal

TFS – Temporary File System

TGTLIBs – Target Libraries

THF – Front Thermostat

Thin Provisioning – Thin Provisioning allows space to be easily allocated to servers, on a just-enough and just-in-time basis.

THR – Rear Thermostat

Throughput – The amount of data transferred from one place to another or processed in a specified amount of time. Data transfer rates for disk drives and networks are measured in terms of throughput. Typically, throughputs are measured in kbps, Mbps and Gbps.

TID – Target ID

Tiered storage – A storage strategy that matches data classification to storage metrics. Tiered storage is the assignment of different categories of data to different types of storage media in order to reduce total storage cost. Categories may be based on levels of protection needed, performance requirements, frequency of use, and other considerations. Since assigning data to particular media may be an ongoing and complex activity, some vendors provide software for automatically managing the process based on a company-defined policy.

Tiered Storage Promotion – Moving data between tiers of storage as their availability requirements change

TLS – Tape Library System

TLS – Transport Layer Security

TMP – Temporary or Test Management Program

TOD (or ToD) – Time Of Day
TOE – TCP Offload Engine
Topology – The shape of a network or how it is laid out. Topologies are either physical or logical.
TPC-R – Tivoli Productivity Center for Replication
TPF – Transaction Processing Facility
Track – Circular segment of a hard disk or other storage media.
Transfer Rate – See Data Transfer Rate.
Trap – A program interrupt, usually an interrupt caused by some exceptional situation in the user program. In most cases, the Operating System performs some action, and then returns control to the program.
TSC – Tested Storage Configuration
TSO – Time Sharing Option
TSO/E – Time Sharing Option/Extended
T-VOL – (ShadowImage) Target Volume for In-System Replication

[-back to top-](#)

—U—

UA – Unified Agent
UBX – Large Box (Large Form Factor)
UCB – Unit Control Block
UDP – User Datagram Protocol is one of the core protocols of the Internet protocol suite. Using UDP, programs on networked computers can send short messages known as datagrams to one another.
UFA – UNIX File Attributes
UID – User Identifier within the UNIX security model
UPS – Uninterruptible Power Supply – A power supply that includes a battery to maintain power in the event of a power outage.
UR – Universal Replicator
UUID – Universally Unique Identifier

[-back to top-](#)

—V—

vContinuum – Using the vContinuum wizard, users can push agents to primary and secondary servers, set up protection, and perform failovers and failbacks.
VCS – Veritas Cluster System
VDEV – Virtual Device

VHDL – VHSIC (Very-High-Speed Integrated Circuit) Hardware Description Language
VHSIC – Very-High-Speed Integrated Circuit
VI – Virtual Interface. A research prototype that is undergoing active development, and the details of the implementation may change considerably. It is an application interface that gives user-level processes direct but protected access to network interface cards. This allows applications to bypass IP processing overheads (for example, copying data, computing checksums) and system call overheads while still preventing one process from accidentally or maliciously tampering with or reading data being used by another.
Virtualization – The amalgamation of multiple network storage devices into what appears to be a **single** storage unit. Storage virtualization is often used in a SAN, and makes tasks such as archiving, backup, and recovery easier and faster. Storage virtualization is usually implemented via software applications.
VLL – Virtual Logical Volume Image/Logical Unit Number
VLUN – Virtual LUN. Customized volume. Size chosen by user.
VLVI – Virtual Logic Volume Image. Marketing name for CVS (custom volume size).
VHD – Virtual Hard Disk
VM – Virtual Machine
VMDK – Virtual Machine Disk file format
VOJP – (Cache) Volatile Jumper
VOLID – Volume ID
VOLSER – Volume Serial Numbers
Volume – A fixed amount of storage on a disk or tape. The term volume is often used as a synonym for the storage medium itself, but it is possible for a single disk to contain more than one volume or for a volume to span more than one disk.
VSAM – Virtual Storage Access Method
VSD – Virtual Storage Director
VSP – Virtual Storage Platform
VSS – (Microsoft) Volume Shadow Copy Service
VTOC – Volume Table of Contents
VTOCIX – Volume Table of Contents Index
VVDS – Virtual Volume Data Set

V-VOL – Virtual Volume

[-back to top-](#)

—W—

WAN – Wide Area Network

WDIR – Directory Name Object

WDIR – Working Directory

WDS – Working Data Set

WFILE – File Object or Working File

WFS – Working File Set

WINS – Windows Internet Naming Service

WLM – Work Load Manager

WORM – Write Once, Read Many

WSDL – Web Services Description Language

WTREE – Directory Tree Object or Working Tree

WWN – World Wide Name. A unique identifier for an open-system host. It consists of a 64-bit physical address (the IEEE 48-bit format with a 12-bit extension and a 4-bit prefix).

WWNN – World Wide Node Name. A globally unique 64-bit identifier assigned to each Fibre Channel node process.

WWPN – World Wide Port Name. A globally unique 64-bit identifier assigned to each Fibre Channel port. A Fibre Channel port's WWPN is permitted to use any of several naming authorities. Fibre Channel specifies a Network Address Authority (NAA) to distinguish between the various name registration authorities that may be used to identify the WWPN.

[-back to top-](#)

—X—

XAUI – "X"=10, AUI = Attachment Unit Interface

XCF – Cross System Communications Facility

XFI – Standard interface for connecting 10Gb Ethernet MAC device to XFP interface

XFP – "X"=10Gb Small Form Factor Pluggable

XRC – Extended Remote Copy

[-back to top-](#)

—Y—

[-back to top-](#)

—Z—

z/OS – z Operating System (IBM® S/390® or z/OS® Environments)

z/OS NFS – (System) z/OS Network File System

z/OSMF – (System) z/OS Management Facility

zAAP – (System) z Application Assist Processor (for Java and XML workloads)

zFS – (System) zSeries File System

zHPF – (System) z High Performance FICON

zIIP – (System) z Integrated Information Processor (specialty processor for database)

Zone – A collection of Fibre Channel Ports that are permitted to communicate with each other via the fabric

Zoning – A method of subdividing a storage area network into disjoint zones, or subsets of nodes on the network. Storage area network nodes outside a zone are invisible to nodes within the zone. Moreover, with switched SANs, traffic within each zone may be physically isolated from traffic outside the zone.

[-back to top-](#)

Evaluating this Course

Please use the online evaluation system to help improve our courses.

For evaluations handled inside the Learning Center, sign in to:

<https://learningcenter.hds.com/Saba/Web/Main>

Evaluations can be reached by clicking on the My Learning tab, followed by Evaluations & Surveys on the left bar. Click on the “Launch” link to evaluate the class.

The screenshot shows the Learning Center interface. At the top, there are tabs: Home, My Success Plan, My Learning (highlighted with a red box), My Skills and Competencies, My Network, and My Profile. On the left sidebar, there is a list of options: In-Progress Learning, Catalog, All Learning Activity, Learning Requests, Approvals Inbox, Evaluations & Surveys (highlighted with a red box), Evaluations, and Surveys. A red arrow points from the 'Evaluations & Surveys' menu item to the 'Evaluations' section in the main content area. In the 'Evaluations' section, there are two tabs: Current and Completed. Below these tabs is a table of evaluations. The table has columns for Evaluation Name, Title, Date Submitted, and Action. One evaluation is listed: WBTEvaluation, Preventing Sexual Harassment (WBT), 01-21-2010. A red box highlights the 'Launch' link in the Action column. Another red arrow points from the 'Launch' link back to the 'Evaluations & Surveys' menu item.

Evaluation Name	Title	Date Submitted	Action
WBTEvaluation	Preventing Sexual Harassment (WBT)	01-21-2010	Launch

