



| Hitachi Data Systems Enterprise Storage Boot Camp

THI0430

Book 2 of 2

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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.

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Product Names

Enterprise Storage Systems

- Hitachi Virtual Storage Platform
- Hitachi Universal Storage Platform® V
- Hitachi Universal Storage Platform® VM

Legacy Products:

- Hitachi Universal Storage Platform®
- Hitachi Network Storage Controller
- Hitachi Lightning 9900™ V Series enterprise storage systems
- Hitachi Lightning 9900™ Series enterprise storage systems

Modular Storage Systems

- Hitachi Adaptable Modular Storage
- Hitachi Adaptable Modular Storage 2000 Family

Legacy Products:

- Hitachi Workgroup Modular Storage
- Hitachi Thunder 9500™ Series modular storage systems
- Hitachi Thunder 9200V™ entry-level storage

Management Tools

- Hitachi Resource Manager™ utility package
 - ♦ Module Volume Migration Software
 - ♦ LUN Manager/LUN Expansion
 - ♦ Network Data Management Protocol (NDMP) agents
 - ♦ Logical Unit Size Expansion (LUSE)
 - ♦ Cache Partition Manager feature
 - ♦ Cache Residency Manager feature
 - ♦ Storage Navigator program
 - ♦ Storage Navigator Modular program
 - ♦ Storage Navigator Modular 2 program

Replication Software

Remote Replication:

- Hitachi Universal Replicator
- Hitachi TrueCopy® Heterogeneous Remote Replication bundle
- Hitachi TrueCopy® Remote Replication bundle (for modular systems)
- Hitachi TrueCopy® Synchronous
- Hitachi TrueCopy® Asynchronous

- Hitachi TrueCopy® Extended Distance

In-System Replication:

- Hitachi ShadowImage® Heterogeneous Replication (for enterprise systems)
- Hitachi ShadowImage® Replication (for modular systems)
- Hitachi Copy-on-Write Snapshot

Hitachi Command Suite

- Hitachi Basic Operating System
- Hitachi Basic Operating System V
- Hitachi Command Director
- Hitachi Device Manager
- Hitachi Dynamic Link Manager Advanced
- Hitachi Dynamic Provisioning
- Hitachi Dynamic Tiering
- Hitachi Global Link Manager
- Hitachi Global Reporter
- Hitachi Replication Manager
- Hitachi Storage Capacity Reporter, powered by APTARE®
- Hitachi Storage Services Manager
- Hitachi Tiered Storage Manager
- Hitachi Tuning Manager
- Hitachi Virtual Server Reporter, powered by APTARE®

Other Software

- Hitachi Backup and Recovery, powered by CommVault®
- Hitachi Backup Services Manager , powered by APTARE®
- Hitachi Business Continuity Manager
- Hitachi Command Control Interface (CCI)
- Hitachi Volume Migration
- Hi-Track® Remote Monitoring system

Other Solutions and Terms

- Hitachi Content Platform
- Hitachi Compute Systems Manager
- Hitachi NAS Platform
- Hi-Star™ crossbar switch architecture
- Hitachi Universal Star Network V

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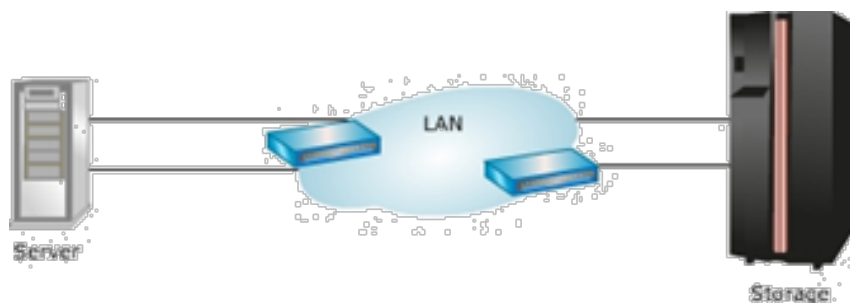
11. Hitachi High-performance NAS Platform

Module Objectives

- Upon completion of this module, you should be able to:
 - Demonstrate understanding of basic Network Attached Storage (NAS) concepts
 - Describe the features and functionality of the Hitachi NAS Platforms

Network Attached Storage Overview

- In **NAS**, the storage device is directly connected to the LAN and there is no server between the data and other network devices. Data is presented to the server at file, not block level, reducing server overhead.



- NAS solves the problem of isolating data behind servers.
- Data is accessed over the IP network.

Network Attached Storage

- **Advantages of NAS**

- Enables multiple computers to share the same storage space
- Can provide storage to different open-system operating systems
- Minimizes overhead by centrally managing hard disks
- Facilitates easy and inexpensive implementation

- **Disadvantages of NAS**

- Extra network overhead
- Lower performance than a SAN

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Applications

- NAS Applications
 - NAS is useful for midsize organizations with remote departments, or branch offices of large organizations, with networks that have a mix of clients, servers and operations.
 - NAS is ideal for organizations that work in a collaborative environment requiring file sharing between departments.
- Ideal NAS applications:
 - File sharing
 - Software development
 - Computer-aided design and computer-aided manufacturing (CAD/CAM)
 - Rich media services
 - Audio-video streaming
 - Publishing and broadcast
 - Tape backup

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Implementation

- Methods of NAS Implementation
 - An organization can implement NAS architecture by following methods:
 - NAS appliance or filer
 - NAS blade
 - NAS gateway

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Appliance

- **NAS Appliance**
 - NAS appliance combines a front-end file server and back-end storage system in a single unit. This approach is called a closed-box approach.
- **NAS appliance has the following advantages:**
 - Combines a file server with the storage array
 - Provides efficient performance
 - Has high reliability
 - Enables easy installation, management and use
 - Provides easy management and the least expensive NAS implementation
- **NAS appliance has the following disadvantages:**
 - Is not scalable
 - Has no pool storage, which makes it difficult to achieve high use



Blade

- NAS Blade
 - NAS blade allows multi-protocol data storage in a large disk array.
- NAS blade has following advantages in addition to an NAS appliance:
 - Is scalable
 - Is easy to manage
 - Provides backup of storage data
 - Supports multiple NAS blades

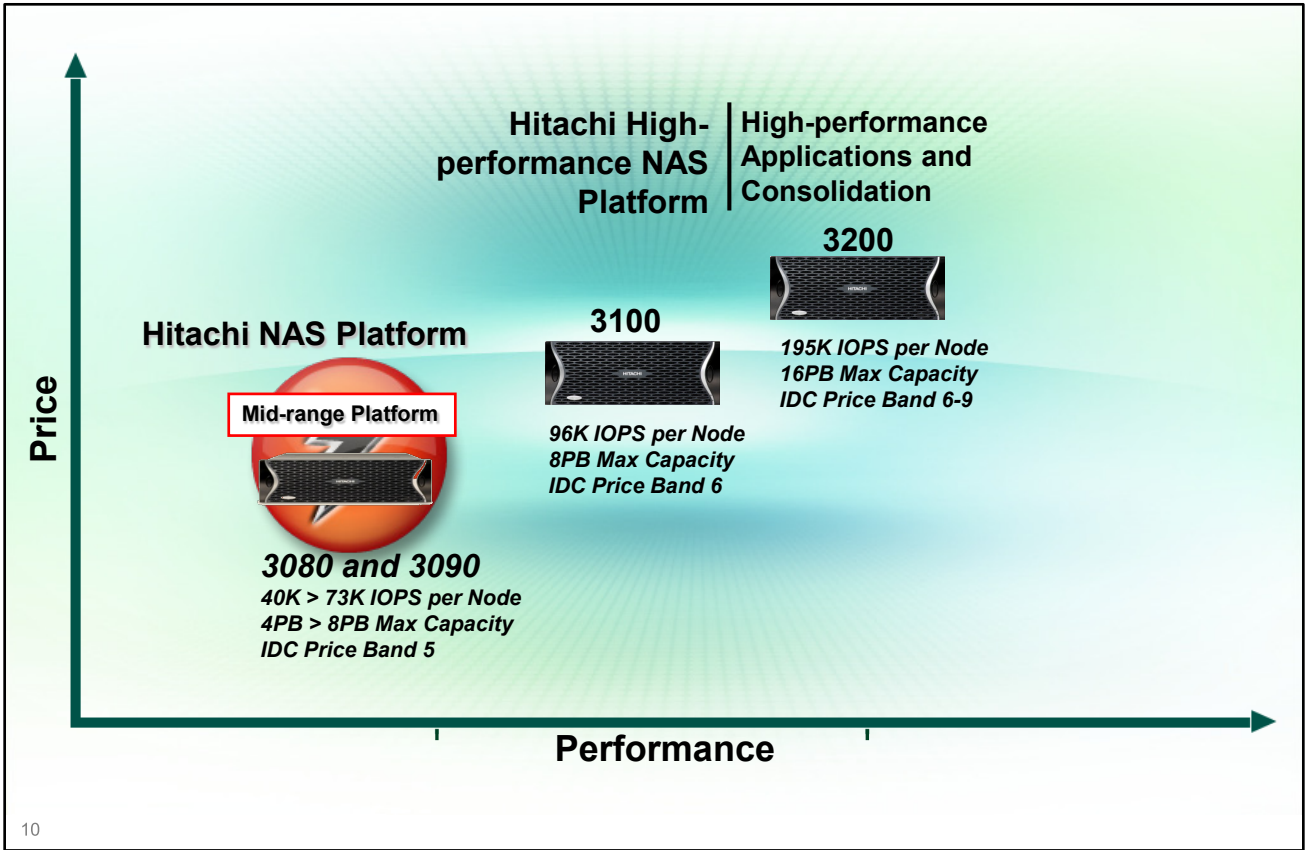


Gateway

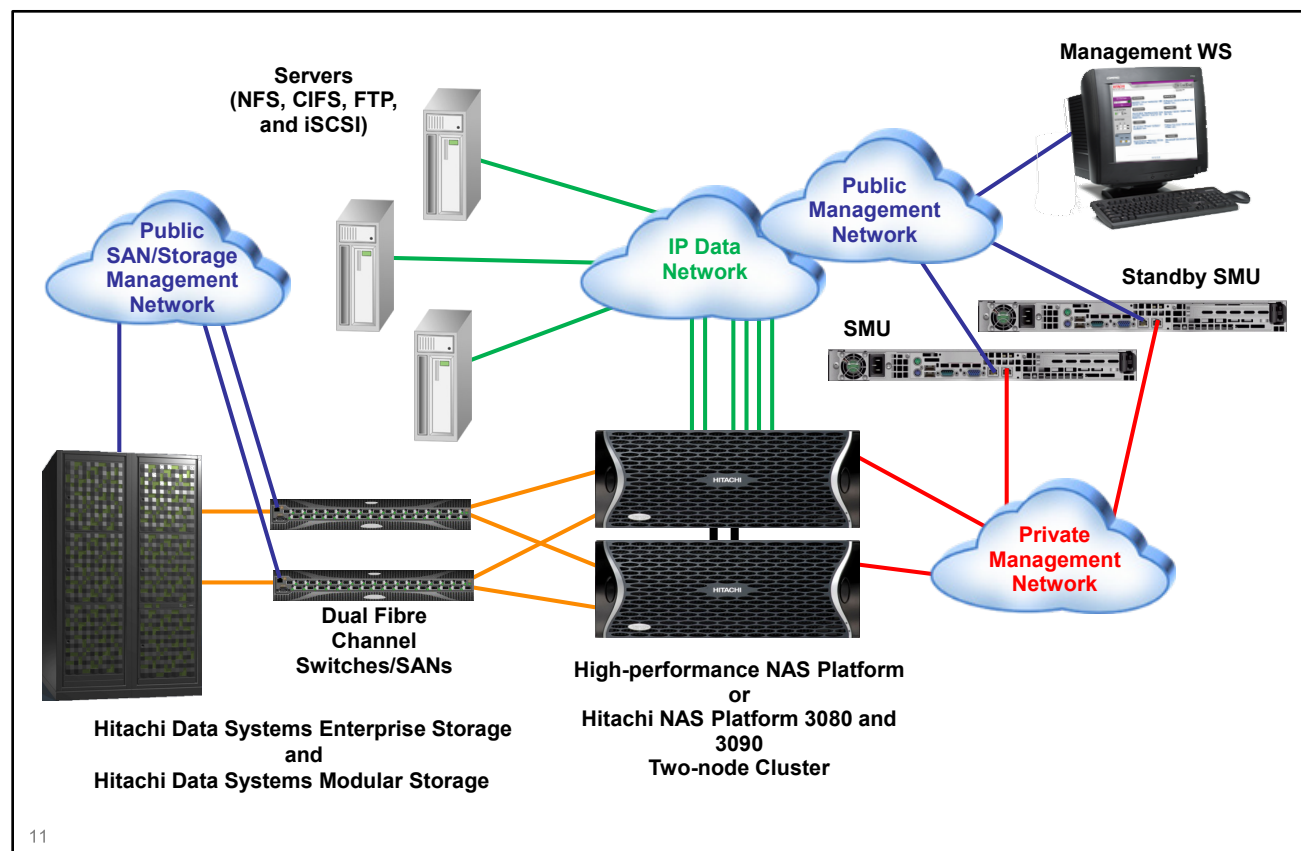
- NAS Gateway
 - In an NAS gateway, all devices communicate directly with the file system.
 - An NAS gateway overcomes the limitations of an NAS appliance.
- It has the following advantages:
 - Separates file server from storage device
 - Is less expensive than an NAS appliance
 - Supports multiple NAS gateways
 - Has better utilization rates
 - Combines NAS with SAN capacity to meet growing storage requirements
- NAS gateway controller uses FC protocol to connect to external storage.



Hitachi NAS Offerings



High-level Implementation



Support for:

Enterprise Storage Systems

- Hitachi Virtual Storage Platform™ (VSP)
- Hitachi Universal Storage Platform™ (USP)
- Hitachi Universal Storage Platform™ V (USP V)
- Hitachi Universal Storage Platform™ VM (USP VM)
- Hitachi Network Storage Controller model 55 (NSC55)
- Hitachi Lightning Hitachi Lightning 9970V single cabinet enterprise storage system
- Hitachi Lightning Hitachi Lightning 9980V multi-cabinet enterprise storage system

Modular Storage Systems:

- Hitachi Workgroup Modular Storage 100 (WMS100)
- Hitachi Adaptable Modular Storage 200 (AMS200)
- Hitachi Adaptable Modular Storage 500 (AMS500)
- Hitachi Adaptable Modular Storage 1000 (AMS1000)
- Hitachi Adaptable Modular Storage 2100 (AMS2100)
- Hitachi Adaptable Modular Storage 2300 (AMS2300)
- Hitachi Adaptable Modular Storage 2500 (AMS2500)
- Hitachi Simple Modular Storage 100 (SMS100)

Legacy Hitachi Modular Storage Systems:

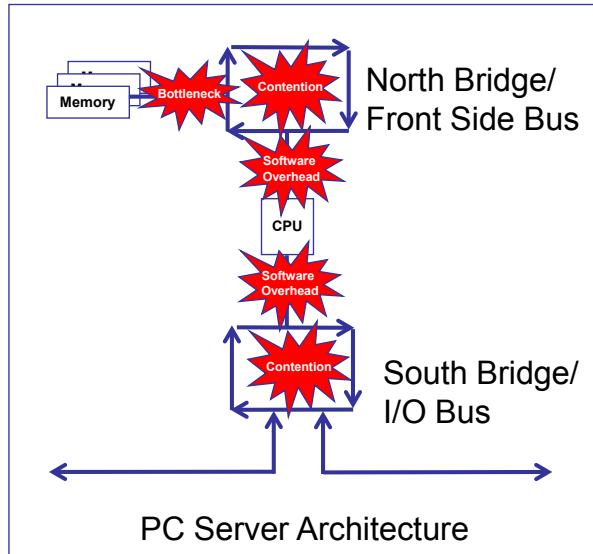
- Hitachi Thunder Hitachi Thunder 9500™ V Series modular storage system

Consult HiFIRE for interoperability with Fibre Channel switches, and supported Firmware levels.

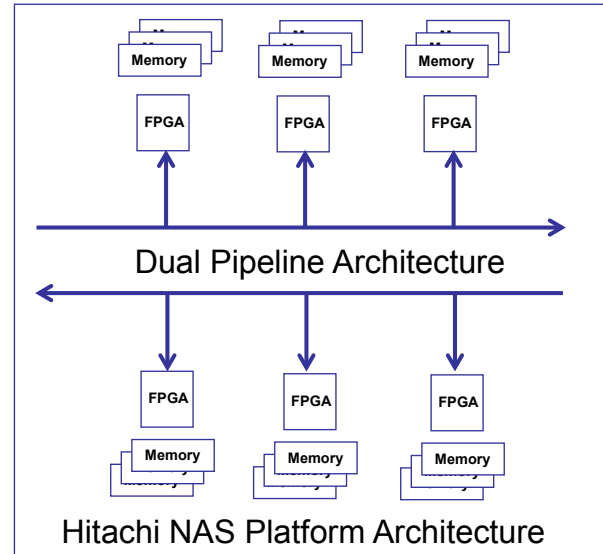
Hitachi NAS Platform Solution Concept



Hitachi NAS Platform Architecture Comparison



- Highly serial
- Optimized for general purpose computing
- Similar to a laptop or PC



- Highly parallel
- Optimized for data movement
- Similar to network switches or routers

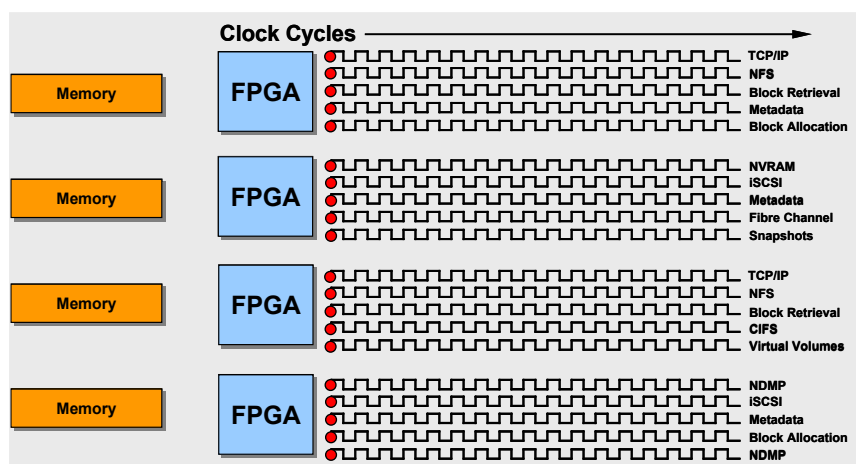
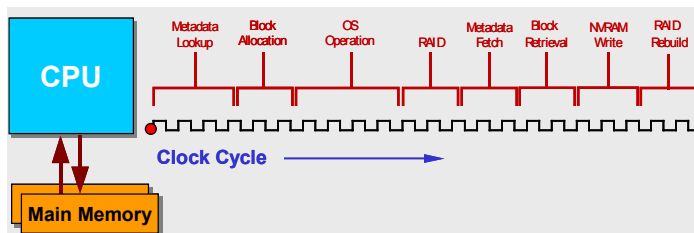
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Note: FPGA stands for Field Programmable Gate Array.

FPGA versus CPU-Based Architectures — Parallelized versus Serialized Processing

Serialized Processing:

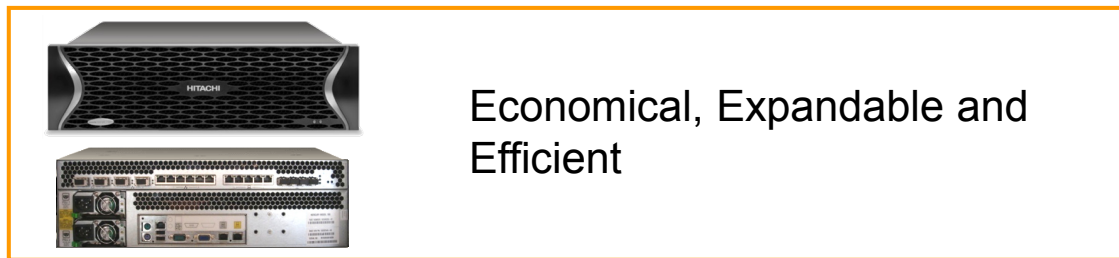
- Shared processor
- Shared memory
- Single tasks per clock cycle
- Shared buses



Parallelized Processing:

- Distributed processing for specific tasks
- Multiple tasks per clock cycle
- Distributed memory
- No shared buses

Hitachi NAS Platform Comparison



	Model 3080	Model 3100	Model 3090	Model 3200
File System Object	Up to 16 million per directory	Up to 16 million per directory	Up to 16 million per directory	Up to 16 million per directory
SPECsfs IOPs	40,000 **	96,000***	73,000 **	195,000 ***
Throughput	700MB/sec	1200MB/sec	1100MB/sec	1600MB/sec
Scalability	256TB (4PB *)	256TB (8PB *)	512TB (8PB *)	512TB (16PB *)
File System	256TB	256TB	256TB	256TB
Ethernet Ports	6 x GbE and 2 x 10GbE	6 x GbE	6 x GbE and 2 x 10GbE	2 x 10GbE
FC Ports	4 x FC 4Gb	4 x FC 4Gb	4 x FC 4Gb	8 x FC 4Gb
Nodes/Cluster	2	8	4	8

* Capacities in parenthesis require Large LUN configuration on arrays.

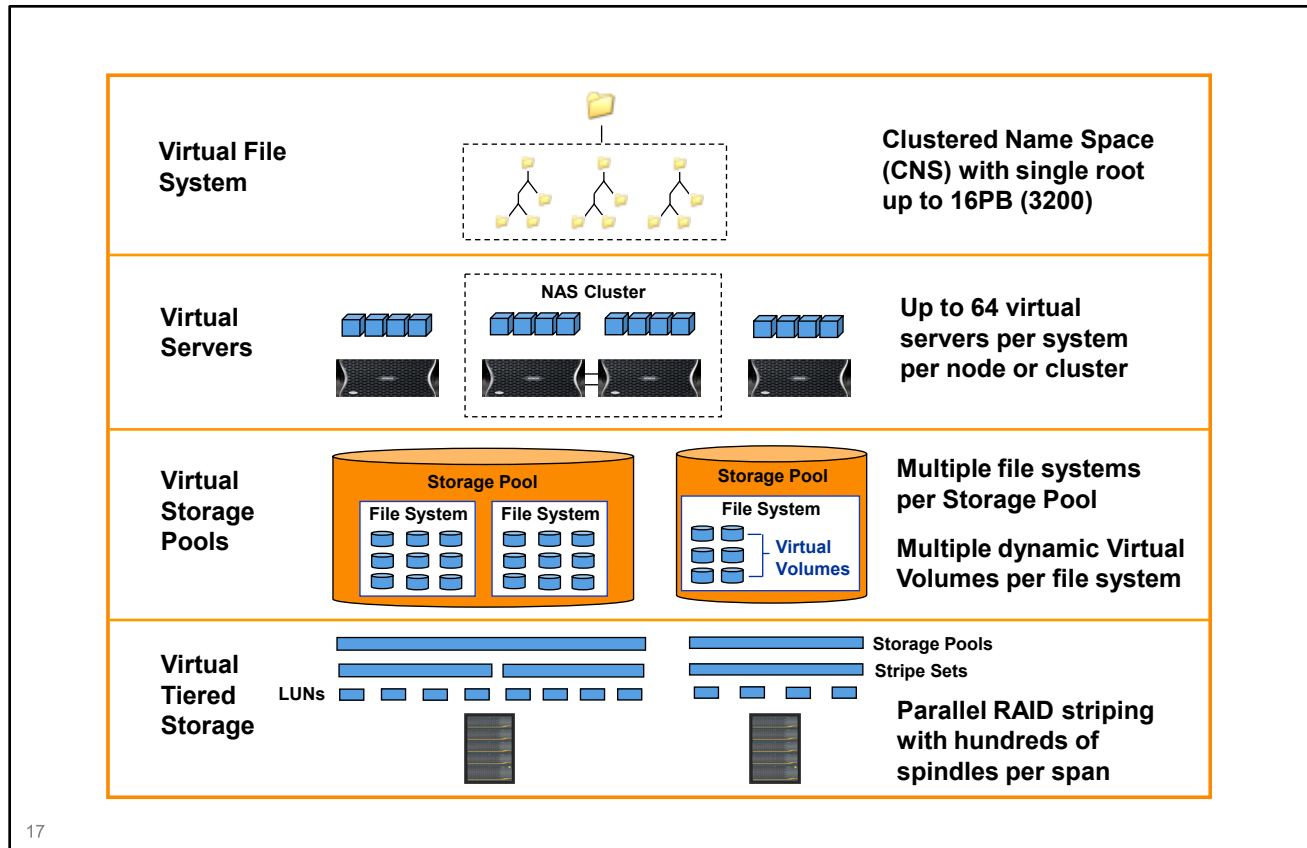
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High-performance NAS Platform Components



- High-performance NAS SiliconServer
 - Provides client connectivity and data access
 - Separate data and management planes
- System Management Unit (SMU)
 - Dedicated appliance for management
 - Functions on the management plane
 - Manages multiple nodes
 - Not involved with any client data movement
- Node and SMU form one product
 - SMU is always part of High-performance NAS solution.
 - Management interface for the BlueArc Storage System.

Hitachi NAS Platform Virtualization Framework



Virtual tiered storage optimizes performance, high availability and disk utilization across arrays.

Virtual storage pools simplify storage provisioning for applications and workgroups.

Virtual servers allocate server resources for performance and high availability.

Virtual file system unifies directory structure and presents a single logical view.

Summary for the High-performance NAS Platform 3200



Performance

- 20Gb/sec throughput
- 200,000+ IOPs
- 400,000+ Cluster
- 30,000 max connections

Scalability

- 125 volumes per cluster
- Volume sizes up to 256TB
- File sizes up to 256TB
- CNS up to 16PB
- Disk capacity 16PB
- Directory capacity up to 16 million files
- Up to 1,024 snapshots

High Availability

- Redundant components
- NVRAM mirroring
- Parallel RAID striping
- Active-Active clustering

- Unified NAS and IP SAN
- Bladed architecture
- Hardware accelerated
- Virtual volumes and servers
- Multi-protocol support
 - CIFS/NFS/FTP
- Multi-Tiered Storage (MTS)
- Policy-based management
- Data protection features

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Disclaimer: For updated specifications and numbers, please refer to the latest specification sheet from product management.

Module Summary

- Demonstrated understanding of basic Network Attached Storage (NAS) concepts
- Described the features and functionality of the Hitachi NAS Platforms

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Module Review

1. What is an NAS Gateway?
2. State the maximum number of nodes in an NAS 3200 Cluster?
3. State the role of SMU?

12. Archiving and Backup

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the Hitachi Content Platform features and functions
 - Describe the Hitachi Data Protection Suite, powered by CommVault® software features and functions

Hitachi Content Platform (HCP)

Hitachi Content Platform

- Multi-purpose, distributed storage solution
- Intelligent, content-based system
- Securely segregates data
- Provides important capabilities, including:
 - Multitenant architecture
 - Object versioning
 - Retention and disposition services
 - Encryption
 - Immutability
 - High availability
 - Search

4

Multi-purpose, distributed storage solution

- Addresses many challenges in unstructured growth data

Intelligent, content-based system

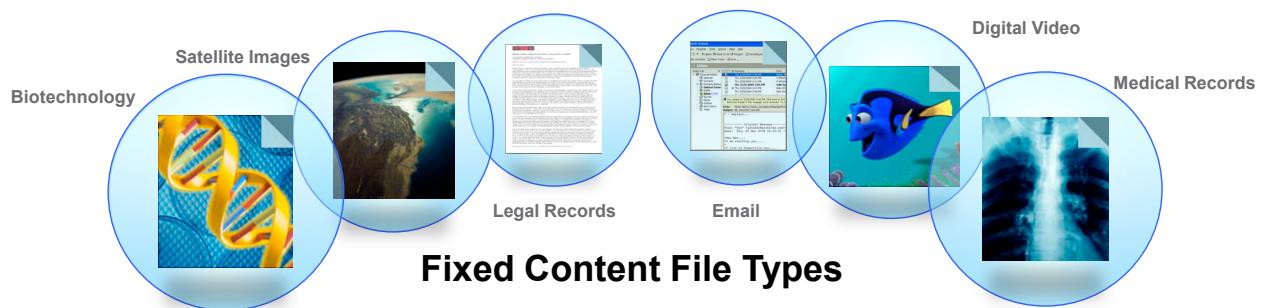
- Supports multiple tiers of storage for a wide range of unstructured content
- All in a single platform

Securely segregate data

- Provide different features and levels of service for different datasets.

Overview

- Fixed content retention — Policies, WORM, Authentication
- Scalability — Capacity, Volume of files
- Reliability — Failures, Disasters
- Accessibility — Across applications, Methods



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Fixed content retention

- Policies for preserving content for long periods
- May require Write Once - Read Many: WORM
- Authentication

Scalability

- Capacity: hold thousands of terabytes in a single repository
- Volume of files: ingest a growing volume of new files, for example: Email

Reliability

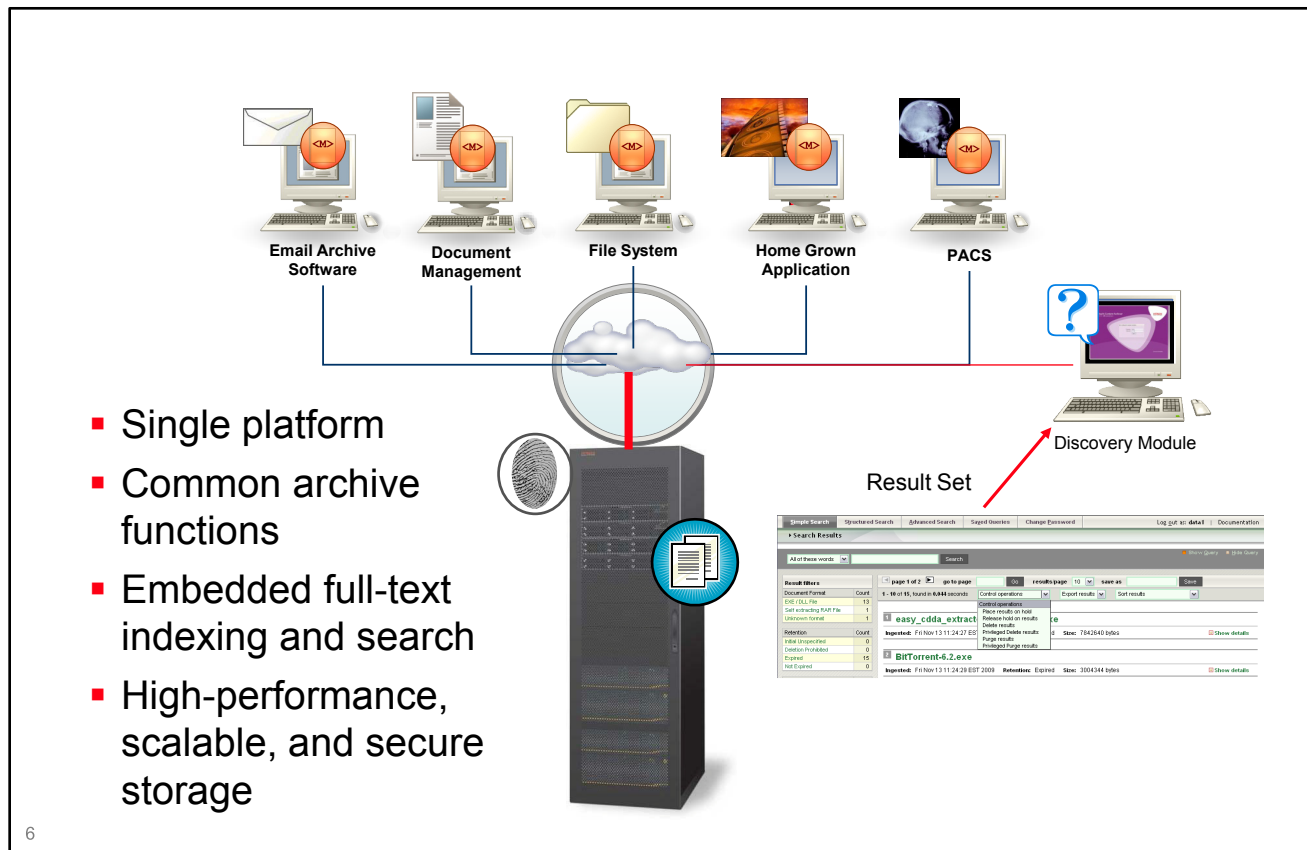
- Can withstand simultaneous points of failure
- Withstand site disasters

Accessibility

- Support and provision files to multiple applications from the same archive
- Search and access files using standard and open methods
- What is Fixed Content?
 - ♦ Static data that is in a final state
 - ♦ Content that will not/cannot change
 - ♦ Large volumes of aged or not frequently accessed data
- Where is it generated?
 - ♦ Applications: Email, Imaging, Content Management, Records Management, Financials, *locked* databases
 - ♦ Devices: Voice recording, scanners, X-Rays, MRI, video, R and D
- What are the requirements for Fixed Content?
 - ♦ Assured data integrity and authenticity
 - ♦ Policy management (specifically retention)
 - ♦ Mitigation of technology obsolescence
 - ♦ Scalability
 - ♦ Controlled access via open standards

Customers demand a product that assures the retention of authentic, fixed content in an immutable form that provides the scalability needed to address ever-increasing volumes of new content and the associated growth in storage capacity. It must provide the reliability required to meet customer DR/BC policies as well as SLAs needed to ensure content is accessible when needed. The Hitachi product delivers on all of these with the most robust platform for fixed content archiving.

How it Works



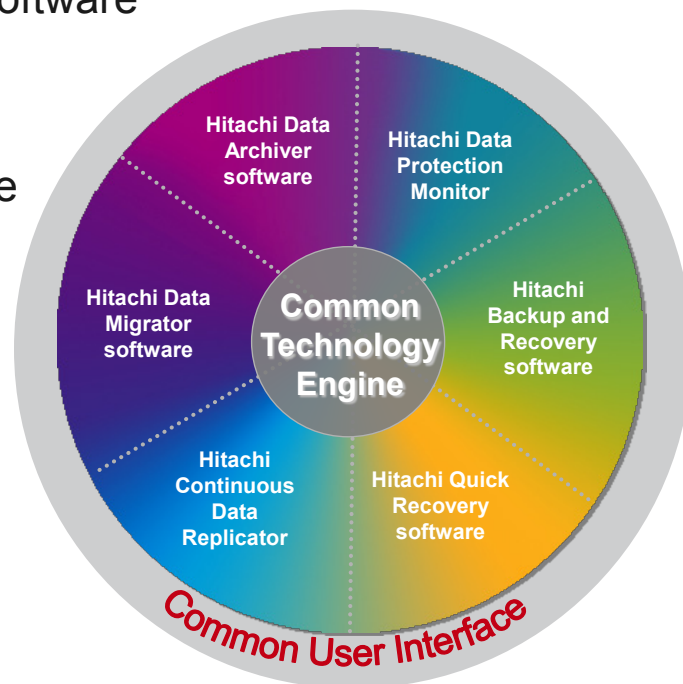
In medical imaging, picture archiving and communication systems (PACS) are computers or networks dedicated to the storage, retrieval, distribution and presentation of images. The medical images are stored in an independent format. The most common format for image storage is DICOM (Digital Imaging and Communications in Medicine).

- Single platform supporting multiple applications simultaneously
- Common archive functions across content types
 - ♦ Data and metadata ingest
 - ♦ Authentication and policies
- Embedded full-text indexing and search
 - ♦ All content in the archive
 - ♦ Retrieve content produced by different applications
- High-performance, scalable, and secure storage

Hitachi Data Protection Suite (HDPS)

What Is It?

- Backup And Recovery software
- Data Migrator software
- Data Archiver software
- Quick Recovery software
- Data Protection Monitor
- Continuous Data Replication



8

The Data Protection Suite platform was designed to automate management of data by changing the approach from static to dynamic. It combines traditionally separate products for data movement with products for data management. Built on the proven CommVault Common Technology Engine (CTE) that moves, manages, and catalogues data, the Data Protection Suite platform integrates the following storage management functions:

- Backup and Recovery Software
- Data Migration Software and Data Archiving Software
- Provide high data availability
- Enterprise data management
- Remote office data protection

The resulting product is a single automated platform with a global catalogue, indexing, data movement, and media management.

Backup and Recovery Software

Backup and Recovery

Backup and Recovery software offers you fast, granular backup and recovery of distributed heterogeneous environments. With Backup and Recovery software, policy-based actions can be enforced across all your operating environments, applications and storage types. This simplifies the management of complex storage environments. The Data Protection Suite Storage Environment is comprised of all data storage resources. Unlike other solutions, Backup and Recovery software addresses storage resources and data as logical entities rather than physical resources. Client data is logically mapped to storage resources (called *Storage Policies*), which eliminates an administrator's need to identify the physical location of data before attempting a restore.

Data Migrator Software

Hierarchical Storage Management (HSM)

Data Migrator software allows you to use existing storage resources more efficiently by overseeing the migration of your data to less expensive secondary storage. This includes file system data from a Microsoft® Windows® or UNIX host and also Microsoft Exchange Email messages and attachments. By shrinking the size of your primary storage, Data Migrator software reduces the backup window and prevents over-capacity, thereby easing IT administrative burden and improving system performance.

Data Archiver Software

Archiving for Exchange

Data Archiver software delivers the data archival, search and retrieval capabilities necessary to meet the mounting demand on organizations for consistent data retention and retrieval capabilities. This demand requires companies to meet data retention regulations and standards set by the government such as SEC 17a-4 or Health Insurance Portability and Accountability Act (HIPAA) as well as establish policies to comply with laws, like the Sarbanes-Oxley (SOX) Act of 2002.

Quick Recovery Software

Point-in-Time Replication

Quick Recovery software offers a simple, unified interface that creates, administers, and tracks point-in-time copies of production data for testing, recovery, or business continuance reasons. Via centralized policy management and scheduling, administrators can define point-in-time Recovery Volume retention periods and recover data when it is required.

Data Protection Monitor Software

Service Level Management

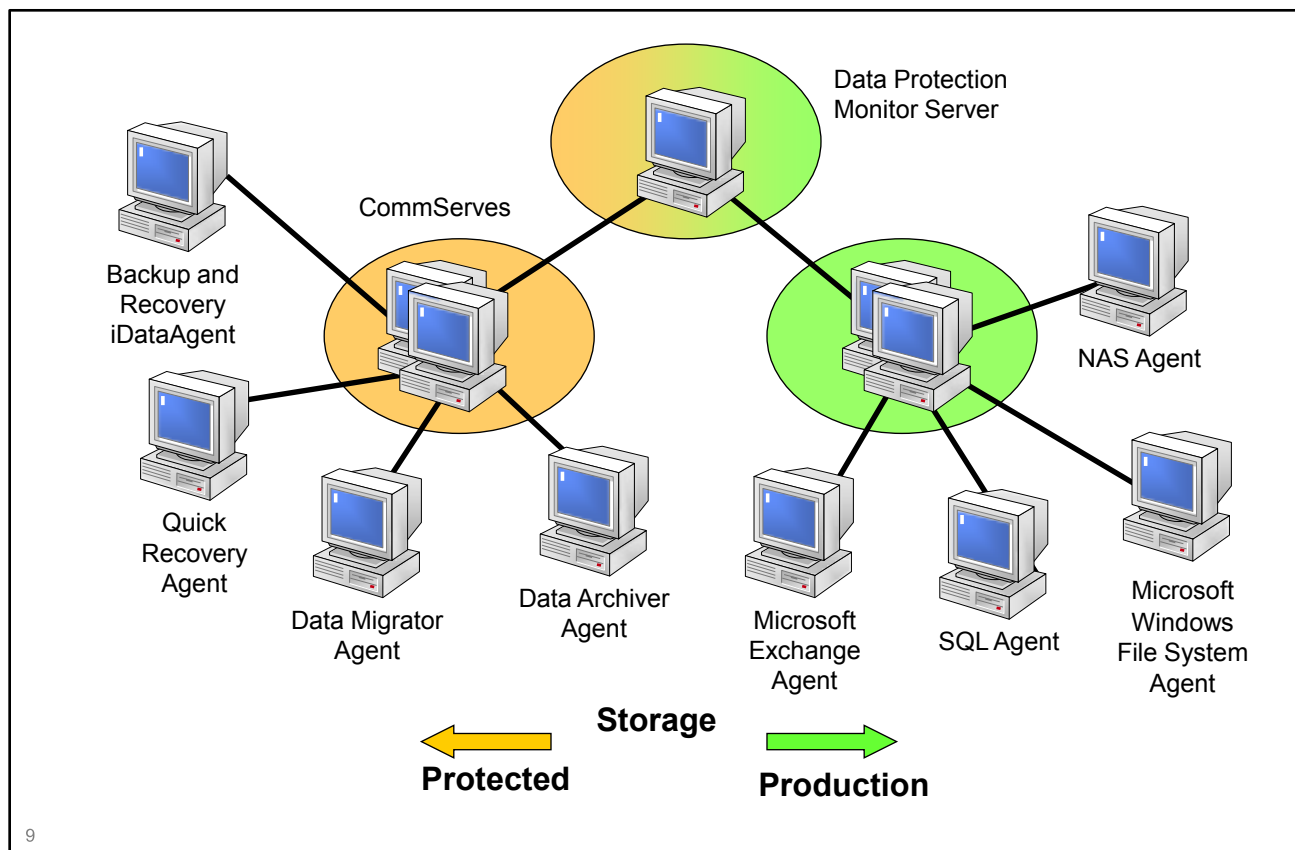
Data Protection Monitor software can change the way IT departments manage data storage. It does so by providing the administrator with tools to create, define, monitor and run storage and data management services. By mapping these services to business units, Data Protection Monitor software gives the administrator a better understanding of storage resource utilization. This will ensure successful delivery of data protection, migration, archiving and replication services. Data Protection Monitor software consolidates physical, logical, and application views of storage resources from across the datacenter or across the globe.

Continuous Data Replicator

Remote Office Data Protection

Continuous Data Replicator is a solution for remote office data protection over a WAN or LAN.

Architecture



The Data Protection Suite architecture allows for flexible as well as scalable scenarios that can span enterprise data centers including all remote offices. Data Protection Monitor software aggregates and synthesizes information from multiple CommCells. It also supports traditional LAN environments, SAN, and NAS architectures. With its GUID (Globally Unique Identifier) capabilities, Data Protection Monitor software always provides a single instance view of your storage resources – assuring administrators of a single, accurate point of view.

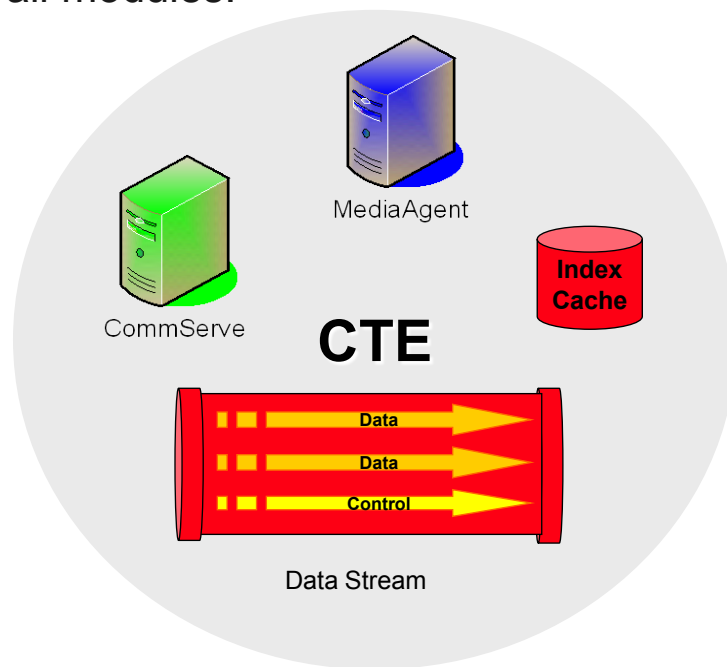
From a logical perspective, the Data Protection Suite solution consists of a Data Protection Monitor server module and Data Protection Monitor agents for the CommCell. Data is collected from all CommCells as well as the resource levels within any registered CommCell.

From a functional perspective, the Data Protection Monitor software interacts with the CommCell to provide a unified, comprehensive view of all data movement and/or management aspects of the enterprise storage environment.

Common Technology Engine

- Core components for all modules:

- CommServe
- MediaAgent
- Dual Level Index
- Data Stream



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The Common Technology Engine (CTE) is the starting point for understanding all activity of the CommCell. All other Data Protection Suite products interface with the CTE. It provides the necessary tools to manage and administer the client agents and manage the storage media associated with the CommCell.

It consists of four major components:

- The CommServe
- MediaAgent
- Dual Level Indexing
- Data Stream

A single **CommServe** provides administrative and management oversight of all tasks and data movement within a CommCell. The CommServe functions as the command and control center. All data protection and recovery activity is managed there. In addition, user security and all Data Protection Suite module licensing is handled by the CommServe.

The CommServe also houses the meta-database catalog. Loosely translated, the meta-database contains the *data about the data*. That would include component configuration information, history, and location of all data backed up within the CommCell.

Three major sub-components within the CommServe are the Job Manager, Scheduler, and the Event Manager. The Job Manager monitors and controls all the scheduled activity of the software and provides Backup and Recovery software with its restart capabilities. The Scheduler allows users to schedule tasks which are then initiated by the Job Manager. The Event Manager logs all events, providing unified notification of important events.

The **MediaAgent** is the workhorse for all data movement. It facilitates the transfer of data between the data source, the client computer, and the destination storage media. It is supported on Microsoft Windows, UNIX, Linux, and Netware systems.

Each MediaAgent manages the reading/writing activity of all attached storage devices. The devices can be locally attached. For example, Small Computer System Interface (SCSI), or remotely attached via Transmission Control Protocol/Internet Protocol (TCP/IP), or a Storage Area Network (SAN, either FC or Internet Small Computer System Interface (iSCSI)).

Index Cache

The major function of the index cache is to provide quick access to indexed data on the media during a browse\restore operation. Whenever a new data protection job starts, the Data Protection Suite will generate a list of all the data objects (for example, files/subdirectories, database objects, mailbox objects) that will be backed up from the source server. This list, along with the path to the actual archive file that stores the data on the media, is called the *index*.

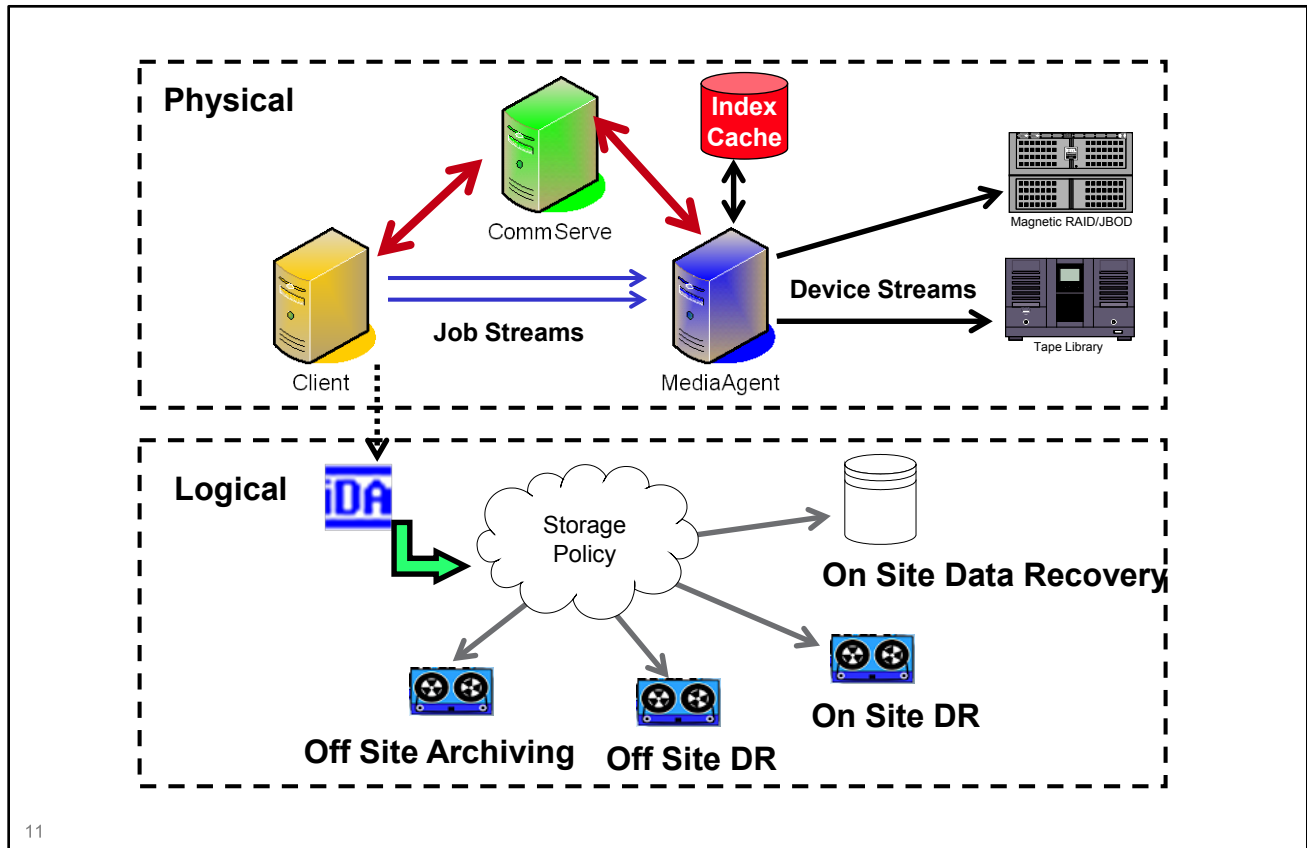
During a data protection operation, or *backup*, the source server sends data to the MediaAgent for archiving on the media. During a data recovery operation, or *restore*, the MediaAgent accesses data on the storage media and sends it to the destination server. The connection set up between the MediaAgent, source or destination server, is called a *Data Pipe* or what is more commonly referred to as a *Data Stream*.

A **Data Stream** is 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. It consists of a shared memory component on each system for multi-thread processing with multiple connections between the components. It handles all data encryption, compression, and disk I/O.

The data stream takes advantage of the shared memory speed and efficiency to double up on data movement functions. Each stream opens multiple connections between the data source and MediaAgent. One of these streams is used for control while the others move data. Whether performing local backups to a MediaAgent installed on the same system, or over the network to a MediaAgent installed on a different system, the data stream processes remain the same.

The CommServe can only be installed on a Microsoft Windows server platform. It may reside on its own dedicated system (recommended), or a system that also contains a MediaAgent and/or client modules. The system requirements are found in the Data Protection Suite Online Documentation or on the CommVault Systems Website.

Data Flow



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To get a better understanding of how all of the CommCell components work in conjunction, let us examine the basic data flow in a data protection operation as it relates to the physical layout and logical layout of Backup and Recovery software.

When a backup operation is conducted, the CommServe will act as the central point of communication. This means that the CommServe must always be running and accessible via TCP/IP in order for jobs to commence. The CommServe will communicate with the Client and the MediaAgent to coordinate operations and ensure necessary resources are available.

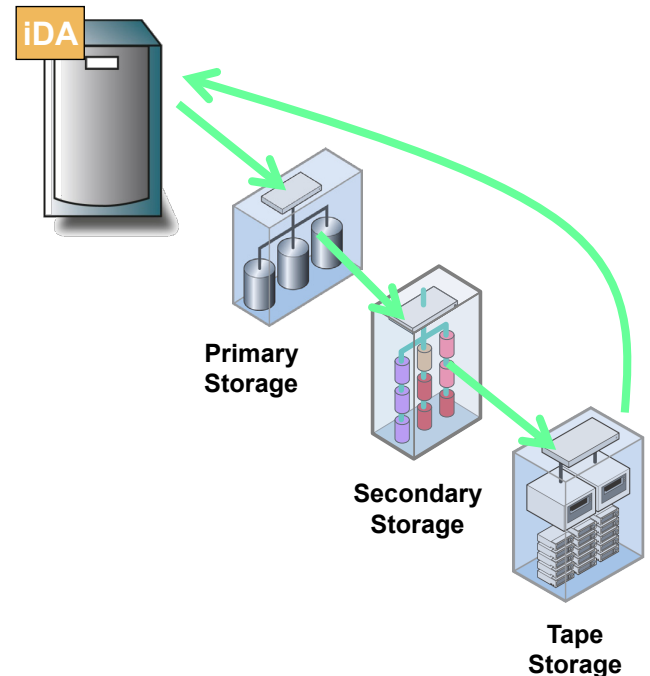
Each client machine will have iDataAgents installed. These agents are logical components which interface between Backup and Recovery software and the application or system being backed up. This allows Backup and Recovery software to backup and restore data directly to and from an application in a format the application can interpret. At a minimum, a file system iDA specific to the operating system will be installed on the client.

iDataAgents are logically divided into backup sets. A backup set is a complete collection of data being protected within the iDA. Each iDataAgents will have at least one backup set called the Default Backup Set.

A backup set can be divided into logical containers called subclients. This is the smallest collection unit for data being protected. The use of subclients facilitates the ability to manage data uniquely within a backup environment. Each subclient will be associated with a storage policy. When creating subclients, data contained within the subclient will be exclusive to that subclient. This prevents data from being backed up more than once within a backup set.

Operational Concept — Data Migrator Software

- Tiered Storage
- Immediate reclamation of disk space
- Transparent recall of data



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Introduction to Data Migrator software

Data Migrator software is a hierarchical data management solution that allows an organization to reclaim critical primary storage space by moving and automatically recalling data from secondary storage for active use. By applying policies to select, move and retain fixed content, organizations gain significant economic and productivity benefits. It allows companies to address aggressive data growth by redistributing older data across tiered-storage architecture. Data Migrator software's transparent in-place recall mechanism maximizes data accessibility for users, without imposing the need for extensive training, physical staging or catalog maintenance over the data's lifecycle. With this, administrators maintain more efficient primary storage architectures.

As part of the Data Protection Suite, Data Migrator software fully complements data protection strategies for Microsoft Internet Exchange, Microsoft Windows, Solaris and Network Appliance file system environments. The impact from migrating data is immediate: the substantial reduction in the production environment's physical storage space directly translates into reclaimed disk capacity and improvements in the speed and size of backup and recovery operations.

Data Migrator Software for Microsoft Windows

Data Migrator software for Microsoft Windows is a policy based migration of files from Volumes, Directories or Shares to secondary storage locations. These policies contain rules definable on thresholds, age, size, filters, and or folders. This process is transparent to end-user and integrated through the file system. Migration also retains the ACL security of the files that are moved. A pointer or Stub replaces the actual file. To the end-user this stub looks like the original file and gives the user or application, the ability to recall the original file for use.

All content is containerized and optionally compressed and encrypted. Each migration job is equivalent to an Archive file that contains chunks of data. Each chunk is 2GB by default and each file is registered in the index by the offset within the chunk.

Data Migrator Software for Solaris/Linux

Data Migrator software for UNIX supports the ability to migrate and recover data from Network File System (NFS) mount points, through the use of CXFS (which is a special file system type for Data Migrator software on UNIX) and the *cxfstab* file. When you have configured a subclient and run a migration, the directories and mount points specified in the subclient content become CXFS partitions or mount points. Like any other locally mounted file system, CXFS must be explicitly exported in order to become available to remote NFS clients.

Data Migrator Software for Netware

Data Migrator software for Netware also removes data from production storage to secondary storage leaving stubs for the files. The option for a common internet file system (CIFS) share or Netware Client is supported.

Data Migrator Software for Network Appliance

This agent unlocks a content area that has been traditionally blocked as a content source for Data Migrator software or Hitachi Systems Manager. Data files stored on a NAS device in Microsoft Windows/CIFS shares are eligible for Migration. A driver is distributed to all Microsoft Windows 2000/2003/XP clients that may mount the CIFS shares and initiate automatic recalls of migrated files. This driver loads as a local Microsoft Windows service and monitors all file I/O from that client machine. If a stub is identified within the read/write request, the driver will read the recovery data key wrapped within a digital signature in the stub file and contact the migration server to restore the item to the stub location.

Due to the restrictive, proprietary nature of NAS device lacking Hitachi Systems Manager application programming interfaces (APIs), the iDataAgent only supports Microsoft Windows data on the Filer. Support for NFS/Unix data will be added in future releases and incorporate the evolving NetApp Hitachi Systems Manager API.

Data Migrator-Network Storage (DM-NS) supports Microsoft Windows data residing on NetApp, EMC or Blue Arc NAS devices. Our framework is based on data movement using the CIFS file access protocol; which means it is not bound to specific restrictions on NAS/OS.

Note: If snapshots are managed locally on the Filer, a migration job will not produce immediate free space on the NAS server. The capacity freed by the migrated space will not be released to the disk scratch pool until the snapshots expire.

Data Migrator Software for Microsoft Internet Exchange

The size of Microsoft Internet Exchange Server Information Store will grow over time. To keep its size under control, administrators and users have to either delete or migrate unwanted messages periodically to release mailbox disk space. However, the migrated messages usually reside on users' workstations as .PST files, which is difficult to manage. So it is necessary to have centralized migration management to keep the size of mailboxes within a healthy range, as well as to provide easy access to the migrated messages.

The Data Migrator software for Microsoft Internet Exchange Agent is designed for the above purpose on Microsoft Exchange Servers. It will automatically migrate messages satisfying certain criteria, and replace them with stubs containing information for recovery. Users can double-click the message stub in Outlook or Outlook Web Access (OWA) to recover the original message. Alternatively, users can also ask the administrator to browse the CommCell Console to recover the message. The latter method is especially useful if the stub is deleted.

Data Migrator software for Microsoft Exchange honors Single Instance Storage by capturing all of the properties of the message and comparing each to the Microsoft Exchange Data Store.

So when a Data Migrator software job runs we group the entire data together and single instance both the message data and attachment data, which is then written to the archive file. This also includes any PST data migrated during that run with Data Migrator software.

While this preserves the single instance state of that data related to Microsoft Internet Exchange, it will not single instance across jobs or servers (as in the case of 1 PowerPoint file found in two exchange servers).

Data Migrator Software Web Proxy Agent for Microsoft Internet Exchange

The Data Migrator software Web Proxy Agent provides Outlook users with the option to route stub recovery through the Internet Information Service (IIS) server over hyper-text transfer protocol (HTTPS). Normally, two direct channels of communication are opened from the Outlook Add-in client, one to the Microsoft Exchange Server and one to the CommServe, over ports 8401 and 8402. When using the Data Migrator software Web Proxy Agent, a single channel of communication is opened through the IIS server. Stub recovery is performed through a single, encrypted and authenticated Secure Sockets Layer (SSL) port.

This solution takes advantage of the remote procedure call (RPC) over HTTP facilities of Microsoft Windows Server 2003; therefore, this solution only applies to Microsoft Internet Exchange 2003 accounts on a Microsoft Internet Exchange 2003 Server, running on Microsoft Windows Server 2003.

Data Archiving

- Compliance
- Complete collection of email
- Ensure accessibility
- Retrieve data for external audits
- Deep search and retrieval with audit controls
- Full-text and sampling

Archiving	Data Protection
Long term data retention	Short and medium term data retention
Removes data from source	Leaves data on source
Archiving is optimized for fixed content, specifically content that does not change over time such as email.	Data Protection designed to handle dynamic data depending on the Agent (for example, multiple file versions)
Designed to retrieve data outside the operational environment.	Designed to recover data back into a production environment.
Data is retrieved out-of-place.	Data can be restored in or out-of-place.

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The Data Archiver software agent is designed for long term storage and indexing of data and to meet security and compliance standards. The primary function of Data Archiver software is to preserve data outside of the operational environment. Data Archiver software removes the data from the source client once it has been archived and/or indexed. In this way, large amounts of data can be stored and reviewed at a later time. The table contrasts archiving with data protection.

Data Archiver software for Microsoft Exchange

Data Archiver software for Microsoft Exchange works in conjunction with the message journaling feature of Microsoft Exchange Server software to archive all incoming and outgoing messages and attachments. This is done at the Microsoft Exchange Message Store level. All incoming messages and outgoing messages are captured in the Microsoft Exchange Journal Mailbox, which is then archived with the Data Archiver software agent according the schedules you set. Incoming messages are written to the journal as they come into the Microsoft Exchange Server. Therefore, all messages are recorded, regardless of whether the message recipient deletes the message in his or her mailbox.

The archived data remains available for retrieval for the length of time set by the retention rules. During this period, the data is readily available for access and retrieval by authorized users. They can retrieve duplicate copies from the archive, which remains under the management of the Storage Policy. All archive data is protected from any edit or alteration from all users within the context of the archival system (that is, the archive data on the storage media cannot be written to or altered).

Module Summary

- Described the Hitachi Content Platform features and functions
- Described the Hitachi Data Protection Suite software features and functions

Module Review

1. List some features of HCP.
2. List the functions of HDPS.

13. Business Continuity

Module Objectives

- Upon completion of this module, you should be able to:
 - Identify the function and features of the business continuity products available for Enterprise Storage

2

Hitachi Replication Products

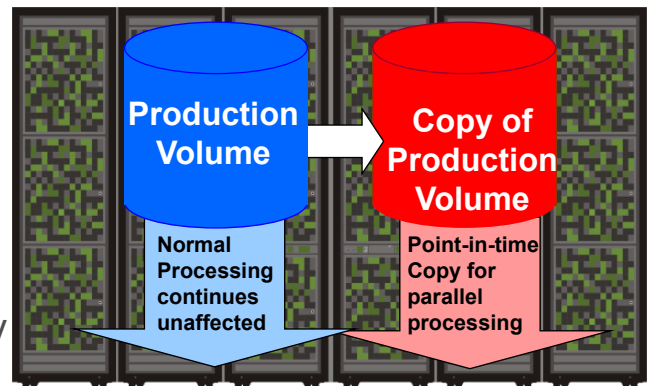
In-System Replication	Remote Replication
Hitachi ShadowImage® In-System Replication Software (SI)	Hitachi TrueCopy Remote Replication Software (TC)
Hitachi Copy-On-Write Snapshot Software (CoW)	Hitachi Universal Replicator (HUR)

3

Hitachi ShadowImage In-System Replication

■ Features

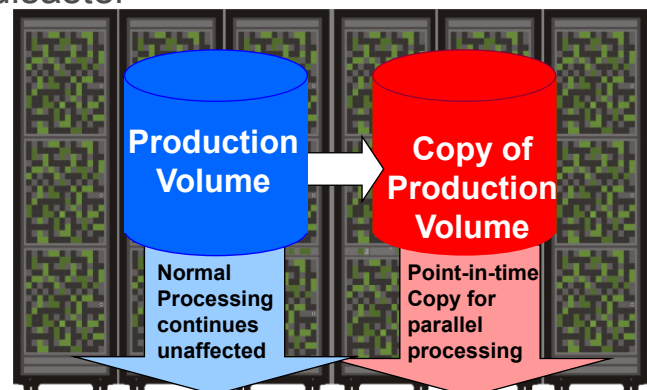
- Full physical copy of a volume at a point-in-time
- Immediately available for concurrent use by other applications
- No host processing cycles required
- No dependence on operating system, file system, or database
- All copies are additionally RAID protected
- Up to 9 copies for a source volume



4

■ 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



5

Hitachi Copy-on-Write Snapshot

■ Features

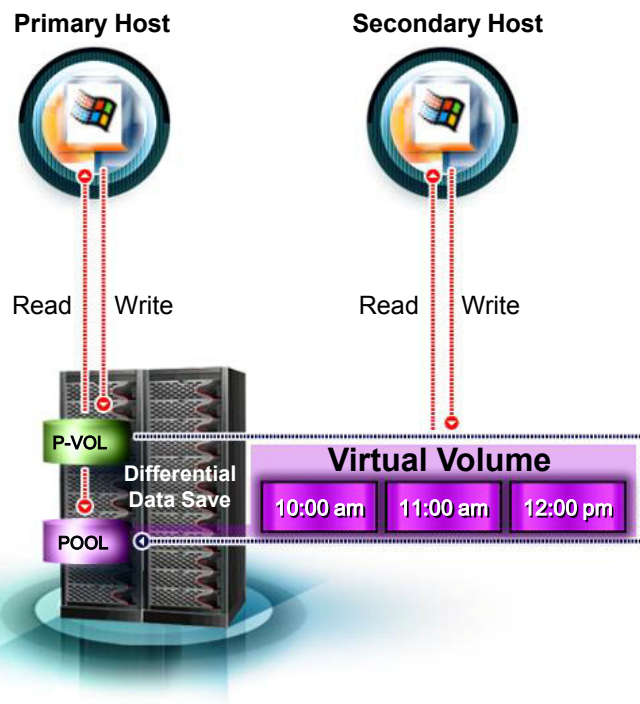
- Provides nondisruptive volume *snapshots*
- Uses less space than ShadowImage
- Allows multiple frequent, cost-effective, point-in-time copies
- Immediate read/write access to virtual copy
- Nearly instant restore from any copy
- Up to 64 snapshots for a source volume



6

■ Benefits

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

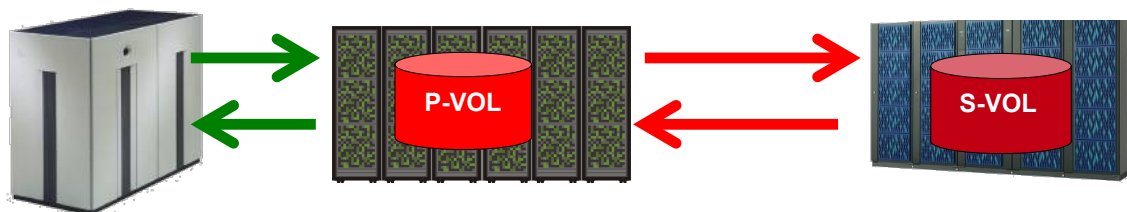


7

Hitachi TrueCopy Remote Replication

■ Features

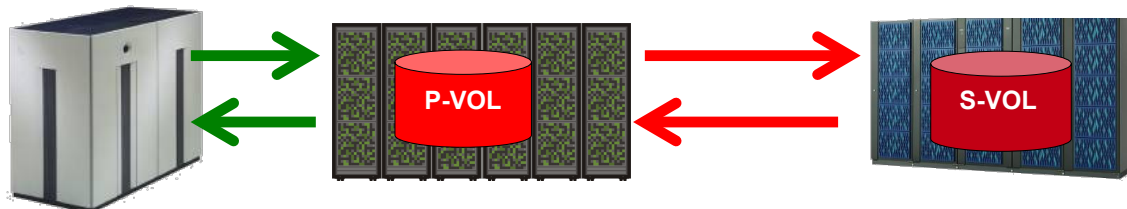
- Synchronous support
- Support for mainframe and Open environments
- Remote copy is always a *mirror* image
- Provides fast recovery with no data loss
- Installed in highest profile DR sites around the world



8

■ 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

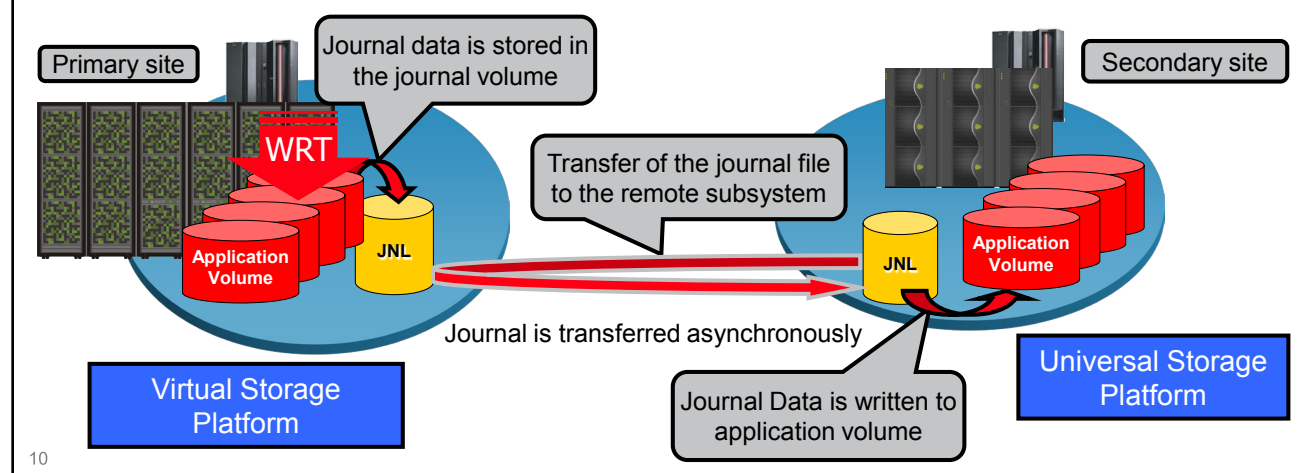


9

Hitachi Universal Replicator

■ Features

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



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

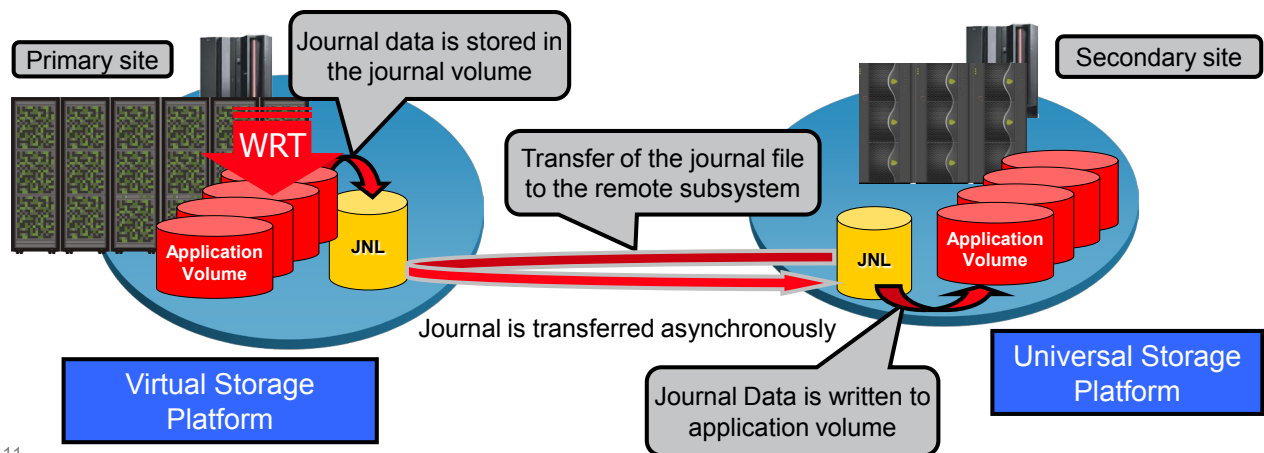
- I/O is initiated by the application and sent to the Universal Storage Platform.
- It is captured in cache and sent to the disk journal, at which point it is written to disk.
- The *I/O complete* is released to the application.
- The remote system pulls the data and writes it to its own journals and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

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

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

■ Benefits

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



11

Tools Used for Setting up Replication

- Graphical User Interface
 - Hitachi Storage Navigator
 - Hitachi Device Manager
 - Hitachi Replication Manager
- Command Line Interface
 - Used to script replication process
 - RAID Manager/CCI Software
 - HORCM configuration Files
 - Command Device

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Graphical User Interface

- Hitachi Storage Navigator — Storage Centric
- Hitachi Device Manager — Data Centre view of resources, limited or no monitoring options, primary focus is provisioning.
- Hitachi Replication Manager — Geographically spread Data Centre and Site views, enhanced monitoring and alerting features, primary focus is replication.

CCI= Command Control Interface

- CCI represents the command line interface for performing replication operations.

HORCM=Hitachi Open Remote Copy Manager

- HORCM files contain the configuration for volumes to be replicated and used by the commands available through CCI.

Requirements for all Replication Products

- Any volumes involved in replication operations should be:
 - Same Size (in blocks)
 - Must be mapped to a FED (CHA) port
 - Same Emulation type
 - If source is a LUSE volume, then destination must be identical LUSE volume
 - Intermix of RAID levels and drive type is supported.
 - Capacity based licensing:

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Any volumes involved in replication operations (source and destination) should be:

- Must be mapped to a FED (CHA) port
 - ♦ Source can be online and in use
 - ♦ Destination must not be in use/mounted.
- If source is a LUSE volume, then destination must be identical LUSE volume with same size and structure
 - ♦ This will reduce the number of copy pairs possible
- Capacity based licensing:
 - ♦ You need to purchase 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
- LUSE volume represents a set of concatenated volumes and were available on the USP Family storage systems

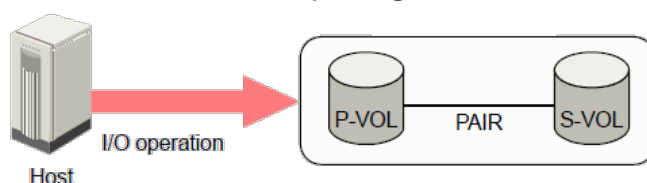
LUSE = logical unit size expansion

Requirements for Command Line Operations

- The management server should have the following:
 - Command Device (at least one)
 - CCI RAID Manager software installed
 - HORCM Configuration files

Replication Operations

- Basic operations when working with replication products:
 - Paircreate
 - Pairsplit
 - Pairresync
 - Pairsplit –S
- Commands are consistent across products, but implementation varies depending on product
 - In-system
 - All operations with LDEVs pairings within the same frame
 - Remote
 - All operations with LDEVs pairings across frames



15

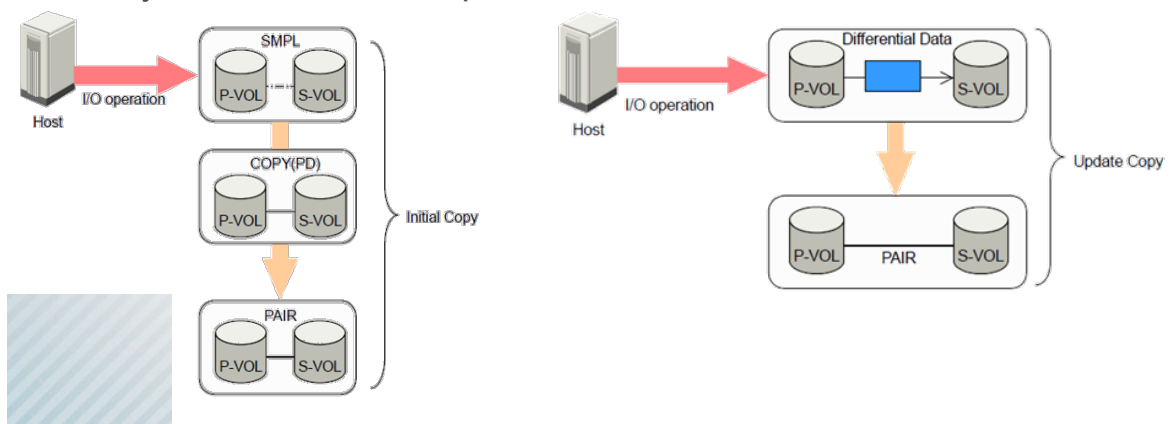
Commands are consistent across products (in-system or remote replication), but implementation varies depending on the product.

- Use manual to identify product specific operations with these commands

Note: A volume that has original data is called a Primary Volume (P-VOL), and a volume to which the data is copied is called an Secondary Volume (S-VOL).

Copy Operations

- Data copy operations
 - Initial Copy
 - Results being copied from P-VOL to S-VOL
 - Copies everything including empty blocks
 - Update Copy
 - Only differentials are copied



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Replication Operations

■ Paircreate

1. Select a volume and issue **paircreate**
2. Initial copy (full copy) takes place
 - Block by block copy of P-VOL to S-VOL happens regardless of the amount of data
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)	NA
After	PAIR	R/W	PAIR	NA

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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:

- Slower
- Medium
- Faster

The slower pace minimizes the impact of software 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.

■ **Pairsplit**

- Update copy takes place to flush all pending changes
- Volume status changes to PSUS
- S-VOL is 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	NA
During	COPY(SP)	R/W	COPY(SP)	NA
After	PSUS	R/W	SSUS	R/W

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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. The pairsplit command 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)	NA
After	PAIR	R/W	PAIR	NA

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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 subsystem copies all data on the P-VOL to the S-VOL, because 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 pair and stop replication operations
- Immediate access to S-VOL:
 - No update copy
 - Pending changes are lost or 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	NA
After	SMPL	R/W	SMPL	R/W

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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.

- Pairedisplay
 - Displays the status of a pair
 - Can be used for checking the status of copy operations

Module Summary

- Identified the function and features of the business continuity products available for Enterprise Storage

22

Module Review

1. List the tools available to perform Replication operations?

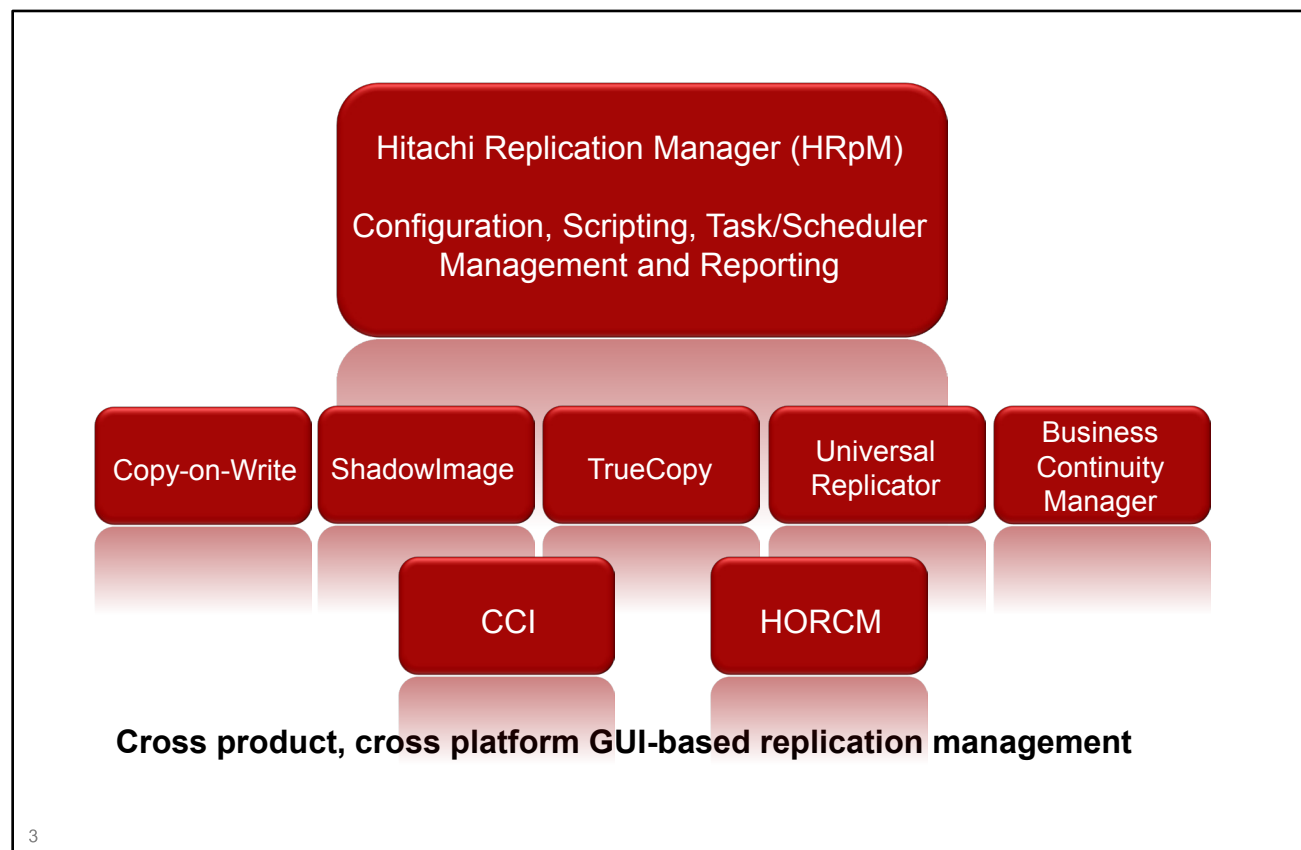
24

14. Hitachi Replication Manager

Module Objectives

- Upon completion of this module, you should be able to:
 - List the key replication management features offered by Hitachi Replication Manager
 - Describe the architecture of Replication Manager for different environments
 - Describe the features, functions and principles of Hitachi Business Continuity Manager

Hitachi Replication Manager Centralized Enterprise-wide Replication Management



Replication Manager allows the user not only to view enterprise-wide replication configuration, but also to configure and manage enterprise-wide replication configurations 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 following:

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

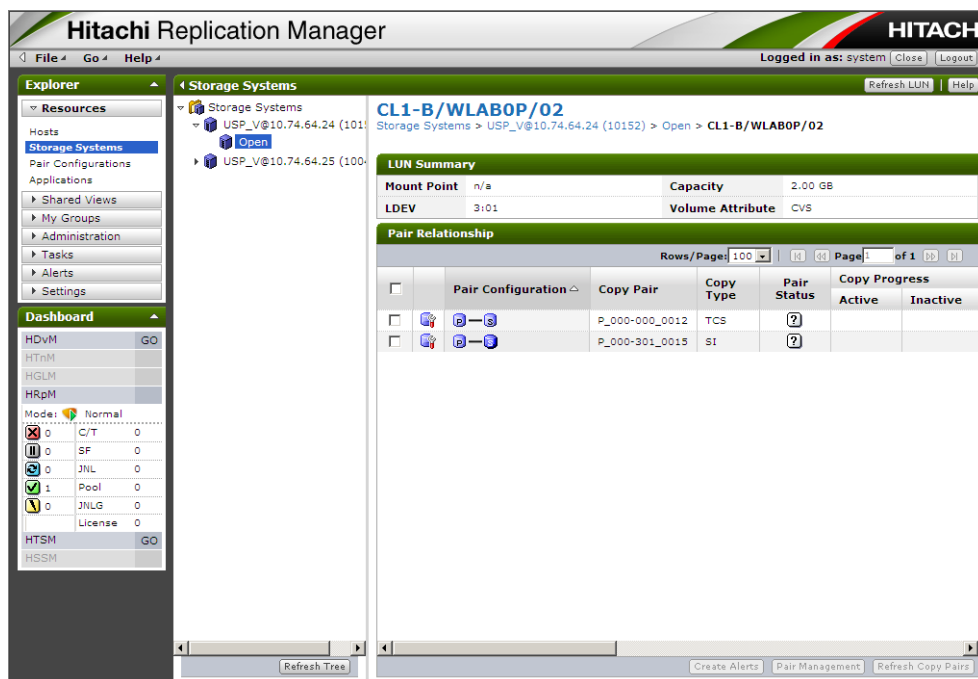
Replication Manager Solutions

- Offers centralized management of Hitachi Universal Replicator, Hitachi TrueCopy®, Hitachi ShadowImage® and Hitachi Copy-on-Write Snapshot
- Focuses primarily on usability and integration
- Resolves administrative scalability challenges by allowing you to manage more with less tools
- Is very intuitive; handles complex copy functions in an easy way
- Provides quick alert mechanism for potential problems
- Monitors data currency and recovery points for both mainframe and open systems environments
- Allows you to perform configuration tasks like creating and setting up command devices, differential management logical units (DM-LUs), pool, remote paths, Journal Group and Virtual volume (for Copy-on-Write Snapshot)
- Provides ability to schedule replication tasks
- Supports application aware copy operations (Microsoft® Exchange and SQL)

4

Hitachi Replication Manager

- GUI consistent with other HCS products



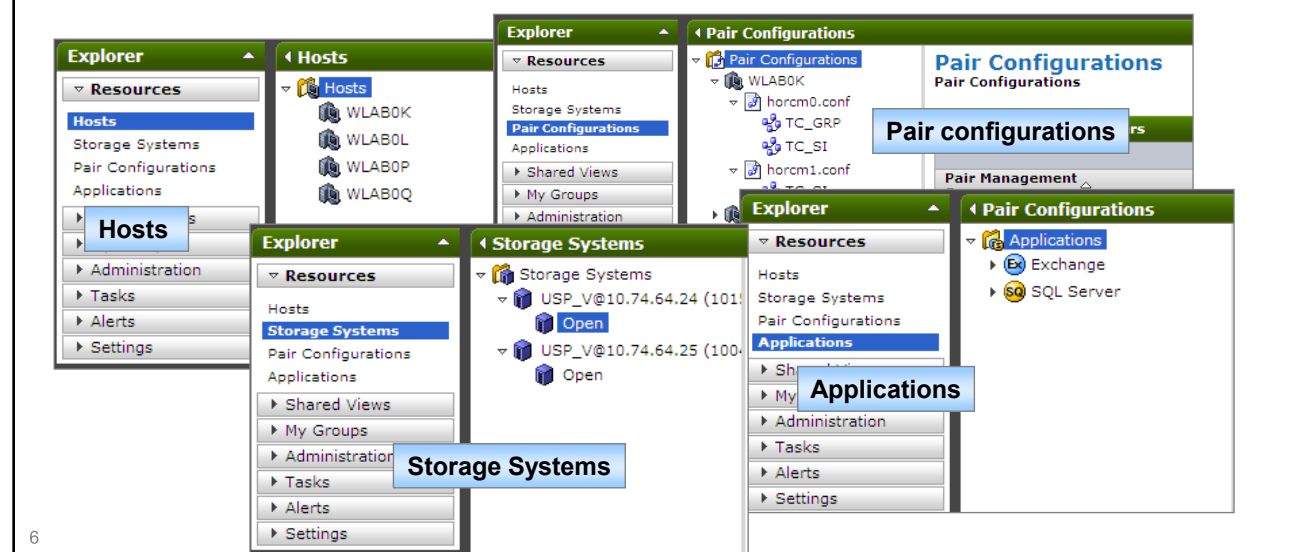
5

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 types of views allow users to understand replication environment depending on the perspective:
 - **Hosts View** — Perspective of hosts using the pairs
 - **Storage Systems View** — Perspective of subsystems containing the pairs
 - **Pair Configurations View** — Perspective of hosts managing the pairs
 - **Applications View** — Perspective of applications (MS-Exchange/MS-SQL) being managed



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:** A view of hosts using the pairs. This view lists open hosts and mainframe hosts and allows you to confirm pair status summaries for each host.
- **Storage Systems view:** A view of storage systems containing the pairs. This view lists open and mainframe storage systems and allows you to confirm pair status summarized for each storage systems. A storage system that is 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:** A view of hosts managing the pairs. 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:** A view of applications (MS-Exchange/MS-SQL servers) being managed. This view lists the application and data protection status. This view also provides a tree structure along with the servers and their associated objects (Storage Groups, Information Stores, and Mount Points).

- Quick alert mechanism of potential problems using SNMP or email
 - Unexpected changes in copy status
 - Exceeded user-defined thresholds
 - Resource use (journals and side file)
 - RPO of Target Copy Group

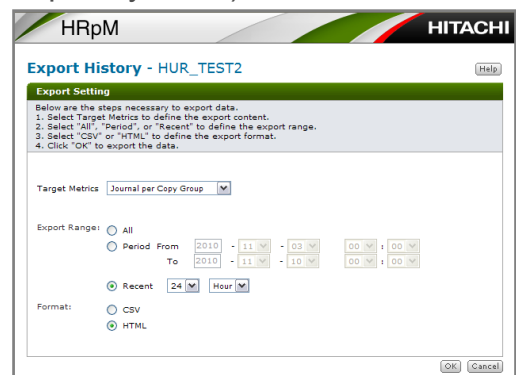
Alerts							
Alert Summary							
Marking Type: Auto							
Alert List Alert Setting List							
Rows/Page: 100 Page 1 of 1							
	Alert Name ^	Resource Type	Enabled / Disabled	Alert Action		Monitoring	
				Email	SNMP	Metrics	Condition
☐	test	Copy Group	Enabled		☒	Pair Status	☒

7

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 use. 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.

- Export Replication Manager management information
 - Determine cause of error
 - Analyze performance information
 - Write delay time (C/T delta) on a copy group basis
 - Side file use 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



8

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.

The following types of management information can be exported:

- Historical performance information items

The following performance information items can be exported:

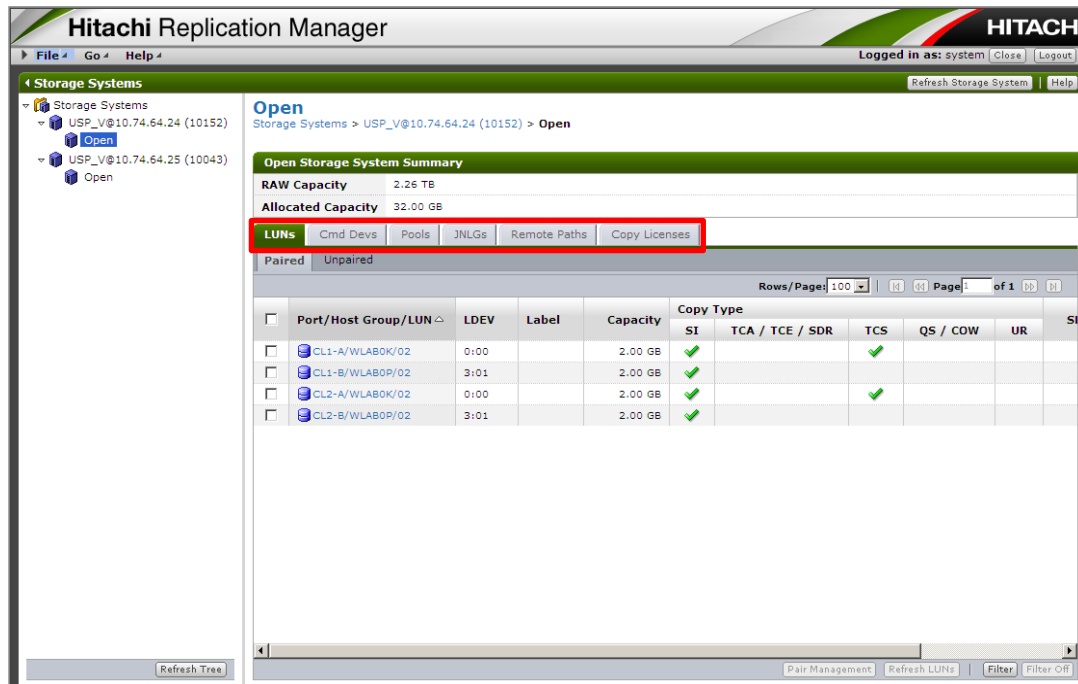
- Write delay time (C/T delta) on a copy group basis
- Side file usage on a copy group basis
- Journal volume use on a copy group basis
- Journal volume use on a journal group basis (in open systems)
- Pool volume use on a pool basis (in open systems)
- The history of received alerts
- Event logs

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

Subsystem View

- **Storage Systems View** — Additional information available on the tabs



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

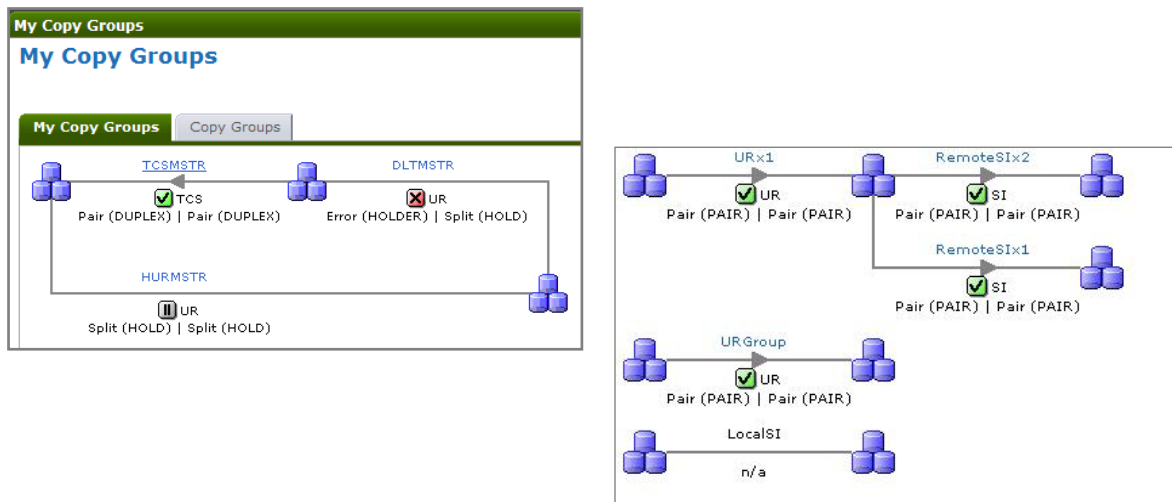
- **LUNs (Paired)** tab shows the list of LDEVs that are already configured as Copy Pairs.
 - ♦ Clicking on a specific LUN provides detailed information about the Copy Pair, Copy Type, Pair Status, and much more.
 - ♦ A filter dialog is available for LUNs tab, which makes it easier to find target volumes. 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 subsystem. This tab is only available for Hitachi Universal Storage Platform™.

- The **Remote Path** tab displays the remote paths configured for Hitachi TrueCopy® and Hitachi Universal Replicator.
- 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



10

Visual Representation of Replication Structure

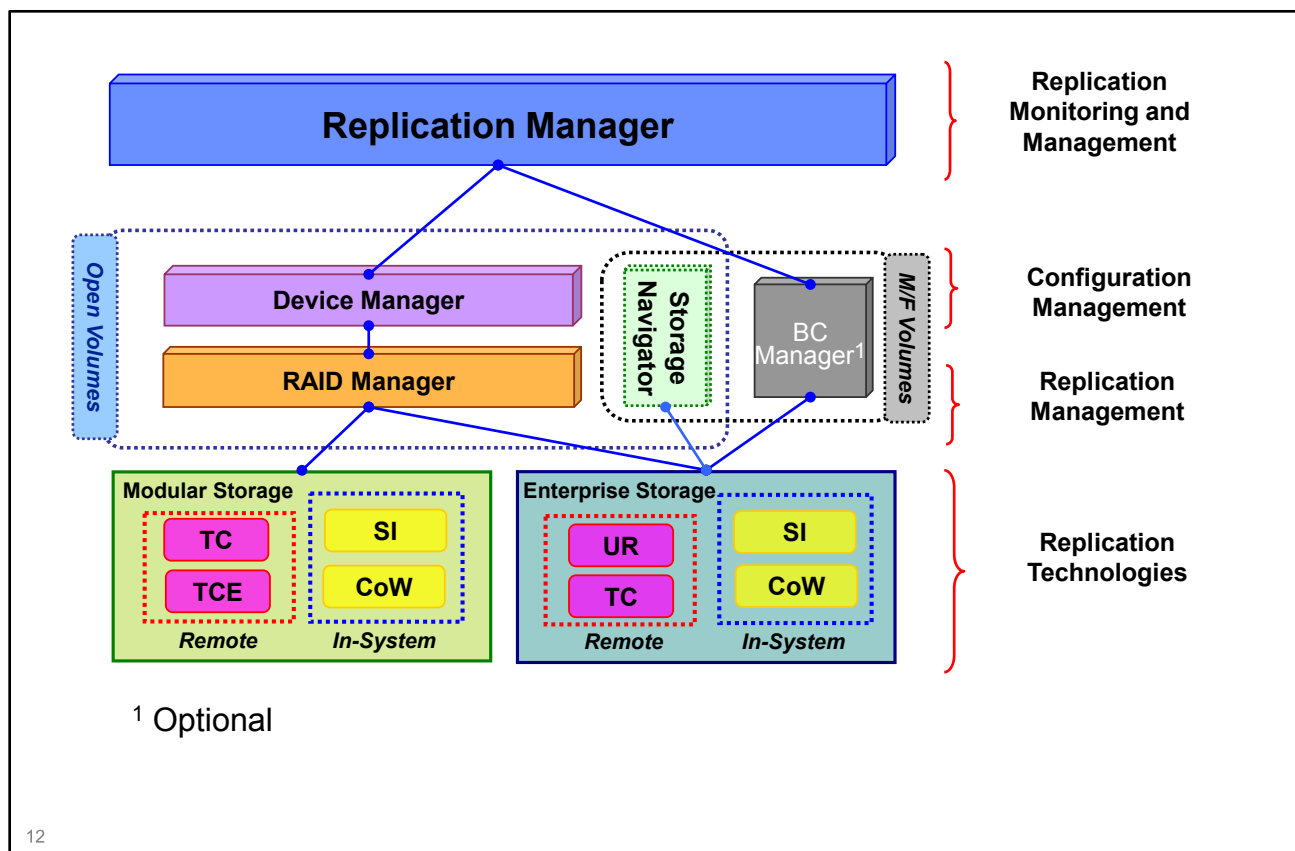
Copy Groups: A group of Copy Pairs created for management purposes, as required by a particular task or job. By specifying a Copy Group, you can perform operations such as changing the Pair Status of multiple Copy Pairs at once.

Using My Copy Groups feature, a user can register a Copy Group into My Copy Groups 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 login to the Hitachi Replication Manager interface.

Sites: With Hitachi 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**
 - Setup 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 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 (is dependent on) Hitachi Device Manager and uses RAID Manager (CCI) / Device Manager agent for monitoring open volumes

- Device Manager provides volume configuration management
- RAID Manager (CCI) is used by Replication Manager for pair status watching

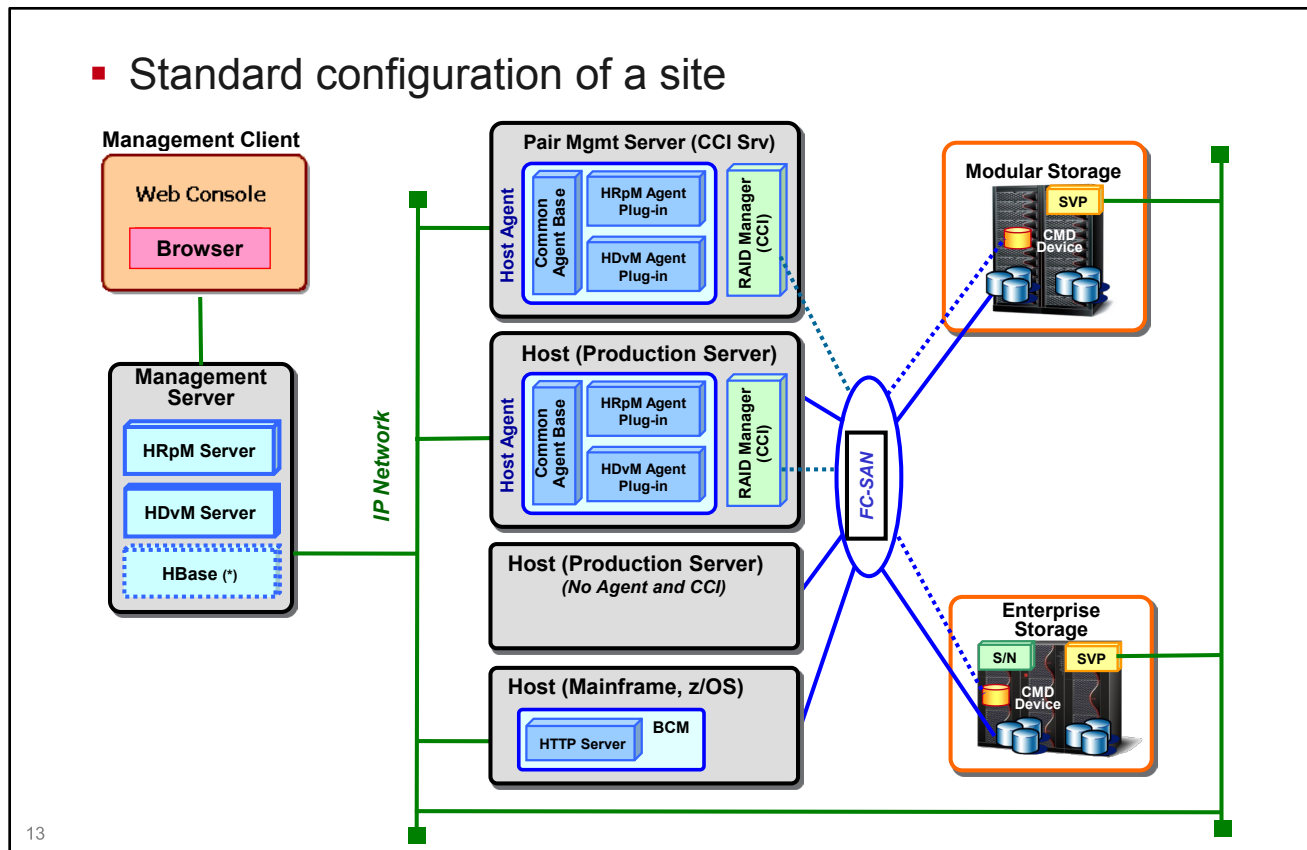
For monitoring mainframe volumes, Replication Manager can work with or without Hitachi Business Continuity Manager (BCM) or Mainframe Agent.

- 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

Chart Legend:

- TC stands for Hitachi TrueCopy® Remote Replication bundle (modular) and Hitachi TrueCopy Remote Replication bundle (enterprise)
- TCE stands for Hitachi TrueCopy Extended Distance
- SI stands for Hitachi ShadowImage® Replication (modular) and Hitachi ShadowImage Heterogeneous Replication (enterprise)
- 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 Environment



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.

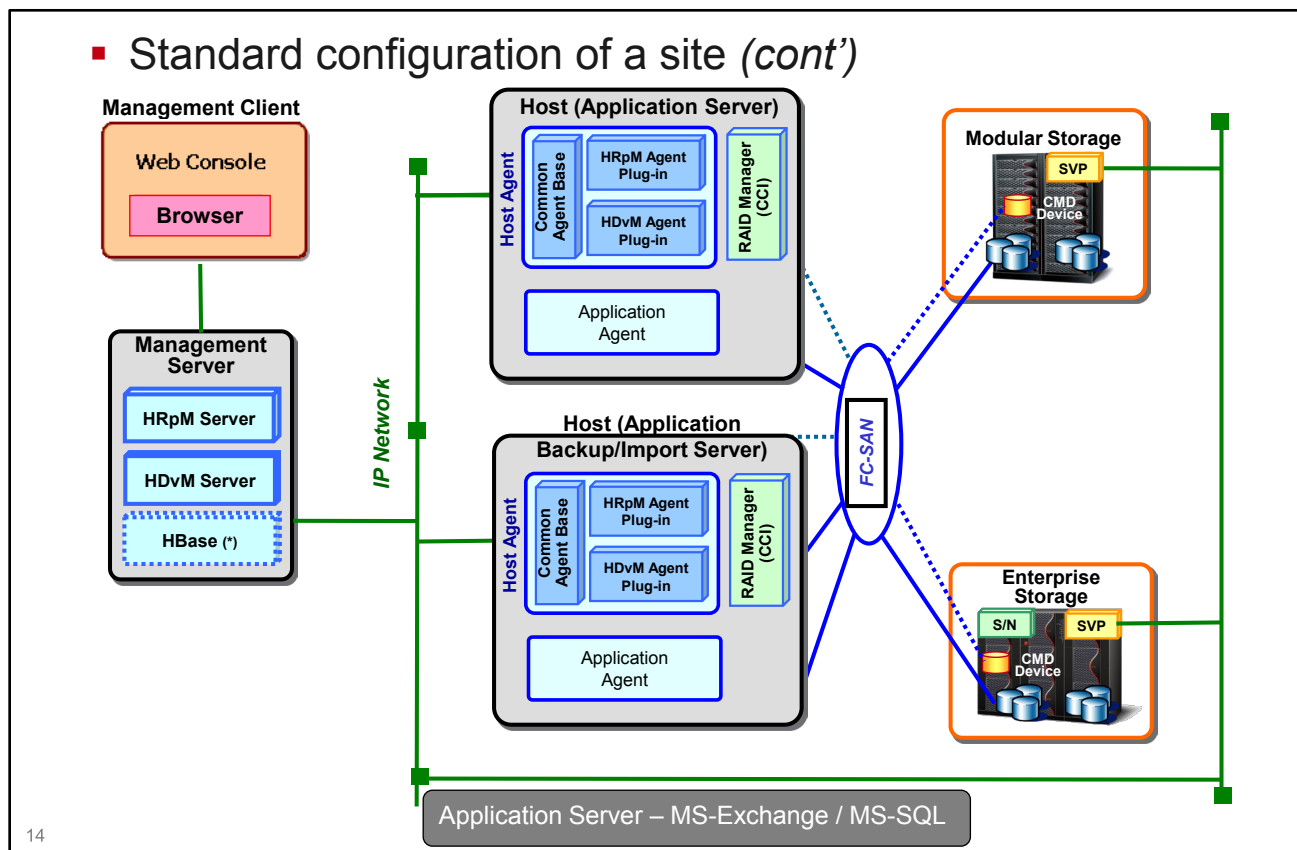
3. Pair Management Server (Mainframes):

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.

Replication Manager Components

- Replication Manager is comprised of the following components:

- 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

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

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Management Server: A management server provides management information in response to requests from management clients. Device Manager is a prerequisite for the 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).

Initial Setup

- Pre-requisites validation
- Register all information sources
- Refresh Information in Replication Manager
- Set up refresh and monitoring parameters
- Set up Users and Resource Groups
- Organize resources — Sites

Prerequisite Software

- Before starting with Replication Manager operations, confirm that:
 - The Pair Management servers are set up with:
 - Device Management Agent
 - CCI
 - Command Device
 - Add the resources 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

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

Configure Hitachi Device Manager: After installing Device Manager, add the storage subsystems, hosts, and Pair Management servers to be managed in Replication Manager to Device 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 needs to be set up with HDvM Agent, CCI and Command Device.

Launching Replication Manager



http://SVR_IP_ADD:23015/ReplicationManager/

or

http://SVR_HOSTNAME:23015/ReplicationManager/

18

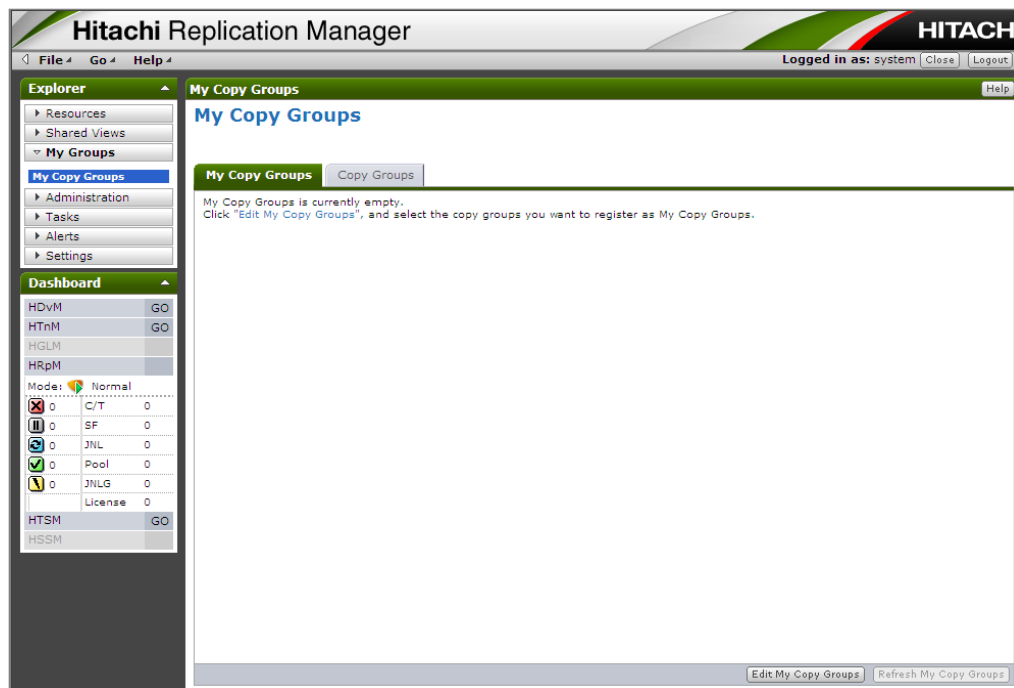
In the Web browser's address bar, enter the login URL for the management server where Replication Manager is installed. The Back To Login window appears, followed by the User Login window.

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.

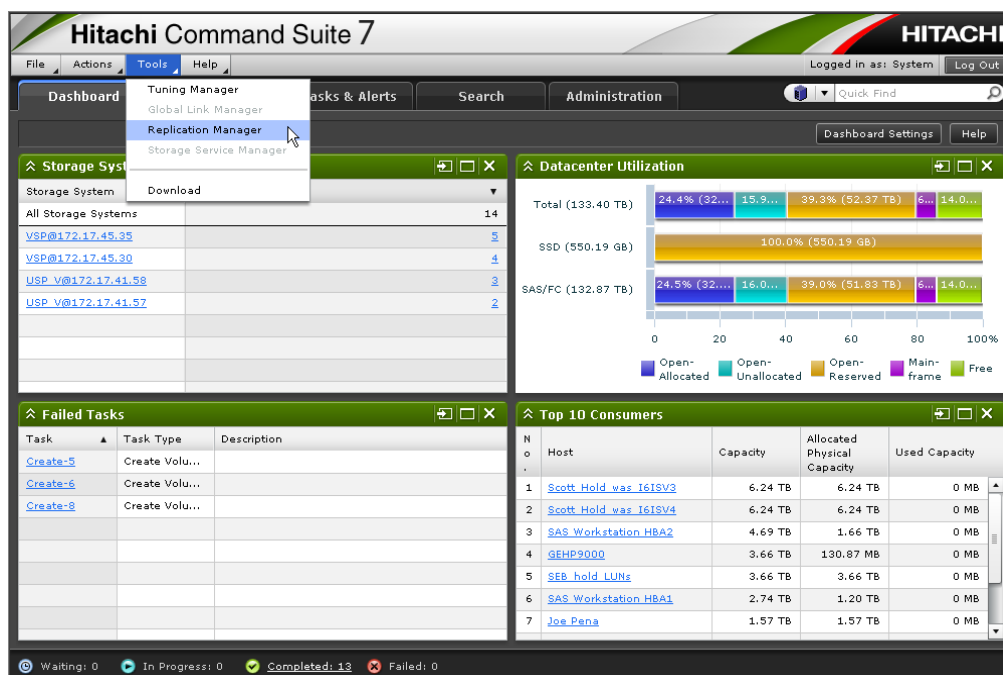
■ Launch Replication Manager



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The Web Client main window opens.

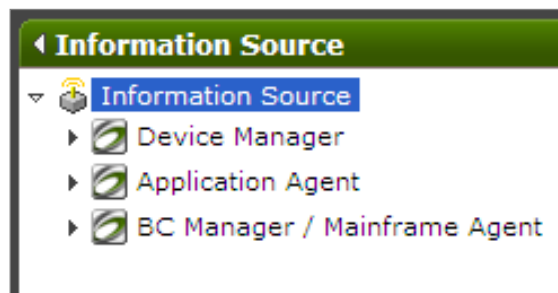
■ Launch Replication Manager from HCS main window



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Register Information Sources

- Information sources
 - Provide environment configuration to Replication Manager
 - Interface with the managed resources for replication operations
 - The Device Manager server on which Replication Manager gets installed is registered automatically as information source.
 - Can register up to 99 additional information sources.
 - Possible information sources:
 - Device Manager Server
 - Application Agent (MS-SQL and MS-Exchange)
 - BC Manager / Mainframe Agent



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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.

■ Add new Information Source

The screenshot displays the Hitachi Replication Manager (HRpM) interface. On the left is the 'Explorer' pane with a tree view containing 'Resources', 'Shared Views', 'My Groups', 'Administration', 'Users and Permissions', 'Security', 'Resource Groups', 'User Roles', 'Event Logs', 'Maintenance', 'Information Source', 'Data Retention', 'Tasks', 'Alerts', and 'Settings'. The 'Information Source' section is expanded, showing 'Device Manager', 'Application Agent', and 'BC Manager / Mainframe'. The main window 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 is open, showing fields for Name (Site2), Host ID (WLAB05), Protocol (HTTP selected), Port (2001), User ID (system), and Password (masked). There's a checkbox for 'Acquire the pair configuration managed by the Device Manager during the registration.' and 'OK'/'Cancel' buttons. At the bottom right of the main window, there are 'Add HDvM' and 'Remove HDvMs' buttons, with 'Add HDvM' highlighted by a red box.

Name	Host ID	Protocol	Port
local HDvM	localhost	HTTP	2001

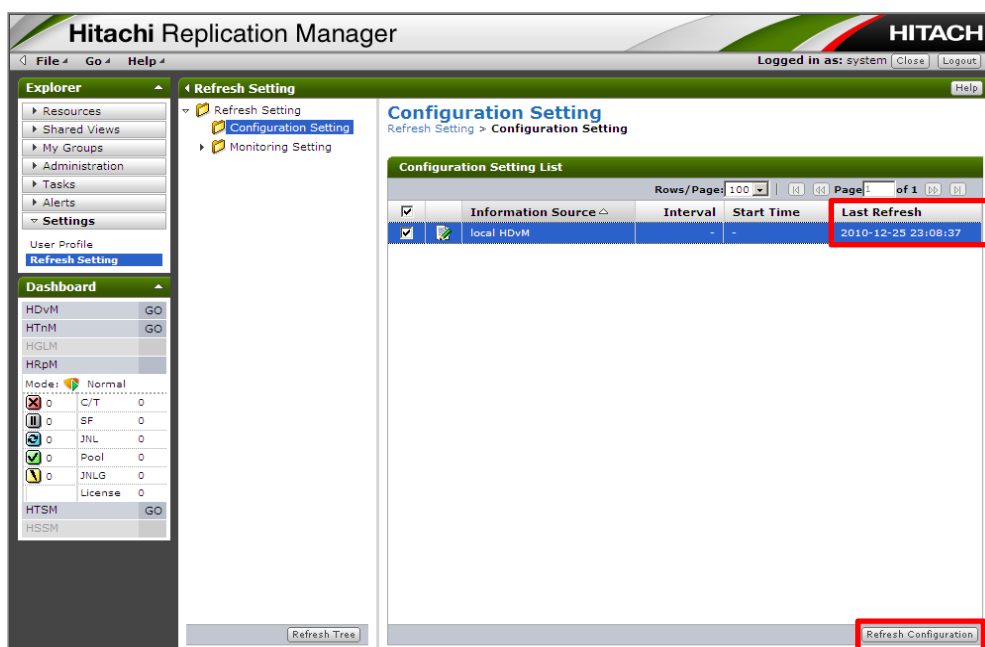
22

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

Refresh Configuration from Information Sources

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

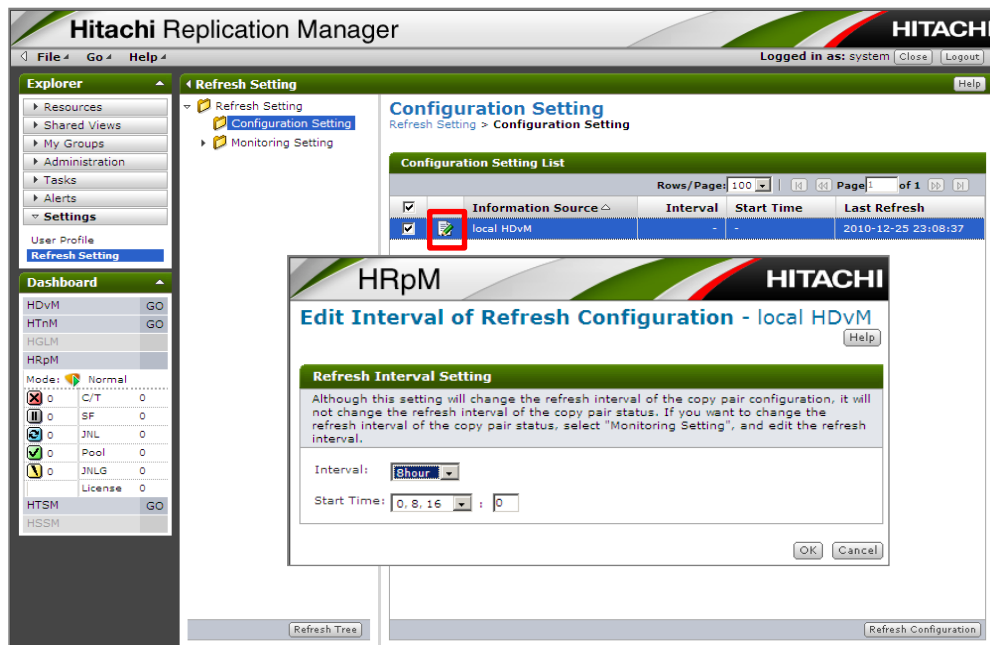


On your first login to Replication Manager, you must execute the **Refresh Configuration** option to ensure that the Replication Manager repository gets synchronized with the local Device Manager server.

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 HRpM



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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

- Configuration information can be refreshed:
 - Manually at any time in a sub window
 - Automatically
- Automatic refreshing of configuration information can be set up using two types of settings:
 - Automatic updating in conjunction with storage systems refresh operations
 - Periodic updating based on a specified refresh interval
- The configuration might 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.

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The following information is automatically refreshed every 5 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

Refresh Information from Pair Management Servers

- Global Refresh settings for Pair Management and Device Manager Server

The screenshot shows the HRpM interface with the 'Refresh Setting' window open. The 'Monitoring Setting' tab is selected, and the 'local HDvM' entry is highlighted in the 'Monitoring Setting List' table. Below the table, the 'Edit Interval of Refresh Pair Status - local HDvM' dialog is displayed, showing settings for the Agent and Device Manager.

Monitoring Setting List

Information Source	Agent / BC Manager	Device Manager	Manual Refresh
local HDvM	Periodical Interval: 5min	Periodical Interval: 24hour 0min	With Agent and Device Manager

Edit Interval of Refresh Pair Status - local HDvM

Refresh Interval Settings for Agent

This setting will overwrite the setting of the following pair management servers managed by Device Manager. If you want to change the setting for a specific server, select the server in "Monitoring Setting", and then edit the parameters. bc-011

Interval: min ☐ Disable periodical refresh

Refresh Interval Settings for Device Manager

Without Device Manager refresh, Replication Manager will not refresh the status of copy pairs that are not managed by a pair management server. If all the copy pairs you want to monitor are managed by a pair management server, select "Disable periodical refresh" and "Do not execute a Device Manager refresh operation during a manual refresh operation".

Interval: hour min ☐ Disable periodical refresh

☐ Do not execute a Device Manager refresh operation during a manual refresh operation.

OK Cancel

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- Refresh settings for Individual Pair Management Server

The screenshot shows the HRpM interface with the 'Refresh Setting' window open. The 'local HDvM' entry is highlighted in the 'Monitoring Setting List' table. Below the table, the 'Edit Interval of Refresh Pair Status - bc-011' dialog is displayed, showing settings for the Agent.

local HDvM

Refresh Setting > Monitoring Setting > local HDvM

Pair Management Server List

Pair Management Server	Refresh Interval with Agent
bc-011	5min

Edit Interval of Refresh Pair Status - bc-011

Refresh Interval Setting for Agent

Interval: min ☐ Disable periodical refresh

OK Cancel

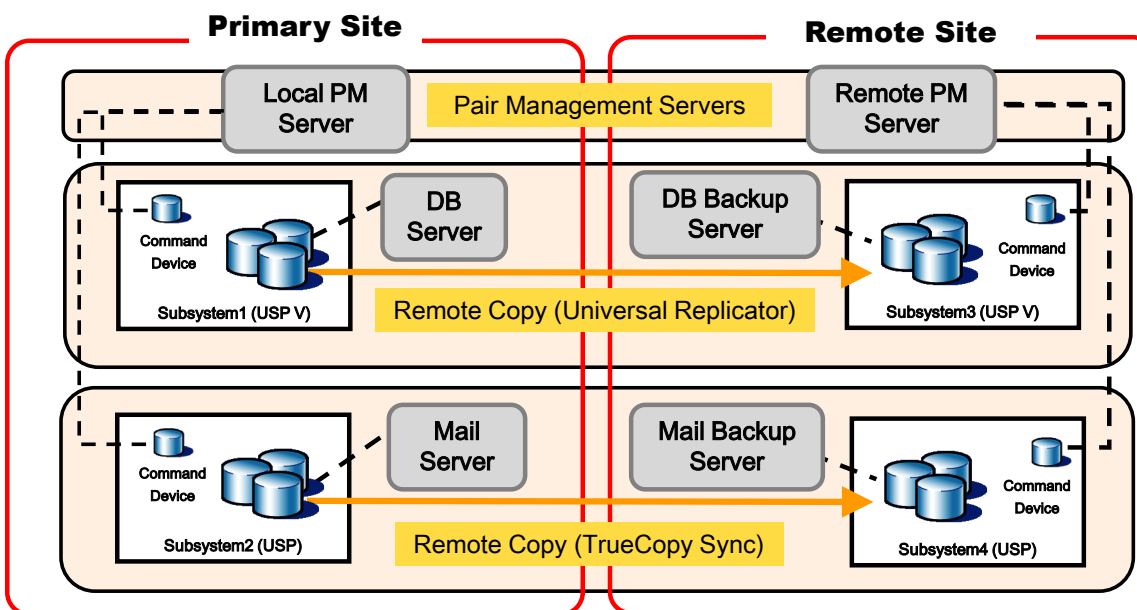
27

Sites

- Site provides 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 resources into them.

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Example of Two Data Centers — Use Case

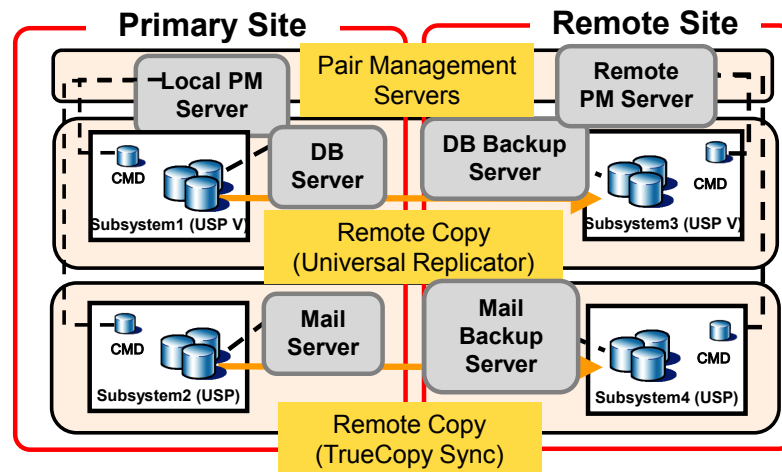


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Example of Two Data Centers — Use Case

■ 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*

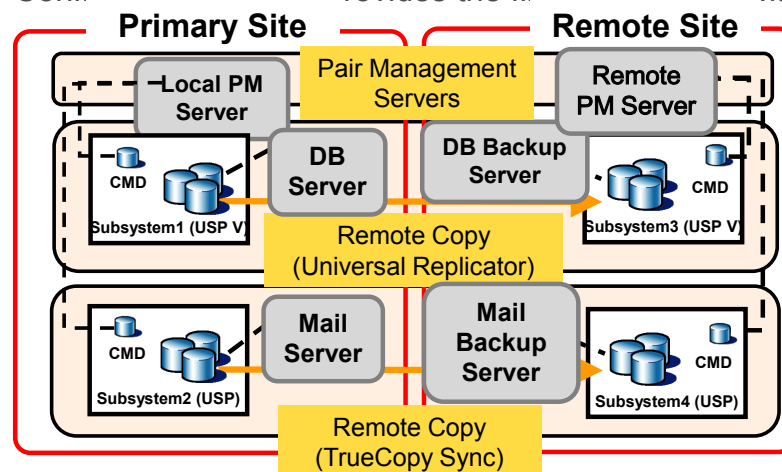


30

Example of Two Data Centers — Use Case

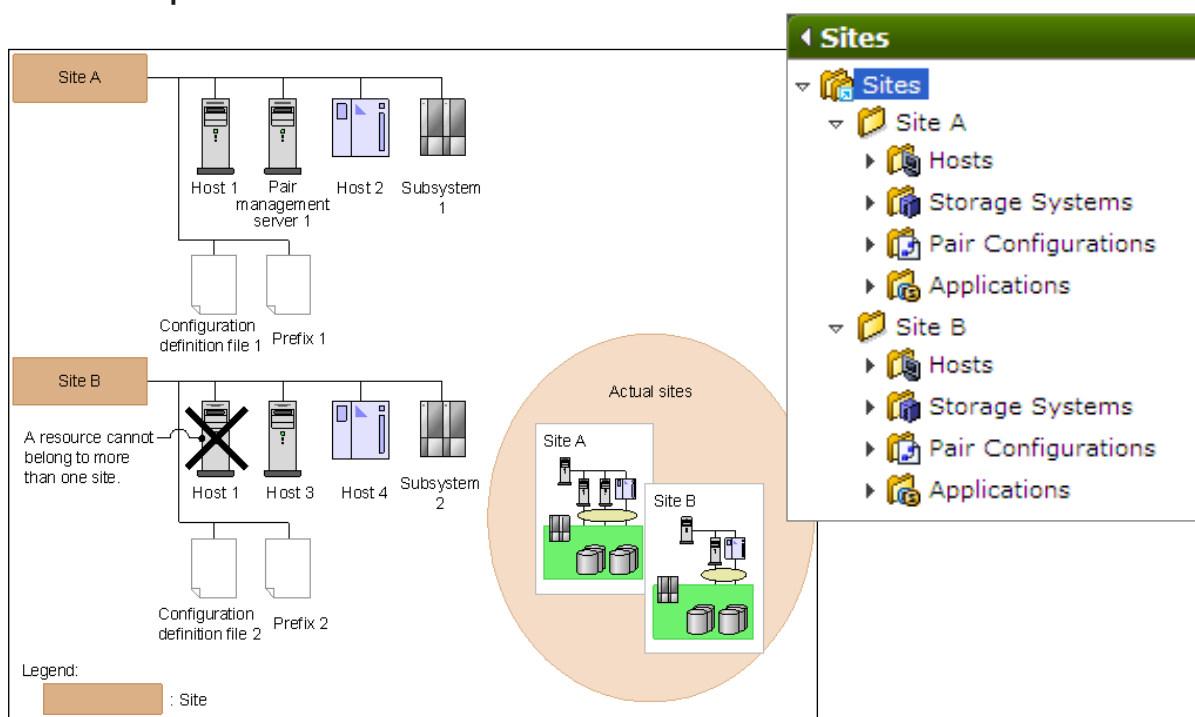
■ Objective

- 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.



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■ Example



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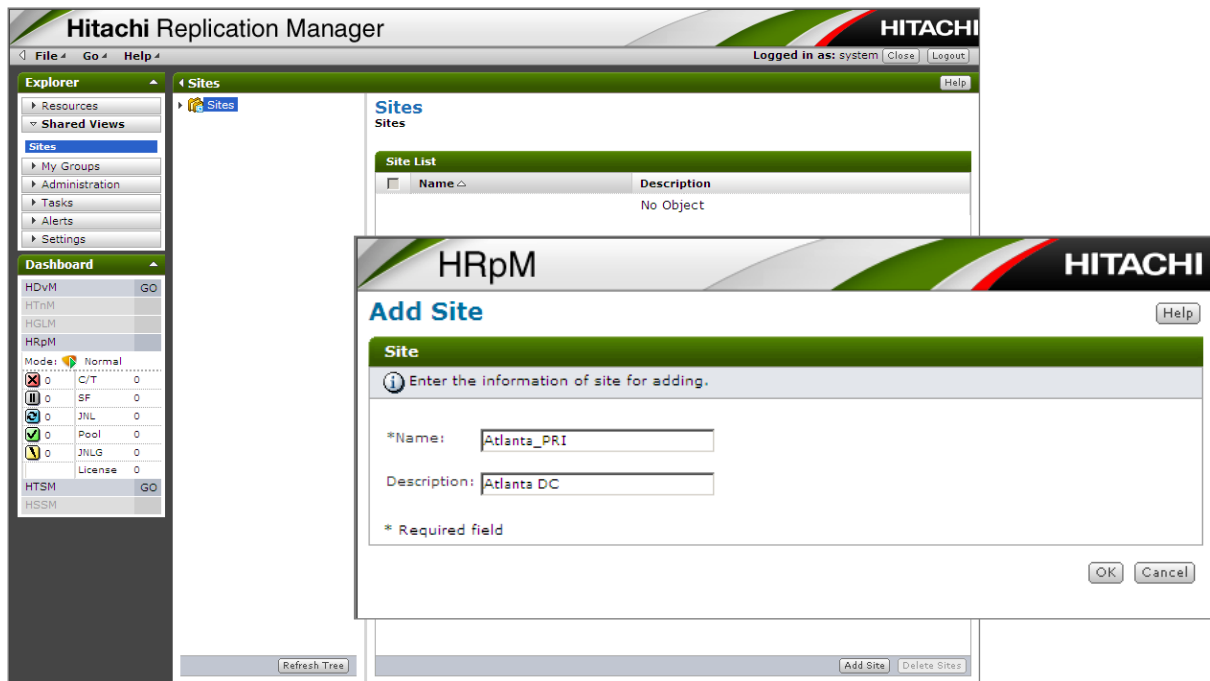
Properties

- 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.

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Setup

■ Add Site



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In the **Explorer** menu, click the **Shared Views** drawer to select the **Sites** option. And then, click **Add Site** to display the Add Site dialog box.

Enter the site name in the **Name** field and then click **OK**.

Setup

■ Add Hosts

HRpM **HITACHI**

Add Hosts

Select hosts to be added in the site "Atlanta_PRI".

Rows/ Page: 100 | Page 1 of 1

Host	IP Address	Information Source
☒ WLABOK	10.74.65.95	local HDvM
☐ WLABOL	10.74.65.56	local HDvM
☒ WLABOP	10.74.65.59	local HDvM
☐ WLABOQ	10.74.65.60	local HDvM

OK Cancel

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Setup

■ Add Storage System

HRpM **HITACHI**

Add Storage Systems

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

Rows/ Page: 100 | Page 1 of 1

Storage System	Storage System Type	Licensed Copy Type
		SI TCA / TCE / SDR TCS QS / COW UR
☒ USP_V@10.74.64.24 (10152)	USP_V	✓ ✓ ✓ ✓ ✓ ✓
☐ USP_V@10.74.64.25 (10043)	USP_V	✓ ✓ ✓ ✓ ✓ ✓

OK Cancel

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Setup

■ Add Pair Configurations and Applications (Hosts)

Sites

- Atlanta_PRI
 - Hosts
 - Storage Systems
 - Pair Configurations
 - Applications
- Dallas_SEC
 - Hosts
 - Storage Systems
 - Pair Configurations
 - Applications

Hosts
Sites > Atlanta_PRI > Hosts

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

Resource Groups

- Resource Groups provide access control functionality
 - 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:
 - Who can access this storage system?
 - An administrator is assigned to hosts and systems that are grouped by a site or department.

Resource Groups	
SVC_DC1 Resource Groups > SVC_DC1	
Summary	
Description	
Number of Hosts	0
Number of Storage Systems	4
Number of Applications	0
Number of Users	0
Hosts Storage Systems Applications Users	
Rows/ Page	
Storage System	Storage System Type
☐ USP_V@172.17.41.57 (10044)	USP_V
☐ USP_V@172.17.41.58 (10033)	USP_V
☐ VSP@172.17.45.30 (53086)	VSP
☐ VSP@172.17.45.35 (53004)	VSP

38

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.

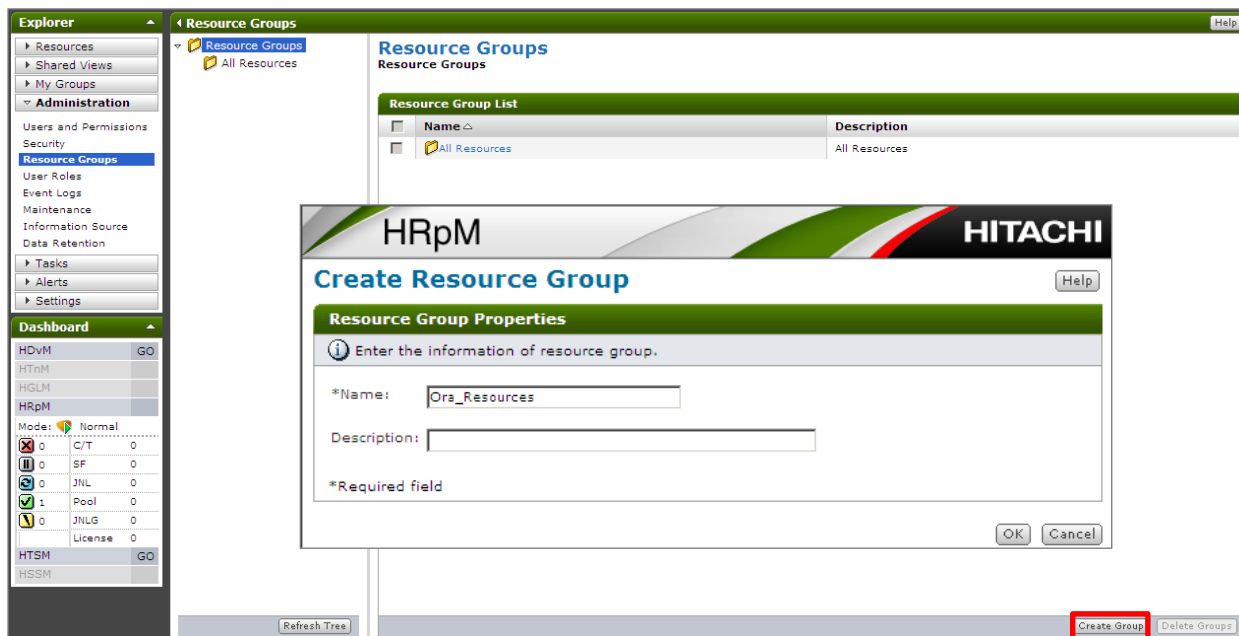
Relationship Between Resource Group and Site

- Each user can view the resources that belong to any site within the range of resource groups assigned to that user for access control.
- In the previous 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.

39

Note: Resource groups and Site groups are both grouping mechanisms, but resource groups are used for access control, whereas Sites are just for organizational purposes.

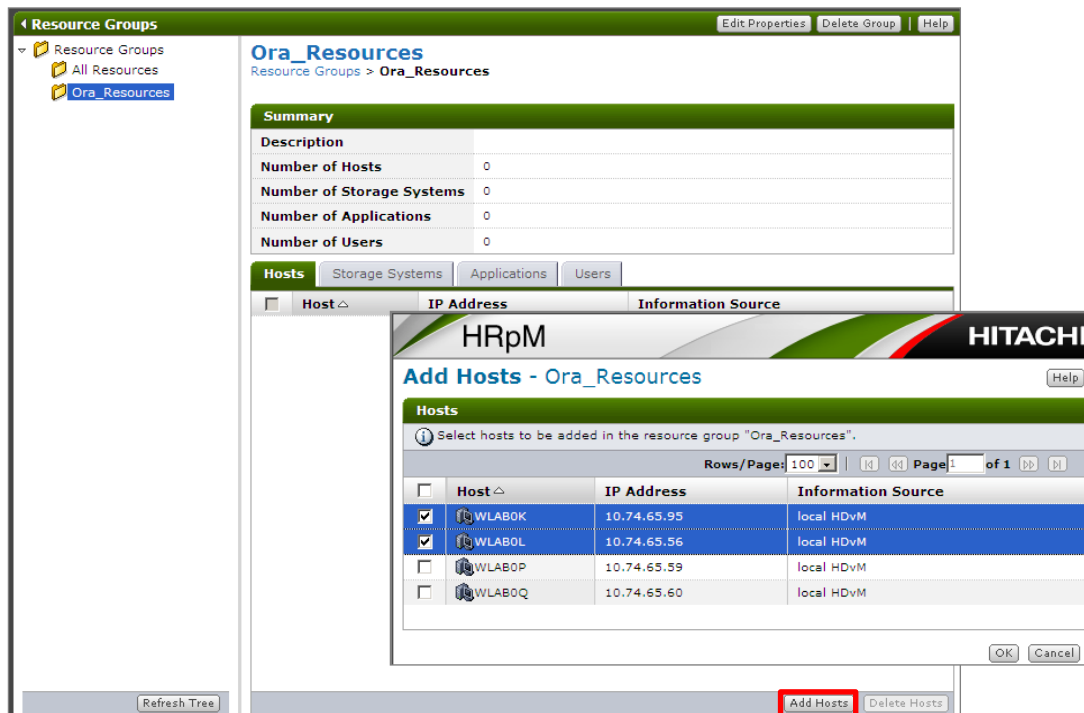
■ Create Resource Group



40

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

■ Add Hosts

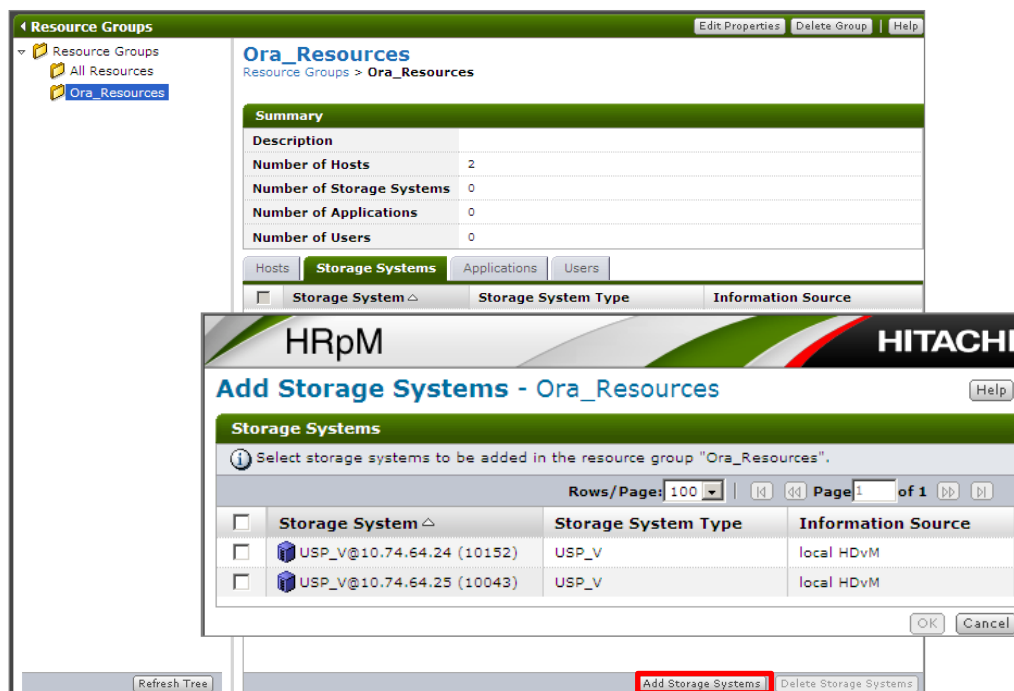


41

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

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

■ Add Storage Systems and Applications



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

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

■ Assign Users

The screenshot displays the Hitachi Replication Manager interface. On the left, the 'Explorer' pane shows the 'Resource Groups' hierarchy with 'Ora_Resources' selected. The main area shows the 'Ora_Resources' summary and the 'Users' tab. The 'Add Users - Ora_Resources' dialog box is open, showing a 'User List' table with columns: User ID, Admin, Modify, View, and Description. The 'WinAdmin' user is selected with a checked checkbox. The 'Add Users' button at the bottom right of the dialog is highlighted with a red box.

User ID	Admin	Modify	View	Description
☒ WinAdmin	☒	☒	☒	

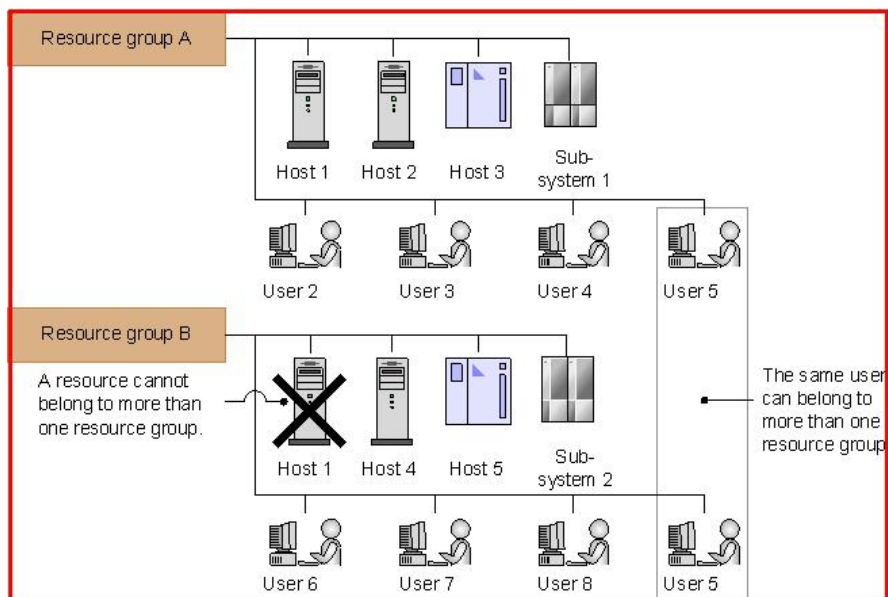
43

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

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

Properties

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



44

Module Summary

- Listed the key replication management features offered by Replication Management
- Described the architecture of Replication Manager for different environments
- Described the features, functions and principles of the Hitachi Business Continuity Manager

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Module Review

1. What is HRPM?
2. What are the prerequisite products to use HRPM?
3. List the information sources in HRPM.

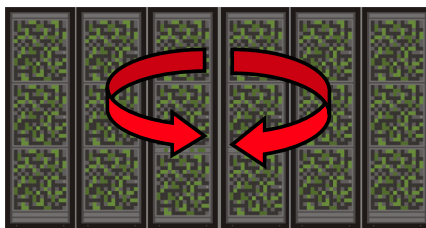
15. Hitachi ShadowImage Heterogeneous Replication

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the features, functions and principles of Hitachi ShadowImage® In-System Replication

What Is ShadowImage?

- ShadowImage is a host-independent, nondisruptive data replication software for creating copies of any customer accessible data within a single Hitachi storage system.
- All copies are additionally RAID protected to ensure the highest data availability.
- ShadowImage also supports replicating to and from external storage.

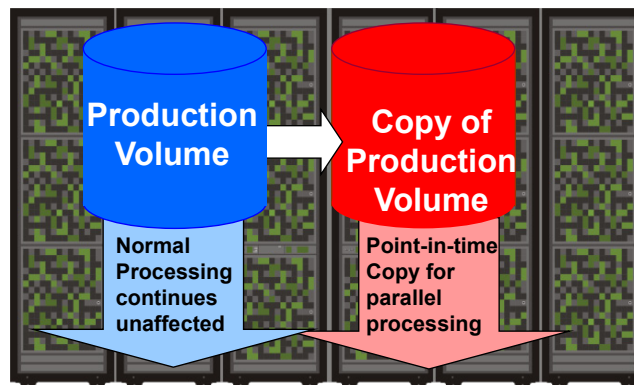


3

The ShadowImage bundle provides a nondisruptive, customer-managed, host-independent data replication solution that creates RAID-protected copies of customer-accessible data within a single Hitachi storage system. The information volumes can then be split away from the host application and used for business continuance, testing, data mining applications, and nondisruptive system backups while your business continues to run at full capacity.

Overview

- High speed full volume local mirroring technology within Hitachi storage systems in mainframe and open systems environments
- ShadowImage replicated full data volumes can easily be split from the host applications.
- No dependence on operating system, file system, or database
- No host processing cycles is required.
- Customer configurable and manageable (no field engineer requirement)



4

- No downtime or impact to production application.
- No impact to server processing; copy operation is completely handled within the storage system.
- All ShadowImage bundle volumes are completely protected by RAID at all times, regardless of the RAID type. An HDD failure or I/O error is recovered automatically and transparently to any application processing.

Benefits

- Protects data availability by providing duplicate data copy
- Simplifies and increases disaster recovery testing
- Eliminates the backup window
- Reduces testing and development cycles
- Enables workload sharing
- Fully leverages the capabilities of the storage system by allowing flexible movement of data volumes across platforms

5

Simplified and more frequent Disaster Recovery testing builds business confidence.

The proof is in the ability to recover, and what better way than to use real life data and scenarios to test Disaster Recovery plans.

Eliminate the Backup Window problem

- Replicates open systems information and duplicates production data nondisruptively through a resynchronization capability that only copies the information that has changed since the last update.
- Configures and executes logical backups at faster speeds, with less effort and resources than previously possible, across your storage area networks.

Reduce testing and development cycles

Current production information is replicated and used to develop, install, test, and modify applications rapidly – in a realistic testing environment.

Share information easily

Provides immediate and nondisruptive access and sharing of time critical information for decision support, populating data warehouses, and performing analysis or other data mining operations

Application of ShadowImage

- Business application of ShadowImage:
 - Business continuity and disaster recovery
 - Backup and recovery
 - Application development and testing
 - Data warehousing and data mining

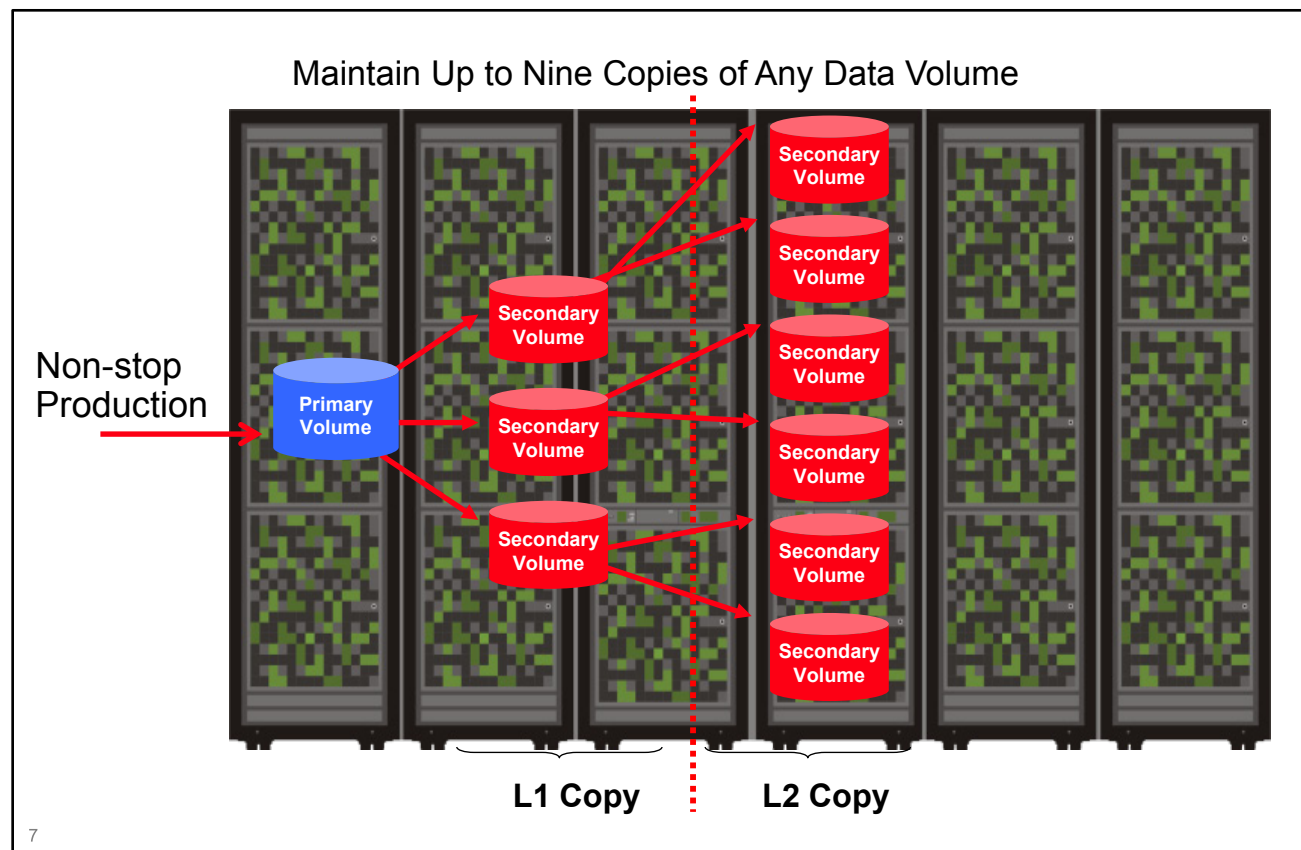
6

After a PiT copy of production volume is created, replicated data (S-VOL) can be used for any application that needs access to real data such as:

- Data warehousing and data mining applications
- Backup and recovery
- Application development and Testing

To perform historical data analysis, complex queries need to be run on real data. These queries now can be run on replicated volume (S-VOLs) rather than production volumes.

Parallel Operations



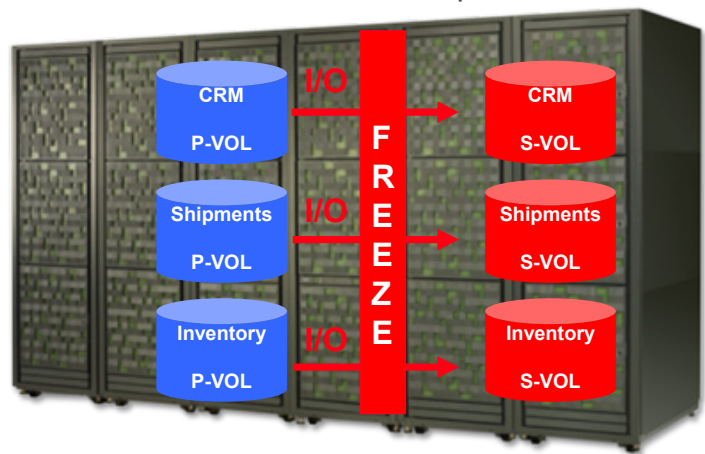
ShadowImage enables you to maintain system internal copies of all user data for purposes such as data backup or duplication. The RAID protected duplicate volumes are created within the same system as the primary volume at hardware speeds. ShadowImage is used for UNIX-based and PC server data as well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

The Paircreate command creates the first Level 1 Secondary volumes. The set command can be used to create a second and third Level 1 Secondary volumes. Also the cascade command can be used to create the Level 2 Secondary volumes from the Level 1 Secondary volumes.

Having multiple copies of the data enables parallel operations without interruption to production. These parallel operations are typically backup, testing and rapid recovery.

Consistency Groups

- Create an *I/O-consistent* Group Copy
 - Create a group of ShadowImage pairs
 - Split them as a group at the same point-in-time using one command.
 - All S-VOLs in group are split at exactly the same time.
 - At the time of the split, all I/Os to the secondary are held until after the split.
 - Simplifies database backup and restore functions, and complex application testing
 - No host software is required.



8

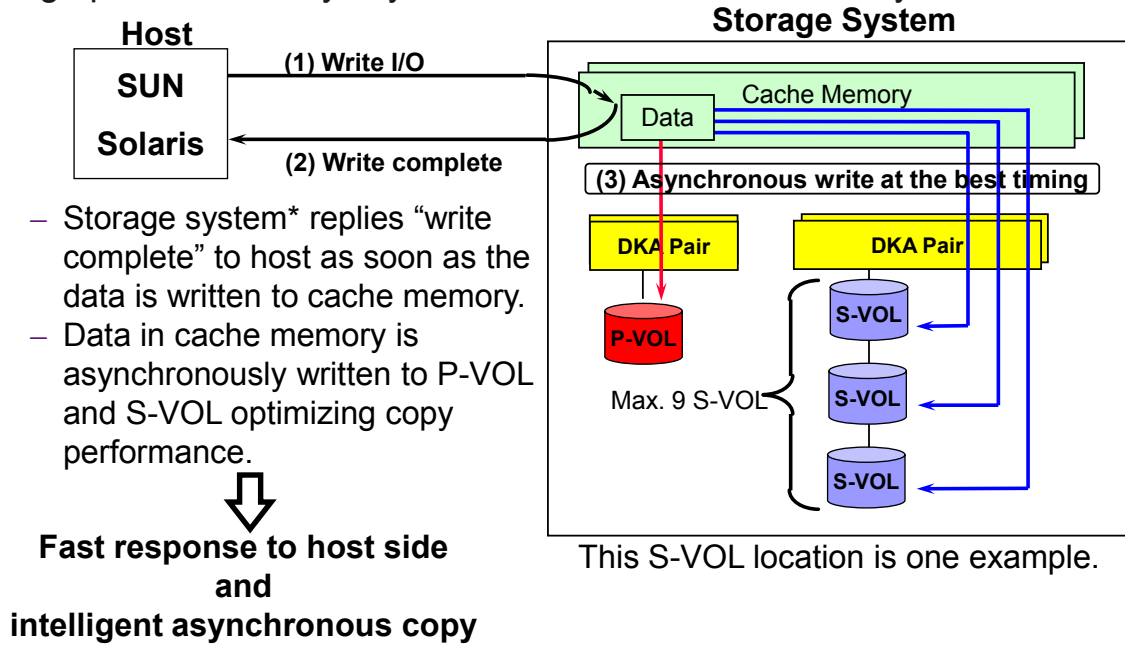
A key element is the ShadowImage bundle's support of a **Consistency group**, a function that guarantees multiple volumes can be quiesced and copied at a specific point in time. The **Consistency group** function reduces restart and recovery times by providing multivolume, I/O-consistent copies for applications and databases that spans multiple volumes. This is an absolute requirement for business applications that typically require multiple volumes of different nature, holding different *parts* of the application. A typical example is a database that spans multiple volumes and has a log volume. If data ever gets out of sync, there is a high risk for corruption or inconsistency.

When a ShadowImage Consistency group is split, all I/Os are held within the storage system.

In the diagram above, **CRM** stands for Customer Relationship Management, **P-VOL** stands for Primary Volume, and **S-VOL** stands for Secondary Volume.

Overview

- High performance by asynchronous access to secondary volumes



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When creating pairs, you can select the pace for the initial copy operation:

- Slower
- Medium
- Faster

The slower pace minimizes the impact of ShadowImage Replication 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.

ShadowImage is not data aware as far as the volume is concerned. Regardless of how much data is stored on the volumes, ShadowImage will copy all the tracks to the destination volume.

Specifications

- Pair specifications
 - Maximum 16,384 pairs
 - 16,383 pairs if Command Control Interface is used (Command Device needs to be created.)
- Maximum concurrent copies is 128.
- The following volumes cannot be used for creating ShadowImage pairs:
 - Journal volumes of Universal Replicator
 - Virtual volumes (except Dynamic Provisioning volumes)
 - Pool volumes
 - Command Devices

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ShadowImage Specific Operations

- **Pairsplit**
 - Quick: Splits then sends the update in the background
- **pairresync**
 - Quick: PAIR status occurs while P-VOL changed tracks are being sent to S-VOL
 - Reverse: Sends S-VOL changes to P-VOL
 - quick restore: Swaps P-VOL and S-VOL logical device (LDEV) mapping
- **Suspend (pairsplit –E):** Forces a split
 - No updates are sent

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Commands

- Pairsplit — quick
 - Volume status changes to PSUS.
 - S-VOL is available instantly.
 - Update copy takes place in background.
 - Differential bitmaps track changes to P-VOL and S-VOL while pair is split.
 - Data integrity is *not* compromised.

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

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- pairresync — quick
 - S-VOL is no longer available to host.
 - Volume status changes to PAIR.
 - S-VOL and P-VOL differential bitmaps are merged.
 - Changed tracks are marked and written from P-VOL to S-VOL in background.

	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/W	COPY(RS)	NA
After	PAIR	R/W	PAIR	NA

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■ **pairresync — reverse**

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

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The reverse 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 reverse 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 reverse pairresync operation can only be performed on split pairs, not on suspended pairs. The reverse pairresync operation cannot be performed on L2 cascade pairs.

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

- **pairresync** — quick restore
 - Swap of LDEV ID takes place.
 - Can only be done from L1 to P-VOL
 - P-VOL is available for r/w.
 - New P-VOL data is copied to S-VOL after the swap.
 - Swap and freeze option available (only swap, no copy)

	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

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The quick restore operation speeds up the reverse resync operation by changing the volume map in the storage system to swap the contents of the P-VOL and S-VOL without copying the S-VOL data to the P-VOL. The 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. The 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.

■ **Pairsplit –E (suspend)**

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

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

16

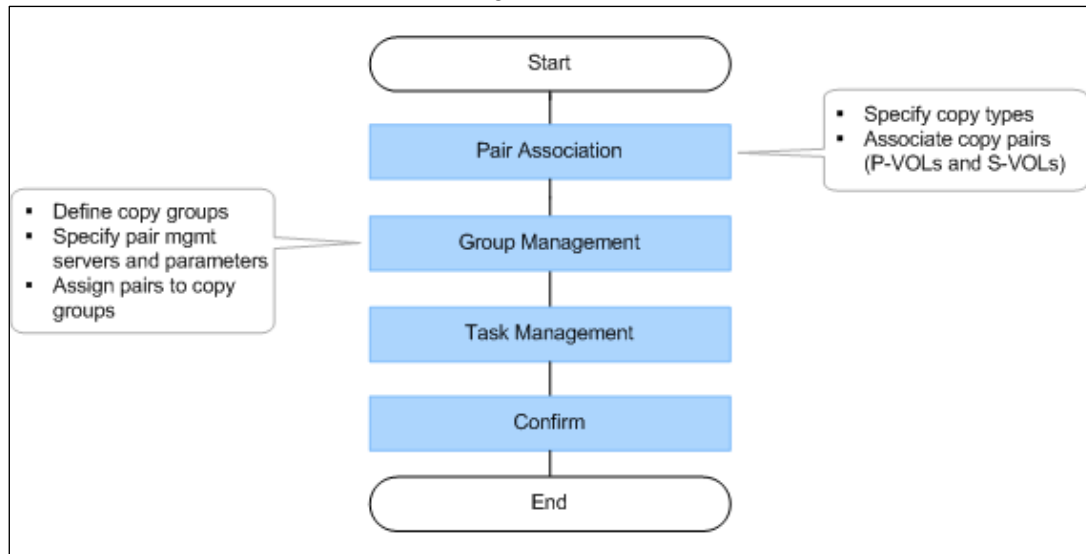
The ShadowImage Heterogeneous Replication pairsplit-E operation suspends the ShadowImage Heterogeneous Replication copy operations to the S-VOL of the pair. The user can suspend a ShadowImage pair at any time. When a ShadowImage pair is suspended (status = PSUE), the system stops performing ShadowImage. 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. Reverse and quick restore pairresync operations cannot be performed on suspended pairs.

The subsystem will automatically suspend a ShadowImage Heterogeneous Replication 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 Heterogeneous Replication 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.

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.



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■ Launching Pair Management operations

The screenshot displays the Hitachi Data Systems management console. On the left, a tree view shows 'Hosts' and 'Storage Systems'. The 'Storage Systems' section is expanded, showing two storage systems: 'USP_V@10.74.64.24 (101)' and 'USP_V@10.74.64.25 (100)'. The 'Open' button is visible next to the first storage system. The main panel shows the 'Open Storage System Summary' for the selected storage system. Below the summary, there are tabs for 'LUNs', 'Cmd Devs', 'Pools', 'JNLGs', 'Remote Paths', and 'Copy Licenses'. The 'LUNs' tab is selected, showing a table of LUNs. The table has columns for 'Port/Host Group/LUN', 'LDEV', 'Label', 'Capacity', 'SLPR', 'CLPR', and 'Volume Attribute'. The 'Pair Management' button is highlighted in red at the bottom right of the LUN 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 Management Wizard

HRpM- Pair Configuration Wizard **HITACHI**

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

Below are the steps necessary to complete the Pair Configuration Wizard.

The Pair Configuration Wizard will take you through the steps necessary to create new Copy Groups.

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

☐ Do not show this message again.

Warning : You need to configure Storage System Configuration before activate Pair Configuration Wizard.
If you need to know the details. [See here.](#)

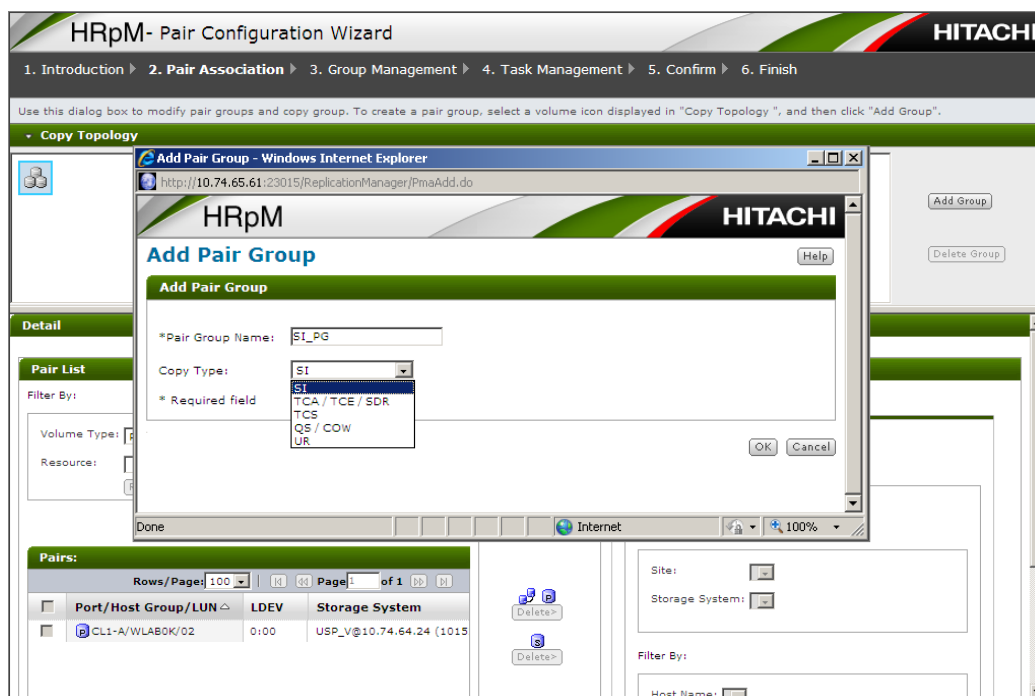
Next> Cancel Help

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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.

Specify Copy Type

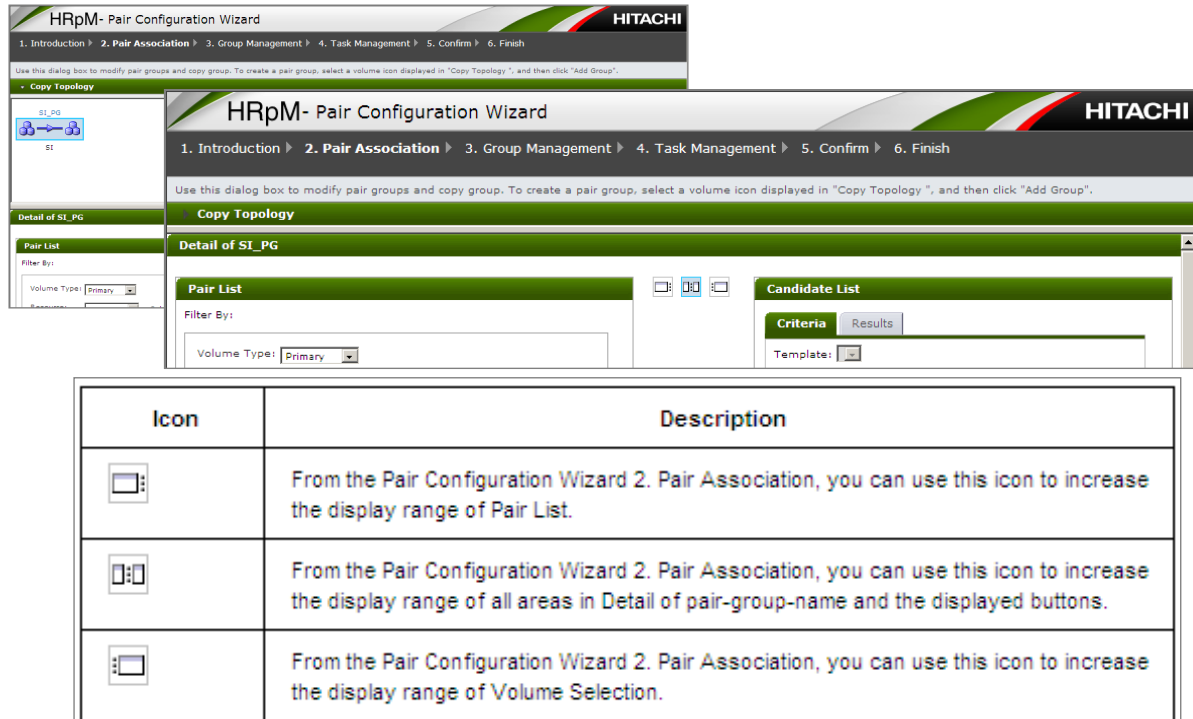
■ Specify Copy Topology



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Specify Pair Volumes (Source and Destination)

■ Detail Window

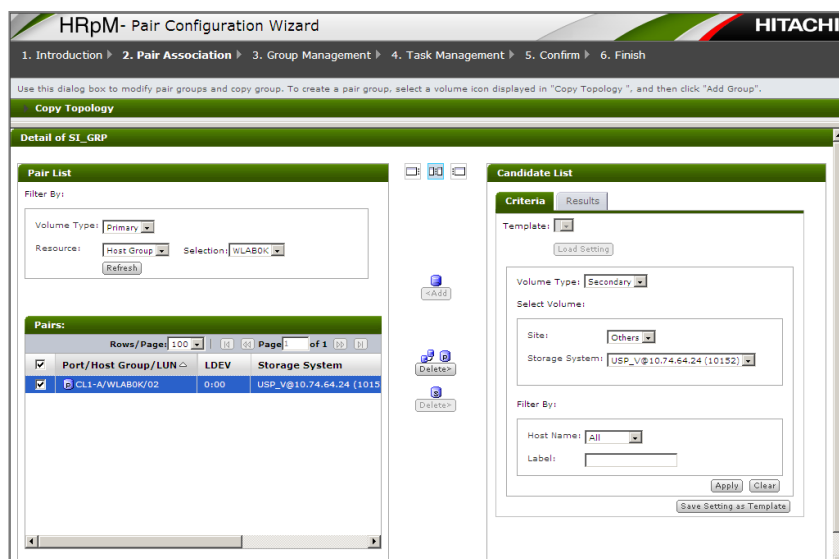


Icon	Description
	From the Pair Configuration Wizard 2. Pair Association, you can use this icon to increase the display range of Pair List.
	From the Pair Configuration Wizard 2. Pair Association, you can use this icon to increase the display range of all areas in Detail of pair-group-name and the displayed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

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■ Pair List (left area)

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

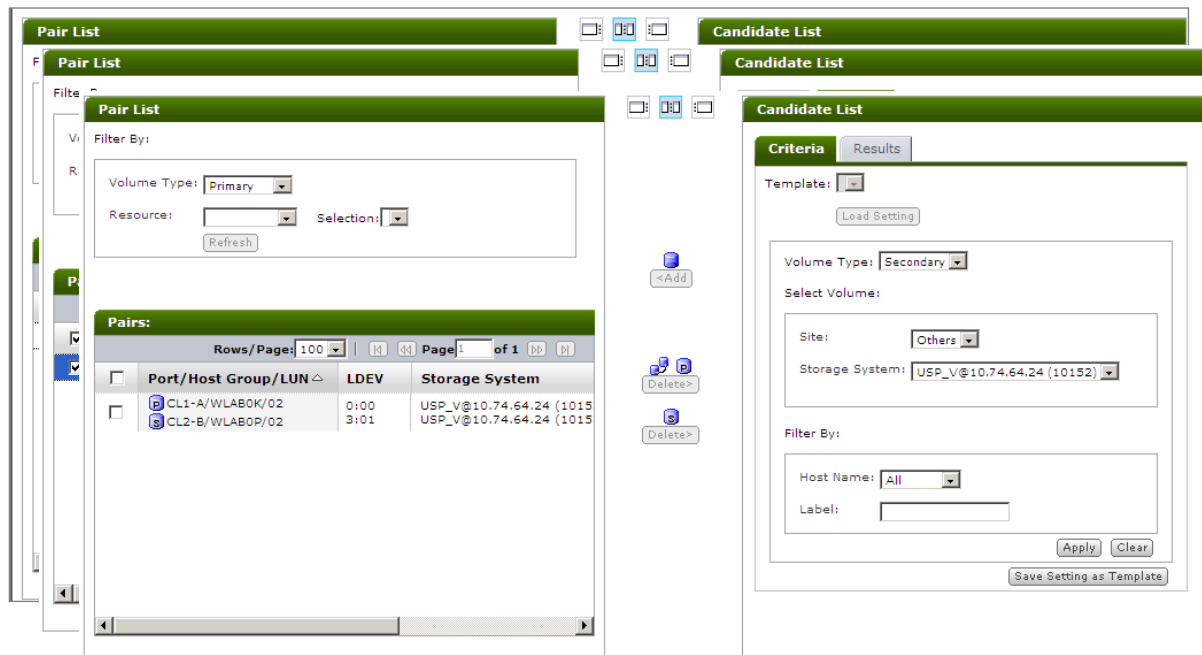


Port/Host Group/LUN	LDEV	Storage System
☒ CL1-A/WLABOK/02	0/00	USP_V@10.74.64.24 (1015)

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■ Candidate List (right area)

- Select Primary or Secondary Volumes to add to Pair List

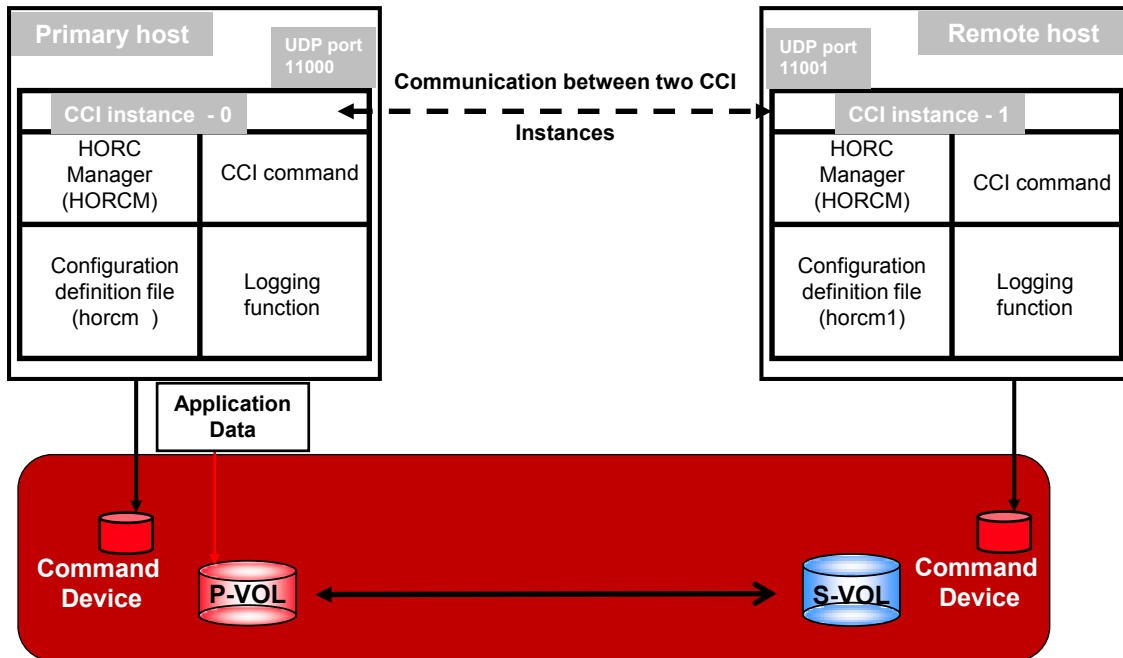


To define a copy pair:

1. In the Pairs pane under Detail of pair-group-name pane, select a primary volume.
2. In the Criteria tab under the Candidate List pane, specify the volume type and optional filtering criteria for obtaining a list of candidate volumes.
3. Click **Apply**.
4. The filtered list of candidate volumes is displayed on the Result tab.
5. 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.
6. You can select multiple volumes on the Result tab.
7. Click **Add**.
8. 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.
9. Click the icon to expand the Candidate List and Pair List panes.
10. Click **Next** to continue creating the copy pair configuration definition or click **Save** to temporarily save the workflow.
11. 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



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The next screen accepts the copy group parameters.

Specify Copy Group

■ Create a Copy Group

Copy Group :

Pair List

Action	Pa
--------	----

of 1

N	LDEV
0:00	
3:01	

Done

Create Group Remove Group Edit Pair Name

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.

■ Assign Pair to Copy group

Copy Group

Copy Group : SI_GRP

Pair List

Rows/Pages	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

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

Pair Group

SI_GRP

Assigned

SI
+1/0/-0

Pair List

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

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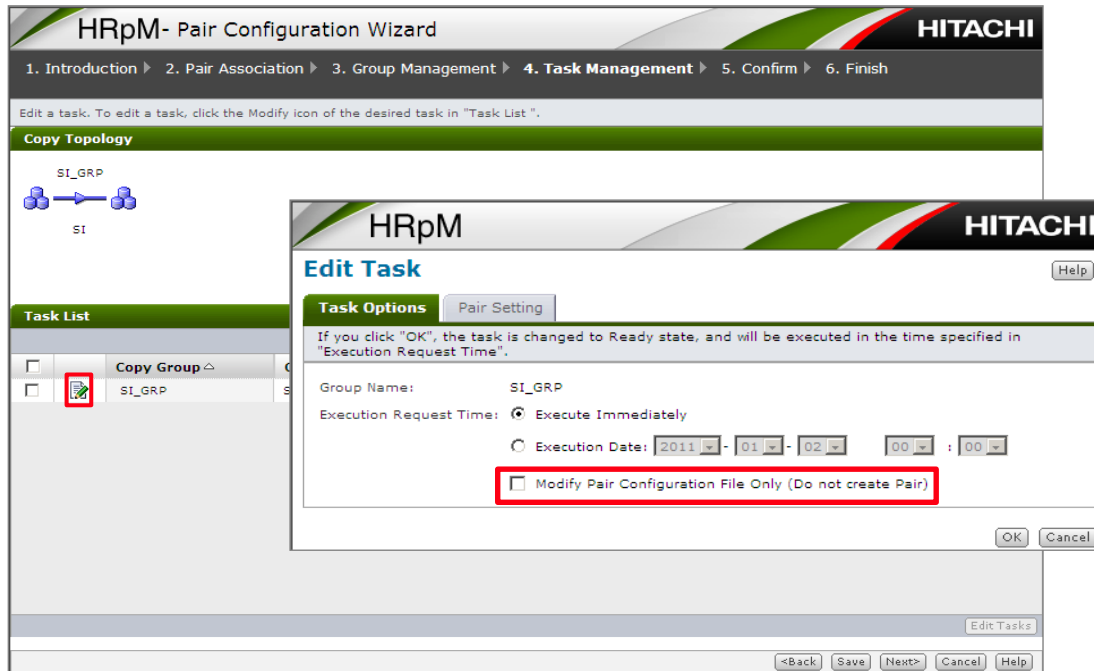
Initially the topology view displays Copy Group attribute as Unassigned.

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.

Configure Task Management Options

■ Set Task Options — Schedule



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 modify the CCI configuration definition file. This item is displayed when the task type is create.

■ Set additional Pair Settings

HRpM- Pair Configuration Wizard

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

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

Copy Topology

SI_GRP
SI

Task List

☐	Copy Group ^	Copy Type
☐	SI_GRP	SI

Edit Task

Task Options | **Pair Setting** | Help

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

Rows/Page: 100 | Page: 1 of 1

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

OK Cancel

Edit Tasks

<Back Save Next> Cancel Help

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Pair Configuration Task Confirmation

■ Final Confirmation

HRpM- Pair Configuration Wizard

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

HRpM- Pair Configuration Wizard

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

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

29

Check Task Status

The screenshot shows the 'Tasks' section of the Hitachi ShadowImage Heterogeneous Replication interface. The left sidebar contains a navigation menu with 'Tasks' highlighted. The main area displays a 'Task List' table. The table has the following columns: Task ID, Workflow, MF/Open, Host, Target, Copy Type, Task Type, Status, and Creation. A single task is listed: TASK0001, with a status of 'Success' (highlighted with a red box). The bottom of the interface has buttons for '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	WLABOK	SI_GRP	SI	modify file + create	Success	2011-01-0

30

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.

Check Pair Status

■ Hosts view

Resources

Hosts

Storage Systems

Pair Configurations

Applications

Shared Views

My Groups

Administration

Tasks

Alerts

Settings

Dashboard

HDvM

HTnM

HGLM

HRpM

Mode: Normal

0 C/T 0

0 SF 0

Hosts

WLAB0K

WLAB0L

WLAB0P

WLAB0Q

SI_GRP

Hosts > WLAB0K > SI_GRP

Create Alert

Change Pair Status

Pair Management

Refresh Copy Group

Help

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
CTGID			1 / 1

Pairs

Copy Group Relationship

Rows/Page: 100

Page 1 of 1

Copy Pair	Copy Type	Pair Status	Copy Progress	Primary
			Active	Inactive
P_000-301_0002	SI	✓	100%	Pair (PAIR)

■ Operations supported

Create Alerts

Change Pair Status

31

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.

information, but there is no actual copy pair configuration.

cannot determine the pair status due to any of the following

are set not to acquire copy pair statuses.

tion does not allow copy pair statuses to be acquired.

tion information has already been acquired, but the copy pair is not.

SDR

tal

1 / 1

CTGID

Pairs

Copy Group Relationship

Rows / Pages: 100

☐	Copy Pair	Copy Type	Pair Status	Copy Progress	Primary
				Active Inactive	Pair State
☐	P_000-301_0002	SI		100%	Pair (PAIR)

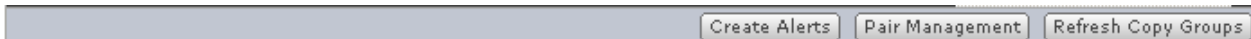
32

■ Hosts view



The screenshot shows the 'Hosts' view in the Hitachi ShadowImage interface. The left sidebar contains a navigation menu with 'Resources' (Hosts, Storage Systems, Pair Configurations, Applications) and 'Dashboard' (HDvM, HTnM, HGLM, HRpM). The main area displays the 'SI_GRP' view for 'Hosts > WLAB0K > SI_GRP'. It includes a 'Copy Group Summary' table with columns for C/T Delta, Side File / Journal Usage, Primary/Secondary Server, Config File, TCA / TCE / SDR, TCS, QS / COW, UR, and Visible / Total. Below this is a 'Copy Group Relationship' table with columns for Copy Group Configuration, SI, TCA / TCE / SDR, TCS, QS / COW, UR, and Copy. The interface also features buttons for 'Create Alert', 'Change Pair Status', 'Pair Management', 'Refresh Copy Group', and 'Help'.

■ Operations supported



The screenshot shows a row of three buttons: 'Create Alerts', 'Pair Management', and 'Refresh Copy Groups'.

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■ Storage Systems view

The screenshot shows the 'Storage Systems' view. The left sidebar has 'Storage Systems' selected under 'Resources'. The main panel displays 'CL1-A/WLAB0K/02' with a breadcrumb trail: 'Storage Systems > USP_V@10.74.64.24 (10152) > Open > CL1-A/WLAB0K/02'. Below this, the 'LUN Summary' table shows 'Mount Point' as 'e:', 'Capacity' as '2.00 GB', 'LDEV' as '0:00', and 'Volume Attribute' as 'CVS'. The 'Pair Relationship' table below it has one row for 'P_000-301_0002' with 'SI' as the 'Copy Type', a green checkmark for 'Pair Status', and '100%' for 'Copy Progress'.

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

Pair Relationship	
Pair Configuration	Copy Pair
	P_000-301_0002

■ Operations supported

The operations bar contains three buttons: 'Create Alerts', 'Pair Management', and 'Refresh Copy Pairs'.

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■ Pair Configurations view

The screenshot shows the 'Pair Configurations' view. The left sidebar has 'Pair Configurations' selected under 'Resources'. The main panel displays 'SI_GRP' with a breadcrumb trail: 'Pair Configurations > WLAB0K > horcm0.conf > SI_GRP'. Below this, the 'Copy Group Summary' table shows 'C/T Delta' as 'SI' with a green checkmark, 'Side File / Journal Usage' as 'TCA / TCE / SDR', 'Primary' as 'Server' with 'WLAB0K' as the 'Config File', 'Secondary' as 'Server' with 'WLAB0K' as the 'Config File', and 'CTGID' as '1 / 1'. The 'Pairs' table below it has one row for 'P_000-301_0002' with 'SI' as the 'Copy Type', a green checkmark for 'Pair Status', '100%' for 'Copy Progress', and 'Pair (PAIR)' for 'Primary'.

Copy Group Summary	
C/T Delta	SI
Side File / Journal Usage	TCA / TCE / SDR
Primary	Server
Config File	WLAB0K
Secondary	Server
Config File	WLAB0K
CTGID	1 / 1

Pairs	
Copy Pair	Copy Type
P_000-301_0002	SI

■ Operations supported

The operations bar contains two buttons: 'Create Alerts' and 'Change Pair Status'.

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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	TCS
	Config File	horcm0.conf	QS / COW
Secondary	Server	WLAB0K	UR
	Config File	horcm1.conf	Visible / Total
			1 / 1
CTGID			

Copy Group Relationship

Rows/ Pages: 100 | Page 1 of 1

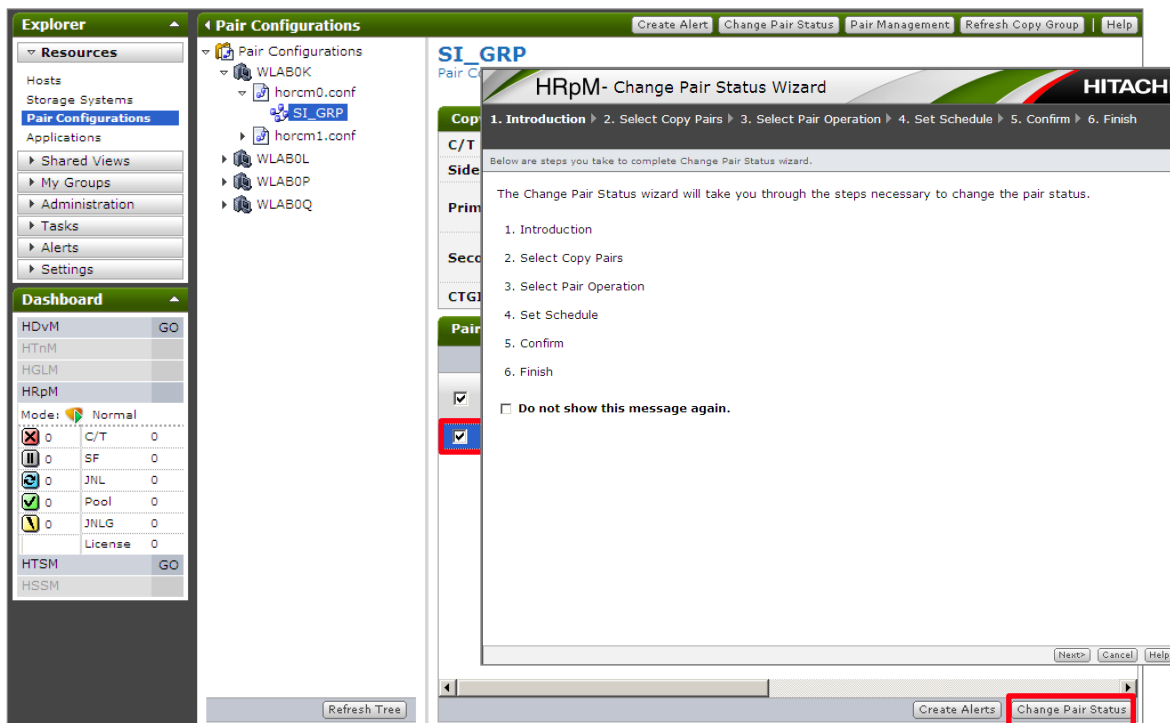
Copy Group Configuration	SI	TCA / TCE / SDR	TCS	QS / COW
✓	✓			

Operations supported

Create Alerts Pair Management Refresh Copy Groups

Change Pair Status

■ Launch Change Pair Status



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Select Pairs

- Select pairs to change status

HRpM- Change Pair Status Wizard

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/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)

Select Pair Operation

- 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 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)

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- 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

Operation: ☒ 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)

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Select Schedule

■ Schedule 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: - - : :

Confirm Pair Change Operation

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

Module Summary

- Described the features, functions and principles of Hitachi ShadowImage In-System Replication

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Module Review

1. Describe the use of differential bitmaps in pair operations.
2. List the ShadowImage pair operation commands.
3. Under what conditions will ShadowImage Heterogeneous Replication pairs be *suspended*? What is the resulting status?
4. What is the benefit of the ShadowImage Heterogeneous Replication Quick Resync and Quick Split commands together?

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16. Hitachi Copy-on-Write Snapshot

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the features, functions and principles of Hitachi Copy-on-Write Snapshot

2

What is Copy-on-Write Snapshot?

- Provides logical snapshot data replication within Hitachi storage systems.
 - Accelerates backup and recovery processes by reducing the amount of disk storage required for the snapshot copies.
 - Since only the changed data blocks are stored in the storage pool, the storage capacity required for each snapshot copy is substantially less than the source volume, which results in a significant savings compared with full cloning methods like ShadowImage.
 - Copy-on-Write Snapshot's capability for quick restoration of data reduces traditional, tape-based application restore time from hours to seconds.
 - Requires ShadowImage license to be installed.
 - Storage Navigator does not have option to create pairs for Copy-on-Write.

3

Overview

■ Features

- Point-in-time copies of only the changed blocks in Copy-on-Write Snapshot data pool, not full volume
- Instantaneous restore of just the data you need
- Versioning of backups for easy restore
- RAID protection of all Copy-on-Write Snapshot copies
- Near-instant copy creation and deletion
- Can be integrated with industry-leading backup software applications
- Integrates with TrueCopy and Hitachi Universal Replicator for enhanced protection of data assets
- Supports external volumes

4

■ Benefits

- Reduces recovery time from data corruption or human error considerably by an immediate restore from a disk-resident, point-in-time data snapshot copy
- Allows frequent data backup operations to be performed nondisruptively, while critical applications run unaffected
- Accelerates application testing and deployment by always providing available copies of current production information
- Enables immediate access to time-critical information
- Eliminates the backup window
- Improves operational efficiency by allowing multiple processes to run in parallel with access to the same information
- Requires less storage space (low cost) when compared to ShadowImage

5

- **Components**

- Primary volume (**P-VOL**)
- Secondary volume (S-VOL) is a virtual volume.
 - Referred to as **V-VOL**
 - Created with VLL
- **Copy-on-Write Pool**
 - Is the logical container to store snapshot data
 - Consists of multiple pool-VOLs
- **Pool Volumes** are registered in the Pool.

6

VLL = Virtual LVI LUN

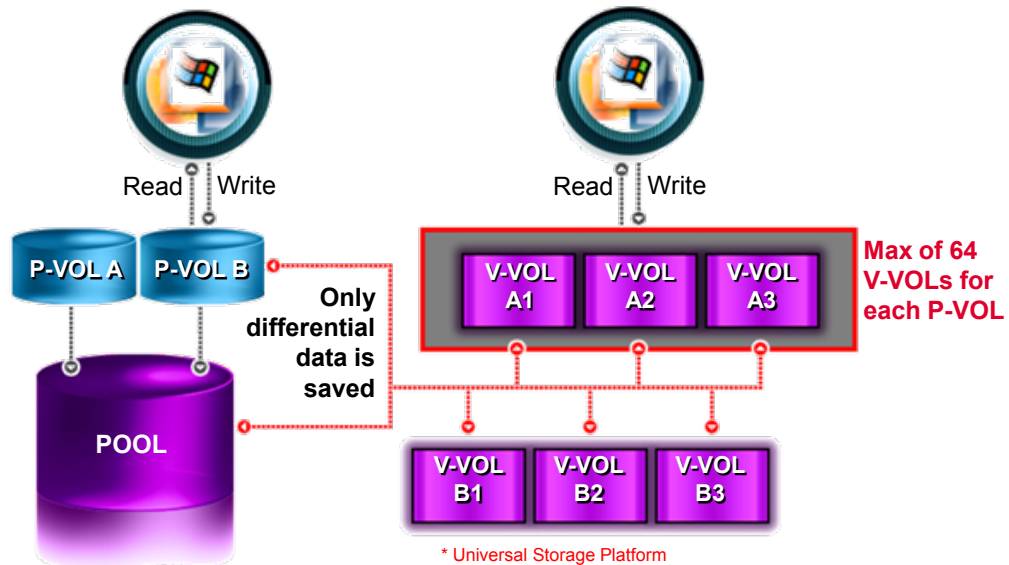
VLL allows users to create Custom Volumes on the storage system.

- V-VOL maintains view of the P-VOL at a particular point in time.
- V-VOL is a composite of data residing in the P-VOL and pool.
- V-VOL appears as a full volume copy to any secondary host.
- Since V-VOL does not copy all data, it can be created or deleted nearly instantly.

7

Maximize Storage Use and Improve ROI

- Pool can be shared by multiple P-VOLs and V-VOLs.
- Each V-VOL uses a fraction of the P-VOL storage space.
- Each P-VOL can have a maximum of 64 V-VOLs.



8

Specifications

- Two LDEVs (P-VOL and V-VOL) which compose a Copy-on-Write snapshot paired volume must have:
 - Emulation type OPEN-V only
 - Maximum of 16,384 pairs

9

- Pool
 - A maximum of 128 Copy-on-Write pools can be created
- Pool Volumes (Pool VOLs):
 - Emulation type OPEN-V only
 - Size can be 8GB–4TB
 - Must *not* be mapped to a FED (CHA) port
 - Maximum of 8192 pool volumes
 - Maximum of 1024 pool volumes can be registered in a single pool

10

Tools

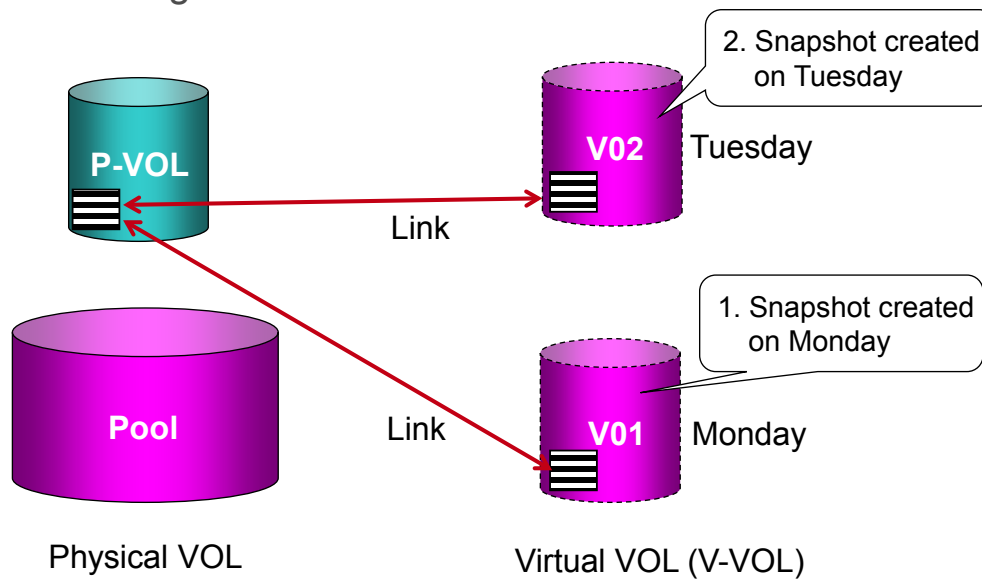
- **Graphical User Interface**
 - Hitachi Storage Navigator
 - Create P-VOLs/S-VOLs, Pool, Pool Volumes, Command device
 - Cannot perform Copy-on-Write pair operations (paircreate, pairsplit, pairresync)
 - Can only display pair status (pairstatus) and delete pair (pairsplit -S) operations
 - Hitachi Replication Manager
- **Command Line Interface**
 - RAID Manager/CCI
 - HORCM
 - HORCM Files
 - Command Line
 - Used to script replication process

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The examples above are a list of GUI and CLI tools to perform Copy-on-Write operations.

Operation Scenarios

- Before modifying the data block on P-VOL
 - V-VOL will get the data from P-VOL.

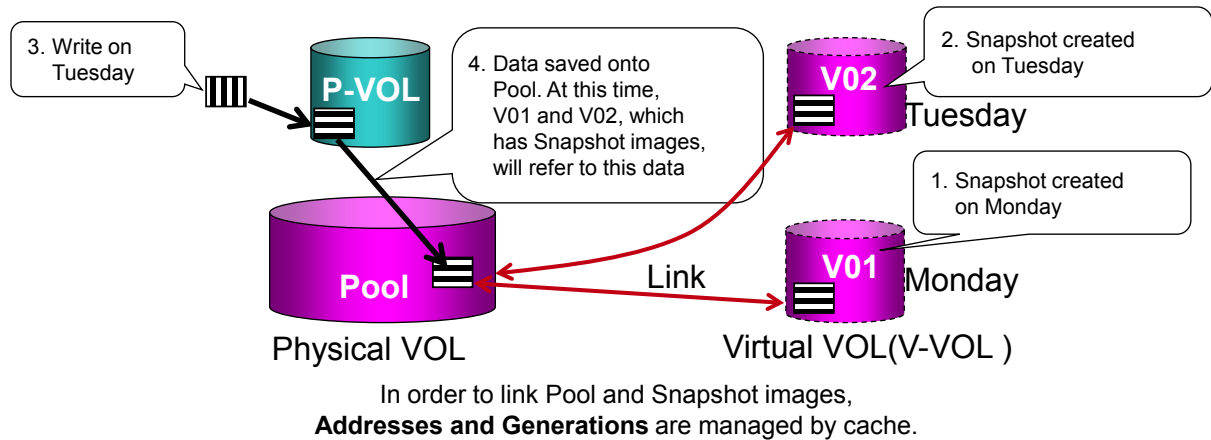


12

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 operation after creating a Snapshot, that data is saved on the Data Pool area (Pool) first.
- This saved data in Pool is used by the V-VOLs from now on.
- Pool can be shared by multiple V-VOLs; therefore only one copy of the data is required.

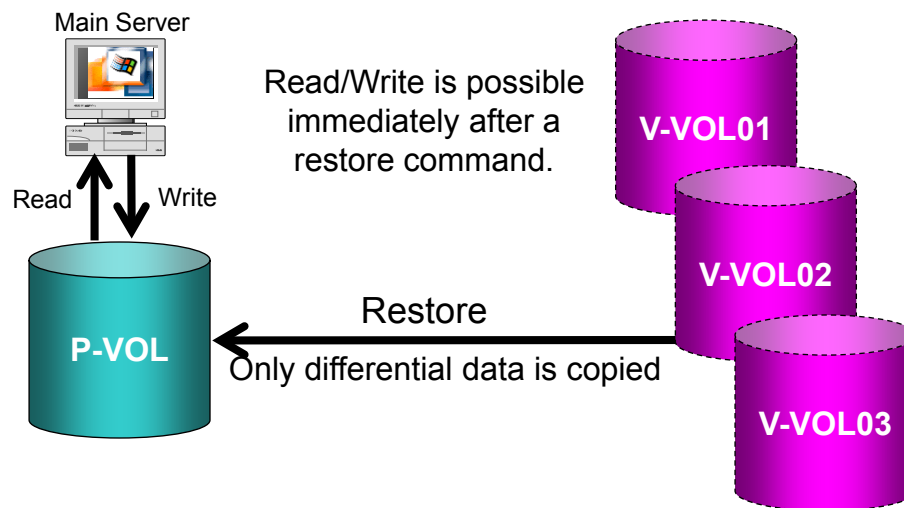


13

Now the data block on the P-VOL needs to be written to. 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.

- Restore is possible from any 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 the background.



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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 need to be modified.

The background data will then be copied from Pool to P-VOL.

If the P-VOL became physically damaged, all V-VOLs would be destroyed as well and a restore is not possible.

Comparison with ShadowImage Bundle

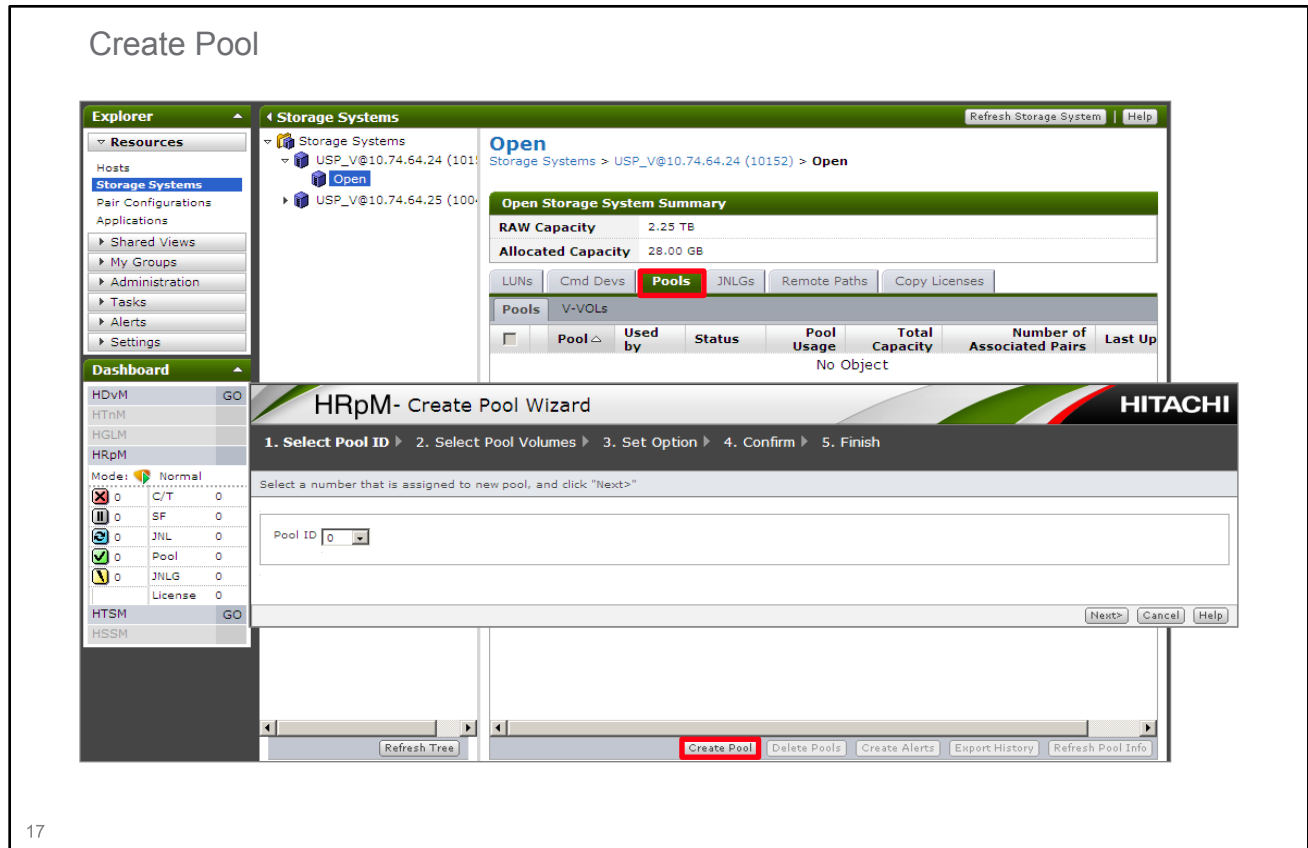
	Copy-on-Write Virtual Volume	ShadowImage Clone
Features	Provides a very quick copy because it is a virtual volume	Superior protection because it is a complete copy Immediate restore if P-VOL becomes corrupted
Time to Create	Instantaneous	From minutes to hours, depending on the size of the P-VOL
Disk 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 from a tape storage or else, data available	Instantaneous
Size of Physical Volume	$P-VOL \geq \text{Pool for one V-VOL}$	$P-VOL = S-VOL$
Pair Configuration	$P-VOL : V-VOL = 1 : 64$	$P-VOL : S-VOL = 1 : 3$
Restore	P-VOL can be restored from any V-VOL	P-VOL can be restored from S-VOL

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Operations

- Steps
 - Setup Copy-on-Write Pool
 - Setup Virtual Volumes for Copy-on-Write operations
 - Manage Pairs
 - Create Pairs
 - Change Pair Status

Pools



From the Explorer menu, choose Resources and then Storage Systems.

1. 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.

Add Capacity to Pool

- Select Volumes to add to the 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", "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: All Capacity: All Parity Group: All
Labels: Refresh

LDEV Total Capacity: 805.21 GB

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

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

<Back Next> Cancel Help

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Set Option

- Specify capacity alert threshold (20% - 95% @ 5% inc)

HRpM- Create Pool Wizard HITACHI

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: 80 %

* Required field

<Back Next> Cancel Help

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Confirm and Finish

■ Confirm pool creation

HRpM- Create Pool Wizard **HITACHI**

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

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Change Pool Capacity and Options

Storage Systems

USP_V@10.74.64.24 (10152) > Open

USP_V@10.74.64.25 (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

Pools

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

HRpM Edit Pool Setting - 0

Pool Setting

Edit pool volumes and pool options.
1. Select "Pool Volume Setting" if you want to edit pool volumes.
2. Select "Pool Option Setting" if you want to edit pool options.

Pool Volume Setting **Pool Option Setting**

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

Filters for Free Volumes:
CU: [All] Capacity: [All] Parity Group: [All]
Label: [] [Refresh]

Free Volumes

LDEV	Label	Operation	Capacity	Parity Group
3:00			805.21 GB	2-3-1
3:00			10.00 GB	2-3-1
3:01			10.00 GB	2-3-1

Pool Volumes

LDEV	Label	Operation	Capacity	Parity Group
2:00			805.21 GB	1-3-1

Pool Volume Setting

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

* Threshold for warning status: 80 %
* Required field

LDEV Total Capacity: 805.21 GB

OK Cancel

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

Virtual Volumes

■ Create V-VOLs

The screenshot displays the Hitachi Replication Manager (HRpM) interface. On the left is the 'Explorer' pane with a tree view showing 'Resources' (Hosts, Storage Systems, Pair Configurations, Applications) and 'Dashboard' (HDvM, HTnM, HGfM, HRpM, Mode: Normal, C/T, SF, JNL, Pool, JNLG, License, HTSM, HSSM). The main area shows the 'Storage Systems' section with a list of systems like 'USP_V@10.74.64.24 (101)' and 'USP_V@10.74.64.25 (100)'. An 'Open' button is visible. Below this, the 'Open Storage System Summary' is shown, including 'RAW Capacity' (2.25 TB) and 'Allocated Capacity' (28.00 GB). A table lists 'Pools' and 'V-VOLs' with columns: LDEV, Label, Pool, Capacity, Parity Group, Emulation Type, SLPR, and CLPR. The 'V-VOLs' section shows 'No Object'. Overlaid on this is the 'HRpM- Create V-VOL Wizard' dialog box. The wizard has a progress bar with steps: 1. Setup V-VOL Group, 2. Select Primary LDEVs, 3. Setup V-VOLs, 4. Confirm, 5. Finish. It prompts the user to 'Specify V-VOL Group ID, and select Emulation Type, CLPR for the V-VOL group. For adding V-VOLs to an existing V-VOL Group, specify existing V-VOL Group ID.' The 'V-VOL Group ID' section has radio buttons for 'Create New Group' (selected) and 'Select Existing Group'. The 'Create New Group' option has a 'V1' field with '-1'. The 'Emulation Type' is set to 'OPEN-V' and 'CLPR' is '0'. Navigation buttons 'Next>', 'Cancel', and 'Help' are at the bottom right. At the bottom of the main window are 'Refresh Tree', 'Create V-VOLs', and 'Delete V-VOLs' buttons.

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Replication Manager supports creation of V-VOLs on storage system configurations. This function is only supported for Universal Storage Platform V/VM or later storage systems.

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.

Select Primary LDEVs

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

Candidate LDEVs			
Rows/ Pages	100	Page 1 of 1	
☐	LDEV	Label	Capacity
☐	0:00		2.00 GB
☐	1:00		4.00 GB
☐	3:01		2.00 GB
☐	3:02		2.00 GB
☐	3:03		2.00 GB
☐	4:01		4.00 GB
☐	4:02		4.00 GB
☐	4:03		4.00 GB

Add> <Delete

Count of Snapshot

Count of Snapshot for each LDEV:

Target LDEVs

Rows/ Pages	100	Page 1 of 1	
☐	LDEV	Label	Capacity
☐	0:00		2.00 GB

<Back Next> Cancel Help

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

Specify 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

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

<Back Next> Cancel Help

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In case you do not specify the starting address; the fir available address will be assigned.

The address for new volumes will be displayed on successful creation of the V-VOLs.

Confirm

■ Task Summary screen

HRpM- Create V-VOL Wizard

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.

<Back Confirm Cancel Help

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Finish

■ Review and note the LDEV addresses

HRpM- Create V-VOL Wizard

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	

Finish

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Pair Management

- Create 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

QS / 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:

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Pair Settings

- Specify additional settings for pair

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

COW_Grp

QS / COW

Task List

☐	Copy Group	Copy Type
☐	COW_Grp	QS / COW

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

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	0:00	USP_V@10.74.64.24 (10152)	2.00 GB
		CL1-A/WLAB0K/05	A:00	USP_V@10.74.64.24 (10152)	2.00 GB

OK Cancel

<Back Save Next> Cancel Help

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Module Summary

- Describe the features, functions and principles of the Hitachi Copy-on-Write Snapshot

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Module Review

1. Describe the operational differences between Copy-on-Write Snapshot and ShadowImage Heterogeneous Replication.
2. True or False: A ShadowImage Heterogeneous Replication license has to be installed before Copy-on-Write Snapshot operations are possible. Why or why not?
3. On Universal Storage Platform V, how many Copy-on-Write Snapshot pairs can be created?
4. True or False: Copy-on-Write Snapshot pairs can be created using the Storage Navigator ShadowImage feature screens.

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17. Hitachi TrueCopy® Heterogeneous Remote Replication

Module Objective

- Upon completion of this module, you should be able to:
 - Describe the features, functions and principles of Hitachi TrueCopy® Remote Replication

What Is TrueCopy Remote Replication?

- Hitachi TrueCopy® Remote Replication (Synchronous) software is a continuous, nondisruptive, host independent remote data replication solution for disaster recovery or data migration for distances within the same metropolitan area.
- TrueCopy Synchronous is available for every Hitachi enterprise storage platform.
- TrueCopy 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 software, combined with Hitachi Universal Replicator, allows for advanced three data center (3DC) configurations for optimal data protection.

3

Data migration between storage systems using TrueCopy Synchronous software

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 logical units (LUs) to balance workloads and distribute I/O activity evenly within and across storage systems to improve performance

Benefits

- **Business Continuity**
 - Local/remote data replication
 - Reduce frequency and duration of planned outages
 - Disaster recovery testing
 - Rapid recovery versus tape restore
 - Government regulations compliance
- **Productivity and Process Improvements**
 - Reduces downtime of customer-facing applications
 - Resource optimization
 - Nondisruptive LAN-free backups
 - Tested maintenance operations applied to production environments
 - Production data for offline data mining

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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 software 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 and data mining investments by replicating production information, either locally or at a remote site

Remote Replication Terminology

- Replication terms
 - Remote copy
 - The mirroring of data, typically in real time
 - Point-in-Time (PiT) copy
 - A copy of data that is taken at a specific point in time
 - Data duplication
 - Software duplicates data, as in remote copy or PiT snapshots
 - Two copies
 - Data migration
 - Moving data from one storage device to another
 - One copy

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Remote Copy: This refers to the mirroring of data, typically in real time, to provide an I/O-consistent remote copy of that data. The purpose of remote copy is to protect the data in the event of a business interruption at the customer's production location.

PiT Copy: Point-in-Time Copy refers to a copy of data that is taken at a specific point in time. Ideally, this copy should be I/O consistent. PiT copies are used in many ways, including backups and checkpoints. More recently, PiT copies have been used in architected disaster recovery solutions.

Data Duplication: Differs from data migration because with data duplication, at the end of the process, there are two copies of data. With data migration, there is only one copy.

Data Migration: This software migrates data from one storage device to another. The purpose of data migration is to reduce operational complexity and costs for storage subsystem upgrades or equipment refurbishment.

- Recovery Point Objective (RPO) and Recovery Time Objective (RTO)
 - Metrics for evaluating disaster recovery schemes
 - **RPO:** Acceptable lag between last consistent data image and current time
 - Usually zero with synchronous recovery solutions, non-zero with asynchronous solutions
 - **RTO:** Acceptable outage length after loss of primary facility
 - Cost-dependent

Connections

- TrueCopy Remote Replication over Fibre Channel connections
 - Direct connection
 - Switch connection
 - Extender connection
 - Dense/Course Wave Division Multiplexing (DWDM/CWDM)
 - Synchronous Optical NETwork (SONET)
 - Fibre Channel over IP (FCIP) and Internet Fibre Channel Protocol (iFCP)

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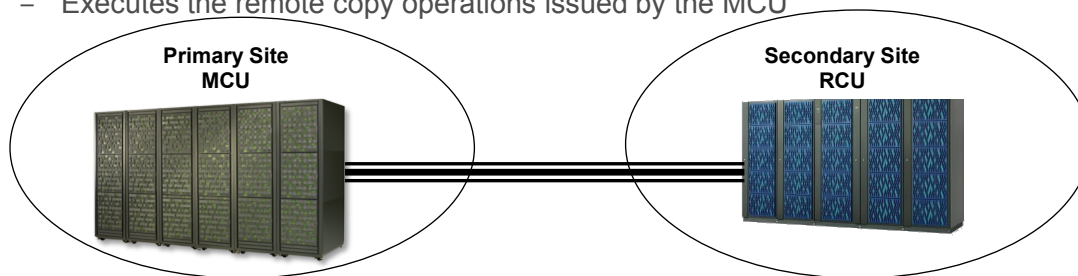
TrueCopy Remote Replication over Fibre Channel connections:

- Direct connection: Two systems are connected directly to each other
- Switch connection: Two storage systems are connected using switches
- Extender connection: Two storage systems are connected using channel extenders and switches for long distance solution support

A Storage System may be connected to a switch and the switch may be connected to SAN Extension equipment (DWDM, FCIP, for example).

Hardware

- **Master Control Unit (MCU)**
 - CU at the primary site
 - Controls the P-VOLs of the TrueCopy pairs
 - Communicates with the RCU via the dedicated remote copy connections
 - Controls the host I/O operations to the P-VOLs
 - Controls initial copy and remote copy operations between the P-VOLs and S-VOLs
 - Manages the TrueCopy pair status and configuration information
- **Remote Control Unit (RCU)**
 - CU at the remote site
 - Controls the S-VOLs of the TrueCopy pairs
 - Assists in managing the TrueCopy pair status and configuration (for example, rejects write I/Os to TrueCopy S-VOLs)
 - Executes the remote copy operations issued by the MCU



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Master (or Main) Disk Control Unit (MCU) – The MCU is the control unit in the primary storage system which controls the P-VOLs of the TrueCopy Remote Replication volume pairs. The Storage Navigator remote console PC must be LAN-attached to the MCU of each TrueCopy Remote Replication pair. The MCU communicates with the RCU via the dedicated remote copy connections. The MCU controls the host I/O operations to the TrueCopy Remote Replication P-VOLs as well as the TrueCopy Remote Replication initial copy and remote copy operations between the P-VOLs and S-VOLs. The MCU also manages the TrueCopy Remote Replication pair status and configuration information.

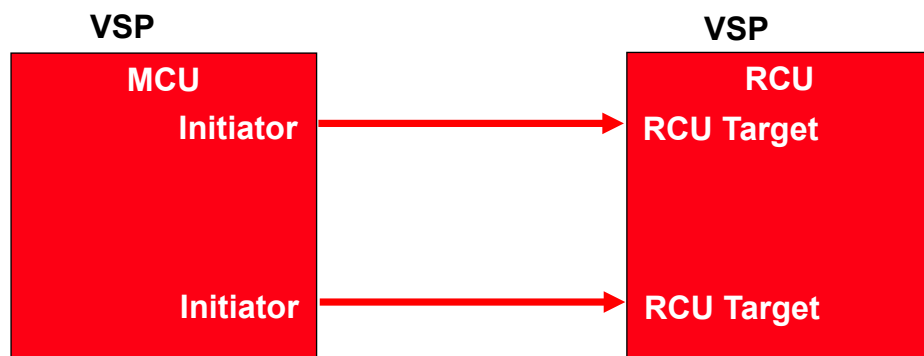
Remote Disk Control Unit (RCU) – The RCU is the CU in the remote storage system which controls the S-VOLs of the TrueCopy Remote Replication volume pairs. The RCU assists in managing the TrueCopy Remote Replication pair status and configuration (for example rejects write I/Os to TrueCopy Remote Replication S-VOLs). The RCU executes the remote copy operations issued by the MCU. The secondary Storage Navigator PC should be attached to the RCUs at the remote site on a separate LAN. The RCUs should also be attached to a host system to allow sense information to be reported in case of a problem with a secondary volume or remote storage system and to provide disaster recovery capabilities.

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: If the update copy is done synchronously, it is called as TrueCopy Remote Replication Synchronous.

- Remote connections (links)

- Unidirectional fibre connections to send data from MCU and RCU
- Minimum two **Initiator ports** (with redundancy) in MCU
- Minimum two **RCU target ports** (with redundancy) in RCU
- Add RCU to MCU Configuration



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Two Fibre Connections Enable Pathway to Send and Receive Data.

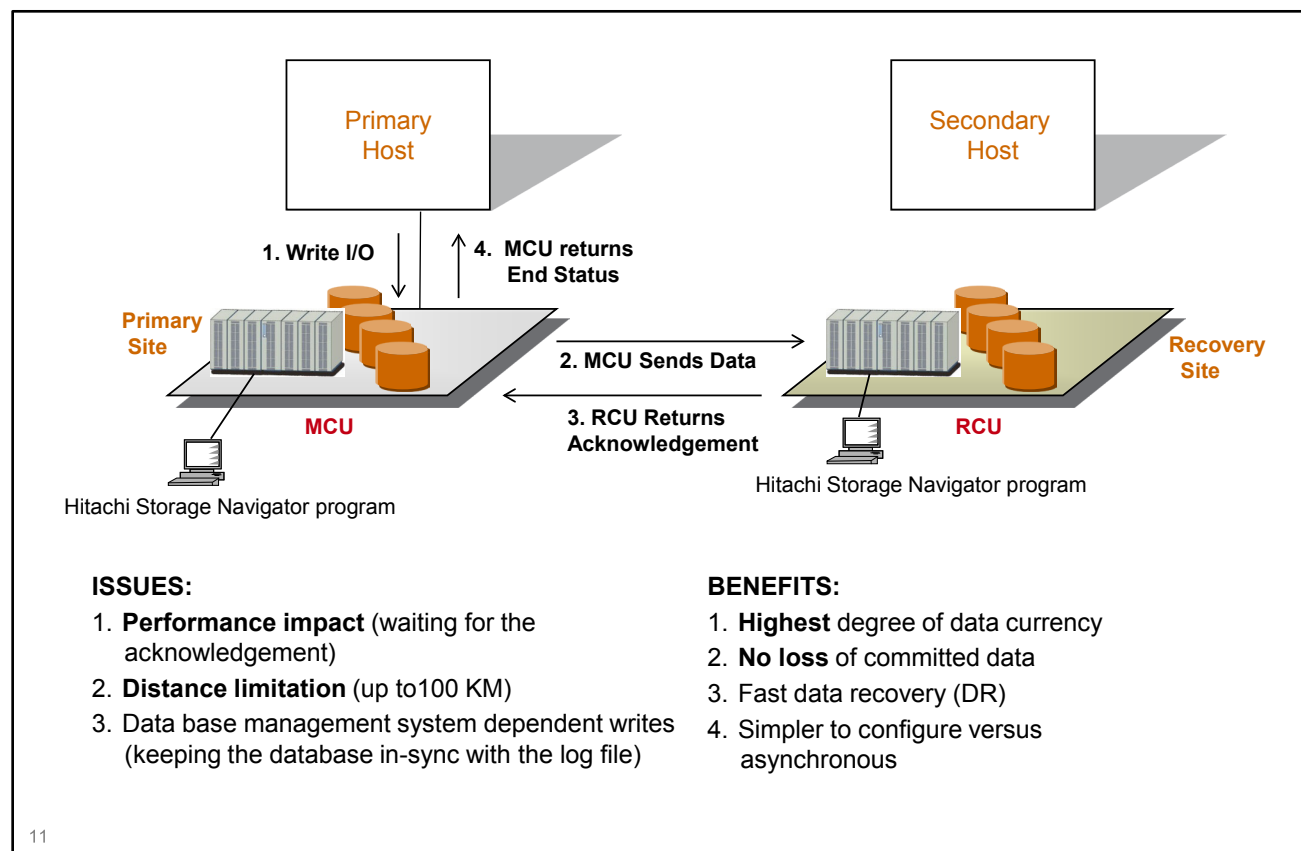
- At least two fiber connections are required.
- Primary site involved in data replication will include:
 - ♦ Initiator → RCU target
 - Two Initiator ports on MCU system for redundancy
- Secondary site involved in data replication will include:
 - ♦ RCU target → Initiator
 - Two RCU target ports on RCU system for redundancy

Software Specifications

- TrueCopy 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.
 - 32,767 pairs, if CCI is used
- If the TrueCopy pairs include the LUSE pairs, the maximum number of pairs decreases because a LUSE volume consists of multiple LDEVs.
- Supports external devices, LUSE volumes, DP volumes (V-VOLs)
- MCU/RCU relationship is at the LCU level.
 - Cannot span subsystems
 - MCU to RCU ratio = 4 to 4
 - Up to 4 MCUs can replicate to as many as 4 different RCUs

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Internal Operations — Synchronous



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 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.

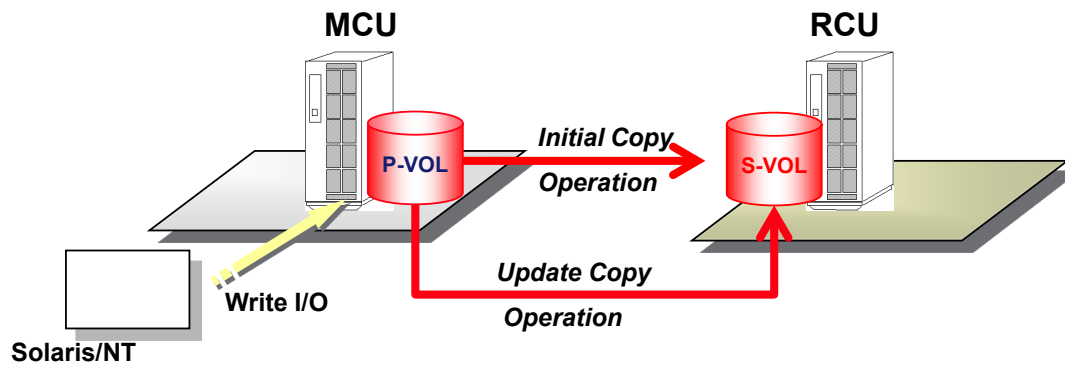
Although there is high confidence factor that the remote storage device has consistent data, there is a risk the number of transactions processed per second will decrease. The rate of decrease depends directly on the distance to the remote location and how fast the device can turn around an acknowledgement.

MCU stands for Master Control Unit.

RCU stands for Remote Disk Control Unit.

Operations

■ Types



■ Initial Copy Operations

- Synchronous 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
- Synchronous Mode: P-VOL and S-VOL kept in sync and updated in the same I/O cycle

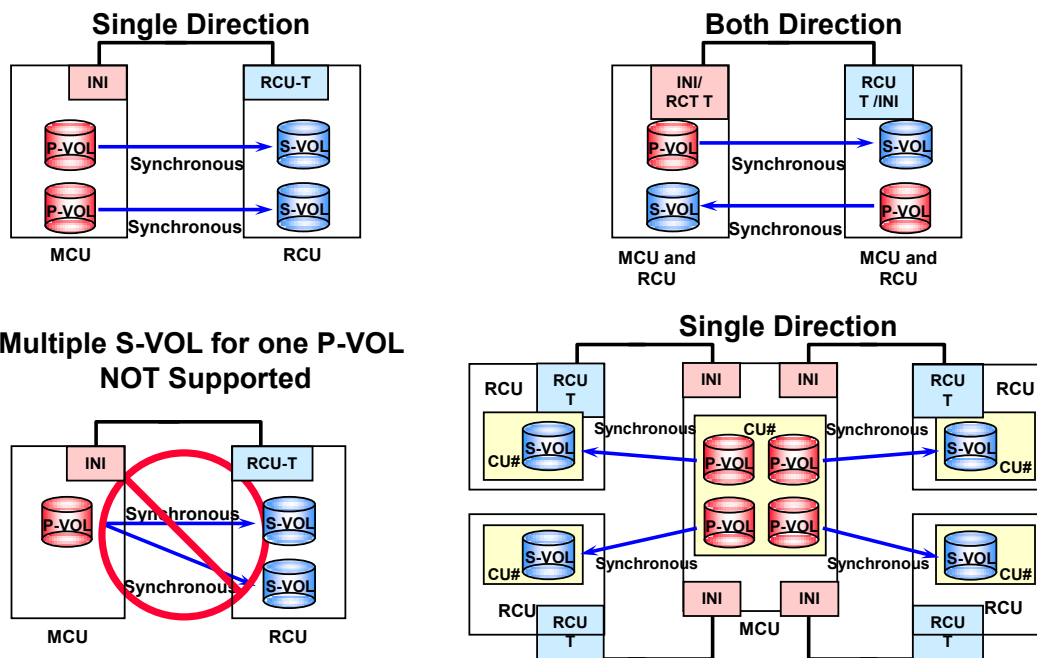
Synchronous Implementation

- Hardware configuration
 - Set ports
 - On the MCU — Initiator (Fibre)
 - On the RCU — RCU target (Fibre)
 - Choose MCU (Production Data)
 - Add RCU (Logical Link)
 - SSID, CU #, Controller ID, Initiator Port/RCU Target Port
 - Other parameters
 - Map S-VOLs to Target LDEVs at the remote site
 - Pair Create
 - Port/Host Group/LUN and other parameters

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Configurations

Example TrueCopy Remote Replication (Synchronous) software configurations

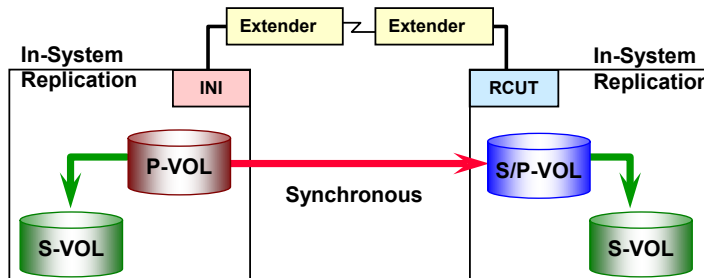


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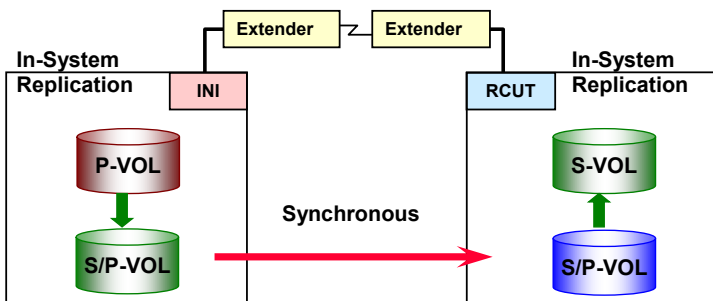
INI stands for Initiator.

RCUT stands for RCU Target.

Remote Replication and In-System Replication Software



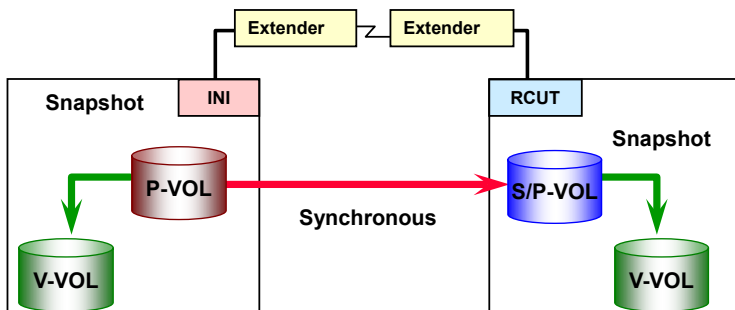
This configuration allows you to use In-System Replication to provide multiple backup copies of a single TrueCopy Remote Replication P-VOL at local and at remote sites.



This configuration allows you to use In-System Replication and TrueCopy Remote Replication to replicate data to a *far* remote site with no performance impact to the production application.

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TrueCopy Remote Replication and Copy-on-Write Snapshot



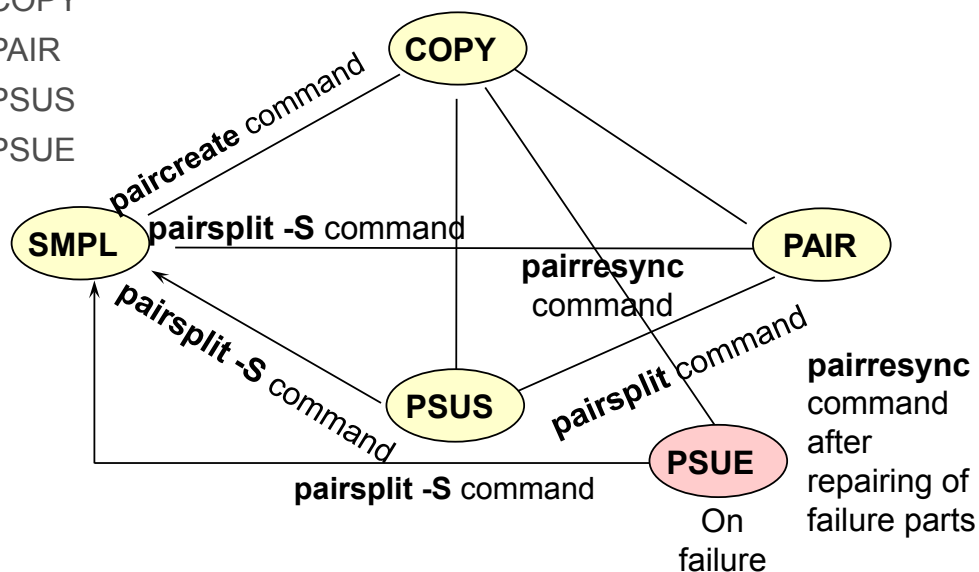
This configuration allows you to use Copy-on-Write to provide multiple backup copies of a single TrueCopy Remote Replication P-VOL at local and at remote sites.

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Volume States

- TrueCopy Remote Replication volume pairs have five states:

1. SMPL
2. COPY
3. PAIR
4. PSUS
5. PSUE



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TrueCopy Remote Replication volume pairs have typically five states. These states are used to manage the health of TrueCopy Remote Replication volume pairs.

- **SMPL (simplex)** – This volume is not currently assigned to a TrueCopy Remote Replication volume pair.
- **COPY** – The initial copy operation for this pair is in progress. This pair is not yet synchronized. During this status, the P-VOL has read and write access, and S-VOL has read only status.
- **PAIR** – This volume is synchronized. The updates to the P-VOL are duplicated to the S-VOL.

- PSUS (Pair suspended-Split) – This pair is not synchronized, because the user has split this pair (Pairsplit-r), or because the user had deleted this pair from RCU (Pairsplit-s).
 - ♦ When you split a pair from the MCU, the MCU changes the status of the P-VOL and S-VOL to PSUS. When you split a pair from the RCU, the RCU changes the status of the S-VOL to PSUS. The MCU detects this (if path status is normal) and changes P-VOL status to PSUS.
 - ♦ When you delete a pair from the RCU, the RCU changes the S-VOL status to SMPL. The MCU detects this (if the path status is normal) and changes the P-VOL status to PSUS. You must delete the pair from the MCU in order to change the P-VOL status to SMPL.
- PSUE (Pair suspend-error) – This pair is not synchronized, because the MCU or RCU has suspended this pair due to an error condition.
 - ♦ For TrueCopy Remote Replication synchronous pairs, if the MCU cannot keep the pair synchronized for any reason, the MCU changes the status of the P-VOL and S-VOL (if possible) to PSUE.
 - ♦ For TrueCopy Remote Replication asynchronous pairs, if the MCU detects a TrueCopy Remote Replication Asynchronous suspension condition, the MCU changes the P-VOL and S-VOL status (if possible) to PSUE.
 - ♦ For TrueCopy Remote Replication asynchronous pairs, if the RCU detects a TrueCopy Remote Replication Asynchronous suspension condition, the RCU changes the S-VOL status to PSUE, and the MCU detects this (if the path status is normal) and changes the P-VOL status to PSUE.

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 cannot change the S-VOL status to suspended when an update copy operation fails.

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P-VOL Fence Level (sync only): Select the fence level for the new pairs. 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 to 15) during the initial copy operation.

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Initial Copy Parameters

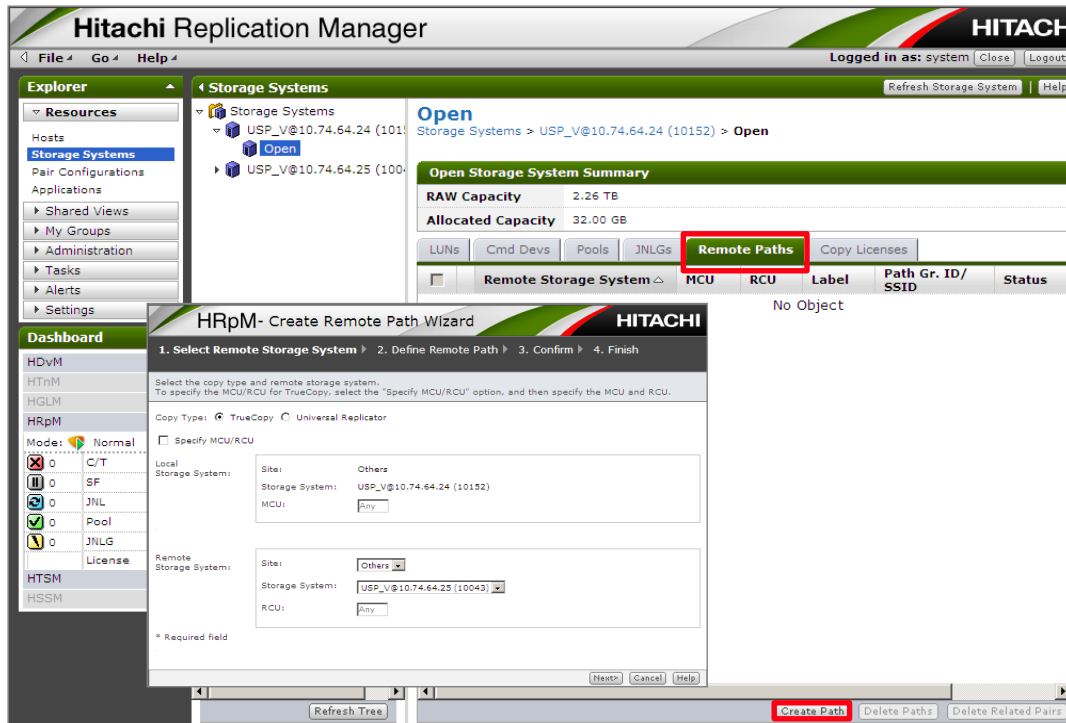
Select the initial copy options for the new pairs. These options cannot be changed after a pair has been added:

- **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 to 15) during the initial copy operation. Default = 15.

TrueCopy Operations

- TrueCopy operations
 - Set up remote paths
 - Manage pairs

■ Create Remote Paths



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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

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 (Initiator)	Remote (RCU Target)
	No Object

Local <- Remote

Label:
*Path Group ID:

Local Port: <- Remote Port:
 <-

Existing Ports

Local (Initiator)	Remote (RCU Target)
	No Object

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

■ Review and Confirm 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.

■ 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.

 "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

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■ 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

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■ Add and Delete Ports to remote path

The left screenshot shows the 'Edit Remote Path' dialog with the 'Add Ports' tab selected. The 'Remote Path Setting' section shows 'Local Port' as CL3-E and 'Remote Port' as CL4-E. The 'Existing Ports' table lists CL3-E and CL7-E as Local (Initiator) ports, and CL4-E and CL8-E as Remote (RCU Target) ports.

The right screenshot shows the 'Edit Remote Path' dialog with the 'Delete Ports' tab selected. The 'Remote Path Setting' section shows 'Local Port' as CL3-E and 'Remote Port' as CL4-E. The 'Existing Ports' table lists CL3-E and CL7-E as Local (Initiator) ports, and CL4-E and CL8-E as Remote (RCU Target) ports.

Below the dialog, a table shows the 'Remote Paths' configuration:

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

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■ Create Pair

- Setup Copy Type as TCS, Select PVOL/SVOL

The 'HRpM- Pair Configuration Wizard' shows the 'Copy Topology' section with 'TCS' selected. The 'Detail of TC_Grp' section shows a 'Pair List' with a table of 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

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■ Specify 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

Copy Group

Copy Group :

Pair List

Action	Pair Name	Port/Host

Create Group

Copy Group Setting

Enter the information of copy group for adding.

*Group Name:

Pair Configuration File:

Primary Server

Site: Server Name:

*Instance:

*UDP Port:

Secondary Server

Site: Server Name:

*Instance:

*UDP Port:

* Required field

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Note that in most of the scenarios, you will need pair management server on the primary as well as secondary site.

■ Pair Configurations view

Explorer

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

Pair Configurations

- Pair Configurations
 - WLAB0K
 - horcm0.conf
 - TC_Grp
 - WLAB0L
 - horcm1.conf
 - TC_Grp
 - WLAB0P
 - WLAB0Q

Pair Configurations

Pair Configurations

Pair Management Servers

Rows/Page: 100 Page 1 of 1

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

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■ Specify 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.

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 data status
Assign CTG: status

Pair List

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

OK Cancel

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■ Pair status

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
 - 0 SF 0
 - 0 JNL 0

Pair Configurations

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

TC_Grp

Pair Configurations > WLAB0K > horcm0.conf > TC_Grp

Copy Group Summary

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

Pairs Copy Group Relationship

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

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Module Summary

- Described the features, functions and principles of Hitachi TrueCopy Remote Replication

Module Review

1. Describe the checklist to configure TrueCopy Synchronous software.
2. What is the difference between PSUS and PSUE volume status?
3. True or False: When a PSUE pair is resynchronized, only the changed tracks are sent from P-VOL to S-VOL. Describe the process.
4. The Pair Configuration Wizard allows you to schedule a task for later execution. (True or False)

18. Hitachi Universal Replicator

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the features, functions and principles of Hitachi Universal Replicator

2

What Is Hitachi Universal Replicator?

- Hitachi Universal Replicator (HUR) software is an asynchronous, continuous, nondisruptive, host-independent remote data replication solution for disaster recovery or data migration over long distances.
- HUR is available for the following Hitachi enterprise storage platform:
 - USP/NSC, USP V, USP VM and VSP
- 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 software and HUR can be combined together to allow advanced three data center (3DC) configurations for optimal data protection.

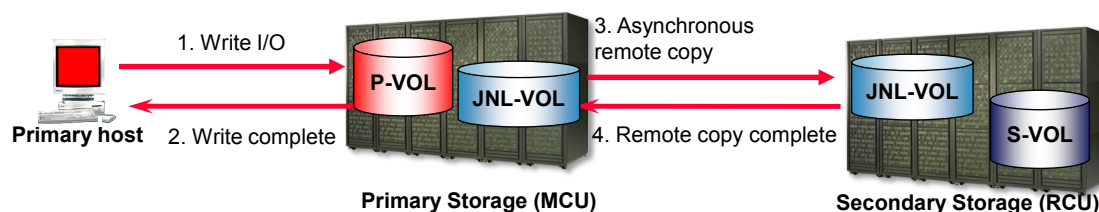
Benefits

- Ensure business continuity
- Optimize resource usage (lower the cache and resource consumption on production/primary storage systems)
- Improve bandwidth utilization and simplify bandwidth planning
- Improve operational efficiency and resiliency (mitigate the impact of link failures between sites)
- More flexibility in trading off between Recovery Point Objective and cost
- Implement advanced multi-data center support more easily
- Move data among levels of tiered storage systems more easily

4

Replication Overview

- Host I/O process completes immediately after storing write data to the cache memory of primary storage system Master Control Unit (MCU).
 - Then the data is asynchronously copied to secondary storage system Remote Disk Control Unit (RCU).
- MCU will store data to be transferred in Journal Cache to be destaged to Journal Volume in the event of link failure.
- Universal Replicator software provides consistency of copied data by maintaining write order in copy process.
 - To achieve this, it attaches write order information to the data in copy process.

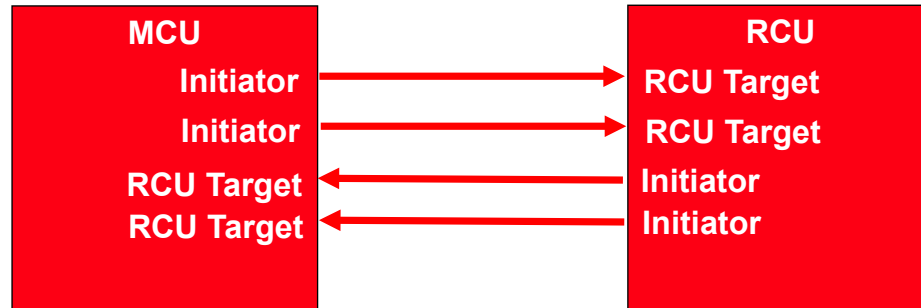


5

Hardware

Remote Connections (Links)

- Bidirectional fibre connections to send and receive data between MCU and RCU.
- Minimum four initiator ports, two (redundancy) in each system.
- Minimum 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.



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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.
- Each site involved in data replication includes:
 - ♦ Initiator → RCU target
 - Two Initiator ports on each system for redundancy
 - ♦ RCU target → Initiator
 - Two RCU target ports on each system for redundancy

Components

- **Master Control Unit (MCU)**
 - It is the storage array at the Primary site and contains P-VOLs and Master Journal Group.
- **Remote Control Unit (RCU)**
 - It 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.
 - Performs the same function as consistency groups in TrueCopy Remote Replication
 - 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.
- **Command device if CCI is used**

Specifications

- P-VOL and 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.
 - 32,767 pairs, if CCI is used
 - If the HUR pairs include the LUSE pairs, the maximum number of pairs decreases because a LUSE volume consists of multiple LDEVs.
 - Supports external devices, LUSE volumes, DP volumes (V-VOLs).

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DP=Dynamic Provisioning (will be discussed in later modules)

V-VOLs=Virtual Volumes (will be discussed in later modules)

■ **Journal Group and Journal Volume**

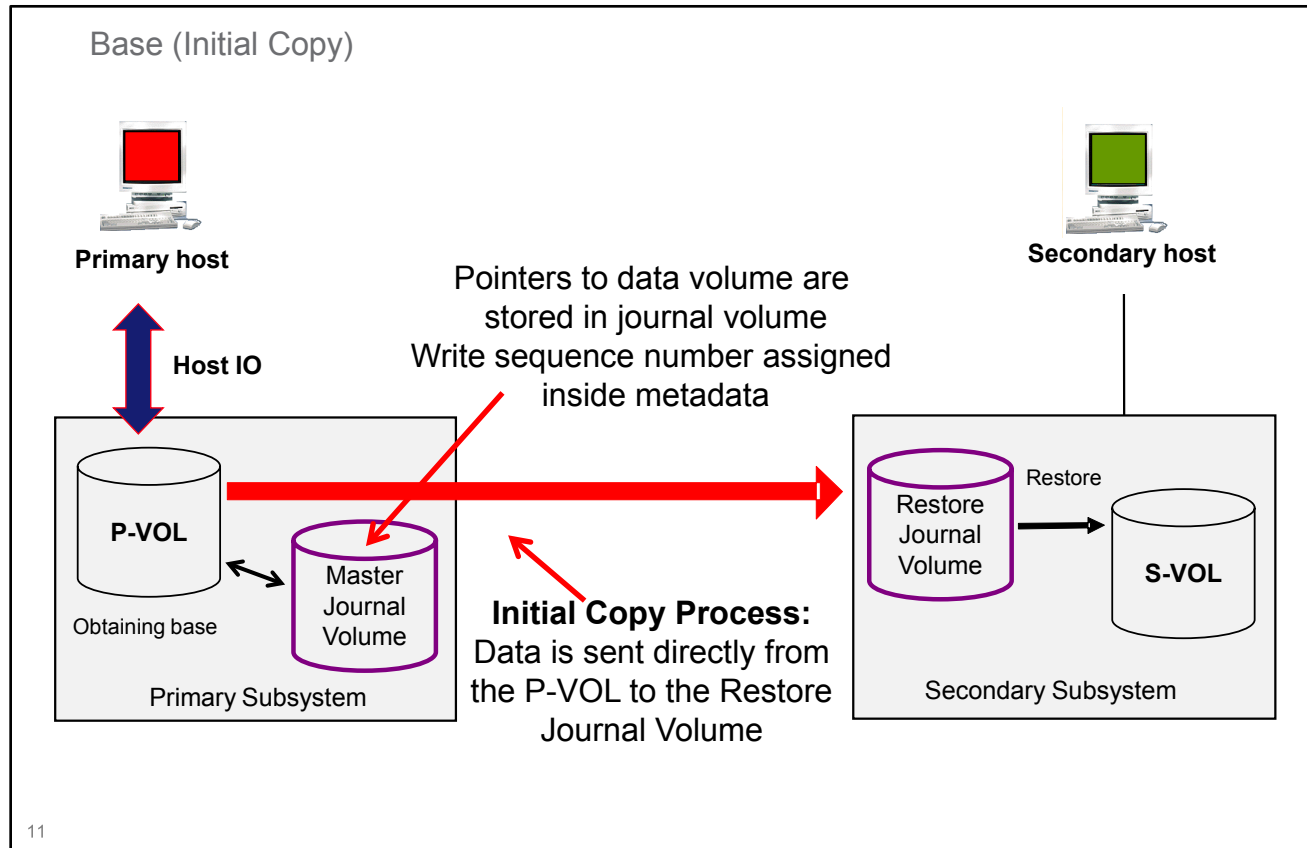
- A maximum of 256 Journal Groups per storage subsystem.
- A maximum of 8192 data volumes in a journal group.
- A maximum of 64 journal volumes in a journal group.
- Only Open-V emulation type is supported for Journal Volumes.
- Journal volumes cannot be a LUSE volume or a DP volume.
- Journal volume 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.

Overview

- Journal volumes are used to store differential data.
- Journal groups are used to maintain volume consistency.
- Pull versus Push:
 - Upon request, secondary storage array (RCU) pulls data from primary storage array (MCU).
 - With TrueCopy Remote Replication software 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.

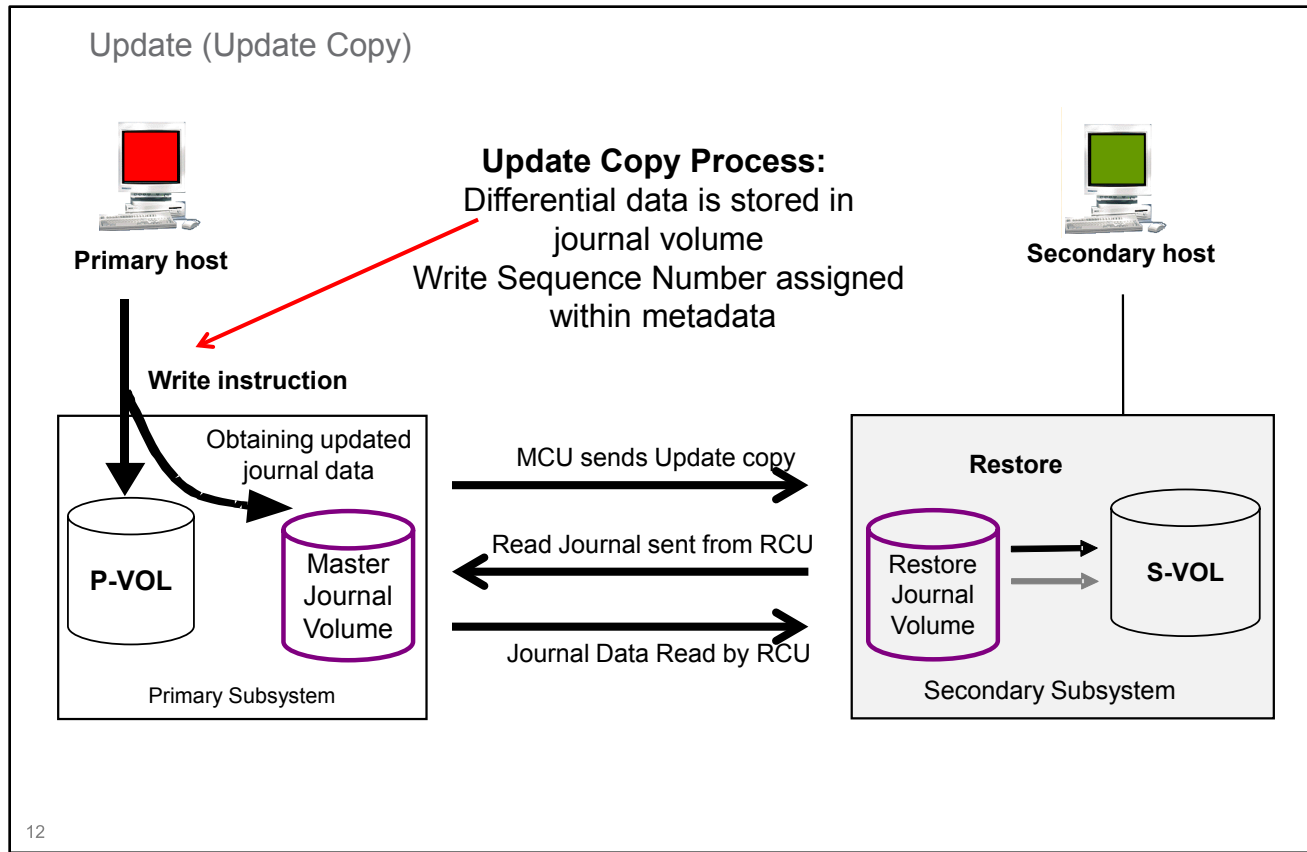
10

Journal



Base Journal – Initial Copy

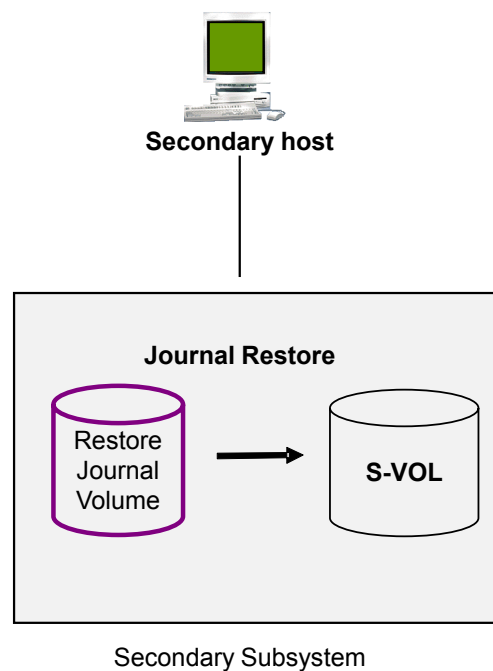
- Upon initiation or the paircreate, the primary site stores pointers to the data in the P-VOL (primary data volume) as a base journal.
 - ♦ For the Base Journal, only metadata is stored in the journal volume. The data in the P-VOL is not copied to the Master Journal Volume.
- The base journal data is 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.



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.

Restore

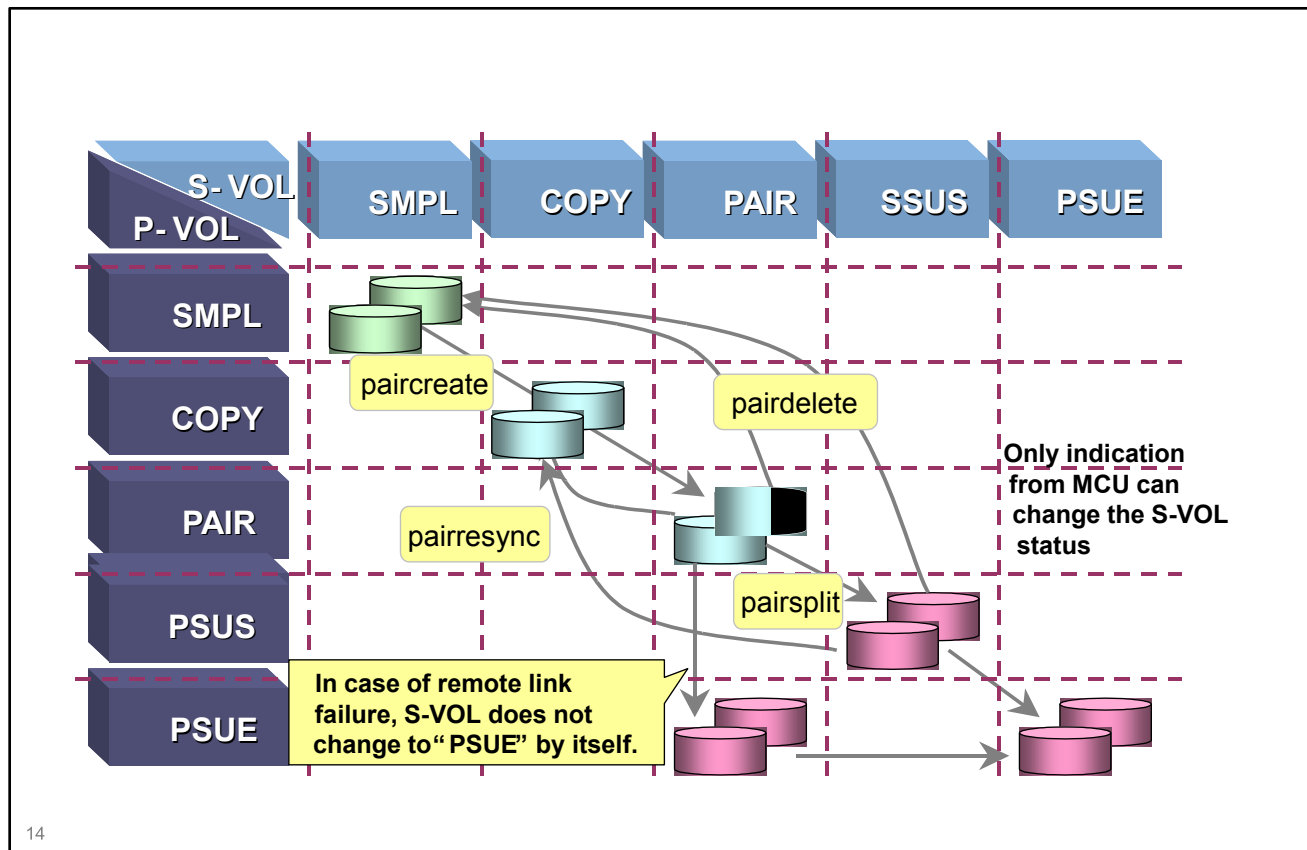
- Data is copied from the Master Journal Volume to the Restore Journal Volume.
- Data is sorted in the Restore Journal Volume by sequence number.
- As data is received in sequence, it is *restored* to the S-VOL



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Journal restore is the function to copy 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 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.

Pair Status Transition



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Pair Status Transition

- A volume which is not assigned to a Universal Replicator data volume pair has the SMPL status.
- When a Universal Replicator data volume pair is started, the MCU changes the status of the primary data volume and secondary data volume to COPY.
- When the initial copy operation is complete, the MCU changes the status of both data volumes to PAIR.
- When a pair is suspended due to an error condition, the MCU changes the primary data volume and secondary data volume status to PSUE (if the path status is normal).
- When a Universal Replicator pair is split, the MCU or RCU changes the status of the primary data volume and secondary data volume to PSUS.
- When a pair is split from the RCU, the RCU changes the secondary data volume status to PSUS, and the MCU detects the pair deletion and changes the primary data volume status to PSUS.
- When Pairsplit command is performed, the MCU changes the primary data volume status to PSUS.

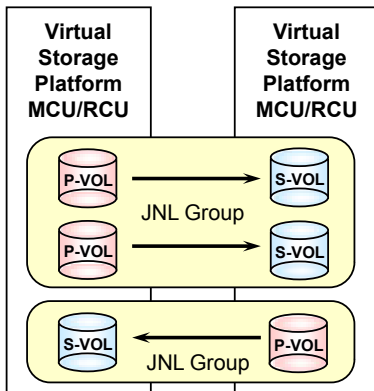
- When a pair is deleted from the MCU, the MCU changes the status of both data volumes to SMPL.
- When a pair is deleted from the RCU, the RCU changes the secondary data volume status to SMPL, and the MCU detects the pair deletion and changes the primary data volume status to PSUS.

Software Configurations

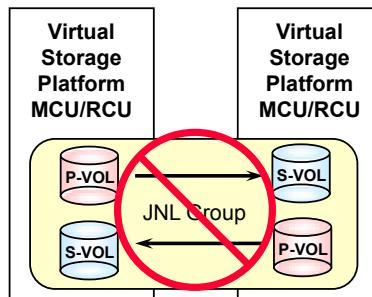
■ Allowable Configurations



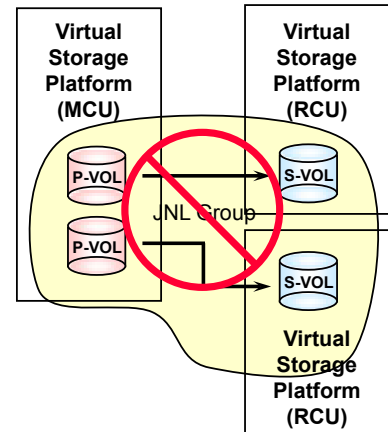
Allowed



Not allowed

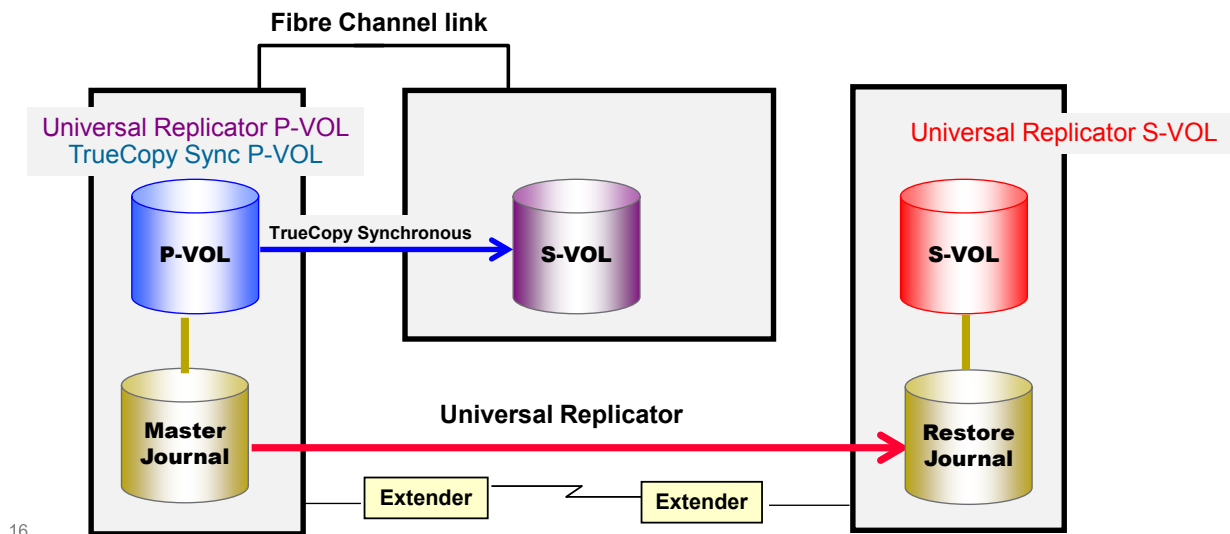


Not allowed



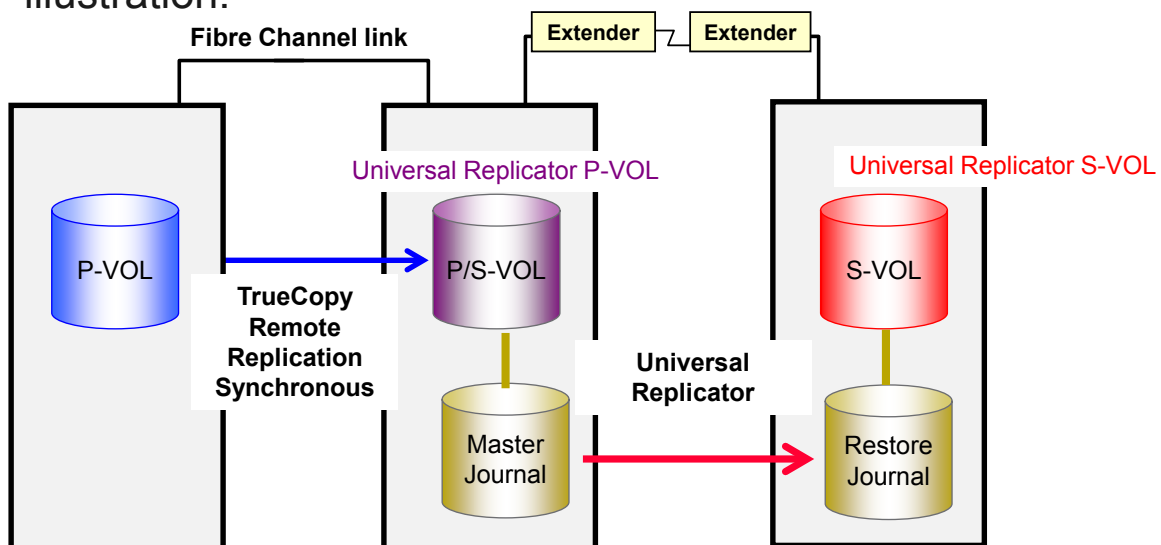
Three Data Center Configuration

- TrueCopy Remote Replication Synchronous and Hitachi Universal Replicator can be combined into a Three Data Center (3DC) configuration. This is a 3DC multi-target illustration.



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- TrueCopy Remote Replication Synchronous and Hitachi Universal Replicator can be combined into a Three Data Center (3DC) configuration. This is a 3DC Cascade illustration.



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Universal Replicator Operations

- Set up remote paths
- Set up journal groups
- Manage pairs

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- Create remote path

The screenshot displays the Hitachi HRpM- Create Remote Path Wizard. The interface includes a left-hand navigation pane with sections like Explorer, Resources, Storage Systems, and Dashboard. The main window shows the wizard steps: 1. Select Remote Storage System, 2. Define Remote Path, 3. Confirm, and 4. Finish. In step 1, the 'Copy Type' is set to 'Universal Replicator', which is highlighted with a red box. Below this, there are fields for 'Local Storage System' and 'Remote Storage System', each with sub-fields for 'Site', 'Storage System', and 'MCU/RCU'. The 'Remote Storage System' fields are currently populated with 'Dallas_SEC', 'USP_V@10.74.64.25 (10043)', and 'Any' respectively. At the bottom of the wizard, there are buttons for 'Next', 'Cancel', and 'Help'. The overall interface is in a green-themed window with a title bar that says 'Hitachi'.

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- Define Remote Paths
 - Reverse path

HRpM - Create Remote Path Wizard

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_M_R
Path Group ID: Default

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_R_M
Path Group ID: Default

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

Existing Ports

Local (RCU Target)	Remote (Initiator)
No Object	

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

- Confirm 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)	Attri
USP_V@10.74.64.24 (10152)	CL1-F	CL3-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 T

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

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■ Set up Journal Groups

The screenshot displays the Hitachi Universal Replicator web interface. On the left is a navigation pane with 'Storage Systems' selected. The main area shows the 'Open Storage System Summary' for a system with RAW Capacity of 2.26 TB and Allocated Capacity of 32.00 GB. The 'JNLGs' tab is highlighted. Below this, the 'HRpM- Create Journal Group Wizard' is shown, with step 1 'Set Journal ID' active. The wizard prompts the user to 'Select a number that is assigned to new Journal group and click "Next>"'. The 'Journal Group ID' field is set to '00'. At the bottom of the interface, the 'Create JNLG' button is highlighted.

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Journal Groups are used to keep the journal data for asynchronous data transfer and must be set up before creating Universal Replicator volume pairs. Journal groups must be set in each storage system on both the primary and secondary side.

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.

■ Select 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", "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: All Capacity: All Parity Group: All
Label: Refresh

LDEV Total Capacity: 30.00 GB

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
☐	0:09		-	2.00 GB	1-1-1	OPE

Add>
<Delete

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

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■ Set Journal Options

HRpM- Create Journal Group Wizard

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

Set journal group option and click "Next>".

Journal Group Options

Inflow Control:

☒ Yes Data Overflow Watch Time: 60 sec

☐ No

*Path Watch Time: 5 min

Forward Path Watch Time: No

Use of Cache: Use

Speed of Line: 256 Mbps

Delta resync Failure: Entire

* Required field

<Back Next> Cancel Help

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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.

■ Confirm 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.

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

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■ Pair Settings

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 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 (10043)	2.00 GB		CVS

Add

Delete

Delete

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■ Set 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

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 CL1-A/WLAB0L/02	0:00 0:00	USP_V@10.74.64.24 (10152) USP_V@10.74.64.25 (10043)	2.00 GB 2.00 GB

OK Cancel

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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.

■ View Pair Status

The screenshot displays the 'Pair Configurations' page in the Hitachi Universal Replicator web interface. The breadcrumb trail is: Pair Configurations > WLAB0K > horcm0.conf > UR_Grp. The left sidebar shows a tree view of configurations under WLAB0K, including horcm0.conf, WLAB0L, WLAB0P, and WLAB0Q. The main content area is titled 'UR_Grp' and shows the 'Copy Group Summary' and 'Pairs' sections.

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

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■ Advanced Options on Pair Operations

The screenshot shows the 'HRpM- Change Pair Status Wizard' in the Hitachi Universal Replicator web interface. The wizard has six steps: 1. Introduction, 2. Select Copy Pairs, 3. Select Pair Operation, 4. Set Schedule, 5. Confirm, and 6. Finish. The current step is 'Select Pair Operation'.

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

split

takeover [horctakeover -S]

swap [pairsplit+pairresync -swaps]

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 S
P_000-000_0005	UR	Pair (PAIR)	0:00	USP_V@10.74.64.24 (10152)	Pair (PAIR)	0:00	USP_Vg

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Module Summary

- Described the features, functions and principles of Hitachi Universal Replicator

Module Review

1. What is the role of Journal Group?
2. To perform HUR operations, bi-directional paths are required. (True or False)
3. Name different HUR 3-DC configurations.
4. Journal volumes can be added to Journal groups online. (True or False)

19. Command Control Interface

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe how Command Control Interface (CCI) is configured
 - Describe the HORCM configuration file
 - List some common CLI commands related to replication operations

2

What Is RAID Manager CCI?

- CCI is the Command Line Interface (CLI) tool to perform pair operations on all Hitachi Replication products:
 - ShadowImage In-System Replication
 - Copy-on-Write Snapshot
 - TrueCopy Remote Replication
 - Hitachi Universal Replicator
- CCI is installed on any host or a dedicated server.
- CCI is a pre-requisite to perform pair operations using Hitachi Device Manager and Replication Manager.
- What are the benefits of using RAID Manager CCI?
 - To control and script ShadowImage, Copy-on-Write Snapshot, and TrueCopy and Universal Replicator operations.
 - CCI is a CLI tool and executes commands faster than the GUI tools.

3

RAID Manager CCI configures and manages the following replication products:

- ShadowImage In-System Replication
- Copy-on-Write Snapshot
- TrueCopy Remote Replication
- Universal Replicator

Components

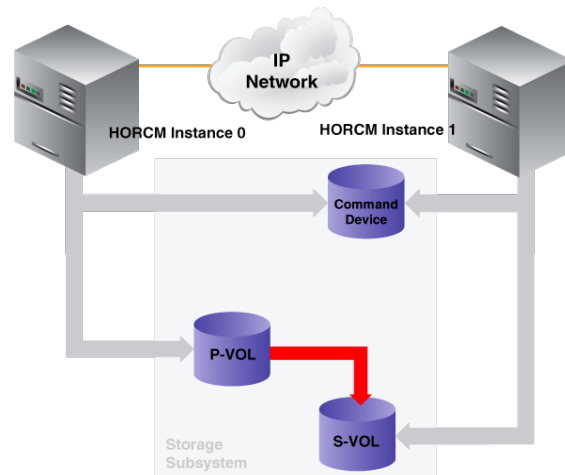
- **HORCM Command Device**
 - Normal LDEV presented to a host
 - Can be as small as 46MB
 - Used to accept commands from HORCM
 - Used to report command results to HORCM
 - Can be set from Storage Navigator or Replication Manager **only**
- **HORCM Instance**
 - Service or daemon
 - Communicates with storage subsystem and with remote server
 - One for each HORCM Configuration File
- **HORCM Configuration File**
 - Defines communication paths
 - Defines LUNs (volumes) to be controlled
- **HORCM Commands**
 - Monitor and control remote copy operations

4

These are four of the CCI components needed for the replication products to work. All this is assuming that the ShadowImage license, for example, is installed already and that the required S-VOLs are created.

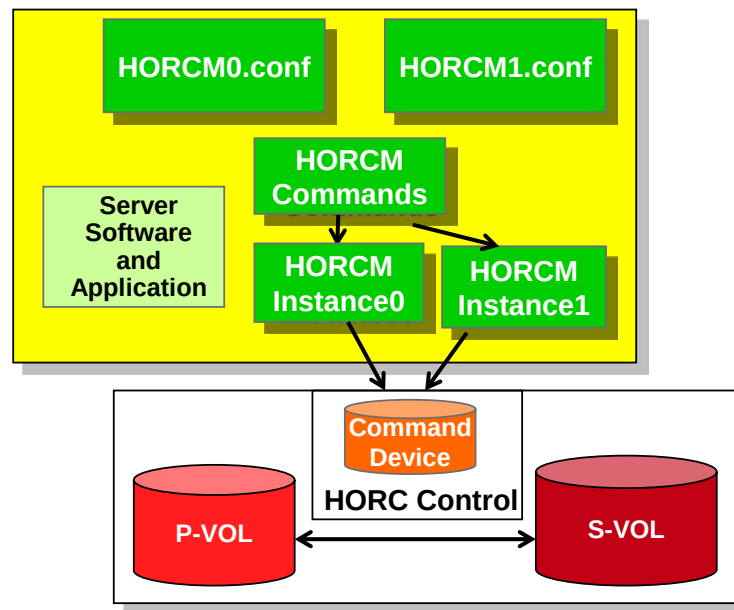
Command Control Interface

- RAID Manager CCI
 - RAID Manager environment establishes a *conversation*.
 - Instances negotiate out of band (TCP/IP).
 - In-band communication with array
 - Through SCSI Channel
 - Command Device



5

■ ShadowImage — One server — Two HORCM instances



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The relationship between the components:

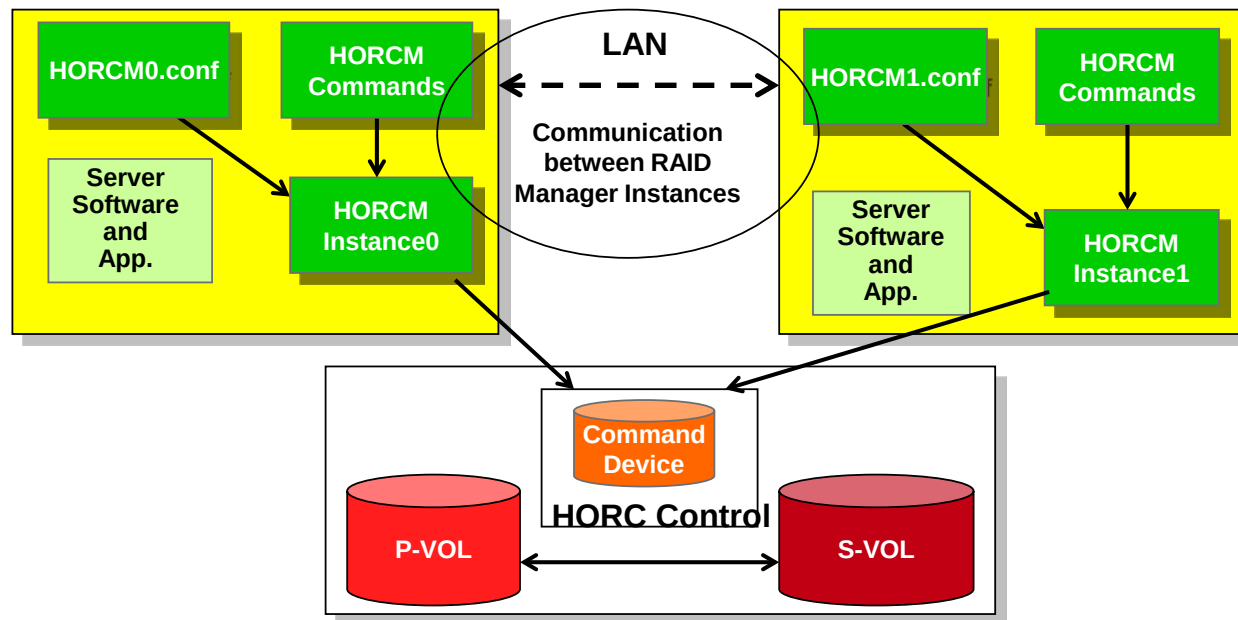
- There are always at least two instances, one controlling the P-VOL and the other one controlling the S-VOL.
- Each instance relies on a configuration file in order to communicate with the other instance, as well as to communicate with the subsystem.
- The configuration file defines the volumes that will be *paired up*.

If you have two instances, you will have two corresponding configuration files.

An environment variable has to be set in order to identify which HORCM instance will be the *command interpreter*.

When a command is issued, usually via a script, the *command interpreting* instance sends the command to the CMD Device. The subsystem will then perform the command.

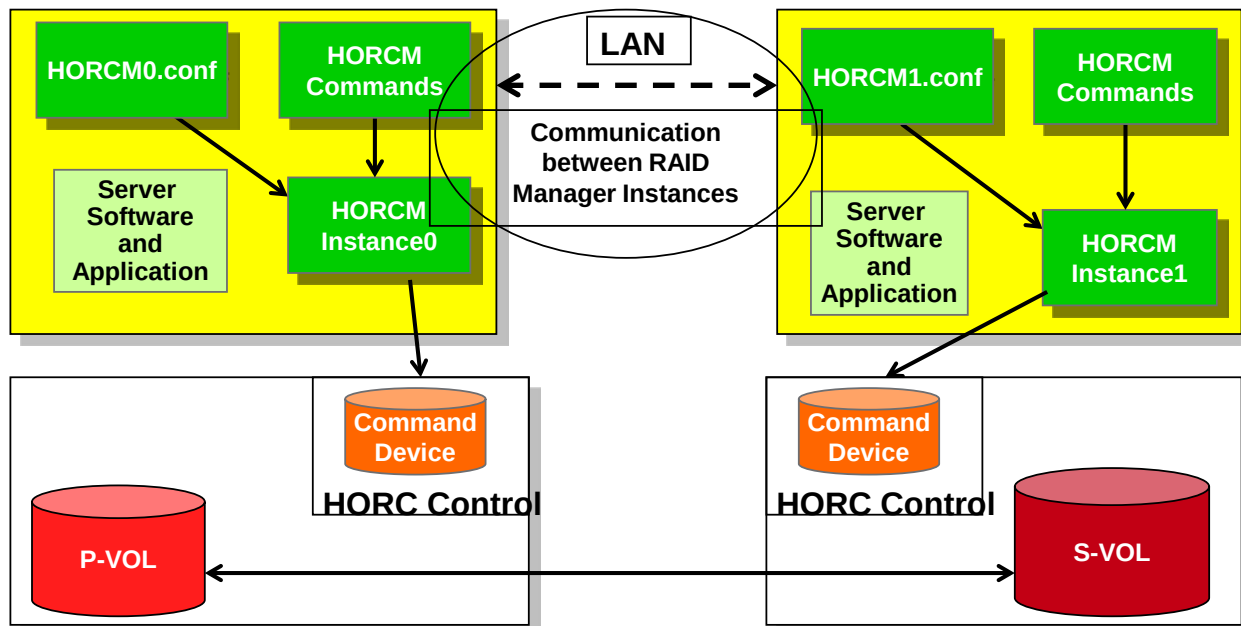
■ ShadowImage — Two servers — Two HORCM instances



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This is the same ShadowImage setup, but with two instances running on two different servers.

▪ TrueCopy — Two servers — Two HORCM instances



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This is a TrueCopy example with two instances and two servers.

HORCM Configuration Files

- ***horcmx.conf***

- A text file located in the:
 - /etc Directory (UNIX)
 - /WINNT Directory (Microsoft Windows NT/ Microsoft Windows 2000)
 - /WINDOWS Directory (Microsoft Windows 2003)
- Provides a definition of hosts, groups, volumes and, command device to the RAID Manager instance
- Can be generated by using Hitachi Device Manager and Replication Manager
- Contains four areas that define the RAID Manager environment
 - HORCM_MON
 - HORCM_CMD
 - HORCM_DEV or HORCM_LDEV (CCI version 01-17-03 or later)
 - HORCM_INST

HORCM.CONF

■ HORCM_MON

- Defines monitoring and communication parameters
 - The host IP address or DNS name, service name, poll rate and timeout value are all set in this section.

■ HORCM_CMD

- Defines the command devices
 - More than one command device can be used to provide failover functionality if the original command device becomes inoperable.
 - More than one path can be used in order to multipath the command device.

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■ HORCM_DEV

- Defines the device groups and creates device names
 - Uses the port ID, target ID, and LUN to identify P-VOLs and S-VOLs
 - Pairs are group and device name dependent

■ HORCM_INST

- Defines the network settings that correspond to the defined group names in the HORCM_LDEV section on the configuration file
 - The group name, IP address of the other host, and the function name are set in the INST section of the configuration file.

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■ Sample HORCM Configuration File

HORCM_MON Identifies the local host	HORCM_MON #IP 172.16.0.44	service horcm0	poll timeout 1000 3000
HORCM_CMD Identifies the command device	HORCM_CMD /dev/rdisk/c4t0d255s2		
HORCM_LDEV ** Identifies the volumes	HORCM_LDEV #dev_group dev_name Serial# CU:LDEV(LDEV#) MU# oradb dev1 30095 02:40 0 oradb dev2 30095 02:41 0		
HORCM_INST Identifies the remote host	HORCM_INST #dev_group oradb	IP 172.16.0.44	service horcm1

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Note: the LDEV still needs to be mapped to a port. If that is not done, you will get an error when you start the HORCM instance.

Configuration

- Create HORCM files for both P-VOLs and S-VOLs
 - Edit sample HORCM.CONF files to create two files. Typically even-numbered HORCM files manage P-VOLs and odd-numbered HORCM files manage S-VOLs.

There is a **one-to-one** relationship between entries of the two configuration files:
The **dev_group** and **dev_name** entries **must be the same** for corresponding lines.

HORCM_MON				
#ip_address	service	poll(10ms)	timeout(10ms)	
172.16.0.44	horcm3	1000	3000	

HORCM_CMD				
/dev/rds/c4t6d0s2 # (Solaris) \\.\ICMD-12345 (Windows)				
HORCM_LDEV				
#dev_group	dev_name	Serial #	CU:DEV	MU#
REG	oradb0	80006	00:20	0
REA	oradb1	80006	00:21	0

HORCM_INST		
#dev_group	ip_address	service
REG	172.16.0.44	horcm4
REA	172.16.0.44	horcm4

HORCM_MON				
#ip_address	service	poll(10ms)	timeout(10ms)	
172.16.0.44	horcm4	1000	3000	

HORCM_CMD				
/dev/rds/c4t6d0s2 #Solaris \\.\ICMD-12345 (Windows)				
HORCM_LDEV				
#dev_group	dev_name	Serial #	CU:DEV	MU#
REG	oradb0	80006	02:20	0
REA	oradb1	80006	02:21	0

HORCM_INST		
#dev_group	ip_address	service
REG	172.16.0.44	horcm3
REA	172.16.0.44	horcm3

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When naming these files, they should be called *horcm + number from 1-9 + .conf*. This is necessary for Command Control Interface to detect which configuration files to use during the process. Command Control Interface uses the decimal number to start the instances and recognize which configuration files are used. There is one environment variable that you are required to set during the process, *HORCMINST*. This variable must be set after the configuration files are set and before you start the Command Control Interface program. (This will be covered later in this training.)

Mirror Unit Number (MU#) for 3DC TrueCopy/Universal Replicator environment:

Defines the mirror unit number (0-3) of one of four possible TrueCopy/Hitachi Universal Replicator bitmap associations for an LDEV in a Cascaded or Multi-target 3DC environment. If this number is omitted, it is assumed to be zero (0). The Universal Replicator mirror description is described in the MU# column by adding *h* in order to identify identical LUs as the mirror descriptor for Universal Replicator. The MU# for TrueCopy must specify *blank* as 0.

Some Commonly Used CCI Commands

- CCI commands are the same for all Hitachi replication products. However, there could be minor syntax differences in the command across different replication products.

– Pairedisplay	Show pair status
– Pairvolchk	Checks the attributes and status of a pair volume
– Paircreate	Create a pair
– pairsplit	Split a pair, temporarily or permanent
– pairresync	Resynchronize a pair after split
– raidscan	Find LUNs and show their status

CCI Operations

■ CCI Operations Steps

1. Install CCI.
2. Present and discover command device.
3. Update services files for HORCM ports.
4. Create HORCM configuration Files.
5. Set up environmental variables.
6. Start HORCM Instances.
7. Execute CCI commands.

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ShadowImage

- Command Device needs to be set using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- CMD DEV/PVOL/SVOL mapping should have been done through:
 - Storage Navigator
 - Device Manager
- All other pair operations through CCI

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Copy-On-Write

- Command Device needs to be set using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- Copy-On-Write Pool/V-VOL should have been created using:
 - Storage Navigator (VLL)
 - Device Manager
 - Replication Manager
- CMD DEV/PVOL/VVOL mapping should have been done through:
 - Storage Navigator
 - Device Manager
- All other pair operations through CCI

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TrueCopy

- Command Device needs to be set using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- Create logical link (RCU, MCU-RCU port mapping) using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- CMD DEV/PVOL/SVOL mapping should have been done through:
 - Storage Navigator
 - Device Manager
- All other pair operations through CCI

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Universal Replicator

- Command Device needs to be set using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- Create Journal Groups/Consistency Groups
 - Storage Navigator
 - Device Manager
 - Replication Manager
- Create logical link (RCU, MCU-RCU port mapping) using:
 - Storage Navigator
 - Device Manager
 - Replication Manager
- CMD DEV/PVOL/SVOL mapping should have been done through:
 - Storage Navigator
 - Device Manager
- All other pair operations through CCI

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Hitachi Business Continuity Manager Software

Business Continuity Manager (BCM)

- Hitachi Business Continuity Manager software for IBM® z/OS® offers:
 - Centralized, enterprise-wide replication management for IBM z/OS mainframe environments.
 - The Business Continuity Manager automates Hitachi Universal Replicator for z/OS, Hitachi ShadowImage® In-System Replication for z/OS, and Hitachi TrueCopy® Remote Replication for z/OS software operations.
 - Access to critical system performance metrics and thresholds allows proactive problem avoidance and optimum performance to ensure that service-level objectives are met or exceeded.
 - The Business Continuity Manager auto-discovery capability eliminates hours of tedious input and costly human error when configuring and protecting complex, mission critical applications and data.

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Business Continuity Manager (BCM)

- Defines copy groups that contain multiple replication objects with similar attributes that can be managed with a single command
- Eliminates errors and streamlines management with auto-discovery for all replication objects
- Views the status of all enterprise-wide replication objects in real time
- Accesses key replication metrics with built-in performance monitoring
- Provides automatic notification of key events completion, such as pair state transitions, timeout thresholds and other system events
- Enables multisite remote replication management for wide-area disaster protection with minimal data loss
- Delivers nondisruptive, periodic, point-in-time remote data copies across any number of storage systems and over any distance
- Requires you to configure Ports and Command Devices

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Module Summary

- Described how Command Control Interface (CCI) is configured
- Described the HORCM configuration file
- Listed some common CLI commands related to replication operations

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Module Review

1. How do two CCI instances communicate with each other?
2. How does a CCI instance communicate with storage array?
3. What are the components of CCI?
4. What are the specifications of a command device?

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20. Hitachi Performance Monitor

Module Objectives

- Upon completion of this module, you should be able to:
 - Demonstrate understanding of basic storage performance concepts

Disclaimer

- The numbers and thresholds are general purpose rules of thumb, not product specifications
- Actual thresholds may vary from application to application and from customer to customer
- Nevertheless, field recommended reports in this course are still very useful for reporting on these key metrics

3

Cache Check

- Cache Write Pending (CWP) $\leq 30\%$
 - Up to 30% is considered normal
 - Frequent or sustained trips to 40% deserves attention
 - Frequent or sustained trips to 50% deserves prompt remediation
 - At 70%, inflow control is enabled
 - This is typically disruptive
 - High write pending is a sign of back end congestion

4

RAID Group Check

- RG Busy% <50%
 - Array Group utilization should be less than 50%
 - Reserve capacity is required for sparing
- Read Hit% >25%

5

Note: Random/Sequential Read/Write are also important metrics for Array Group usage patterns, but are not be covered in this course.

Performance

RAID Levels and Performance

	RAID-10	RAID-5	RAID-6
Description	Data striping and mirroring	Data striping with distributed parity	Data striping with two distributed parities
Disks	4/8	4/8	8
Benefit	▪ Highest performance with data redundancy ▪ Higher write IOPS per Parity Group than with RAID-5	Best balance – Cost – Reliability – Performance	▪ Balance of cost ▪ Extreme emphasis on reliability
Disadvantages	Higher cost per number of physical disks	Performance penalty for high percentage of Random Writes	Performance penalty for all writes

- Good small block Random Reads and Writes
- Lower Sequential MB/sec

- Good small block Random Reads, but lower Writes
- Good Sequential MB/sec

- Good small block Random Reads, but low Writes
- Good Sequential MB/sec

6

Performance Monitor



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Performance Monitor feature provides usage statistics about physical hard disk drives, volumes, processors, or other resources in your storage system. Performance Monitor also provides statistics about workloads on disk drives and traffic between hosts and the storage system. The Monitor Performance window provides a line graph indicating changes in the usage rates, workloads, or traffic. You can view information in the window and analyze trends in disk I/Os and detect peak I/O time. If system performance is poor, you can use information in the window to detect bottlenecks in the system. When using Performance Monitor, you must specify the volumes to be monitored in (control units). Therefore, depending on your storage system configuration, the list may show performance statistics for some volumes but not other volumes. This can occur if the range of used CUs does not match the range of CUs monitored by Performance Monitor.

Overview

- Performance Monitor supports:
 - VSP resource data supports graphing resource utilization, including:
 - Controller
 - MPs, DRRs
 - Cache
 - Access Paths
 - CHA, DKA, MPs, Cache
 - Ports
 - WWNs
 - LDEVs
 - LUNs
 - External Storage

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User identifies CUs and HBAs to *monitor*. VSP collects resource data.

- Performance Monitor collects various statistics per resource:
 - Utilization Rates
 - Host I/O Rates and Response
 - Disk I/O Rates and Response

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Utilization Rates

- Usage Rate (%)
 - ♦ This applies to MP, DRR, Cache, CHA/DKA/MP/Cache ESW
- Write Pending Rate (%)
 - ♦ This applies to Cache

Host I/O Rates and Response

These apply to Ports and WWNs)

- Throughput (IOPs)
- Data Trans (MB/s)
- Response Time (ms)

Disk I/O Rates and Response

All or some apply to LDEVs, LUNs, PGs, External

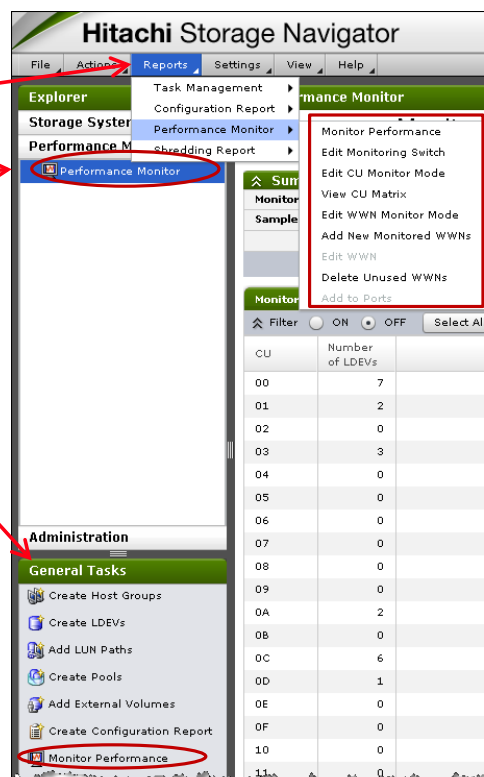
- Total Throughput (IOPs)
- Read Throughput (IOPs)
- Write Throughput (IOPs)
- Cache Hit (%)
- Data Trans (MB/s)

- Response Time (ms)
- Back trans (count/sec)
- Drive Usage Rate (%)
- Drive Access Rate (%)
- ShadowImage (%)

Accessing

- Accessed three ways:

- Reports
- Accordion Menu
- General Tasks



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1. The Accordion option (**Performance Monitor**) allows configuring CUs, WWNs, Short-Range monitoring and so on, in addition to displaying the **Monitor Performance** screen with a button. The **Monitor Performance** screen is the main tool for tracking resource utilization.
2. The **Reports** option, like the **Accordion** option, allows for configuration and monitoring, but with menu selections instead of buttons.
3. The **General Tasks** option does *not* provide for configuration; it goes straight to **Monitor Performance**. If you look carefully in **General Tasks**, it says **Monitor Performance** rather than **Performance Monitor**.

Performance Monitor on VSP

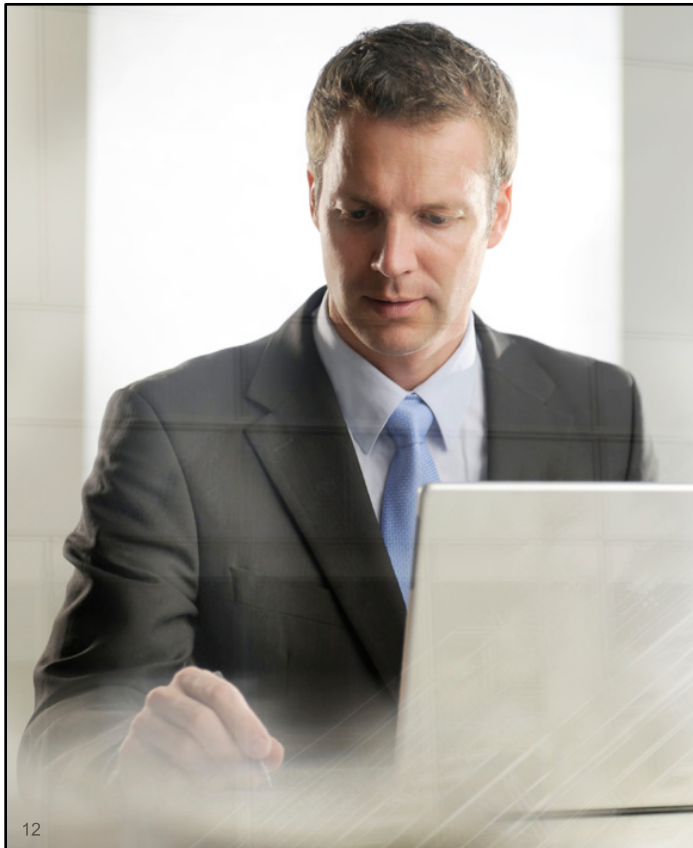
- Parity Group Usage
- Logical Volume Usage
- External Volume Group Usage
- External Volume Usage
- Channel Processor Usage
- Disk Processor Usage
- Write Pending Rate + Cache Memory Usage
- Access Path Usage
- Hard Disk Drive Workload Usage
- Port Traffic
- LU Path Traffic
- Traffic between HBAs and storage system ports

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Hard Disk Drive Workload Usage

- I/O Rate
- Transfer Rate
- Read Hit Ratio
- Write Hit Ratio

Instructor Demonstration



- View Storage Performance Data
 - LDEV
 - Parity Groups
 - MPB



Module Summary

- Demonstrated understanding of basic storage performance concepts

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Module Review

1. List four of the monitoring areas of Performance Monitor
2. Short range statistical data can be obtained up to _____ days in the SVP?
3. Long range statistical data collection interval is set to _____ minutes and is collected for _____ days?

21. Hitachi Tuning Manager

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe Hitachi Tuning Manager (HTnM) features and functions
 - Log in to Hitachi Tuning Manager using the web client
 - Use the Tuning Manager graphical user interface (GUI):
 - Main Console
 - Performance Reporter
 - Administration

Overview

- Top Five Needs of Customers
 - Determine quickly *if* performance trouble is within the storage subsystem or not
 - Determine the *cause* of performance trouble within the storage subsystem and logically organize storage resources
 - Forecast *when* a storage subsystem will saturate in terms of performance
 - Determine *quickly* if close attention to storage performance is necessary
 - Extract performance data *easily* (for use and analysis by user, user tools, or ISV)

3

Hitachi Tuning Manager

- **Storage Performance Management**
 - Hitachi Tuning Manager (HTnM) is the Hitachi advanced storage performance reporting application that maps, monitors and analyzes network resource performance from the application through to the storage logical devices and also reports on the capacity use by the resources.
- **Provides**
 - Detailed storage performance reporting
 - Custom storage reports and real time performance alerts
 - Supports VMware virtual server environments
 - Provides performance data to Hitachi Tiered Storage Manager to create performance metrics based tiers

4

HTnM Provides:

Detailed storage performance reporting

- In-depth performance statistics of Hitachi storage systems and all network resources on the application's data path
 - ♦ Reporting of Hitachi Dynamic Tiering and Hitachi Dynamic Provisioning pools for usage analysis and optimization
- Custom storage reports and real time performance alerts
 - ♦ Customizable storage performance reports and alerts for different audiences and reporting needs
- Supports VMware virtual server environments
 - ♦ Provides performance correlation for VMware virtual servers, virtual machines, data stores and Hitachi storage logical devices

- Provides performance data to Hitachi Tiered Storage Manager to create performance metrics based tiers
 - ♦ By leveraging performance data gathered from network resources throughout the application's data path, Hitachi Tuning Manager (HTnM) provides the following business and customer benefits:
 - **Improves management of storage growth** — Supports faster application deployment through improved planning and forecasting of storage resource requirements
 - **Enables operational excellence** — Maintains storage performance by reviewing historical trends and identify the sources of bottlenecks
 - **Mitigates risks and increase efficiency** — Prevents outages with advanced forecasting and alerts
 - **Reduces operational and capacity costs** — Enables more storage resources to be managed per person

Product Positioning

Name	Description
Hitachi Tuning Manager	Advanced reporting, analysis, and troubleshooting application for Hitachi Data Systems storage systems and services Application-to-spindle visibility and correlation in near-time and historical Full storage path awareness and deep knowledge of Hitachi Data Systems storage systems
Performance Monitor	Performance Monitor is a monitoring product that provides detailed point-in-time reporting within Hitachi Data Systems storage.

5

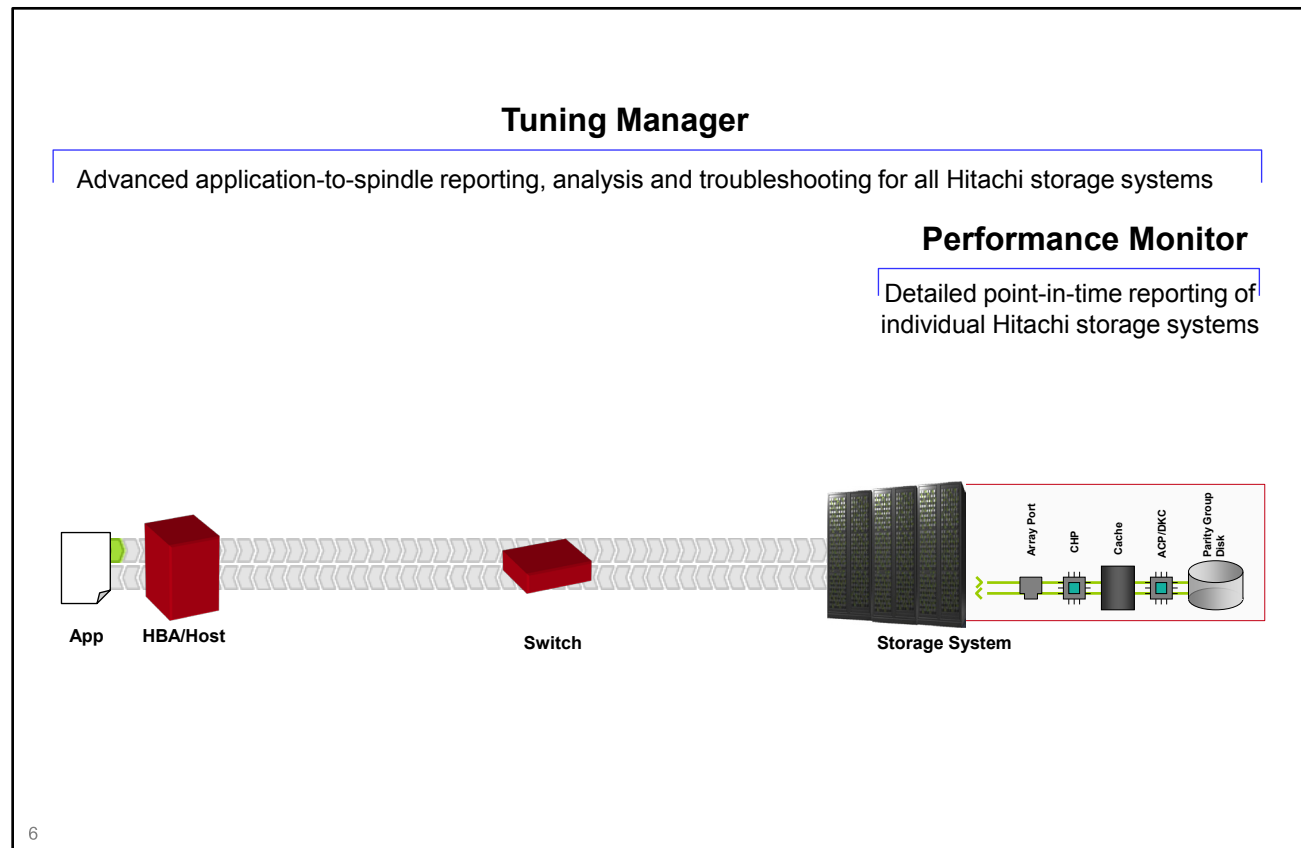
Tuning Manager is our premier performance and capacity analysis tool:

- Its strength is its ability to view performance from the application, through the network, and within the storage system.
- It is our most robust performance analysis tool.

Performance Monitor is a monitoring product that provides detailed point-in-time reporting within Hitachi Data Systems storage.

- It provides basic reporting and monitoring within a storage system, but only within the storage system. It has no knowledge of applications.
- It cannot correlate information outside the storage system.

Hitachi Performance Monitoring and Reporting Products



This is a visualization of how these products work, and what they cover.

Performance Monitor provides in-depth, point-in-time information about performance within a Hitachi storage system. It does not provide any information about the network, the host, or the application. Nor does it provide any correlation to that information.

Tuning Manager provides end-to-end visibility for storage performance. Although it is limited to Hitachi storage systems, it provides the most thorough view of the system, tracking an I/O from an application to the disk. This ability to correlate this information and link from step-to-step in the I/O path provides the most efficient solution to identifying performance bottlenecks.

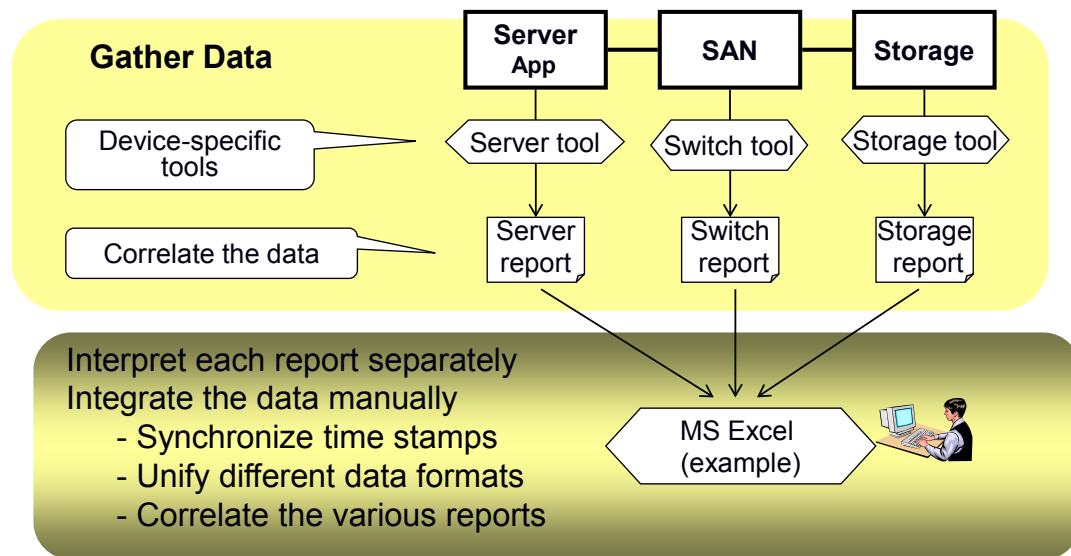
I/O response time, both host side and array side:

- It provides the ability to monitor the round trip response time for troubleshooting and proactive service level error condition alerting results in improved application performance. On the Hitachi Enterprise Storage products, this ability includes and extends to round trip response to/from external storage.

Notice there is no correlation between Storage Service Manager and Performance Monitor, so the two combined do not provide the same end-to-end performance information that Tuning Manager does.

Performance and Capacity Management Challenge of a Networked Storage Environment

- Gather data from servers, databases, switches, and storage systems with device-specific tools, then consolidate, analyze, and correlate data that is presented in different formats



7

Troubleshooting requires a view of the path from the application to the storage system. Without a tool that consolidates and normalizes all of the data, the system administrator has difficulty distinguishing between possible sources. When a performance problem occurs or the "DB application response time exceeds acceptable levels," they must quickly determine if the problem is in the application server.

Server / App Analysis — Is the problem caused by trouble on the server? (DB, file system, HBA)

Fabric Analysis — Is there a SAN switch problem? (Port, ISL, for example)

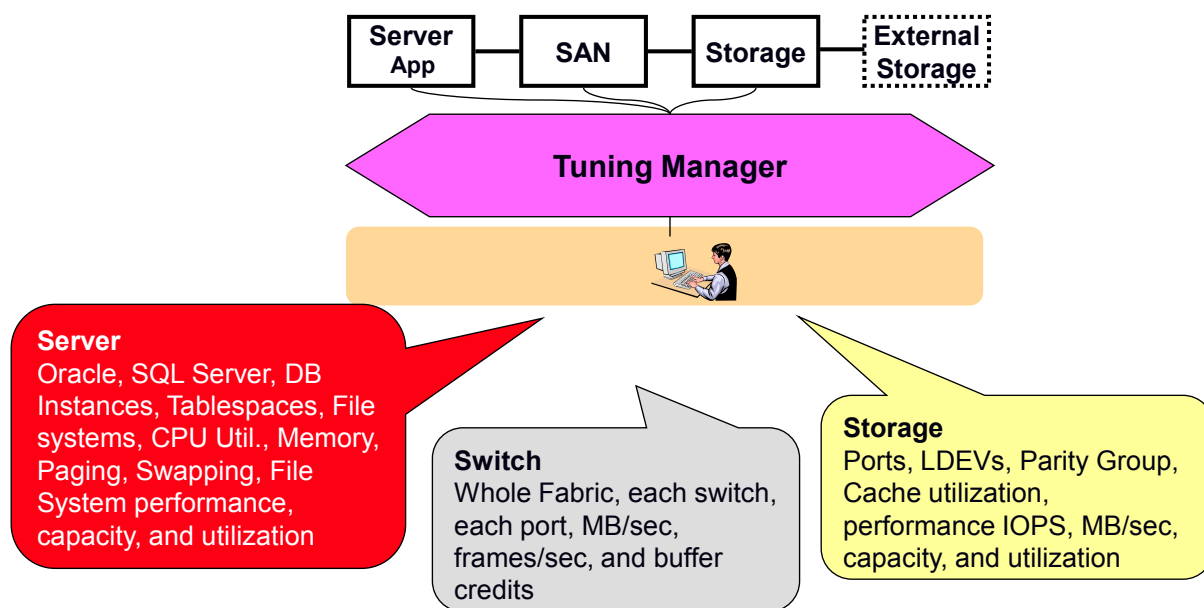
Storage Analysis — Is the storage system a bottleneck?

All of the data from the components of the Storage network must be gathered by different device-specific tools and interpreted, correlated and integrated manually, including the timestamps, in order to find the root cause of a problem.

Some customers achieve this by exporting lots of data to spreadsheets and then manually sorting and manipulating the data.

Scope of Tuning Manager

- Consolidates and analyzes performance and capacity data while hiding platform-dependent differences



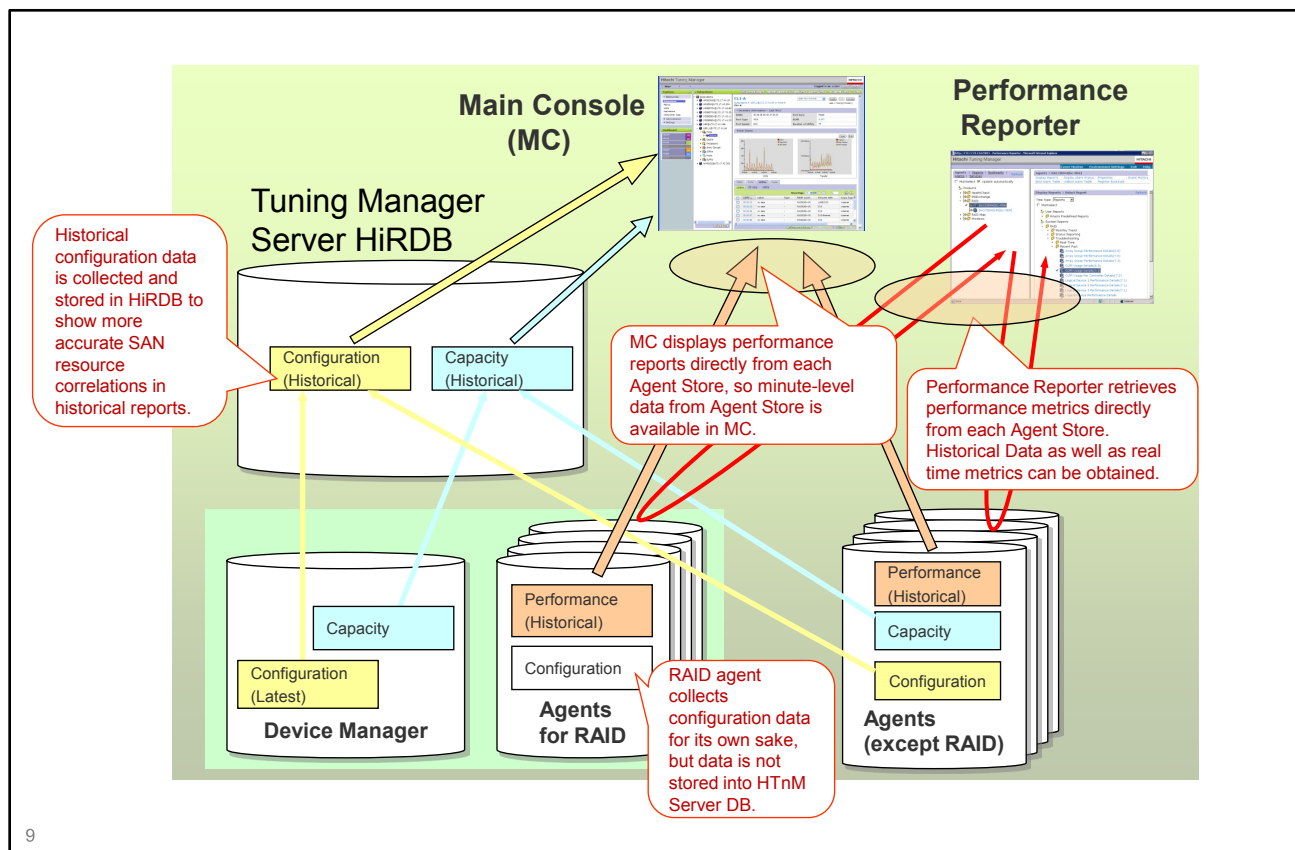
8

Tuning Manager is a collection of programs that provide information allowing for central management of a whole network including SAN. Specifically, the program components collect performance and capacity data from various parts of the system, such as host OS, file system, switch, and storage systems. Therefore, Tuning Manager is highly valuable for simplifying network management and reducing maintenance costs.

Tuning Manager consolidates the data from the entire storage path. It hides much of the platform dependent differences in performance and capacity data from the operating system, database, file system, switch port, storage port, LDEV, Parity Group for historical, current, and forecast data. It also does the following:

- Eliminates the user tasks of gathering and integrating metrics
- Provides a single performance view for end to end resources
- Uses automated metrics gathering and various reporting

High-level Architecture



Storage Configuration information is extracted from Device Manager. This is copied to the Tuning Manager server repository Hitachi Relational Database (HiRDB) and stored as historical information.

The storage view of capacity information is also collected from Device Manager and stored in HiRDB.

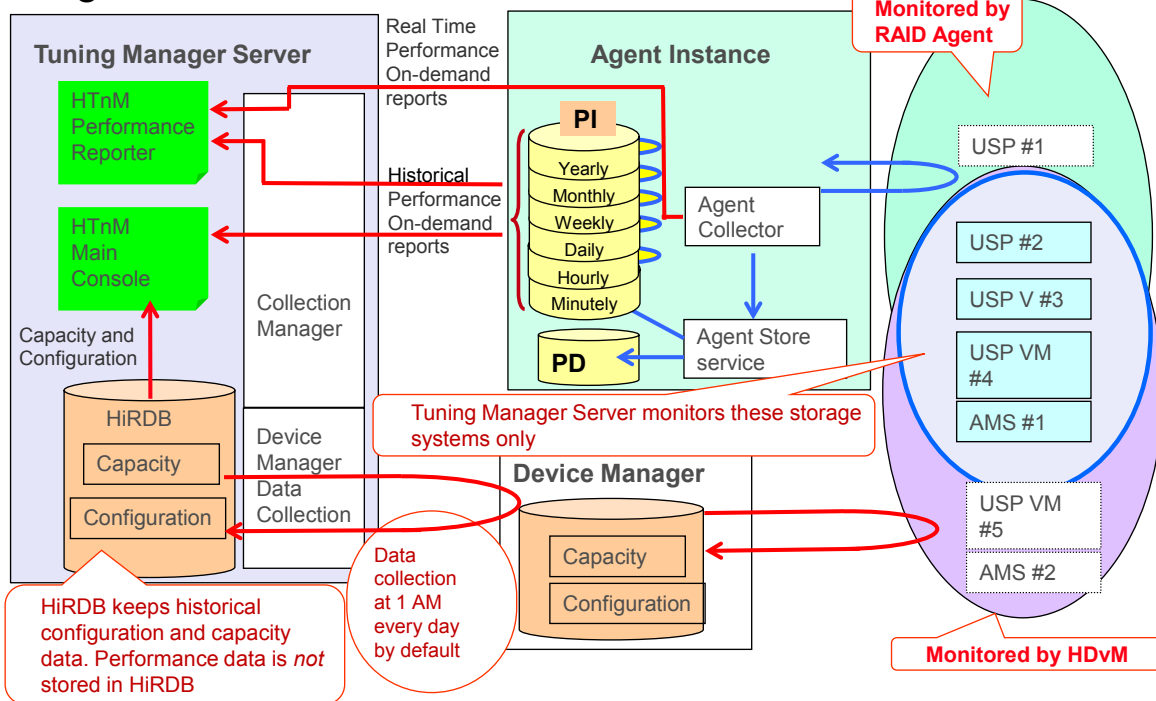
Server and switch configuration information is collected from their respective agents and historical data is stored in the server database. Server-based capacity data is collected by the host agents.

Performance Information, collected by the Agents, is available through *Main Console* reports, directly from the Agent Store databases without going through HiRDB.

The Tuning Manager Performance Reporter retrieves performance metric data from the agents on demand executing predefined system reports or user-defined reports. Depending on the type of report, data either is taken from the Agent Store DB (historical reports) or directly from the resources through the Agent Collector (real time reports).

Data Collection Basics

■ Agent for RAID



10

The Tuning Manager server gets the Array Configuration data from Hitachi Device Manager. The HiRDB of Tuning Manager only keeps configuration and capacity data.

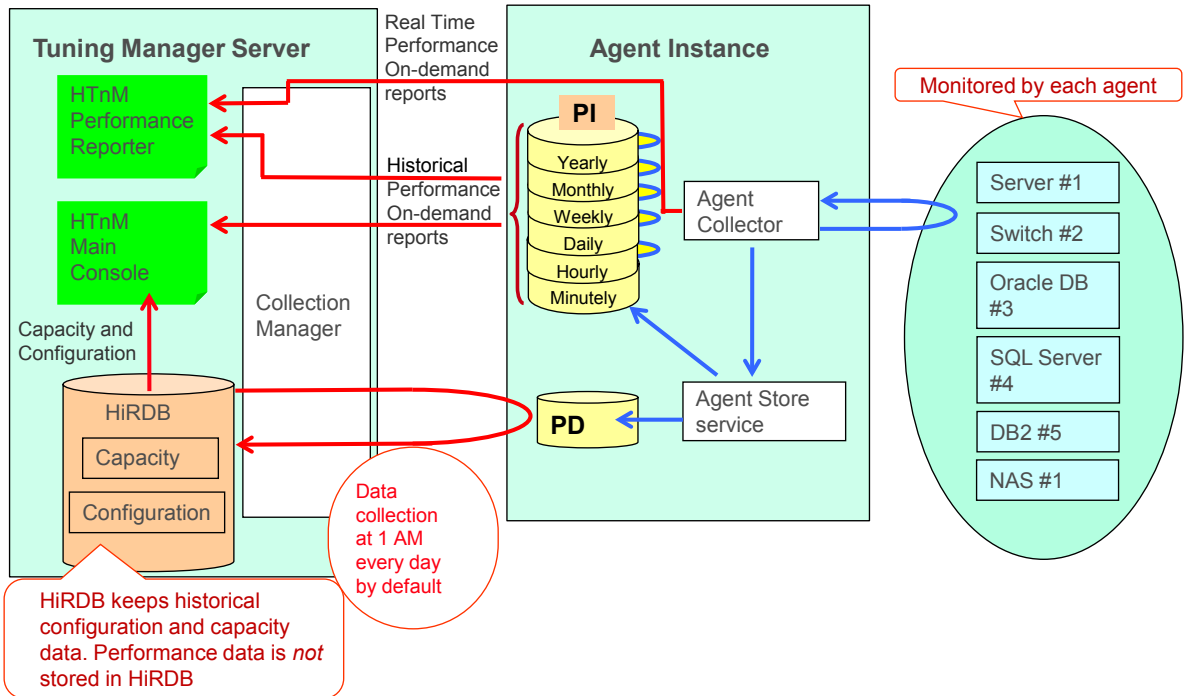
The Tuning Manager Main Console (MC) retrieves performance data on demand from the agents based on the stored configuration information in HiRDB.

Performance metric data does *not* get stored in the HiRDB.

In the diagram above and following slides:

- **HDvM** stands for Hitachi Device Manager
- **USP** stands for Universal Storage Platform
- **AMS** stands for Adaptable Modular Storage
- **PI** stands for Product Interval – Collected performance data over specified intervals, such as the number of processes per minute. This record type is suitable for monitoring system performance over extended time periods.
- **PD** stands for Product Detail – Collected performance data indicating system status at a specified time, such as detailed information about currently active processes. This record type is suitable for analysing system status when a problem occurs.

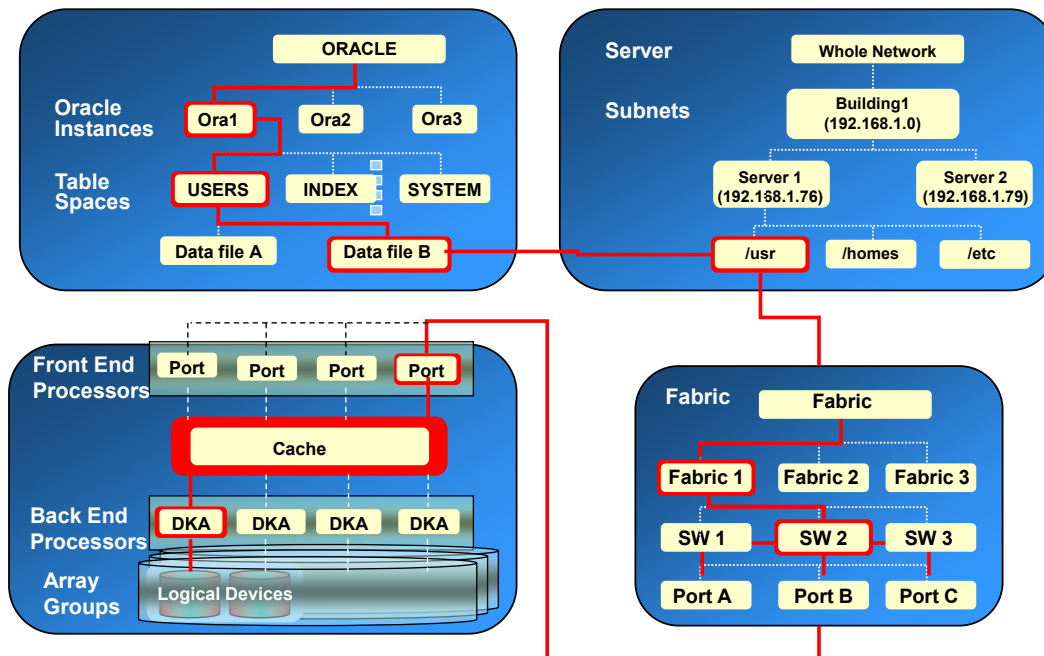
■ Agents, except for RAID



11

Overview of Components

- Server, Application, and Fabric Down to Storage View



12

Programs in Tuning Manager collect performance and capacity data from the OS installed on the servers and databases (such as Oracle) connected to a SAN. Metrics from fabrics are collected as well as the ones from storage systems. Displaying this data facilitates proper management and configuration of each resource in a SAN environment.

Components

- **Device Manager**
 - Device Manager collects and manages the configuration information of storage devices.
 - Device Manager is a prerequisite for the Tuning Manager server.
- **Tuning Manager server**
 - The Tuning Manager server collects information from Device Manager and Agents, organizes the information into formats that suit the levels of monitored resources, and then displays the operating status of the system on the screen.
- **Agents**
 - Agents manage, as monitored resources, Hitachi disk array subsystems, SAN switches, file systems on hosts, operating systems, and Oracle and other applications according to their features.
 - Agents also collect performance information (such as the I/O count per second) and capacity information (such as logical disk capacity) from these resources as performance data.

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Device Manager

Device Manager provides consistent, easy to use, and easy to configure interfaces for managing storage products. In addition to a command line interface (CLI) for scripting, Device Manager provides a Web-based GUI for managing storage products. Device Manager also provides maintenance commands for backing up and recovering the database that stores configuration information.

Tuning Manager – Distributed Metrics-Repository Architecture

Tuning Manager programs have the capability to manage the large-scale infrastructures of storage environments: This capability is provided by a distributed metrics-repository architecture consisting of the Tuning Manager server database for trend analysis and forecasting, and distributed Store databases deployed to each Agent for troubleshooting and deeper analysis. The Tuning Manager server database stores configuration and capacity information about resources, while the Store databases of Agents store mainly performance information.

A Tuning Manager server has two viewers:

- The Main Console, which allows you to view data retrieved from Device Manager and Agents from a perspective based on the storage environment
- Performance Reporter, which allows you to view real-time data and detailed data retrieved from each Store database

Agents

Agents run in the background and collect and record performance data. A separate Agent must exist for each monitored resource. For example, Agent for RAID is required to monitor storage subsystems, and Agent for Oracle is required to monitor Oracle. The Agents can continually gather hundreds of performance metrics and store them in the Store databases for instant recall.

- **Main Console**
 - The Main Console stores the configuration and capacity information that the Agents and Device Manager collect from the monitored resources in the database.
 - The Main Console displays links to Performance Reporter.
- **Performance Reporter**
 - Performance Reporter displays performance data collected directly from the Store database of each Agent.

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Main Console

The Main Console stores the configuration and capacity information that the Agents and Device Manager collect from the monitored resources in the database. According to the specified time frame and interval, the Main Console displays reports in which the data accumulated in the database is mapped to the performance data managed by the Agents. The Tuning Manager server database is managed by the relational database system HiRDB.

The Main Console displays links to Performance Reporter.

Performance Reporter

Performance Reporter displays performance data collected directly from the Store database of each Agent and also provides a simple menu-driven method to develop your own custom reports. In this way, Performance Reporter enables you to display Agent-instance level reports and customized reports with a simple mouse click. Performance Reporter also enables you to display reports in which the current status of monitored targets is shown in real time. Performance Reporter does not connect to HiRDB.

- **Main Console** allows you to perform the following operations:
 - Obtain an overview of the system, perform comparative data analysis, and understand trends
 - Display a summary of resource configuration and capacity data that is stored in the Tuning Manager server database and Store databases of Agents
 - Display a summary of the resources related to the resources displayed in a report
 - Simplify analysis tasks, such as comparing data at different points in time, by allowing each user to define and retain time ranges for displaying data
 - Generate detailed capacity and performance reports that show:
 - Historical data
 - Future forecasts
 - Relationship between resources

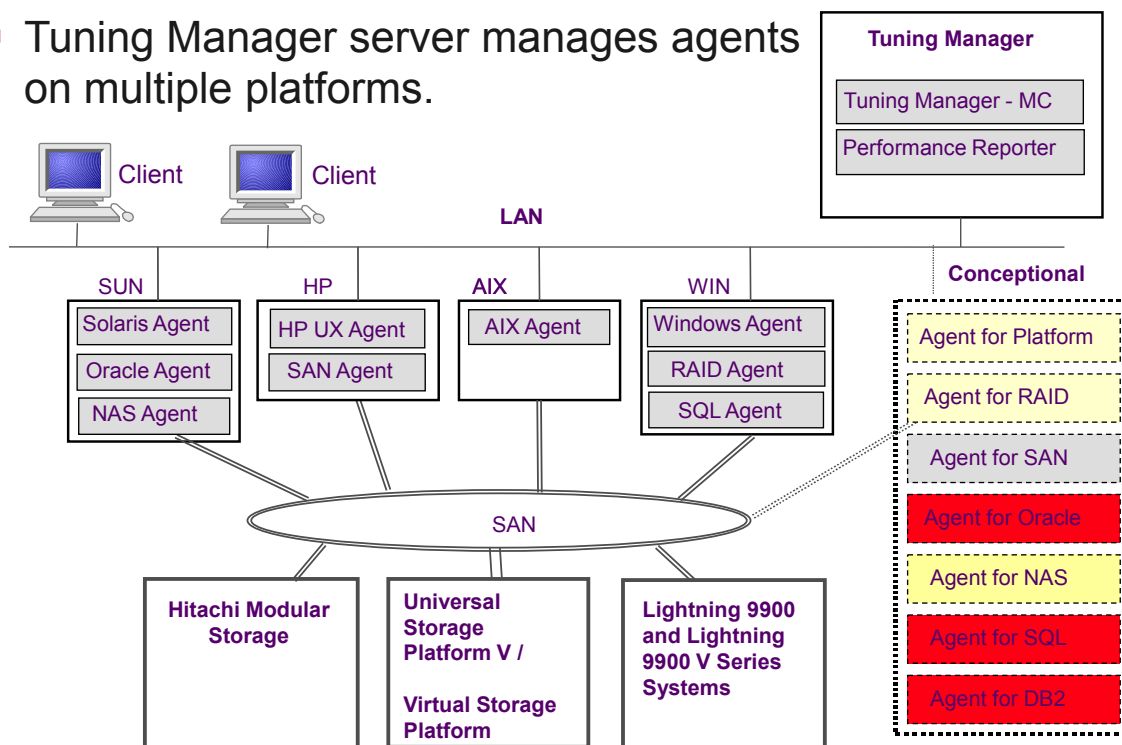
15

- **Performance Reporter** allows you to complete the following operations:
 - Analyze trends and performance in detail
 - Display near real-time reports (by the minute)
 - Specify the display formats of graphs and change time ranges
 - For historical reports, display data stored in Store databases of Agents
 - Display all data collected by Agents
 - Display data from single instance records or multi-instance records
 - Output CSV or HTML files
 - Display different historical reports in one report

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Agents

- Tuning Manager server manages agents on multiple platforms.



17

Tuning Manager consists of agents and a server. The agents collect performance and capacity data for each monitored resource, and the server manages the agents. This diagram shows an example system configuration.

Agents can run multiple instances to collect metrics from multiple application instances, fabrics, and storage systems.

The instances of the Agent for RAID collect metrics from enterprise storage systems using in-band Fibre Channel connection communicating to the CMD device in the array. Modular storage is accessed via LAN using the DAMP utility to collect metric data.

Tuning Manager server can concurrently serve as business server on SUN Solaris and Microsoft Windows in small environments. The maximum number of resources manageable by one Tuning Manager server is 16,000 and in this case Tuning Manager requires installation on a dedicated server. To be able to manage as many resources as possible with good performance, carefully consider the Tuning Manager system requirements.

Hitachi modular storage consists of the Hitachi Adaptable Module Storage family.

Key

Agent	Installed On
Platform	Server being monitored
RAID	Enterprise Storage – Server with FC connectivity to monitored storage system (uses command device) Modular Storage – Server with IP connectivity to monitored storage system
SAN	Server with IP connectivity to monitored proxy/seed switch and also the SMI Agent for the switch
Database	Server on which Database is installed

Note: All Agent instances communicate with Tuning Manager server over IP.

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- Considerations for installing Tuning Manager agents:
 - Are all types of agents always required?
 - Are agents required for every application on the production server?
 - Is a server box required for each agent?

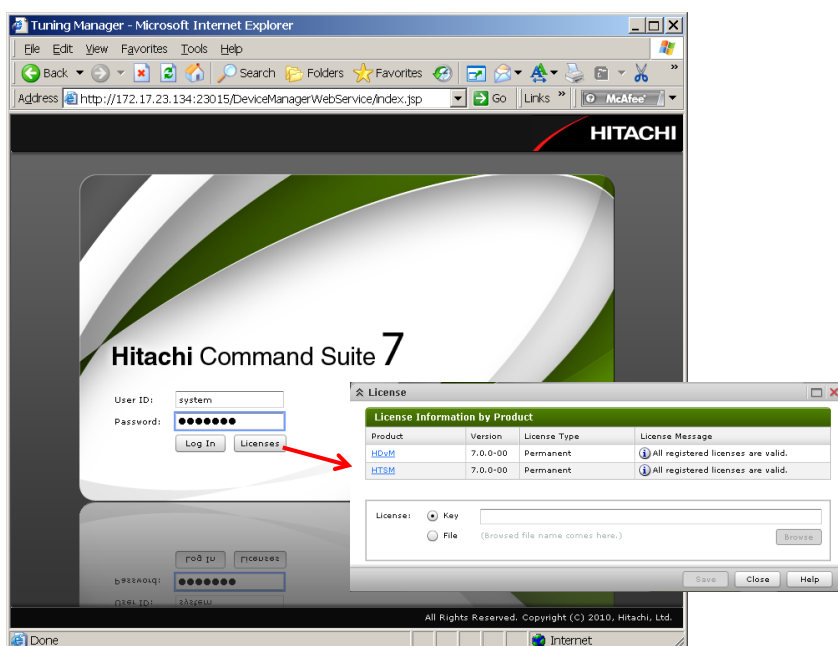
The answer is No...

- The installation and setup requirements for agents depend on what and how a customer wants to manage the business.

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Login Window

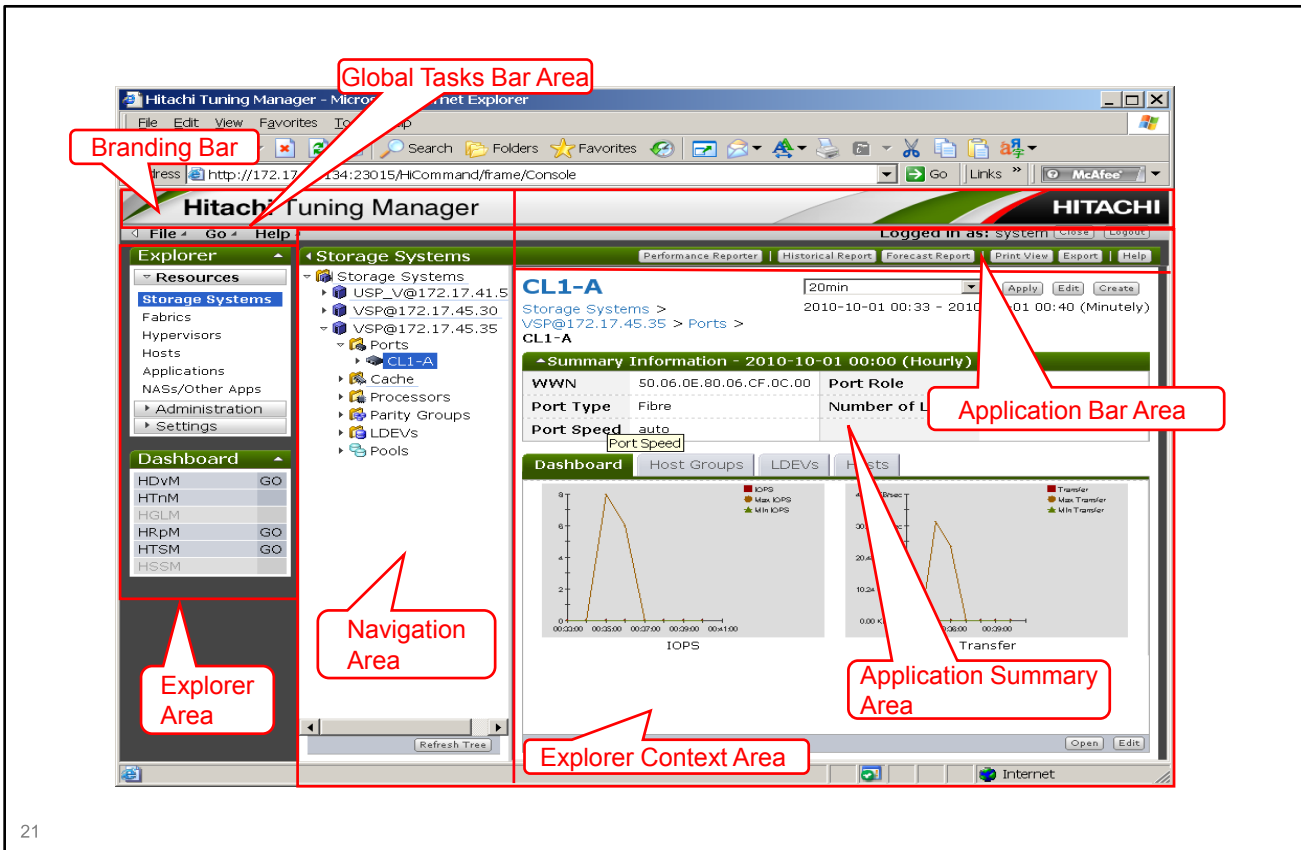
- Web Client URL to open the User Login window
`http://<Tuning Manager Server IP address>:23015/TuningManager/`

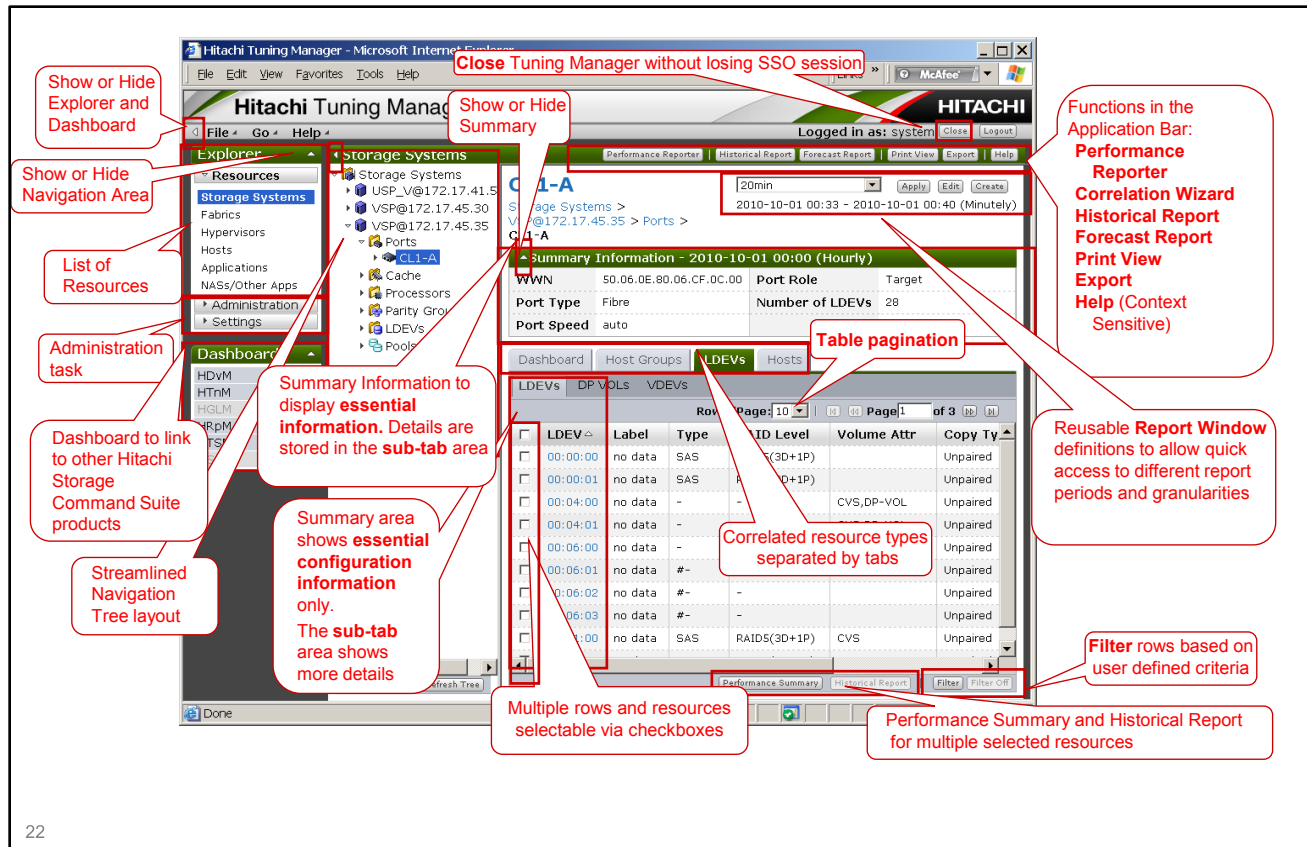


20

The default User ID and Password for global system administrator mode is **system** and **manager**. If the license key information does not match the current managed configuration, a warning message is displayed.

Main Screen Layout of GUI



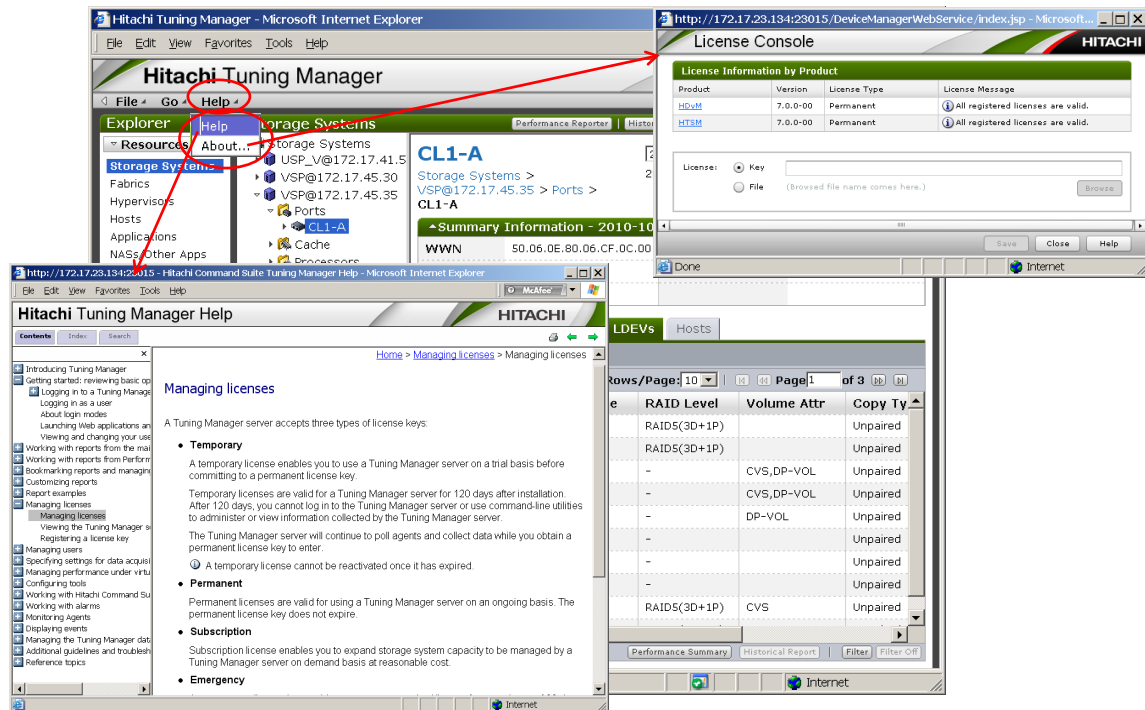


22

Global Tasks Bar Area

File	Close	Close Tuning Manager window only
	Logout	Terminate all Suite products windows
Go	Performance Reporter...	Launch Performance Reporter main window
Help	Help...	Show Help window
	About...	Show product version, license
Close	Close current application only	
Logout	Exit Tuning Manager session completely	

Online Help and License Display



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License Exception is a warning information indicating that the installed License Key does not match the real monitored hardware environment. Tuning Manager operation will continue. Please contact your HDS account team to resolve the license issue.

The online **Help** file allows for quick and easy lookup of information.

Global Task Bar — Call Performance Reporter

The screenshot displays the Hitachi Tuning Manager web interface. In the left sidebar, the 'Reports' tab is selected, and the 'CLPR Usage Details(7.2)' report is highlighted. A 'Display report settings' dialog box is open, allowing configuration of the report's time range and record count. The main panel shows the selected report's details, including a table of usage data over time.

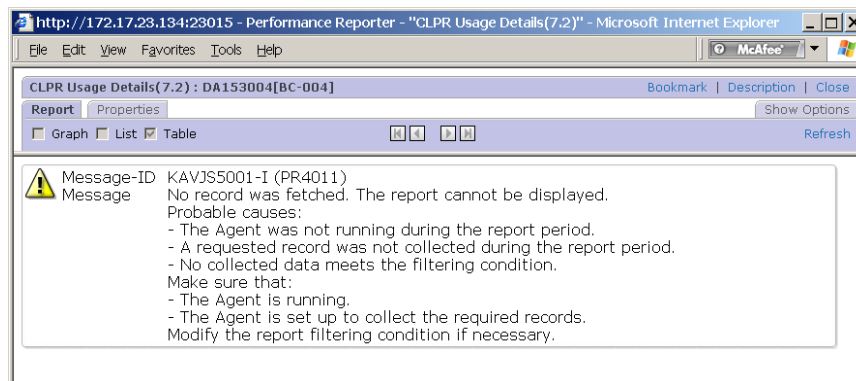
24

With Performance Reporter, metrics collected from resources, by installed agents, can be displayed by running appropriate reports. System Reports are pre-coded, while customized reports can be created in the User Report area and run from this structure.

Displaying reports by use of Performance Reporter can be used as a quick check, whether an installed agent is capable to collect metrics from the resources and communicate with the Tuning Manager server.

Agent Communication Validation

Error Message



25

If the selected report generates an error message, the agent instance was not able to deliver the metric data correctly. A possible cause for this could be that the metric asked for is not available, the service of the agent instance is not running or the agent instance is not setup correctly.

Application Bar Functions

Performance Reporter — In-context launch

The screenshot illustrates the 'In-context launch' of the Performance Reporter. The main window is titled 'Hitachi Tuning Manager - Microsoft Internet Explorer'. The left sidebar shows the 'Storage Systems' tree, with 'CLPR0' selected. The top navigation bar has 'Performance Reports' highlighted. The right pane displays a list of reports, with 'CLPR Usage Details(7.2)' selected. A secondary window titled 'http://172.17.33.134:23015 - Performance Reporter - Microsoft Internet Explorer' is open, showing the 'Performance Reporter' details for the selected report.

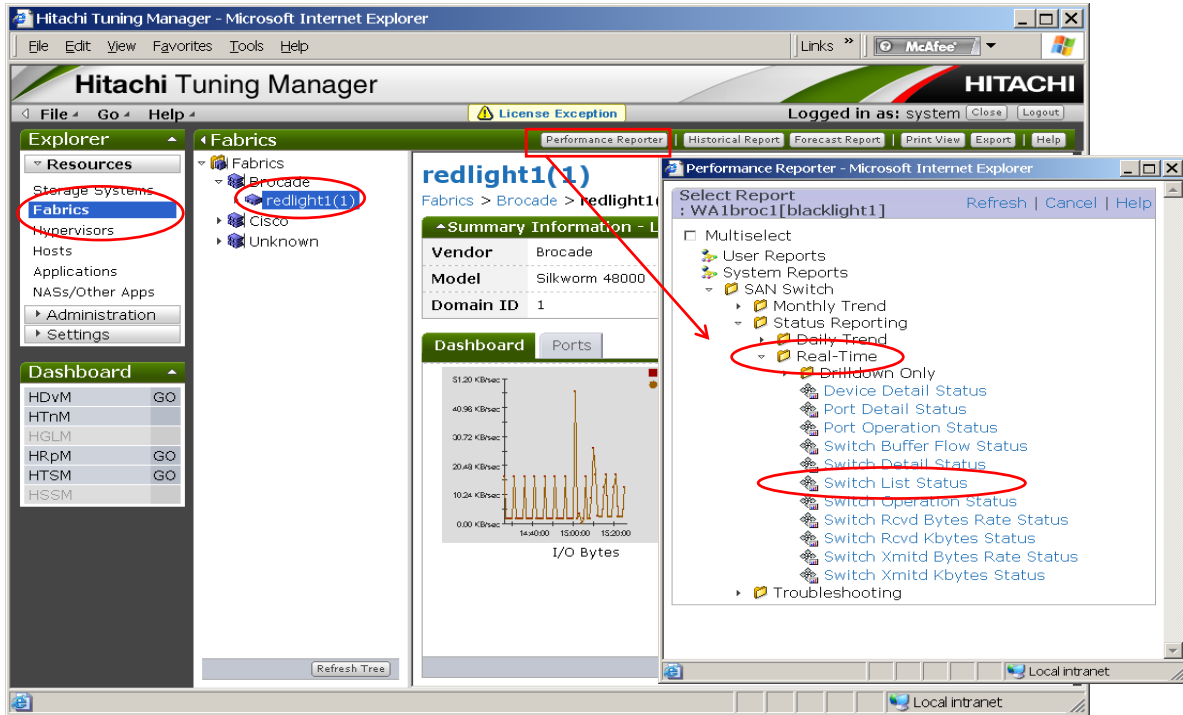
26

Performance Reporter – In-context launch of Performance Reporter.

Preselected resource will be automatically called to show in Performance Reporter

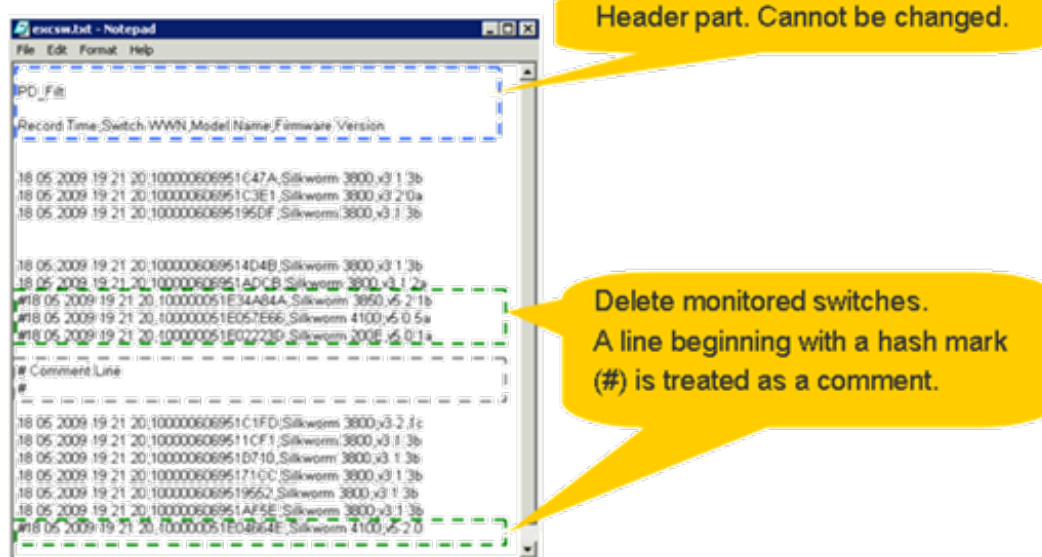
Performance Reporter

- Performance Reporter to display the Switch List Status report



Output the Switch List Status report in CSV format, name the file **excsu.txt**.

- Performance Reporter to display the Switch List Status report

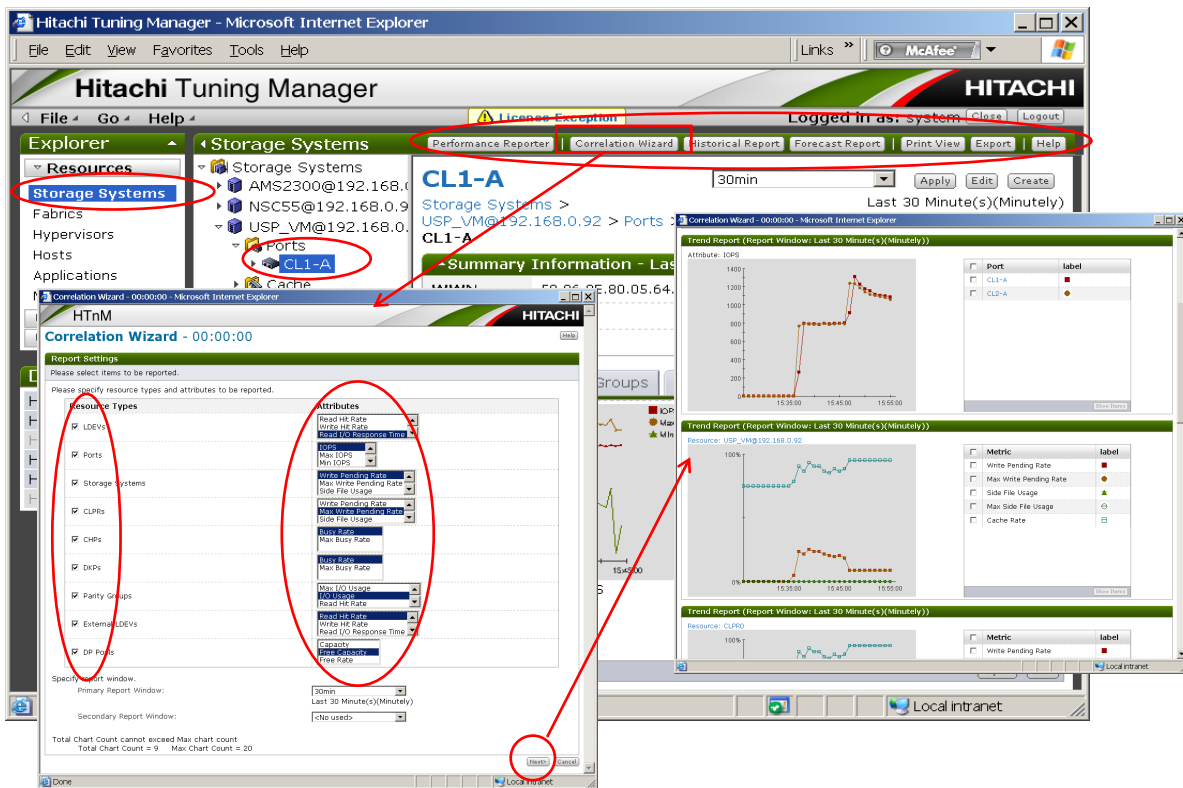


28

A text editor can be used to edit the **excsw.txt** file.

Deleting the lines with the information about the switches supported by Agent for SAN Switch causes only the lines with the information about the unsupported switches and the file header to remain in the list.

Correlation Wizard



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Correlation Wizard – Shows trend charts of related resources.

Historical Reports

The screenshot shows the Hitachi Tuning Manager interface in a Microsoft Internet Explorer browser. The main window displays the 'Historical Report' for the resource 'CL1-A'. The interface is divided into several sections:

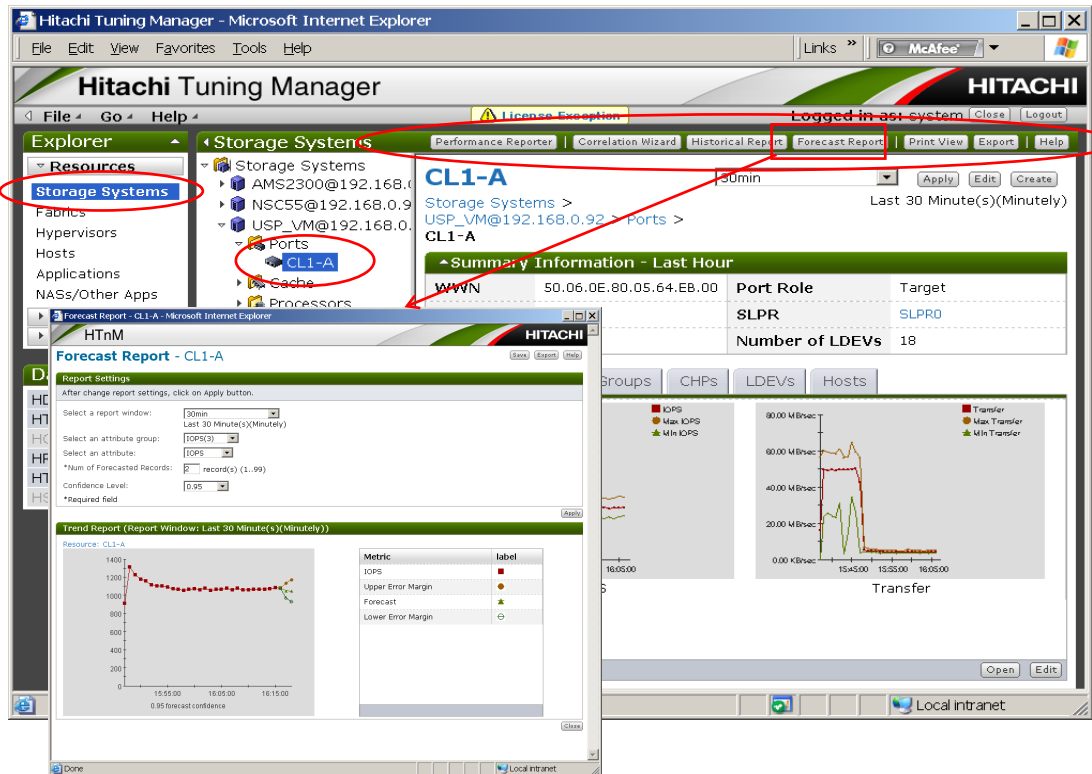
- Navigation Pane (Left):** Shows a tree view of resources. 'Storage Systems' is selected and highlighted with a red circle.
- Summary Information - Last Hour:** A table displaying key metrics for the selected resource.

Metric	Value
WWN	50.06.0E.80.05.64.EB.00
Port Role	SLPR0
SLPR	SLPR0
Number of LDEVs	18
- Trend Report (Report Window: Last 30 Minute(s)(Minutely)):** Two line charts showing performance trends over the last 30 minutes.
 - OPS Chart:** Shows IOPS (Input/Output Operations Per Second) with a peak around 15:45:00. The y-axis ranges from 0 to 2800.
 - Transfer Chart:** Shows data transfer rates (Max Transfer, Min Transfer) with a peak around 15:45:00. The y-axis ranges from 0.00 to 80.00 MB/sec.

Red circles and lines highlight the 'Storage Systems' in the navigation pane, the 'CL1-A' resource, and the 'Historical Report' tab in the top menu.

Historical Reports – Shows trend charts about the resource displayed on title area.

Forecast Report



Forecast Reports – Shows forecast report about the resource displayed on title area.

Print View and Export

The screenshot displays the Hitachi Tuning Manager web interface. In the top navigation bar, the 'Print View' and 'Export' buttons are circled in red. The left-hand navigation pane also has 'Storage Systems' circled in red. The main content area shows the configuration for 'CL1-A', including a 'Summary Information - Last Hour' table and two line graphs for IOPS and Transfer. A 'Print View - Main Report' window is open, showing a detailed report of the same data. A 'Microsoft Excel - MainReport(1).csv' window is also open, displaying the data exported in CSV format.

WWN	Port Role	Target
50.06.0E.80.05.64.EB.00	SLPR	SLPR0

Port Type	Port Speed	Number of LDEVs
Fibre	auto	18

HostStorage	Number of LDEVs
1A-G00	0
blacklight2	2
bluehighlight1	4
greenlight1	4
greenlight2	8

32

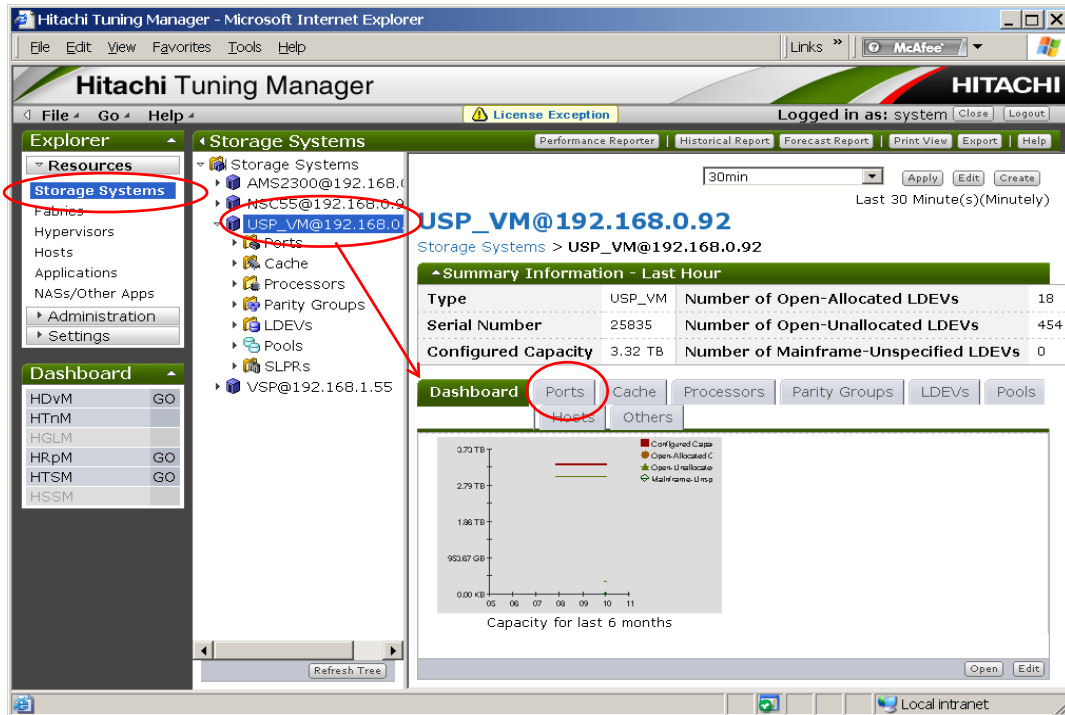
Print View - Prints out report in the current window.

Export - Exports all data shown in main screen. CSV format is supported.

Help - Shows context sensitive help about main screen in separate windows.

Correlation

Without Host Agent Installed



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The tree structure in the Navigation Area for the selected **Resource Subsystem** is listing the supported storage systems by type and IP address. Detail information of any selected substructure of a Subsystem is displayed in the Application Area.

Ports

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Links » McAfee

Hitachi Tuning Manager HITACHI

File Go Help License Exception Logged in as: system Close Logout

Performance Reporter Historical Report Forecast Report Print View Export Help

Explorer

- Resources
 - Storage Systems
 - AMS2300@192.168.0.92
 - NSC55@192.168.0.92
 - USP_VM@192.168.0.92**
 - Ports
 - Cache
 - Processors
 - Parity Groups
 - LDEVs
 - Pools
 - SLPRs
 - VSP@192.168.1.55
 - Fabrics
 - Hypervisors
 - Hosts
 - Applications
 - NASs/Other Apps
 - Administration
 - Settings
- Dashboard
 - HDvM GO
 - HTnM GO
 - HGLM GO
 - HRpM GO
 - HTSM GO
 - HSSM GO

Storage Systems > USP_VM@192.168.0.92

30min Apply Edit Create

Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

Type	USP_VM	Number of Open-Allocated LDEVs	18
Serial Number	25835	Number of Open-Unallocated LDEVs	454
Configured Capacity	3.32 TB	Number of Mainframe-Unspecified LDEVs	0

Dashboard **Ports** Cache Processors Parity Groups LDEVs Pools Hosts

Ports Host Groups

Rows/Page: 10 Page 1 of 2

Port	WWN	Port Type	Port Speed	Port Role	Number of
☐ CL1-A	50.06.0E.80.05.64.EB.00	Fibre	auto	Target	
☐ CL1-B	50.06.0E.80.05.64.EB.01	Fibre	auto	Target	
☐ CL2-A	50.06.0E.80.05.64.EB.10	Fibre	auto	Target	
☐ CL2-B	50.06.0E.80.05.64.EB.11	Fibre	auto	Target	
☐ CL3-A	50.06.0E.80.05.64.EB.20	Fibre	auto	Initiator	
☐ CL3-B	50.06.0E.80.05.64.EB.21	Fibre	auto	External	
☐ CL4-A	50.06.0E.80.05.64.EB.30	Fibre	auto	Initiator	
☐ CL4-B	50.06.0E.80.05.64.EB.31	Fibre	auto	External	
☐ CL5-A	50.06.0E.80.05.64.EB.40	Fibre	auto	Target	

Performance Summary Historical Report Filter Filter Off

Local intranet

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Cache

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Links » McAfee

Hitachi Tuning Manager HITACHI

File Go Help License Exception Logged in as: system Close Logout

Performance Reporter Historical Report Forecast Report Print View Export Help

Explorer

- Resources
 - Storage Systems
 - AMS2300@192.168.0.92
 - NSC55@192.168.0.92
 - USP_VM@192.168.0.92**
 - Ports
 - Cache**
 - Processors
 - Parity Groups
 - LDEVs
 - Pools
 - SLPRs
 - VSP@192.168.1.55
 - Fabrics
 - Hypervisors
 - Hosts
 - Applications
 - NASs/Other Apps
 - Administration
 - Settings
- Dashboard
 - HDvM GO
 - HTnM GO
 - HGLM GO
 - HRpM GO
 - HTSM GO
 - HSSM GO

Storage Systems > USP_VM@192.168.0.92

30min Apply Edit Create

Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

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Configured Capacity	3.32 TB	Number of Mainframe-Unspecified LDEVs	0

Dashboard Ports **Cache** Processors Parity Groups LDEVs Pools Hosts

Cache

Total CLPRs

Cache Capacity 24.00 GB

Local intranet

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Processors

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links McAfee

Hitachi Tuning Manager License Exception Logged in as: system Close Logout

Explorer Storage Systems Performance Reporter Historical Report Forecast Report Print View Export Help

Resources Storage Systems Fabrics Hypervisors Hosts Applications NASS/Other Apps Administration Settings

Dashboard HDvM GO HTnM HGLM HRpM GO HTSM GO HSSM

Storage Systems AMS2300@192.168.0.92 NSC55@192.168.0.92 USP_VM@192.168.0.92 VSP@192.168.1.55

Ports Cache Processors Parity Groups LDEVs SLPRs

USP_VM@192.168.0.92 30min Apply Edit Create

Storage Systems > USP_VM@192.168.0.92 Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

Type	USP_VM	Number of Open-Allocated LDEVs	18
Serial Number	25835	Number of Open-Unallocated LDEVs	454
Configured Capacity	3.32 TB	Number of Mainframe-Unspecified LDEVs	0

Dashboard Ports Cache Processors Parity Groups LDEVs Pools Hosts Others

CHPs DKPs Rows/Page: 10 Page: 1 of 1

Processor

☐	CHA-1G-0
☒	CHA-1G-1
☐	CHA-1G-2
☐	CHA-1G-3
☐	CHA-2L-0
☐	CHA-2L-1
☐	CHA-2L-2
☐	CHA-2L-3

Performance Summary Historical Report Filter Filter Off

Local intranet

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Ports

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links McAfee

Hitachi Tuning Manager License Exception Logged in as: system Close Logout

Explorer Storage Systems Performance Reporter Correlation Wizard Historical Report Forecast Report Print View Export Help

Resources Storage Systems Fabrics Hypervisors Hosts Applications NASS/Other Apps Administration Settings

Dashboard HDvM GO HTnM HGLM HRpM GO HTSM GO HSSM

Storage Systems AMS2300@192.168.0.92 NSC55@192.168.0.92 USP_VM@192.168.0.92 VSP@192.168.1.55

Ports Cache Processors Parity Groups LDEVs SLPRs

CHA-1G-0 30min Apply Edit Create

Storage Systems > USP_VM@192.168.0.92 > Processors > CHPs > CHA-1G-0 Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

Port Controller CHA-1G

Dashboard Ports

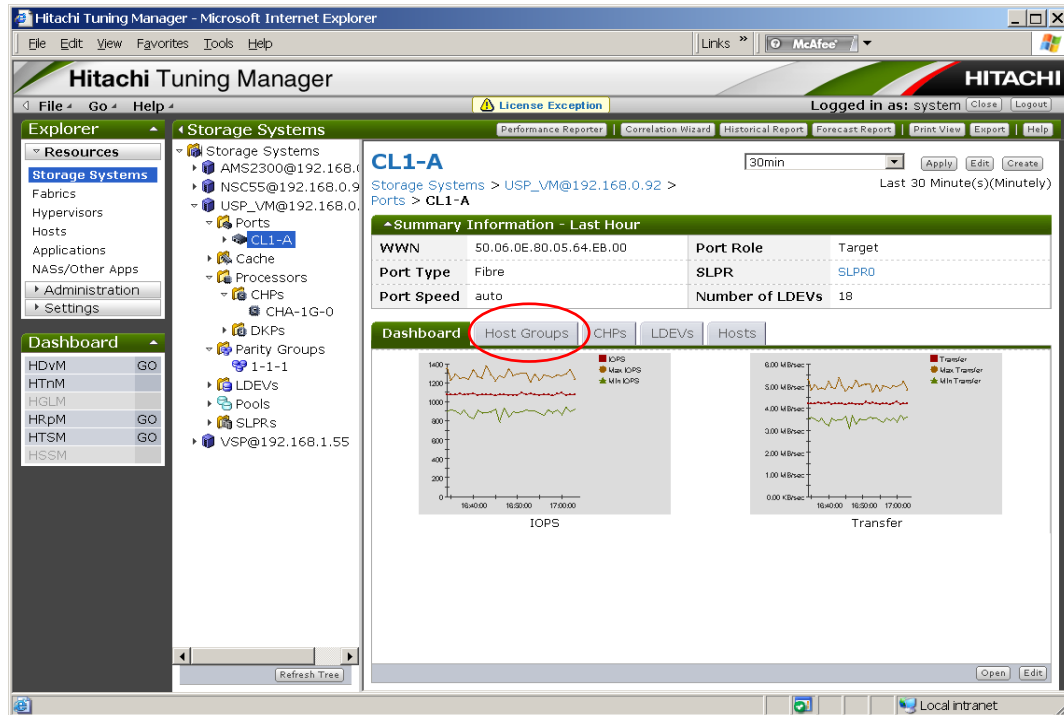
Port	WWN	Port Type	Port Speed	Port Role	Number of LC
☐	CLS-A	50.06.0E.80.05.64.EB.00	Fibre	auto	Target
☒	CLS-A	50.06.0E.80.05.64.EB.40	Fibre	auto	Target

Performance Summary Historical Report Filter Filter Off

Local intranet

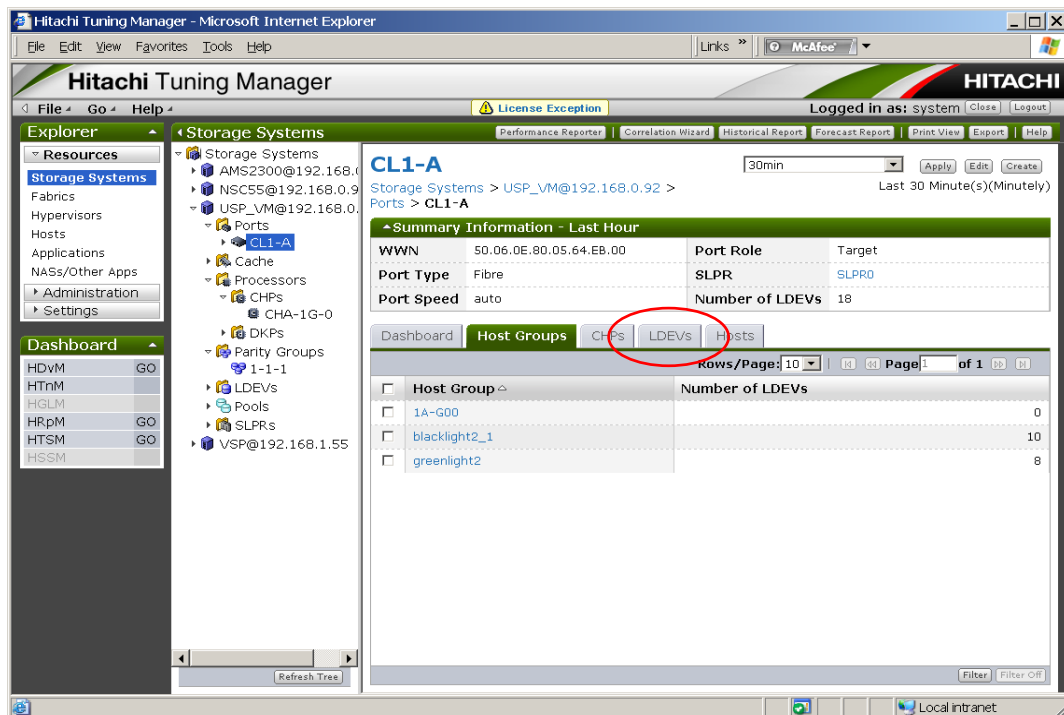
37

Ports



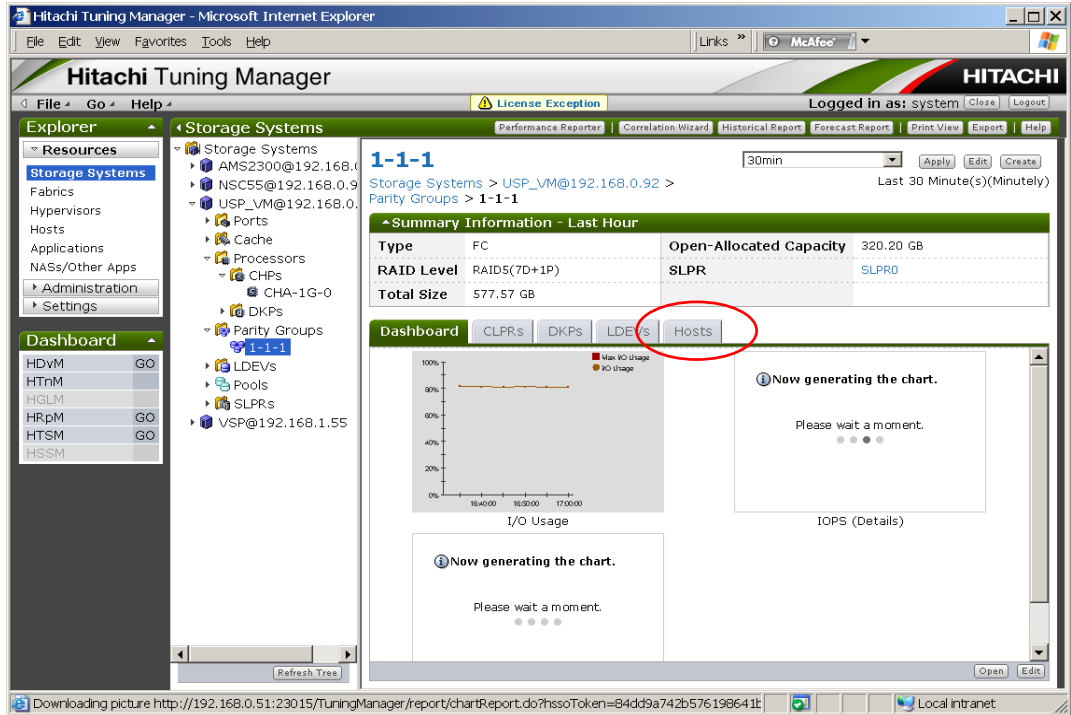
38

Host Groups



39

Hosts



Hosts

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links McAfee

Hitachi Tuning Manager License Exception Logged in as: system [Close] [Logout]

Explorer: Resources, Storage Systems, Fabrics, Hypervisors, Applications, NASs/Other Apps, Administration, Settings

Storage Systems

- Storage Systems
 - AMS2300@192.168.0.92
 - NSC55@192.168.0.92
 - USP_VM@192.168.0.92
 - Ports
 - CL1-A**
 - Cache
 - Processors
 - CHPs
 - CHA-1G-0
 - DKPs
 - Parity Groups
 - 1-1-1
 - LDEVs
 - Pools
 - SLPRs
 - VSP@192.168.1.55

CL1-A 30min [Apply] [Edit] [Create]

Storage Systems > USP_VM@192.168.0.92 > Ports > CL1-A

Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

WWN	50.06.0E.80.05.64.EB.00	Port Role	Target
Port Type	Fibre	SLPR	SLPR0
Port Speed	auto	Number of LDEVs	18

Dashboard Host Groups CHPs LDEVs **Hosts**

File Systems **Device Files** VMs Datastores

Rows/Page: 10 Page 1 of 2

File System	Host	Capacity	Free Capacity	Free Rate
☐ D:	greenlight2	no data	no data	no data
☐ F:	greenlight2	no data	no data	no data
☐ G:	greenlight2	no data	no data	no data
☐ H:	greenlight2	no data	no data	no data
☐ I:	greenlight1	19.99 GB	19.93 GB	100%
☐ J:	greenlight1	19.99 GB	19.93 GB	100%
☐ K:	greenlight2	no data	no data	no data

Historical Report Filter Filter Off

Local intranet

41

Hosts are grouped by operating system in the Navigation Area and detailed information of a selected Host is provided in the Application Area.

Hosts

Hitachi Tuning Manager - Microsoft Internet Explorer

File Edit View Favorites Tools Help Links » McAfee

Hitachi Tuning Manager License Exception Logged in as: system Close Logout

Explorer

- Resources
 - Storage Systems
 - AMS2300@192.168.0.92
 - NSC55@192.168.0.92
 - USP_VM@192.168.0.92
 - Ports
 - CL1-A**
 - Cache
 - Processors
 - CHPs
 - CHA-1G-0
 - DKPs
 - Parity Groups
 - 1-1-1
 - LDEVs
 - Pools
 - SLPRs
 - VSP@192.168.1.55

- Fabrics
- Hypervisors
- Applications
- NASs/Other Apps
- Administration
- Settings
- Dashboard
- HDvM GO
- HTnM
- HQLM
- HRpM GO
- HTSM GO
- HSSM

CL1-A 30min Apply Edit Create

Storage Systems > USP_VM@192.168.0.92 > Ports > CL1-A

Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

WWN	50.06.0E.80.05.64.E8.00	Port Role	Target
Port Type	Fibre	SLPR	SLPRO
Port Speed	auto	Number of LDEVs	18

Dashboard Host Groups CHPs LDEVs **Hosts**

File Systems Device Files **VMS** Datastores

Rows/Page: 10 Page 1 of 2

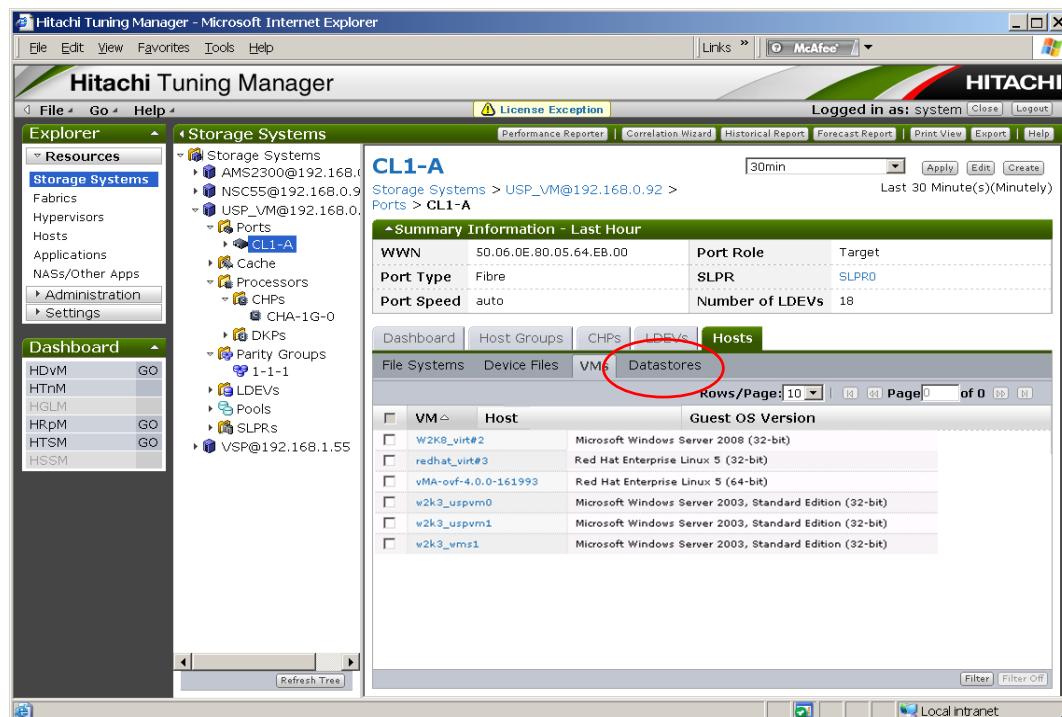
	Device File	Host	Host Group	LDEV
☐	1	greenlight1	greenlight2 , greenlight2	00:00:04
☐	1	greenlight2	greenlight2 , greenlight2	00:00:00
☐	2	greenlight1	greenlight2 , greenlight2	00:00:05
☐	2	greenlight2	greenlight2 , greenlight2	00:00:01
☐	3	greenlight1	greenlight2 , greenlight2	00:00:06
☐	3	greenlight2	greenlight2 , greenlight2	00:00:02
☐	4	greenlight1	greenlight2 , greenlight2	00:00:07
☐	4	greenlight2	greenlight2 , greenlight2	00:00:03
☐	5	greenlight2	greenlight2 , greenlight2	00:00:04
☐	6	greenlight2	greenlight2 , greenlight2	00:00:05

Performance Summary Historical Report Filter Filter Off

Local intranet

42

Hosts



43

ESX Hosts are available as monitoring targets only for the ESX Servers which are added to **Device Manager** either by the ADDVIRTUALIZATIONSERVER CLI command or by Add Virtualization Server function launched from within the Device Manager GUI.

Hosts

The screenshot shows the Hitachi Tuning Manager interface in a Microsoft Internet Explorer browser. The left sidebar contains a tree view with 'Resources' expanded, showing 'Storage Systems', 'Fabrics', 'Hypervisors', 'Hosts', 'Applications', 'NASs/Other Apps', 'Administration', and 'Settings'. The 'Hosts' item is highlighted. The main content area displays the 'CL1-A' host configuration. The 'Summary Information - Last Hour' section shows:

WWN	50.06.0E.80.05.64.E8.00	Port Role	Target
Port Type	Fibre	SLPR	SLPRO
Port Speed	auto	Number of LDEVs	18

Below this, there is a table of datastores:

Name	Type	Capacity	Used Capacity	Free Capacity	Free Rate
acad01-ds0	Datastore	39.75 GB	5.47 GB	34.28 GB	
ds1_ext_jun0	Datastore	19.75 GB	19.59 GB	162.00 MB	
ds3_ext_jun2	Datastore	19.75 GB	18.59 GB	1.16 GB	
ds4_ext_jun3	Datastore	19.75 GB	18.59 GB	1.16 GB	
ds5_ext_jun4	Datastore	19.75 GB	397.00 MB	19.36 GB	
ds6_ext_jun5	Datastore	19.75 GB	397.00 MB	19.36 GB	
uspvms0	Datastore	19.75 GB	18.39 GB	1.36 GB	

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The same information can be retrieved from the Resource Hypervisor.

Hosts

The screenshot shows the Hitachi Tuning Manager interface in a Microsoft Internet Explorer browser. The left sidebar contains a tree view with 'Resources' expanded, showing 'Storage Systems', 'Fabrics', 'Hypervisors', 'Hosts', 'Applications', 'NASs/Other Apps', 'Administration', and 'Settings'. The 'Hypervisors' item is highlighted. The main content area displays the 'VMware ESX' hypervisor configuration. The 'Summary Information - Last Hour' section shows:

Number of Hosts	0	Number of Datastores	0
Number of VMs	0		

Below this, there is a table of datastores:

Name	Type	Capacity	Used Capacity	Free Capacity	Free Rate
acad01-ds0	Datastore	39.75 GB	5.47 GB	34.28 GB	
ds1_ext_jun0	Datastore	19.75 GB	19.59 GB	162.00 MB	
ds3_ext_jun2	Datastore	19.75 GB	18.59 GB	1.16 GB	
ds4_ext_jun3	Datastore	19.75 GB	18.59 GB	1.16 GB	
ds5_ext_jun4	Datastore	19.75 GB	397.00 MB	19.36 GB	
ds6_ext_jun5	Datastore	19.75 GB	397.00 MB	19.36 GB	
uspvms0	Datastore	19.75 GB	18.39 GB	1.36 GB	

45

Resource

Fabrics

Hitachi Tuning Manager - Microsoft Internet Explorer

Hitachi Tuning Manager

Logged in as: system

Explorer

- Resources
 - Storage Systems
 - Fabrics**
 - Hypervisors
 - Hosts
 - Applications
 - NASs/Other Apps
 - Administration
 - Settings
- Dashboard
 - HDvM GO
 - HTnM GO
 - HGLM GO
 - HRpM GO
 - HTSM GO
 - HSSM GO

Fabrics

- Brocade
 - redlight1(1)**
 - Cisco
 - Unknown

redlight1(1)

Fabrics > Brocade > redlight1(1)

30min Apply Edit Create

Last 30 Minute(s)(Minutely)

Summary Information - Last Hour

Vendor	Brocade	Switch WWN	10.00.00.05.1E.36.0A.D4
Model	Silkworm 48000	Number of Ports	64
Domain ID	1		

Dashboard Ports

Port	Port Module	Port Number	Port WWN	Port Type	Port Spe
1-0	1	0	20.00.00.05.1E.36.0A.D4	F port	4G
1-1	1	1	20.01.00.05.1E.36.0A.D4	F port	1G
1-2	1	2	20.02.00.05.1E.36.0A.D4	G port	4G
1-3	1	3	20.03.00.05.1E.36.0A.D4	F port	1G
1-4	1	4	20.04.00.05.1E.36.0A.D4	F port	2G
1-5	1	5	20.05.00.05.1E.36.0A.D4	G port	4G
1-6	1	6	20.06.00.05.1E.36.0A.D4	G port	4G
1-7	1	7	20.07.00.05.1E.36.0A.D4	G port	4G
1-8	1	8	20.08.00.05.1E.36.0A.D4	G port	4G
1-9	1	9	20.09.00.05.1E.36.0A.D4	F port	4G

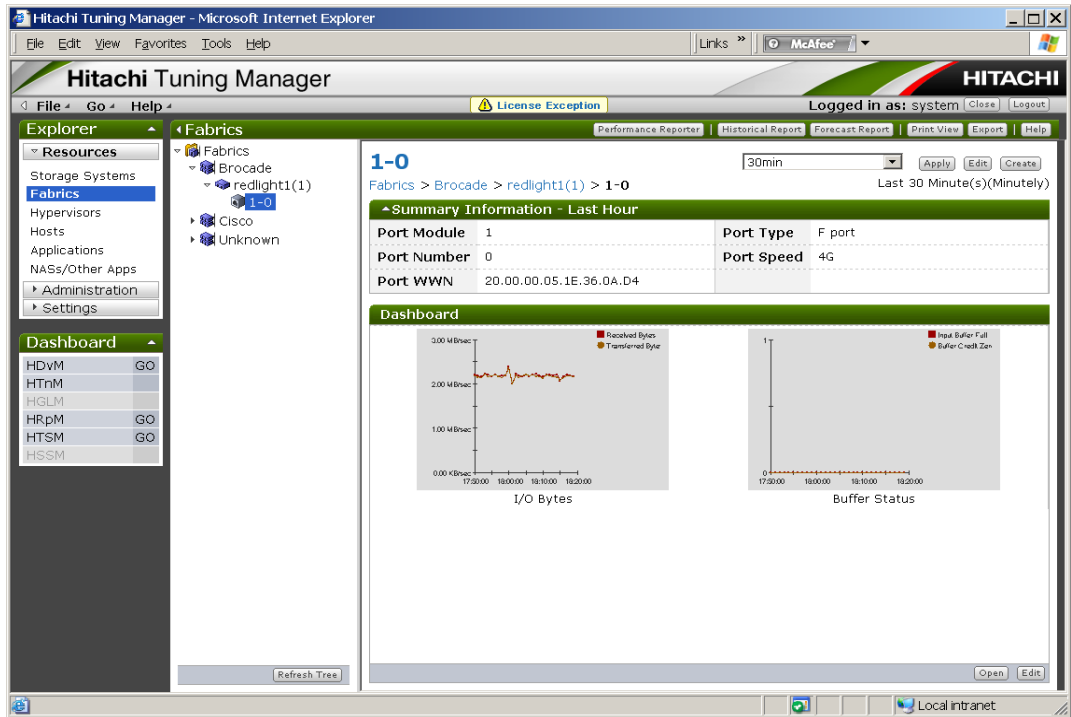
Refresh Tree

Performance Summary Historical Report Filter Filter Off

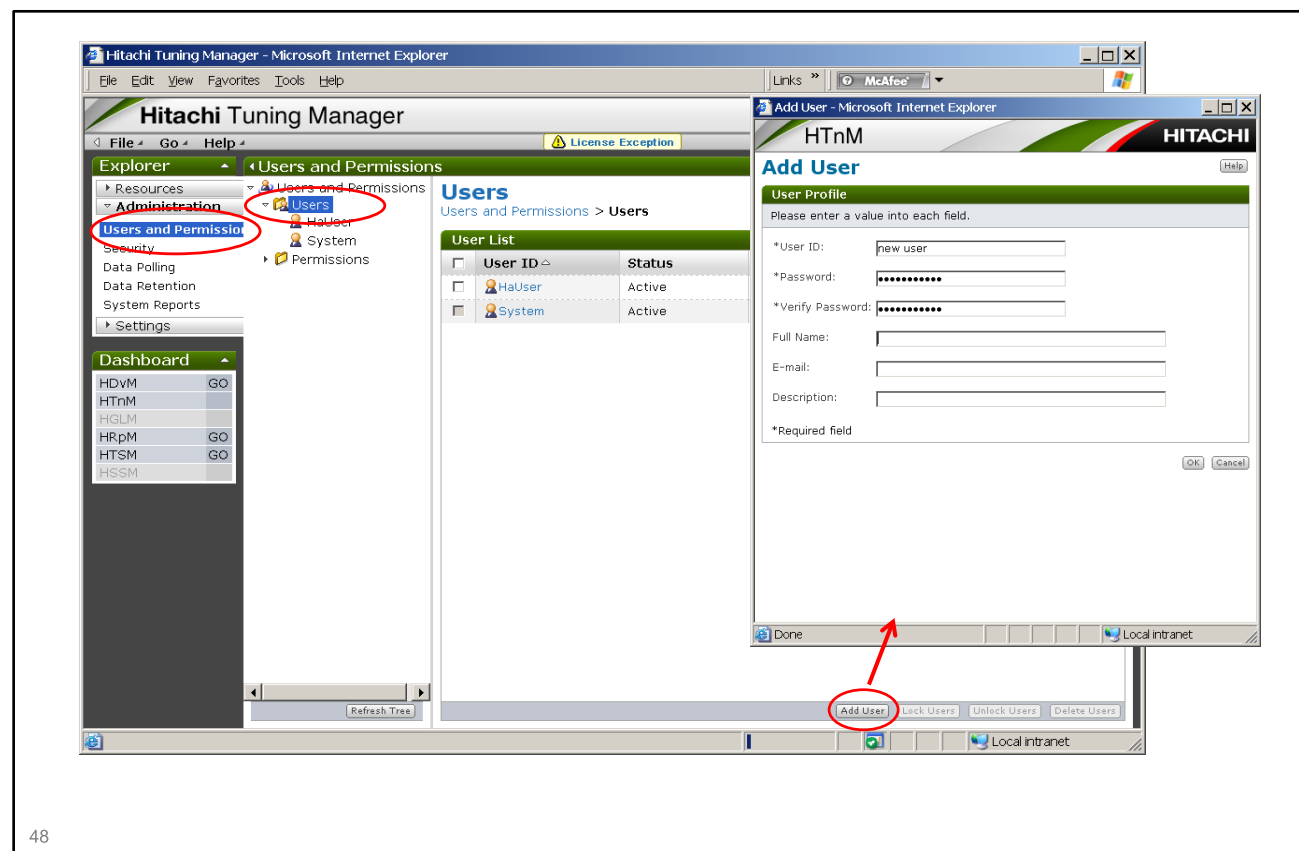
46

The Resource **Fabrics** is grouped by vendors in the Navigation Area. Details of the switches in a fabric, as well as their ports, are shown in the Application Area.

Fabrics



Users and Permissions

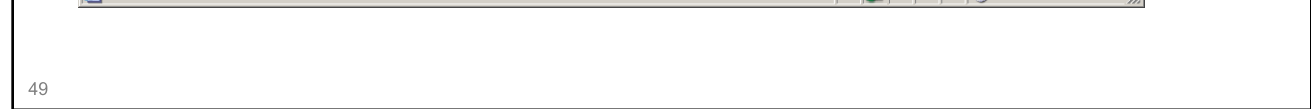


48

The **User and Permission** function allows for creation of user accounts common to all Hitachi Command Suite products.

The HaUser account must not be deleted. This account is the default user for the Device Manager Agent to log in to Hitachi Device Manager (HDvM).

Deleting a user who is currently logged in will cause the user to be unable to continue operations.

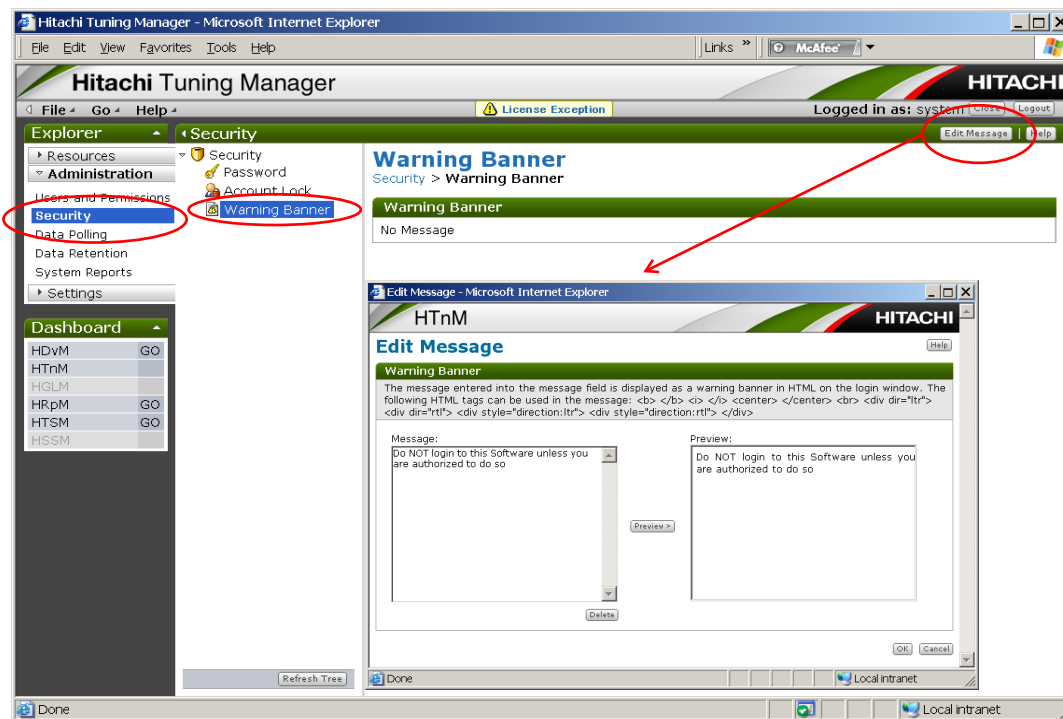


Options are:

- User Management permission, which is common to all Hitachi Command Suite products
- Operation permissions for the Tuning Manager server
- Permissions for Hitachi Command Suite products other than the Tuning Manager server

If the **exauth.properties** file of the Tuning Manager server is edited to specify linking with an external authentication server, external authentication is the default method used to authenticate a new user. For details on the **exauth.properties** file, see the *Hitachi Tuning Manager Server Administration Guide*.

Security



50

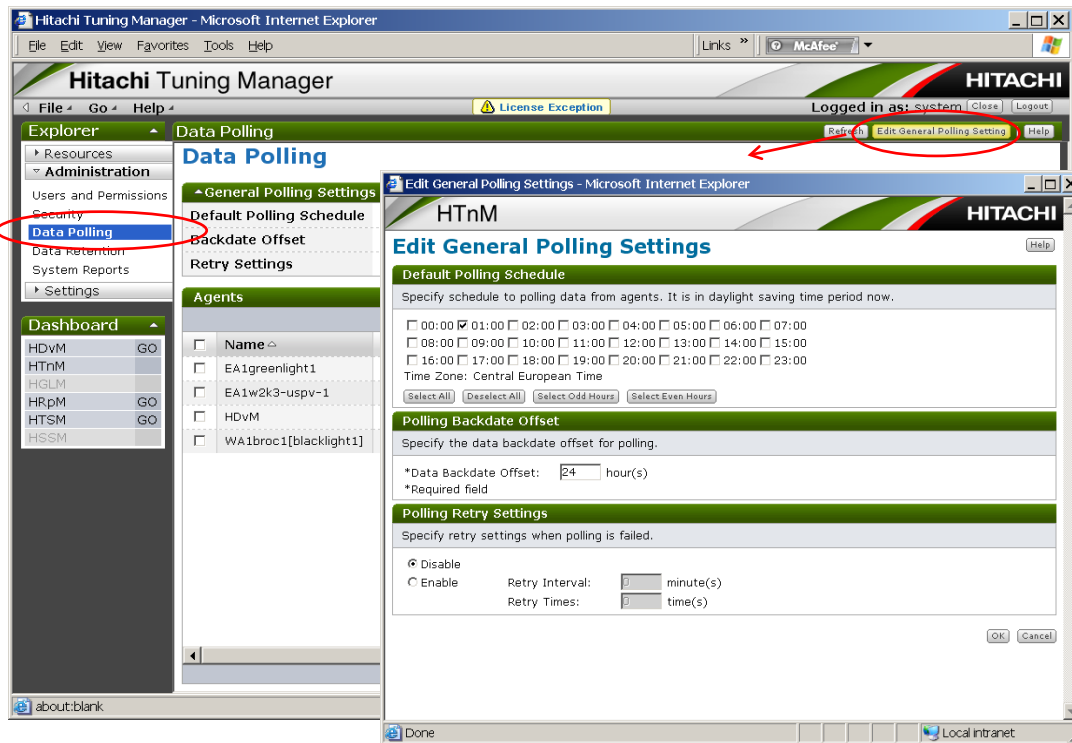
To enhance security when a user logs in, users who have the User Management permission can set security options. The following login security options can be set:

- Setting password conditions
- Setting automatic locking of user accounts
- Setting a warning banner message

For details, see the *Hitachi Tuning Manager Server Administration Guide* sections on:

- “Setting Password Conditions”
- “Setting Automatic Locking of User Accounts”
- “Setting a Warning Banner Message”

General Polling Settings



51

Scheduled Polling of all Agents registered to Tuning Manager can be set by the function *General Polling Setting*. By default, polling is set to 00:00 AM once a day for all the agents and Device Manager.

To have precise array configuration, polling to Device Manager software should be synchronized with a refresh function of Device Manager to reflect configuration changes.

Device Manager Array Configuration Refresh

1. With the Device Manager Full license installed, the functions **add/delete/refresh** can be executed from the Device Manager GUI and/or Device Manager CLI.
2. In case the Device Manager Core License is used, the functions **add/delete/refresh** can only be executed as Device Manager CLI commands.

Data Polling – Individual Agent

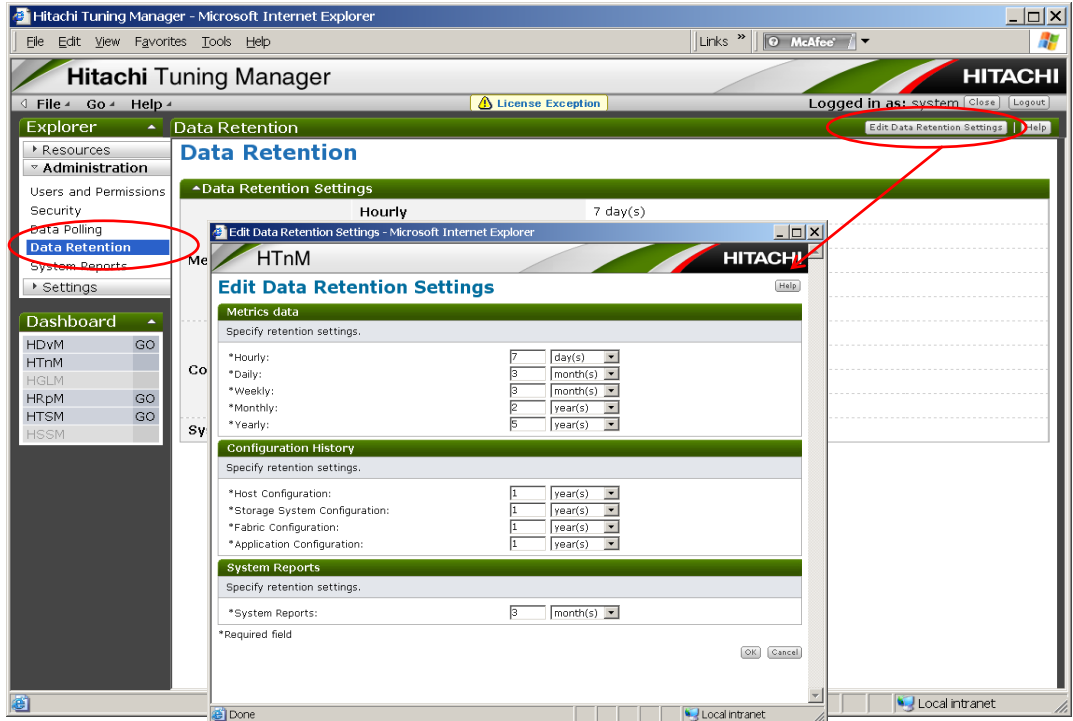
The screenshot displays the Hitachi Tuning Manager web interface in a Microsoft Internet Explorer browser. The main window shows the 'Data Polling' section with 'General Polling Settings' and a table of agents. The 'Agents' table has columns: Name, Type, Polling Schedule, and La. The 'HDvM' agent is selected, highlighted in blue. A red circle highlights the 'Data Polling' link in the left navigation pane. Another red circle highlights the 'Edit Polling Schedule' button in the bottom toolbar. A third red circle highlights the 'Filter' button in the bottom toolbar. A fourth red circle highlights the 'Edit Polling Schedule' button in the 'Edit Polling Schedule' dialog box. The 'Edit Polling Schedule' dialog box is open, showing a 'Polling Schedule' section with a radio button for 'Specify polling schedule' and a list of time slots from 00:00 to 23:00. The 'Filter - Data Polling' dialog box is also open, showing 'Filtering Conditions' with a dropdown for 'Attribute' set to 'Type' and a dropdown for 'Value' set to 'HDvM'.

52

The schedule for polling individual Agents as well as Device Manager can be altered from the General Polling Setting schedule by selecting the appropriate Agent and the function *Edit Polling Schedule*.

Data Retention Settings

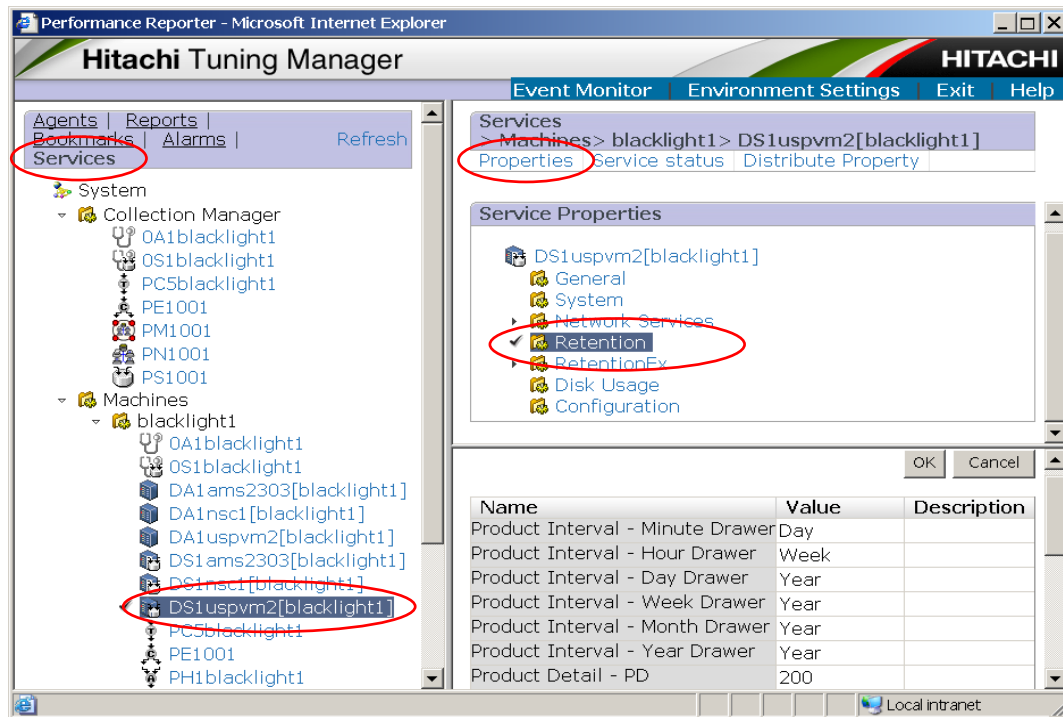
HiRDB



53

The retention periods of metric data in HiRDB can be specified by MC GUI.

Agent for RAID



54

Agent Store data retention periods can be altered with Performance Reporter. In the Tuning Manager series programs, the record storage period and the maximum number of stored records can be set to prevent large increases in the amount of data stored in the Store database. The data save condition that can be set differs depending on the Store database version and the record type.

For details see the *Hitachi Tuning Manager Agent Administration Guide* section, "Using Store Databases to Manage Data."

System Reports

Polling Status Report

The screenshot displays the Hitachi Tuning Manager interface in a Microsoft Internet Explorer browser window. The main window shows the 'System Reports' section with a 'Polling Status Report' table. A red circle highlights the 'System Reports' link in the left navigation pane. Another red circle highlights the 'Filter' button at the bottom right of the report table. A separate window titled 'Filter - System Reports' is open, showing filtering conditions. The table in the main window contains the following data:

Polling Time	Mode	Status	Total Time
2010-10-01 15:37	Manual	Done	00:04:39
2010-10-01 12:43	Manual	Warning	00:06:45
2010-10-01 12:00	Manual	Done	00:00:44
2010-10-01 01:05	Scheduled	Warning	00:05:54
2010-09-30 22:05	Scheduled	Warning	00:05:59
2010-09-30 01:05	Scheduled	Warning	00:05:49
2010-09-29 22:05	Scheduled	Warning	00:05:52
2010-09-29 01:05	Scheduled	Warning	00:06:04
2010-09-28 22:05	Scheduled	Warning	00:06:05
2010-09-28 01:05	Scheduled	Warning	00:05:59

Polling Details

The screenshot shows the Hitachi Tuning Manager interface. The left sidebar has 'System Reports' selected. The main window displays the 'Polling Status Report' with a table of polling events. The 'Polling Details' tab is active, showing a table of polling information for the date 2010-10-01 12:43. The table includes columns for Name, Type, Polling Time, Record Taken (From, To), and Last Record.

Name	Type	Polling Time	Record Taken From	Record Taken To	Last Record
DA1ams2303[blacklight1]	RAID	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00
DA1nsc1[blacklight1]	RAID	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00
DA1uspvm2[blacklight1]	RAID	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00
DA1vsp55[w2k3-uspvm-1]	RAID	2010-10-01 12:00	n/a	n/a	n/a
EA1w2k3-uspvm-1	RAID Map	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00
HDvM	HDvM	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00
TA1w2k3-uspvm-1	Windows	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00	2010-10-01 12:00

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System Alerts Setting

The screenshot shows the Hitachi Tuning Manager interface. The left sidebar has 'System Reports' selected. The main window displays the 'System Alerts Settings' tab. The 'Edit System Alerts' window is open, showing a list of alert definitions and notification settings. The 'Alert Definitions' section includes checkboxes for various alerts, and the 'Alert Notification' section includes fields for email settings.

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System Alerts

- Health check of Tuning Manager server (Main Console) status
 - An administrator is notified by email for the following system alerts to ensure the healthy operation of Tuning Manager.

Alerts for	Monitored events	Default	Default Value
Agent status	Checks time interval from one successful polling to another for each agent.	Disabled	24 hours
Polling skip	Checks whether a polling is skipped or not, due to ongoing previous polling.	Disabled	—
Time consumed in polling	Checks if polling takes too long. Time that has elapsed since a polling starts.	Disabled	3 hours
Error in aggregation	Checks whether a polling fails during aggregation.	Disabled	—
More than 85% database space in use	Checks if database space is consumed more than 85%.	Disabled	85% in use

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Note that system alerts are not stored into database. For resources alerts, Agent alarms can be used instead.

Settings

User Profile and License Info

Hitachi Tuning Manager

Logged in as: system | Close | Logout

User Profile

User ID: System

Full Name: _____

E-mail: _____

Description: Built-in account

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

59

Module Summary

- Described Hitachi Tuning Manager features and functions
- Described how to log in to Hitachi Tuning Manager (HTnM) using the web client and
- Explained how to use the Tuning Manager graphical user interface (GUI):
 - Main Console
 - Performance Reporter
 - Administration

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Module Review

1. What are the SAN elements HTNM can monitor?
2. What are the benefits of HTNM?
3. What are Alerts and Alarms?

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22. Hitachi IT Operations Suite

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe the features and functions of Hitachi IT Operations Analyzer
 - Describe the features and functions of Hitachi IT Operations Director

2

Hitachi IT Operations Analyzer (ITOA)

The Pain of Systems Management Software



Customer Challenges



When your network goes down –
you need to know where to start



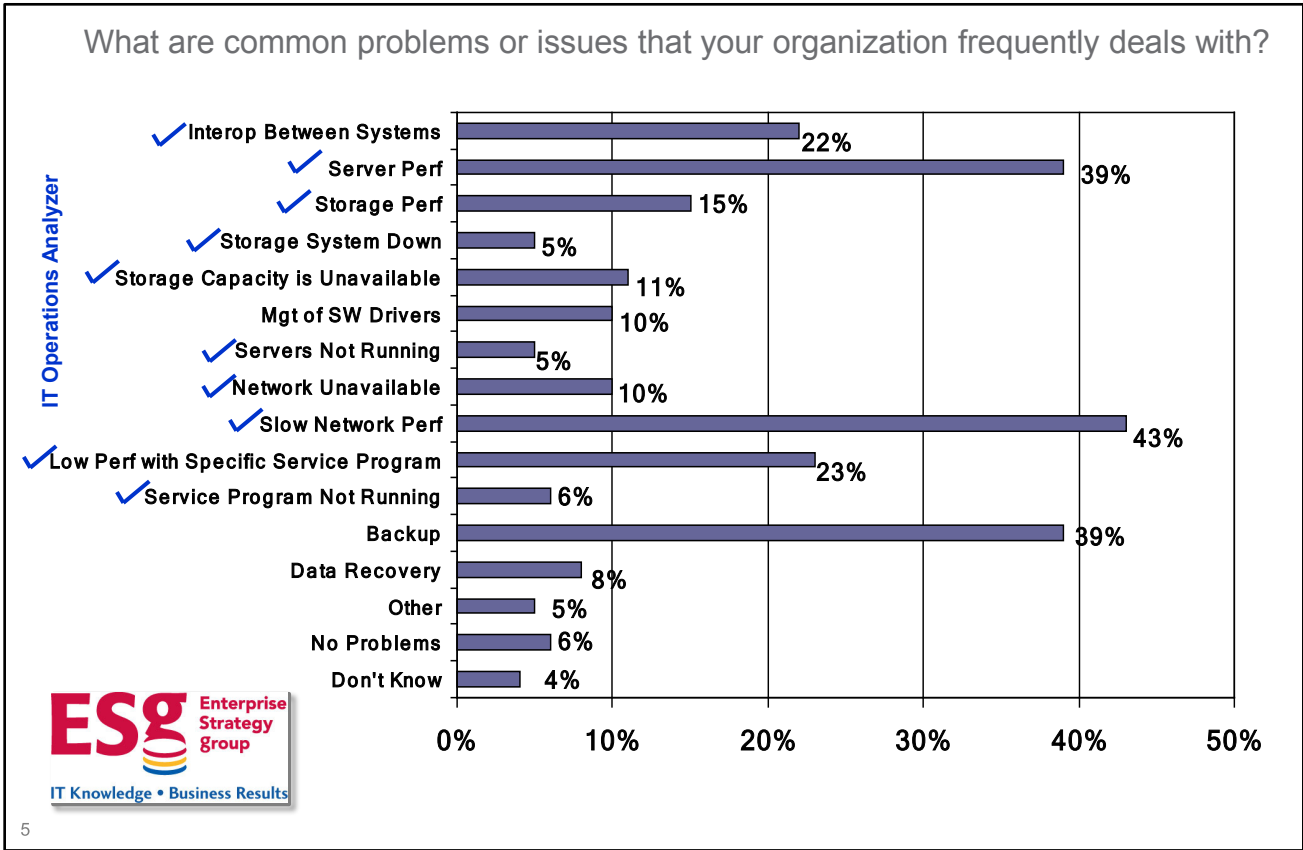
- Managing more with less
 - Make managing increasing complexity more straightforward
- Improving availability and service quality
 - Faster, easier identification of problems
 - Identify potential problem areas prior to failure
- Increasing IT efficiency, reducing complexity
 - Minimize training requirements
 - Smart and easy-to-understand

Some of the challenges or hot buttons relevant to this demographic of IT Operations:

Complexity: Make the management of increasing complex infrastructures, less complex.

Speed and Ease of use: Helps to easily understand the problems with the IT infrastructure and to quickly identify and analyze what to do to fix it. Gives the capability to be proactive, even pre-emptive, not reactive.

Common IT Problems



5

Product Overview

- Gives IT managers in medium to large sized businesses efficient, cost-effective IT environment performance and availability monitoring.
- Provides essential capabilities to monitor heterogeneous server, network and storage devices.
- Features automated root cause analysis, logical path infrastructure views, agentless architecture, an open platform and a unified, intuitive web-based interface.



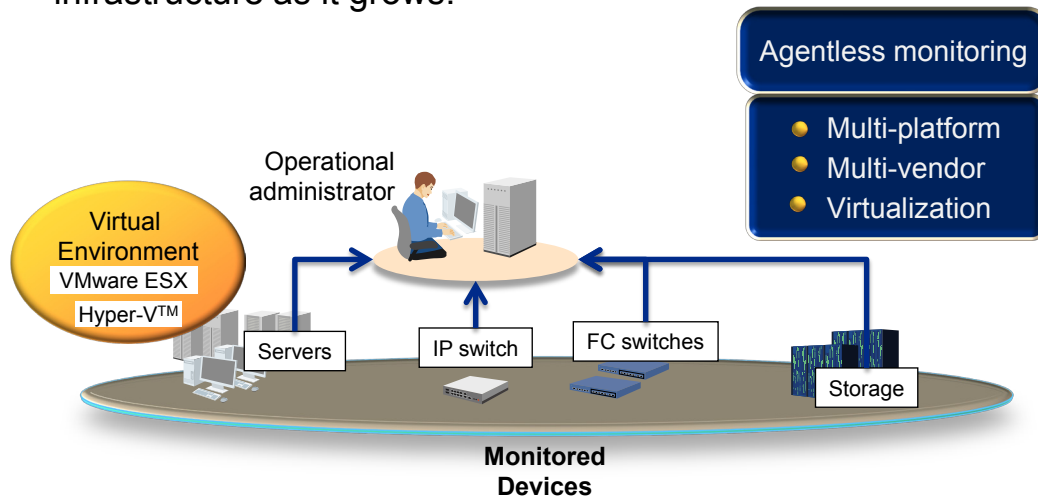
6

For simple, cost-efficient performance and availability monitoring, ITOA provides all the essential capabilities for medium businesses to manage up to server, network and storage devices.

Analyzer delivers unmatched, fully featured tools through an award winning unified, intuitive Web-based interface, including automated root cause analysis, logical network path views, agentless architecture, and an open platform enabling both XML and Java based plug-in development for Partners/Community and ISVs. The root cause analysis feature can help reduce the mean time to diagnose network issues by up to 90%.

Analyzer provides support for multiple vendors and platforms, virtualization support for VMware and Hyper-V, and easy-to-manuever topology mapping for faster impact analysis – helping to simplify IT infrastructure management and maximize system uptime.

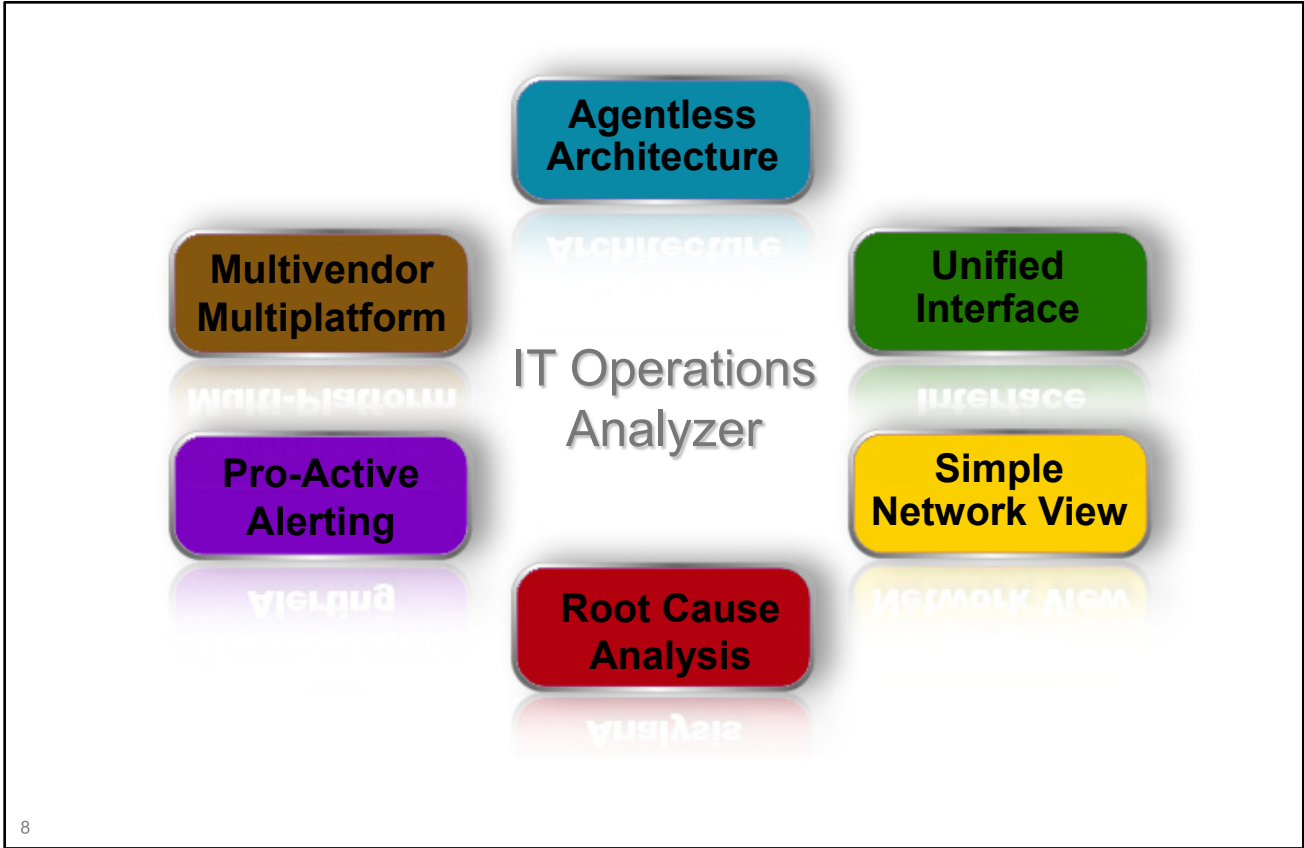
- Analyzer is an excellent fit for customers requiring an all-in-one monitoring product for servers, LAN, SAN and storage devices, that minimizes IT environment downtime, reduces mean time to diagnose, and cost-efficiently simplifies management of the infrastructure as it grows.



7

Not a scaled-down version of complex enterprise software, ITOA is designed specifically for businesses with up to 750 server, switch and storage nodes requiring greater IT efficiency, faster and easier problem resolution and simplified datacenter management.

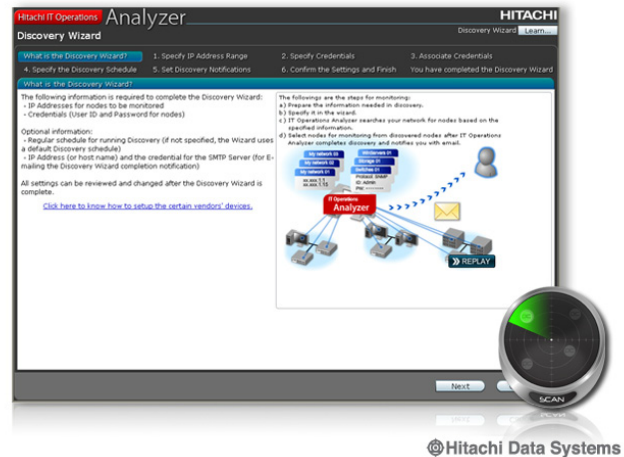
Features Overview

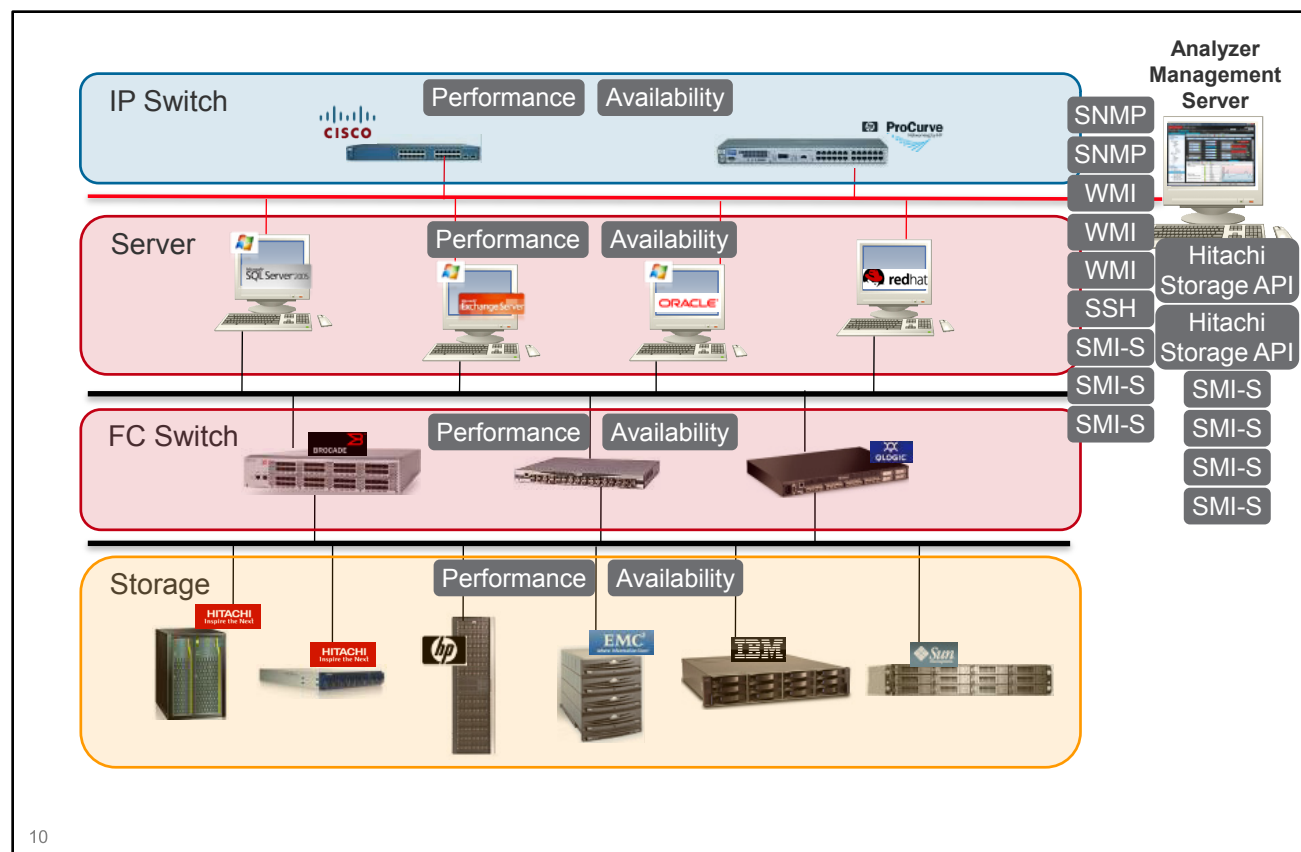


8

Agentless Architecture

- **Capability**
 - No agents required for monitored IT components
 - Easy, cost effective deployment and maintenance
 - Wizard-based discovery configuration
 - Standards interface-based monitoring
- **Business Value**
 - Faster, easier deployment
 - Make managing increasing complexity less complex
- **What Makes it unique?**
 - Enables easy deployment and coverage across IT infrastructure
 - No footprint in managed devices
 - Broader device support





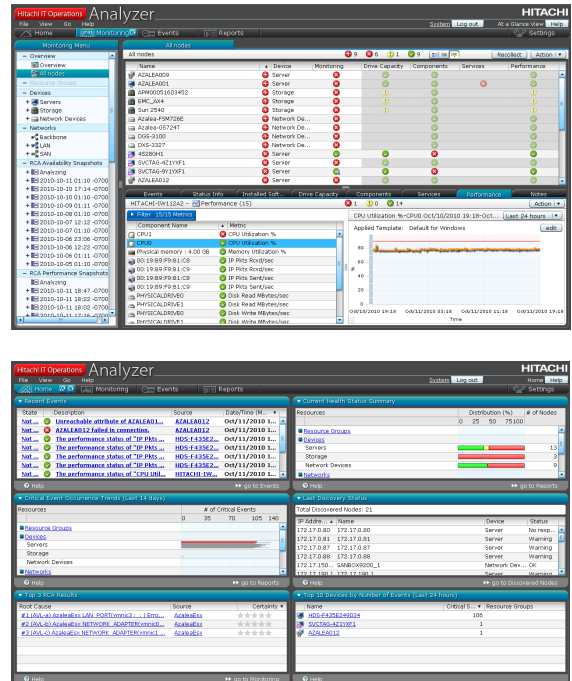
10

Unlike many other performance monitoring software products, ITOA software monitors all the devices in the IT infrastructure without having to install agents on any devices. Installing agents can be problematic, requiring server reboots, affecting application performance and ongoing maintenance to insure that the latest versions of the agents are properly installed and operating. Analyzer uses industry standard protocols including SMI-S, SNMP, WMI and SSH, to monitor the devices in the data center. This simplifies and speeds the deployment of the Analyzer software. In addition when new software versions are released there are no agents that have to be updated or re-installed.

Unified Interface

For Performance and Availability Monitoring

- **Capability**
 - Single console for monitoring LAN, SAN, servers and storage
 - Dashboard provides summarized availability and performance information
 - User installable and wizard-based GUI
- **Business value**
 - Improve IT efficiency, reduce IT infrastructure management complexity
 - Eliminates need for multiple tools
- **What makes it unique?**
 - Monitoring heterogeneous LAN, SAN, servers and storage devices



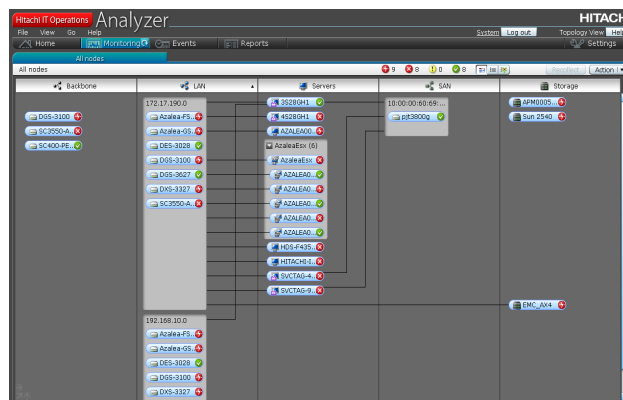
11

One of the key features of Analyzer is the unified interface – a single dashboard that allows customers to monitor servers, networks (both LAN and SAN) as well as storage.

Most of the other products focus are typically server-centric or network-centric (and usually IP networks only). This dashboard provides users with a simple, easy way to see what's going on in their data center in one view.

Simple Network View

- **Capability**
 - Simplified network topology view
 - Integrated with root cause analysis to provide impact analysis
- **Business value**
 - Improves IT efficiency
 - Smart and easy-to-understand solution
- **What makes it unique?**
 - Automatically discovers all devices in IT environment
 - Displays logical connections and topology map in easy-to-understand grid-based layout



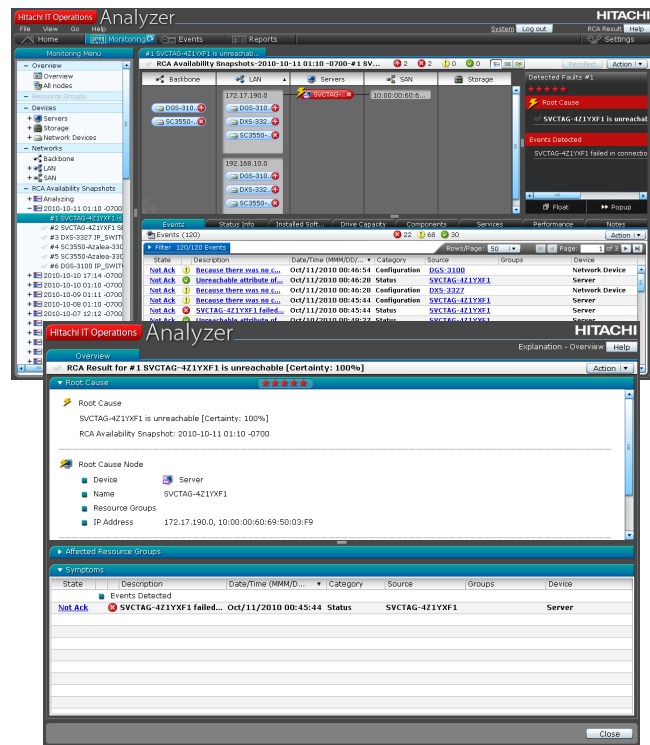
Device configuration and the operating status of each device on a network can be seen at a glance

12

The Topology List View is a technology for viewing the IT infrastructure, paths and relationship. Its unique capabilities help customers view the networks at-a-glance.

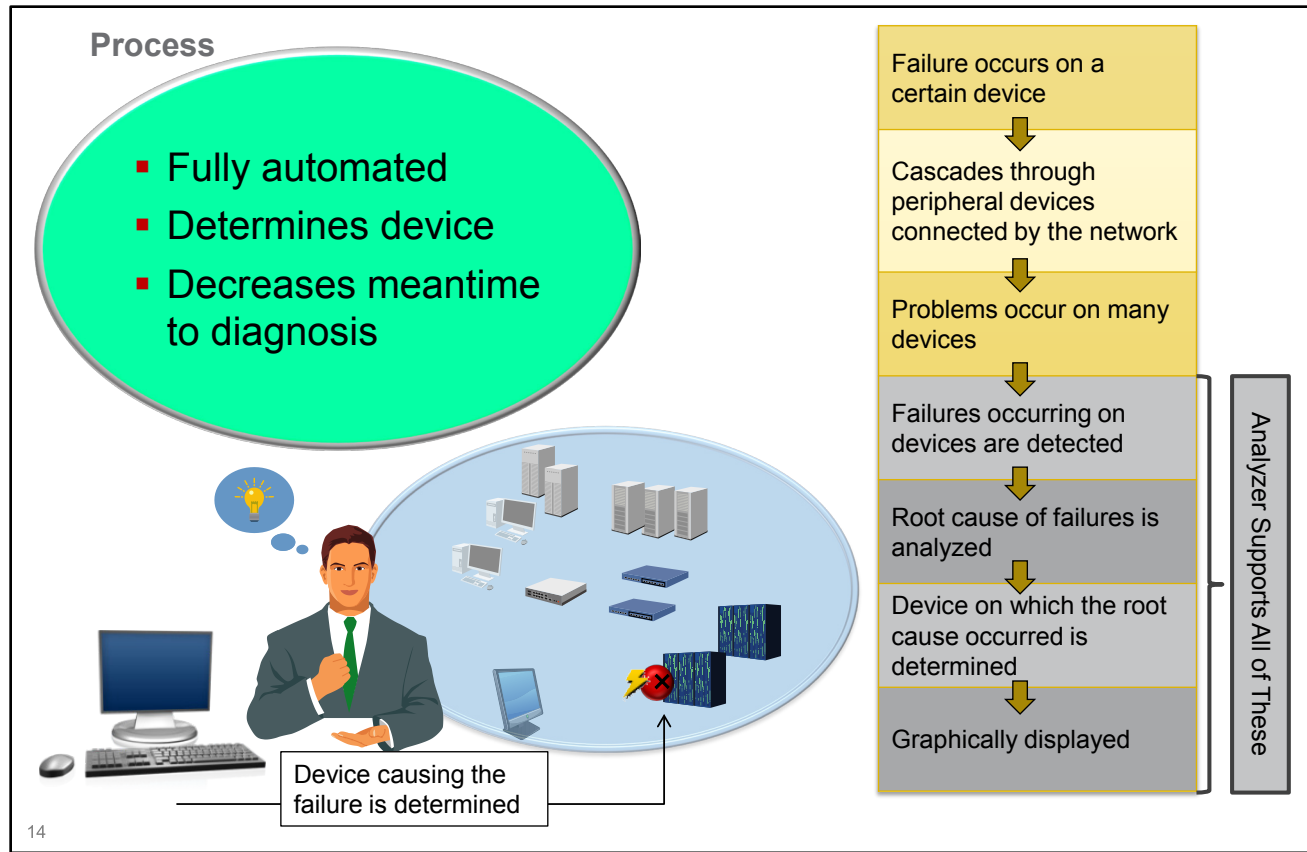
Root Cause Analysis

- **Capability**
 - Unique, expert system-based algorithm
 - Indicates root cause noted for quick recovery
- **Business value**
 - Reduces meantime to diagnose by up to 90 percent
 - Improved availability and service quality
- **What makes it unique?**
 - Fully automated analysis with no manual intervention or configuration



13

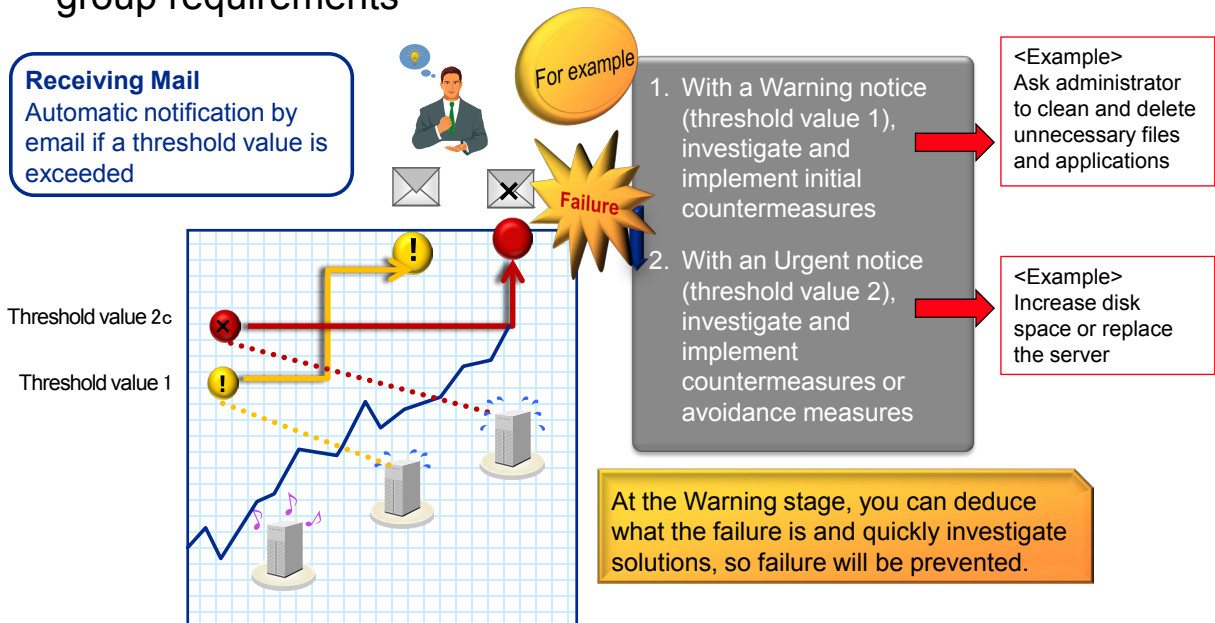
The Root Cause Analysis feature in the ITOA software examines monitored messages and events and then correlates the information and automatically tries to identify the primary event, or root cause, of the event that was responsible for the problem or failure, reducing the mean time to diagnose by up to 90 percent. This helps customers to sift through multiple messages and events that can flood administrators and allows them to quickly and easily identify and resolve problems.



- Fully automated analysis function that does not require manual operation
- Analyzer finds the root cause of failure and determines the device causing it
- Supports significant decrease in mean time to diagnose leading to shortened repair time

Pro-Active Alerting

- Identifies potential problem areas prior to failure
- User-definable threshold templates based on applications or group requirements



15 7

8

At the Warning stage, you can deduce what the failure is and quickly investigate solutions, so failure will be prevented.

Multi-Vendor and Device Support

Supports Virtualization

- VMware
- Microsoft® Hyper-V™

Supports Multiple Operating Systems

- Microsoft Windows®
- Sun Solaris
- Red Hat & SUSE Linux
- IBM® AIX®
- HP-UX

Supports Multiple Devices from Multiple Vendors

- IP and FC Switches
 - Cisco, HP, Juniper, Extreme, Enterasys, NETGEAR, D-Link, Brocade®, QLogic
- Storage
 - Hitachi, EMC, IBM, HP, Sun, NetApp

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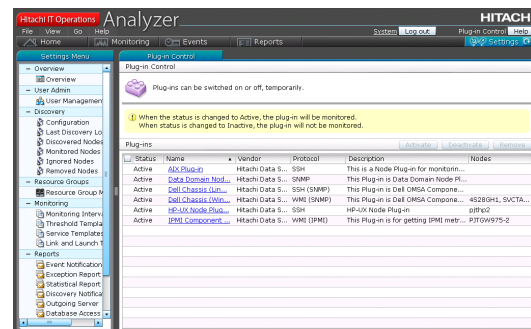
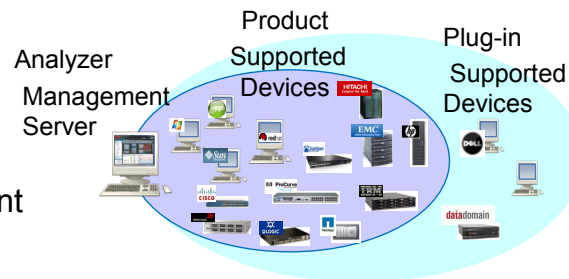
Multi-Vendor Multi-Platform Support

- Enables performance and availability monitoring of multiple operating systems including Microsoft Windows
- Monitors server environmental information
 - Industry-standard IPMI protocol through plug-in
 - OMSA metrics through built-in plug-in for Dell Servers
- Further extends monitoring options with open platform capabilities
 - Includes more flexible plug-in framework
- Offers new Java plug-in framework
 - Provides flexible and powerful way for users to monitor a wider variety of devices in their IT environment

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Open Platform

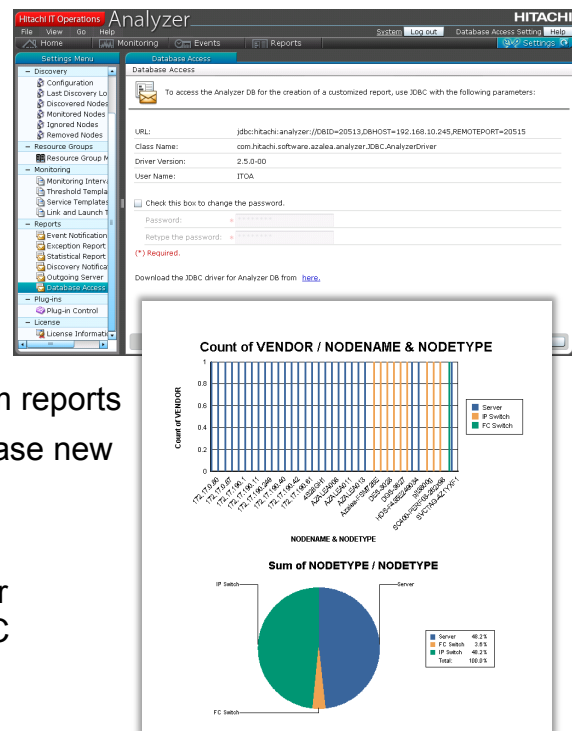
- **Capability**
 - Allows more flexible and powerful plug-ins to be developed
- **Business Value**
 - Plug-ins can be written to meet the specific needs of your IT environment
 - Developed individually
 - Partner developed
 - Available at no cost from Hitachi
- **Technical Benefit**
 - Two development technologies:
 - XML based plug-ins
 - Java based plug-ins (*new*)
 - More flexible and powerful



Reporting Tools

Access for 3rd Party Reporting Tools

- **Capability**
 - Generate reports using your preferred 3rd party reporting tool (such as Crystal Reports), using the Analyzer software DB information (read only access)
- **Business Value**
 - Provides the ability to create custom reports
 - Does not require the need to purchase new reporting tool or product
- **Technical Benefit**
 - Simple to set-up –install JDBC Driver (shipped with Analyzer) into client PC



Hitachi Data Systems Software Offerings

Product Comparison

Feature or Function	Hitachi Device Manager Software†	Hitachi Tuning Manager Software	Hitachi Storage Services Manager Software	Hitachi Storage Capacity Reporter Software	Hitachi IT Operations Analyzer Software
Comprehensive Single Screen View of LAN, SAN, Servers and Storage					●
Storage System: Disk Capacity Utilization Monitoring and Reporting	●	●	●	●	●
Storage System: Disk Capacity Historical Trending and Forecasting		●	○	●	
Host: Disk Capacity Utilization Monitoring and Reporting	○*	●*	●*	●	●
Application: Disk Capacity Utilization Monitoring and Reporting	○*	●*	●*	●	
Deep Storage System Performance Monitoring and Reporting		●			
System Provisioning	●		○		
Monitoring and Notification		●	○	○	●
Heterogeneous Storage Support	○**		●	●	●
Topology Rendering			●		●
Customer Installable and Configurable	○			●	●
Agentless				●	●
Impact and Root Cause Analysis		○			●
IP Switch Monitoring and Notification					●
Auto Device Discovery				○	●
Support for VMware and Microsoft® Hyper-V®	○***	○***	○***	○***	●
Enterprise	●	●	●	●	
Small and Medium Business (SMB)/Small and Medium Enterprise (SME)	○	○		○	●

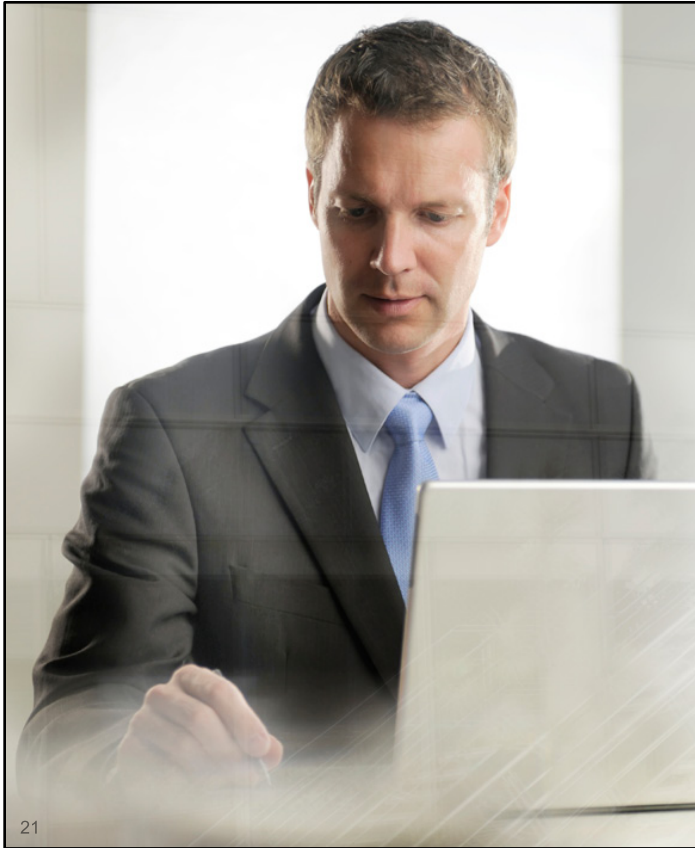
● Full functionality ○ Partial functionality * Full functionality requires installation of Agent software.
 ** External storage only *** Supports VMware only † Status update not automatic. Click required for fresh data

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ITOA software is a monitoring product for the entire IT infrastructure, including servers, IP and Fibre Channel network devices and storage systems. Hitachi Command Suite software products are primarily focused on storage.

ITOA is a software product in a new category for Hitachi Data Systems, extending beyond storage into overall IT infrastructure monitoring.

Instructor Demonstration



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- HITOA GUI



Hitachi IT Operations Director (ITOD)

Key Challenges

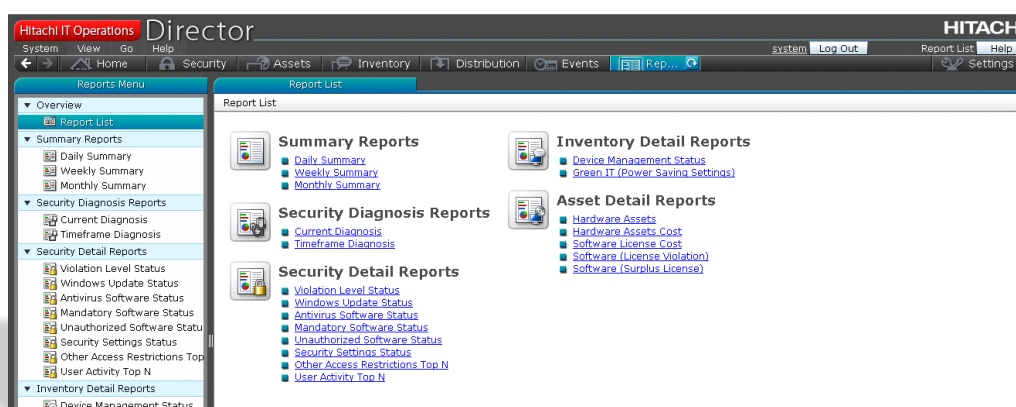
- Software management
- Software license agreements compliance
- Tracking all of your IT hardware and software assets
- Proactive hardware and software issues management
- Information security
- Software and file distribution
- Downtime due to software maintenance

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Some of the IT management related challenges faced by medium to large sized businesses.

Product Overview

- All-in-one IT lifecycle management software solution
- Designed for medium businesses
- Administers key lifecycle functions
 - Security management
 - Asset management
 - Software distribution



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For businesses seeking greater control over their IT environments, ITOD provides an integrated IT lifecycle management software solution.

Director is an all-in-one, world-class software solution focused on the key lifecycle management functions of Security Management, Asset Management and Software Distribution.

Designed specifically for medium businesses, Director is easy to install, easy to configure and easy to learn – so you can spend more time growing your business and less time managing your IT environment. Director offers flexible deployment options, including agentless operation and integration with Active Directory.

By combining Security Management, Asset Management and Software Distribution all in one product, each will integrate with the other to provide a powerful solution in managing the IT environment.

Key Features

■ Security Management

- Automatically correct a computer's inappropriate or risky settings
- Issues pro-active alerts to system administrator
- Prohibits use of unauthorized USB drives
- Records and traces user activity
- Provides file-level auditing
- Enables mass distribution and installation of any software application or file.
- Blocks and removes prohibited software
- Enables generation of a wide variety of security-focused reports

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- Allows System Administrators (SAs) to automatically correct a computer's inappropriate or risky settings
 - ♦ Simply by applying a security policy
- Issues pro-active alerts to the SA
 - ♦ Identify potential risky action involving information disclosure
- Records and traces user activity
 - ♦ Only logging information that violates security policies to reduce the volume of data
- Provides file-level auditing
 - ♦ Allows administrators to quickly determine if a file has been copied, moved, emailed, modified or deleted
- Enables mass distribution and installation of any software application or file
 - ♦ Including anti-virus software and updates.
- Blocks and removes software
 - ♦ That the SA defines as prohibited
 - ♦ Automatically installs mandatory software
- Enables generation of a wide variety of security-focused reports
 - ♦ Including top offender|| reports that prioritize actions

■ Asset Management

- Manages hardware assets ,software license assets.
- Manages and stores contracts with related hardware and software.
- Integrates with Active Directory to discover PCs
- Provides simple and flexible methods to import asset information not connected to the network
- Aggregates total costs associated with assets
- Displays licenses allowed versus installed

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- Manages hardware assets and software license assets
 - ♦ Server, desktop, storage, switch, etc.
- Manages and stores contracts with related hardware and software
 - ♦ Type, cost structure, start and end date, etc.
- Integrates with Active Directory to discover PCs
 - ♦ Can scan office networks for quick inventory of assets
 - ♦ Details of the assets are automatically stored and organized
- Aggregates the total costs associated with asset
 - ♦ Purchase, lease, rental, support etc.
 - ♦ Quarterly, bi-annual and annual increments to support budget planning
- Displays licenses allowed versus installed
 - ♦ In a single screen the number of licenses allowed per the current software license agreement
 - ♦ The number of licenses currently assigned
 - ♦ Any surplus or over-allocated licenses.

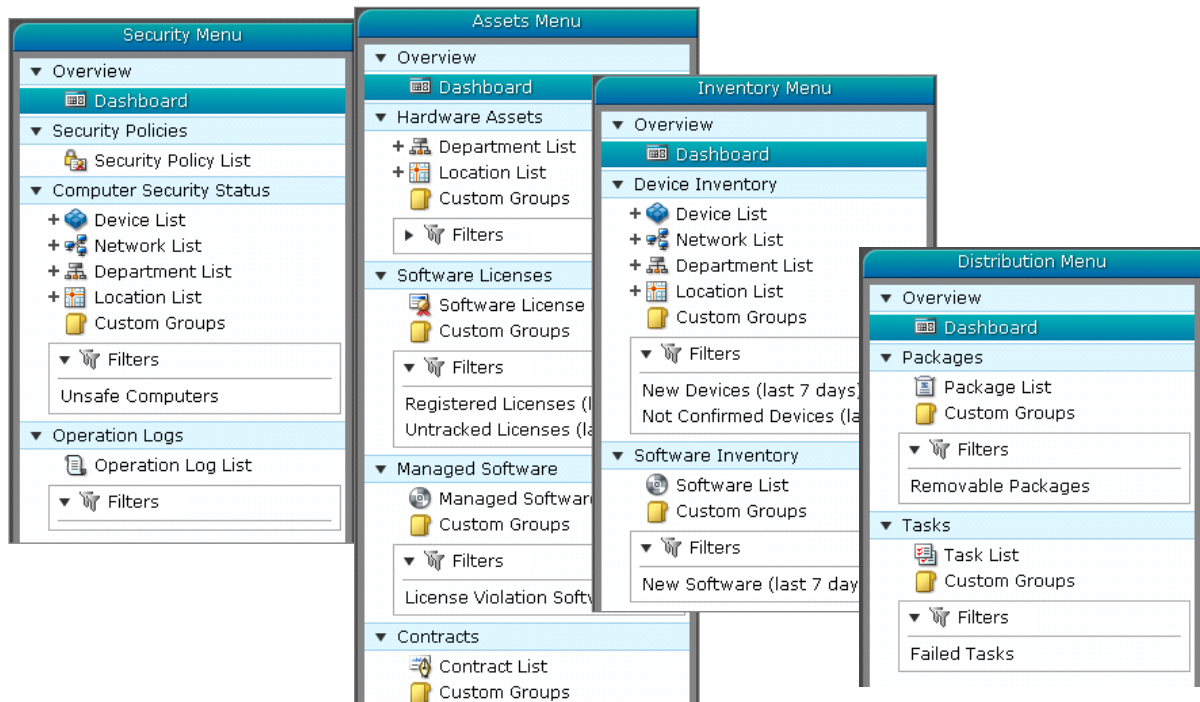
- **Software Distribution**
 - Distributes software packages
 - Installs software to multiple computers
 - Deploys software and patches on computers

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- Distributes software packages
 - ♦ Executables (MSI, EXE)
 - ♦ Compressed packages (ZIP)
 - ♦ Scripts (BAT)
- Installs software to multiple computers
 - ♦ In one simple task
- Deploys software and patches on computers
 - ♦ Specified times
 - ♦ Scheduled maintenance

Operations

■ ITOD Functionality



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Security Management

Director provides a comprehensive security solution that relieves the pressure on the IT staff and enables them to focus on supporting a growing business. Director includes both security policy management and PC auditing.

Asset Management

Director provides complete management of hardware assets (server, desktop, storage, switch, etc.), software license assets and asset contracts. It manages and stores contracts (type, start and end date, etc.) with related hardware and software. It gives you the control you need to manage your assets in less time. You can ensure compliance and reduce the ongoing headaches and worries so often attached to asset management.

Inventory Management

Quickly inventories and lists all monitored computers. Collects installed software information for each PC automatically

Software Distribution

Efficiently managing software distribution and provisioning is an ongoing challenge in many IT environments, especially where software has to be installed one computer at a time. Such methods are time-consuming and often lead to errors and oversights.

Reports



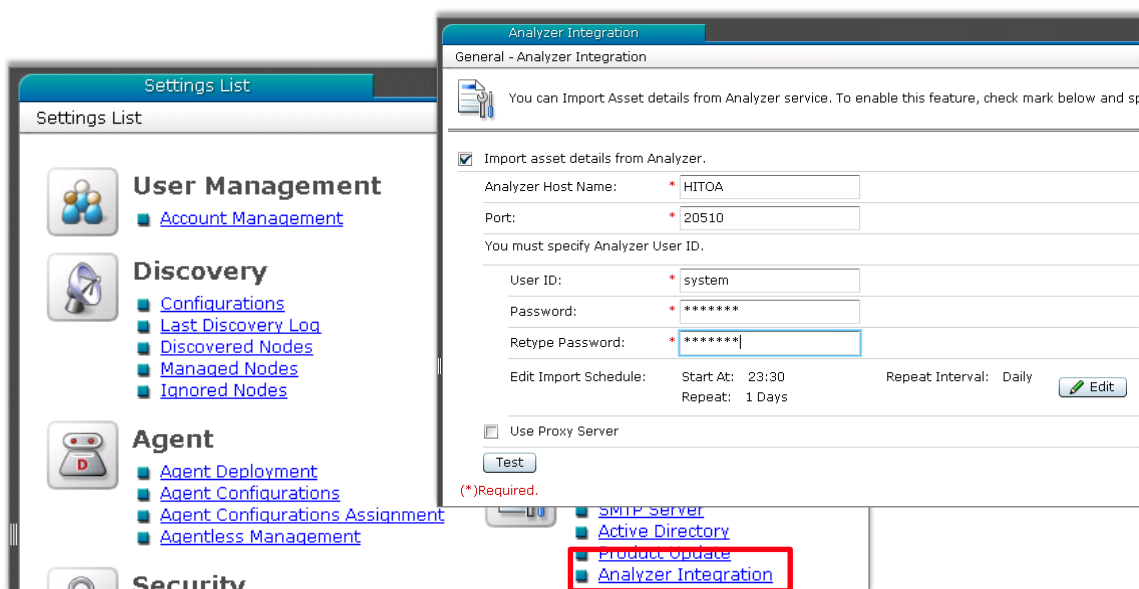
29

Reporting

- Provides 20 pre-configured reports that can be customized using report options that allow for comparison over various time frames, device types, departments, locations, etc.
- Allows reports to be stored for up to 10 years, supporting year-over-year trend analysis.
- Enables reports to be sent to a new window for side-by-side comparison.
- Supports easy report formatting for printing.
- Provides detailed and summary reports; allows IT managers and executives to see a brief, insightful status of the IT infrastructure.

ITOA and ITOD

- ITOD can integrate with ITOA 2.5 or later
 - Import hardware assets information from ITOA



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ITOD can integrate with ITOA 2.5 or later. In this Analyzer Integration window, you can enable and specify settings to import asset details from ITOA. When you turn Analyzer Integration on, ITOD will create two custom fields Number of Ports and Number of Storage Disk Drives for Analyzer Integration.

■ Information imported from ITOA

N o.	Item	Description
1	Hardware	Common name (AnalyzerNode.elementName). For servers, usually a host name. For other hardware, usually a device name.
2	Description	A description is copied in plain-text format, if available.
3	Hardware type	Hardware types that are set by users (servers, network devices, storage devices, and unknown) are mapped to the corresponding hardware types. If the administrator has already set hardware types by using ITOD, users cannot overwrite them.
4	Model	Hardware model
5	Manufacturer	Hardware manufacturer
6	Serial number	Hardware serial number
7	CPU	A CPU name is set for servers. If multiple CPUs exist in an SMP configuration, the name of one of them is set.

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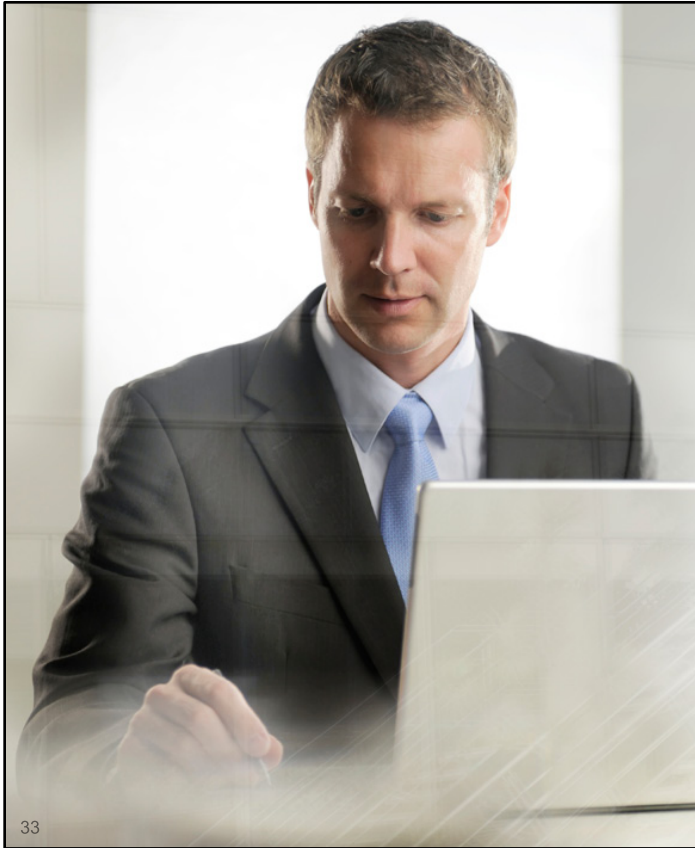
■ Information imported from ITOA (cont')

N o.	Item	Description
8	Memory	The amount of memory installed is stored in bytes (for servers).
9	HDD	Total capacity of all hard disk drives is stored (for servers and storage).
10	IP Address	One of the available IP addresses is transmitted and stored.
11	MAC Address	One of the available MAC addresses is transmitted and stored.
12	Host Name	Host names and other device names are stored (for servers).
13	OS	The OS (for servers) or firmware (for others) is stored.
14	Number of Ports	The number of managed ports is stored (for IP switches or FC switches). Custom Field (Number) is used to store this information.
15	Number of Drives	The number of hard disk drives for the device is stored (for IP switches or FC switches). Custom Field (Number) is used to store this information.

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For ITOD's management purposes, You can import hardware assets information from ITOA.

Instructor Demonstration

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.

- HITOD GUI

The logo is a square with a blue border. Inside, there is a white letter 'D' with a blue outline. To the left of the 'D' is a green vertical bar, and to the right is a red vertical bar.

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Module Summary

- Described the features and functions of Hitachi IT Operations Analyzer software
- Described the features and functions of Hitachi IT Operations Director software

Module Review

1. What is the purpose of IT Operations Analyzer?
2. What is the purpose of IT Operations Director?

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23. Hitachi Command Director

Module Objectives

- Upon completion of this module, you should be able to:
 - Describe Hitachi Command Director software features and functions

2

Introduction

- Centralized business application management policies and operations
- Monitor compliance to application-based storage service levels
- Improves capacity utilization and planning of Hitachi storage environments

3

Centralized business application management policies and operations

- Organize and view storage assets based on business applications and functions
- Consolidates reporting and management of storage configuration, tier, policy, capacity, and performance across the Hitachi Command Suite
 - ♦ Easily align Hitachi storage assets with the business applications that rely on them

Monitor compliance to application-based storage service levels

- Define policy-based storage service levels by business application
- Monitor key storage capacity and performance indicators by applications to ensure their adherence to required service levels
- Global dashboard for storage system health and application performance tracking

Improves capacity utilization and planning of Hitachi storage environments

- Properly analyzes key statistics aggregated from multiple Hitachi Command Suite products
- End-to-end capacity utilization trends from application, hosts/virtual host, to storage devices
- Supports all Hitachi storage environments

By leveraging data from Hitachi Device Manager, Hitachi Tuning Manager, and Hitachi Tiered Storage manager, Hitachi Command Director provides the following business use cases:

- Business centric view of storage allocations and utilizations
- Monitor application's performance and capacity utilization health
- Troubleshoot performance service level violations related to applications
- Provide chargeback support in terms of performance and capacity
- Correlate host and storage side capacity utilization trends for capacity planning
- Analyze capacity utilization to identify waste and risk
- Plan and identify the best place to introduce new application/workload in my storage system

Helps to Address Following Challenges

Storage Status Summary

Quickly check storage status for my data center and monitor any service level violations

- Review global dashboard or overall storage utilization summary report
- Near real time application status and service level monitoring
- Global reporting of defined thresholds and when they have been exceeded

Global Dashboard



Business Views



Reports



Application Service Level Management

Assign service level objectives for my applications and investigate any service level violations.

- Define service level objectives per application
- Enforce application service levels and storage tier policies
- Drill down service level violations to isolate and investigate bottlenecks

Business View of Utilization

Organize my storage assets to support the following business use cases:

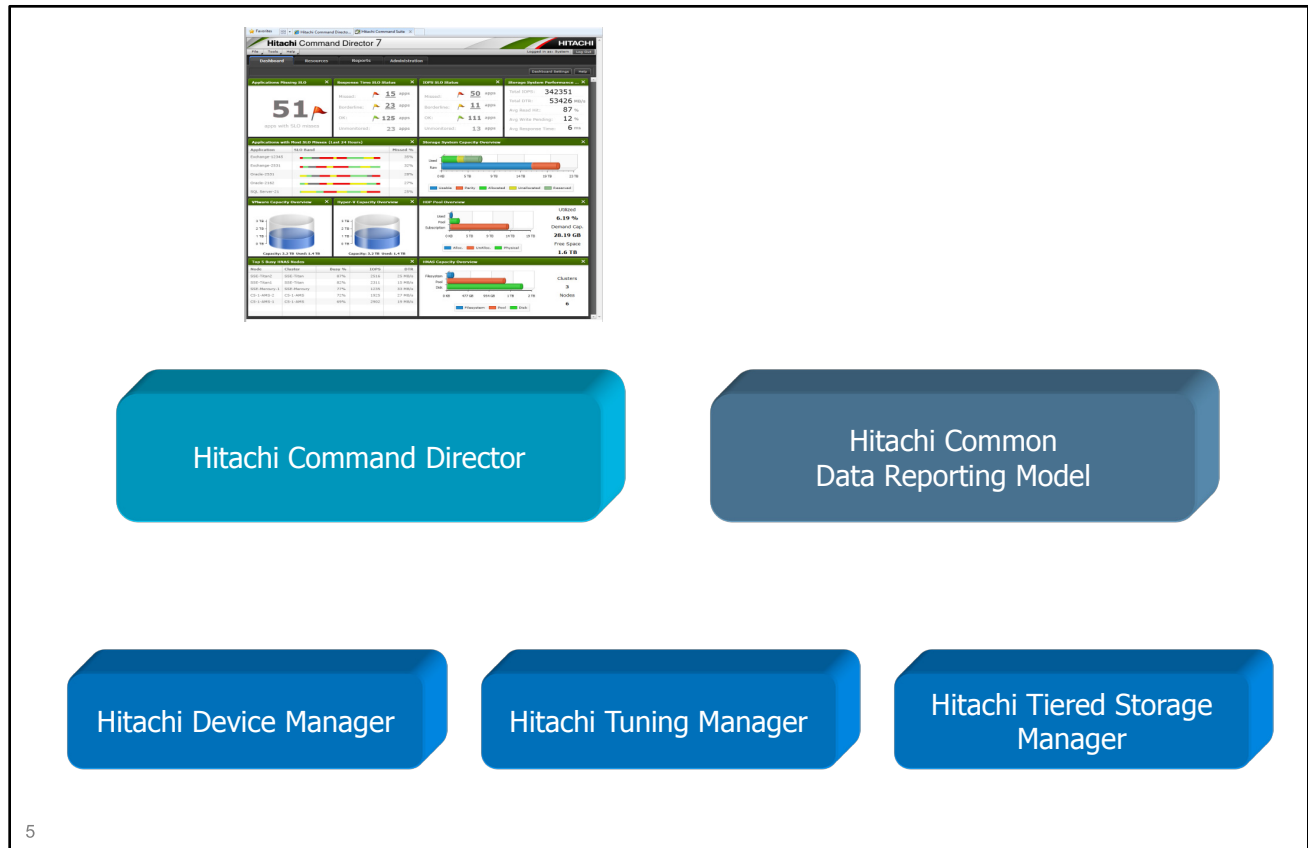
- Align mission critical business applications to tier 1 storage assets
- Increase and optimize capacity utilization
- Implement chargeback and cost analysis

Capacity Management

View and analyze historical utilization trends for the following activities:

- Identify underutilized storage capacity
- Determine optimal deployment for new application workloads
- Properly plan future storage purchases

Central HCS Reporting and Operations



5

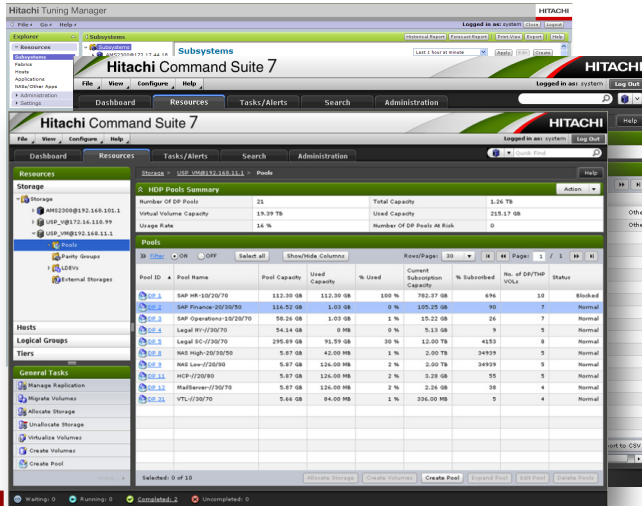
HCS = Hitachi Command Suite

Hitachi Command Director introduces a new common data reporting model across the Hitachi Command management suite. Utilizing a common data reporting model, the Hitachi Command Director consolidates management statistics from Hitachi Device Manager (Hitachi Basic Operating System), Hitachi Tuning Manager, and Hitachi Tiered Storage Manager for centralized storage management operations.

Hitachi Command Director



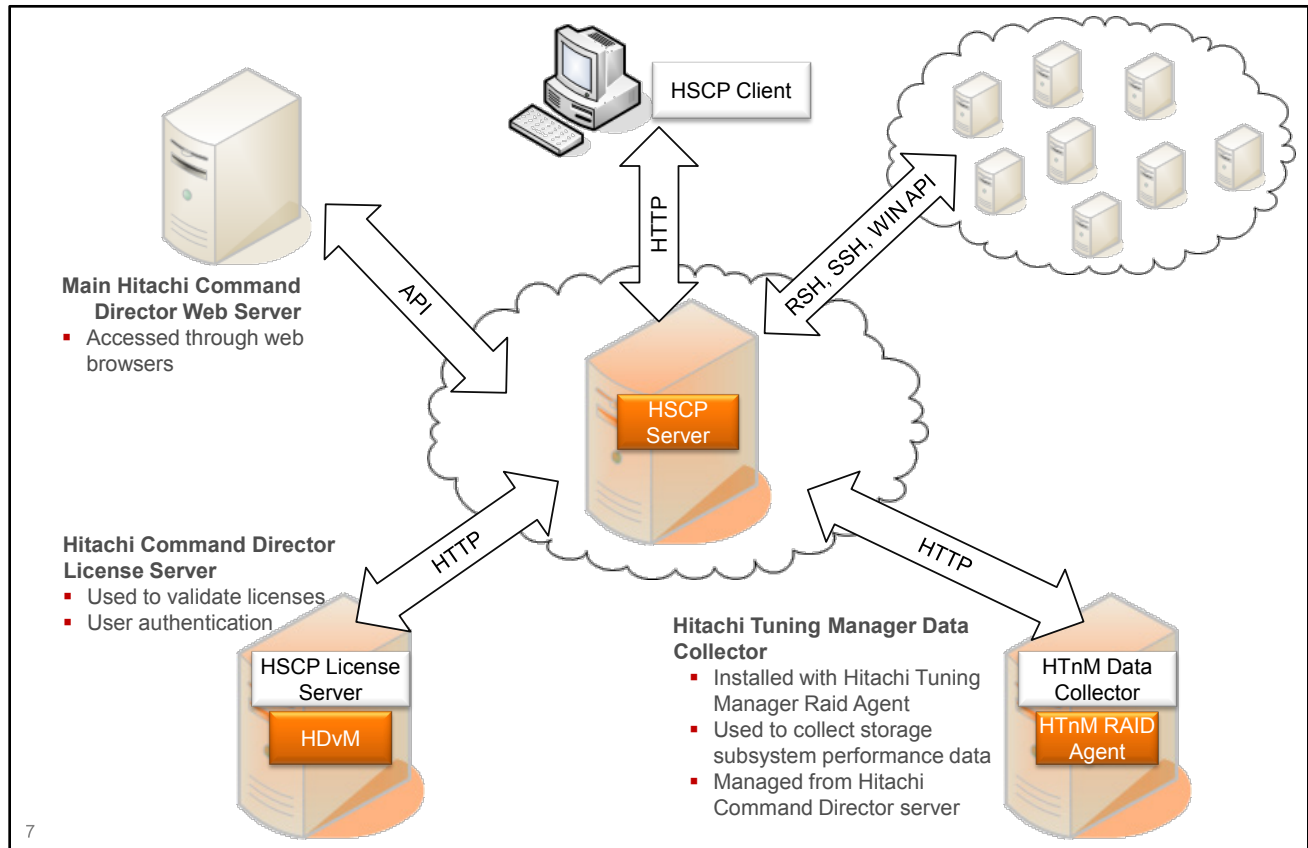
Merge storage performance data from multiple instances of *Hitachi Tuning Manager*



Merge storage configuration data from multiple instances of *Hitachi Device Manager*

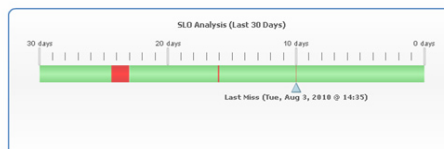
Merge storage tier data from *Hitachi Tiered Storage Manager (Optional)*

Software Architecture



Storage Service Level Monitoring and Troubleshooting

- Monitor Service Level Objectives for Business Applications
 - When storage resources are provisioned to a business application, they need to be properly monitored to ensure specific application service requirements are being met.
 - Define storage policies for each application measured by appropriate storage capacity and performance metrics
 - Alert administrators when application service level objectives have been exceeded or violated.



- Investigate Service Level Objective Violations
 - Global dashboard monitors application service level objective status.
 - SLO investigation unit helps to quickly identify and isolate potential causes of SLO violations



Application Service Level Objectives

- Average storage response time
- Total IOPS
- Data transfer rate (MB/s)

8

Feature: Improve capacity utilization and planning of Hitachi storage environments

Capabilities

- Report and analyze end-to-end views of current and historical trends for storage capacity and performance utilization
 - ♦ Identifies underutilized capacity
 - ♦ Identifies optimal deployment of new application workloads
- Facilitates chargeback of storage utilization back to consumers
- Supports all Hitachi storage environments
 - ♦ Hitachi NAS: Provides storage capacity reporting for HNAS clusters, file systems, storage pools and nodes

Business value

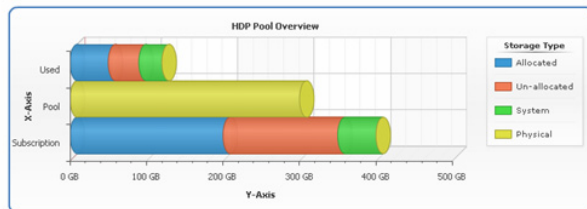
- Aggregates and trends the statistics required for proper storage capacity and performance analysis
- Reduces the resources and effort required for effective storage forecasting and planning

What is unique about this feature?

- Improves capacity utilization and performance

Storage Capacity Utilization and Planning

- Analyze storage capacity and its consumption patterns
 - Overall storage utilization and growth trends for HDP and HDT
 - Storage to physical and virtual server inventory and usage reporting
 - Correlate virtual server to logical device mappings
- Plan for optimal utilization and future growth
 - Storage Economics based reporting for improved ROI and TCO
 - Storage waste identification and reclamation
 - Capacity efficiency analysis
- Facilitate chargeback
 - Reporting of application per gigabyte by storage tier and frequency
 - Monitor and record static growth and dynamic movement across storage tiers



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HDP = Hitachi Dynamic Provisioning

HDT = Hitachi Dynamic Tiering

ROI = Return On Investment

TCO = Total Cost of Ownership

- Analyze storage capacity and its consumption patterns
 - ♦ Overall storage utilization and growth trends: both applications and business units
- Plan for optimal utilization and future growth
 - ♦ Storage Economics based reporting for improved ROI and TCO
 - Storage waste identification and reclamation
 - Capacity efficiency analysis

Application reporting frequency: day, week or month

Summary

- Centralized business application management policies and operations
- Business value: Ensures Tier 1 storage assets are properly aligned with mission critical, business applications

Capability – Define and enforce application based service levels and storage tier policies

Capability – Monitor key storage capacity and performance indicators by applications

Feature – Ensures compliance to application-based storage service levels

- Business value: Improves capacity utilization and performance

Capability – Report and analyze end-to-end views of current and historical trends for storage capacity and performance utilization

Capability – Identifies underutilized capacity and optimal deployment of new application workloads

Capability – Facilitates chargeback of storage utilization back to consumers

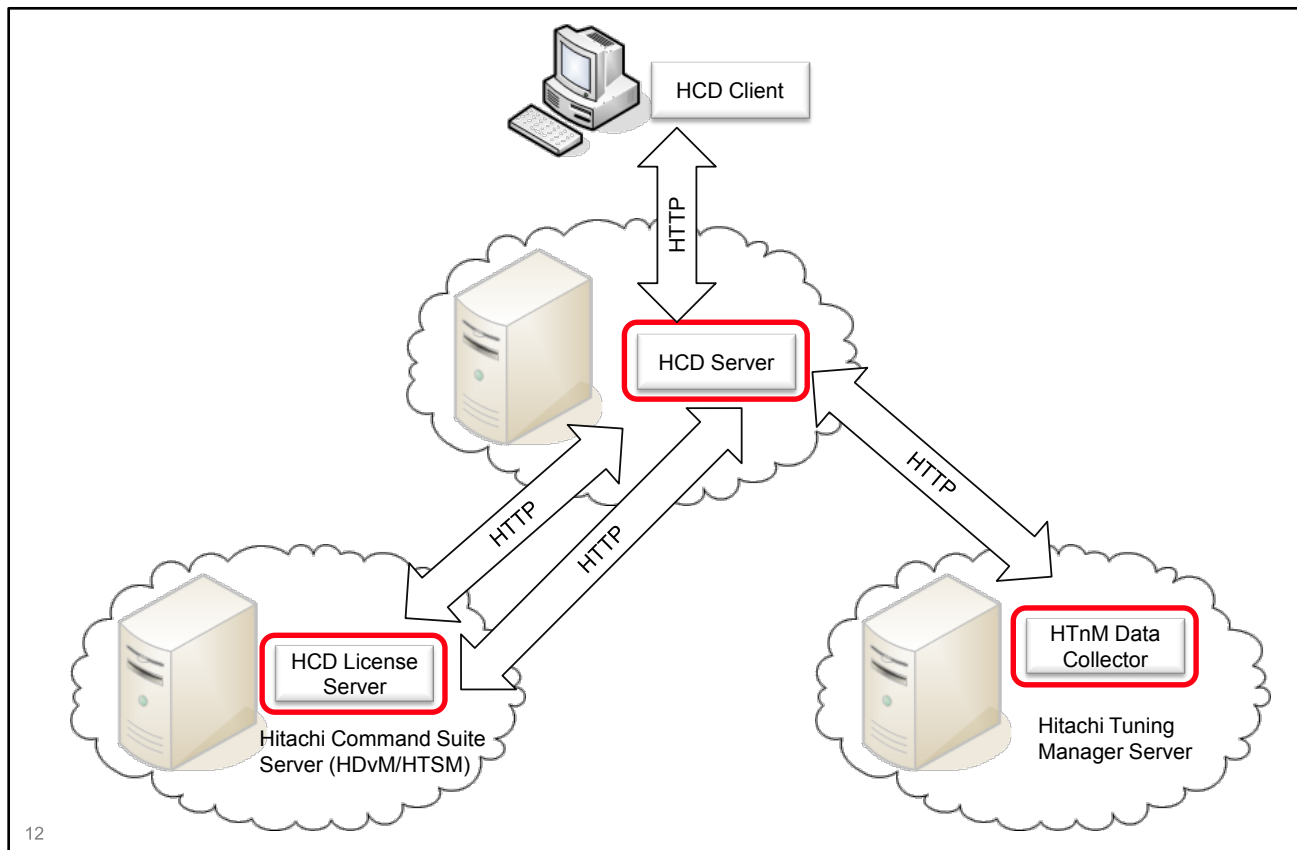
Feature – Improves capacity utilization and planning of Hitachi storage environments

Architecture

- Components
 - License Server
 - Device Manager and Tuning Manager Collectors
 - Host Collector
- Architecture Overview
 - Host Collector
 - Data Flow
 - Data Collection Process

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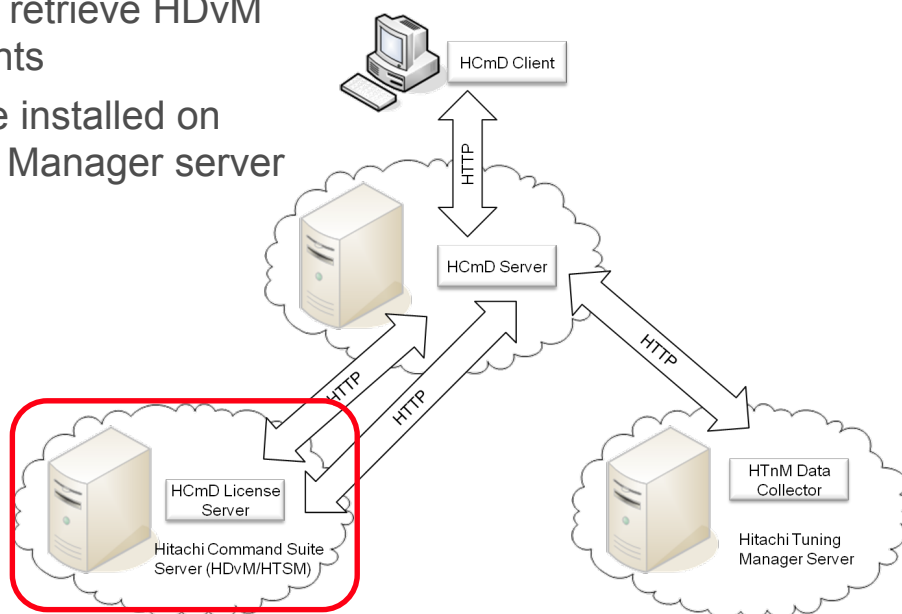
Components



License Server

■ Installation

- Installed on HDvM server to validate Command Director license and retrieve HDvM user accounts
- Can only be installed on one Device Manager server



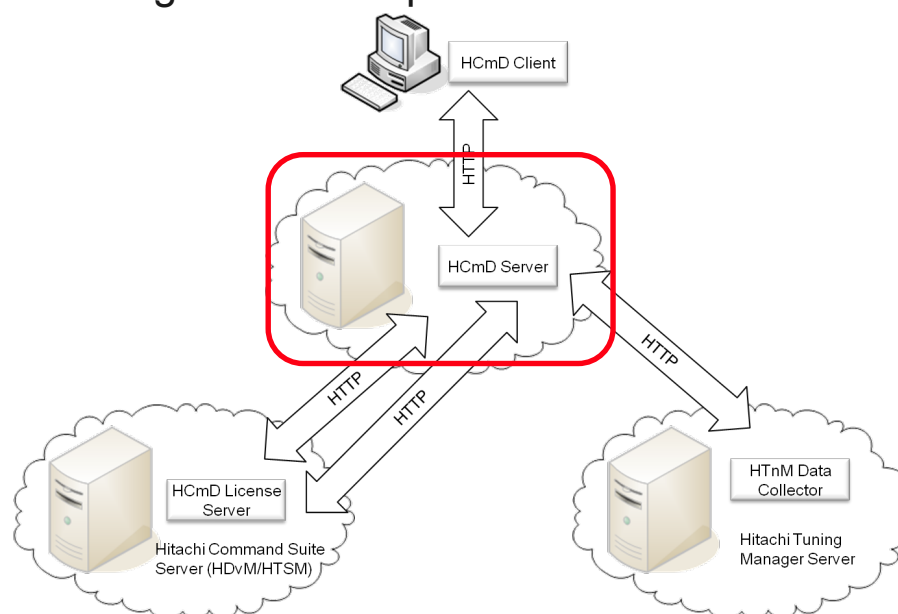
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The user accounts from the Device Manager instance where the License Server is installed are also used by Command Director. To utilize user accounts from a different Device Manager instance, install the License Server on the corresponding Device Manager instance host. Only one running instance of the License Server is supported at a time.

Collectors

Device Manager and Tuning Manager

- HCD server uses HDvM and HTnM collectors to retrieve storage system configuration and performance data

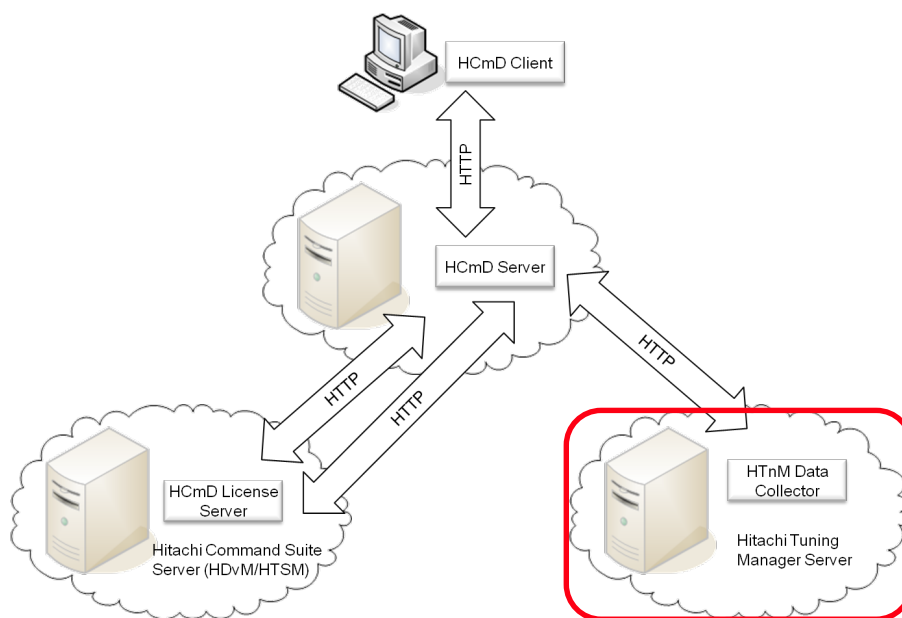


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The HCD Server also provides the Host Collector that discovers hosts on your network and gathers file system and storage utilization information from the hosts in your network. This allows HCD to provide mapping of a complete end-to-end path from the host to the storage system volumes.

Tuning Manager

- HTnM Data Collector is installed on every HTnM server

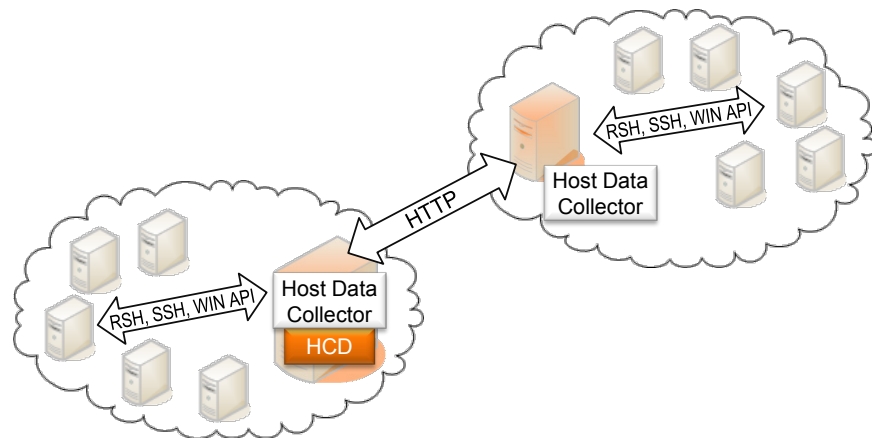


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You must install a HTnM Data Collector module on each server where the Tuning Manager Server is installed. The HTnM Data Collector must be installed as described in Installing the HTnM Data Collector section of the *Hitachi Command Director Installation and Configuration Guide*.

Host

- Configure host probes that discover the hosts
- Install the Host Collector software on one server in each



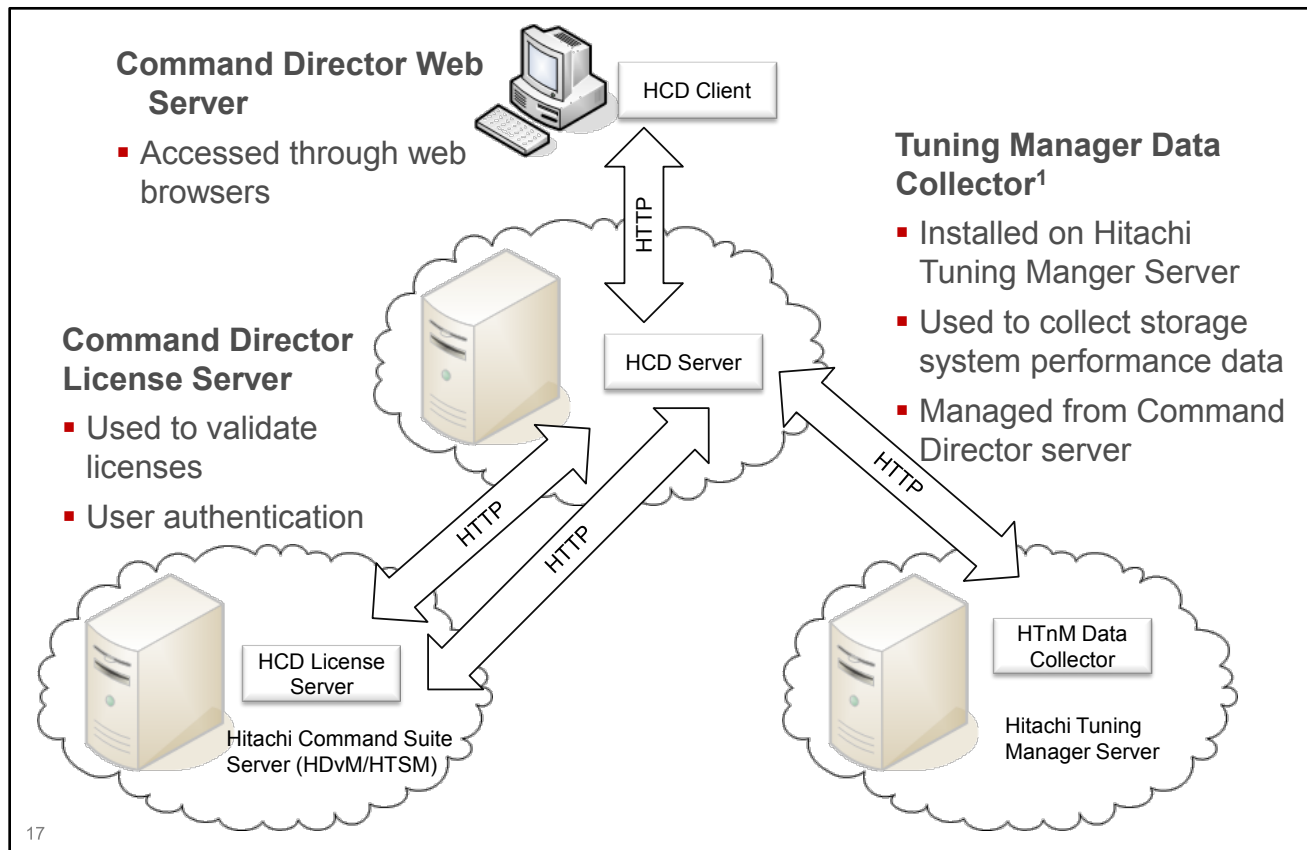
16

The Host Collector allows you to configure host probes that discover all the hosts in your network and provides end-to-end mapping of the path from the hosts to the storage system volumes. You must install the Host Collector software on one server in each subnet in the network in which you wish to discover the hosts.

You can use the Host Collectors feature to perform an agent-less discovery of the hosts on your network and gather their file system and storage utilization information. This allows HCD to provide end-to-end mapping of the path from the host to the storage system volumes.

For example, consider a scenario in which a particular host has two host bus adapters with two ports each. From the point of view of the storage array, the four ports appear as four different WWNs. But when HCD collects the host data, you can see that the volumes provisioned to the four WWNs are actually used by the same host or application. Thus, HCD allows you to see the big picture of how your storage is used.

Software Architecture Overview



Here is a depiction of the basic software architecture that the Command Director leverages to gather and consolidate data from both Device Manager and Tuning Manager:

Note:

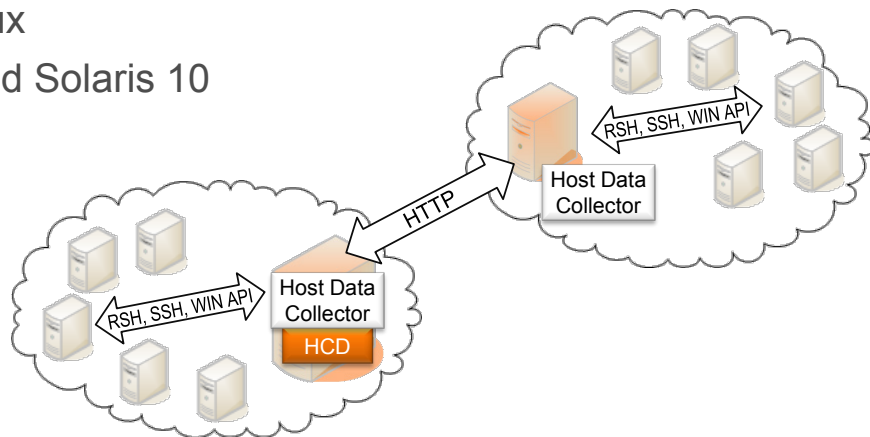
- Installed on the same host where the Tuning Manager Agent for RAID is installed.
- One or more per host, but cannot be shared across multiple Command Director servers.
- Used to collect storage system performance data and send it to the registered Command Director server.
- Does not have a user interface (GUI).
- Managed from Command Director server.
- Tuning Manager software works with full or core licenses.
- An SMTP server is necessary for sending alarms and reports.

HDvM = Device Manager software

HTnM = Tuning Manager software

Host Collector

- Host Collector can discover hosts on the following platforms:
 - Windows 2003 and Windows 2008
 - HyperV
 - VMware
 - Redhat Linux
 - Solaris 9 and Solaris 10
 - HP-UX
 - HNAS



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Host Discovery executes scripts remotely. When absolutely needed, binaries and libraries are copied to target servers, executed, and then cleaned up (including all the files generated during execution).

The benefits of the agent-less data gathering mechanism used by the Host Collector are as follows:

- Removes the need for manual installation, upgrades, and uninstallation of agents on the target servers.
- These executables are no different in functionality than executables run by a deployed agent.
- All data gathering operations are done within the allowed security framework. There is no hacking, no malware, and no Rootkits deployed.
- The agent-less data gathering mechanism uses only open-standard protocols (such as Telnet, SSH, Win Service, WMI, etc.). No proprietary protocols are used.

For a complete listing of supported hosts refer to **Host Collector Server support matrix** section of the **Hitachi Command Director Installation and Configuration Guide**.

Internal Data Collection Process

- All data collection done in two passes:
 1. Collector Scan
 2. Data Gathering
- Collection steps are:
 1. Scan all HDvM/HTSM instances to find the storage systems being monitored
 2. Scan all Tuning Manager data collectors to find the storage systems being monitored
 3. Get the configuration data from HDvM/HTSM software
 4. Initiate the performance data collection in the HTnM data collector
 5. Data Refresh: After collection process is complete, at start of SLO monitoring process
- Logical Group data is collected together with storage system configuration data
- User data refresh

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Two passes:

- Collector Scan: find the available storage systems
- Data Gathering: initiate the gathering process in order to collect data from the available storage systems

By default the performance data collection interval is five minutes.

If the collecting interval for any metric that Command Director polls from the Tuning Manager Agent for RAID is set to more than five minutes, Command Director will not monitor this storage system.

Licensing Scheme

- Capacity/Frame licensing
- VSP licensing
 - By VSD Pair and total usable capacity in blocks
- USP V or VM licensing
 - By Base plus capacity range for total raw capacity
- AMS 2000 licensing
 - By AMS2000 model, unlimited capacity
- USP/NSC55 licensing
 - By USP or NSC55 system, unlimited capacity
 - Based on average capacities – USP 50TB, NSC55 16TB

Overview

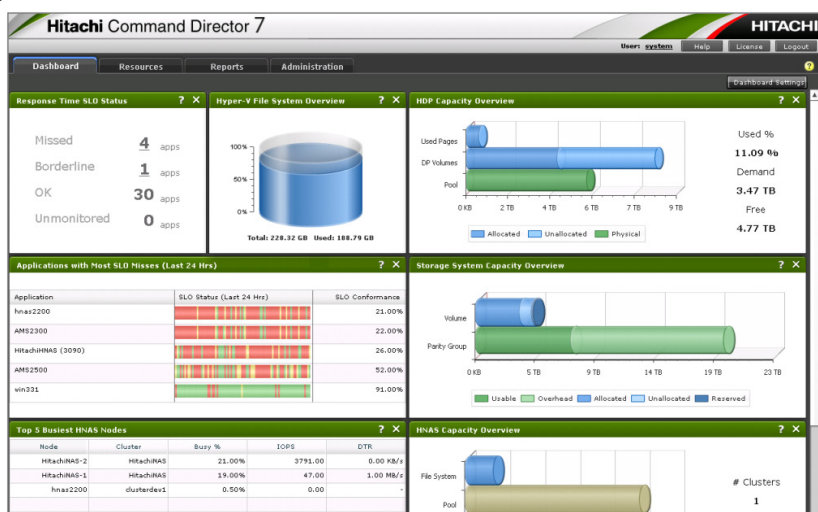
- Dashboard
- Business Views
- Administration
- Functionality Overview



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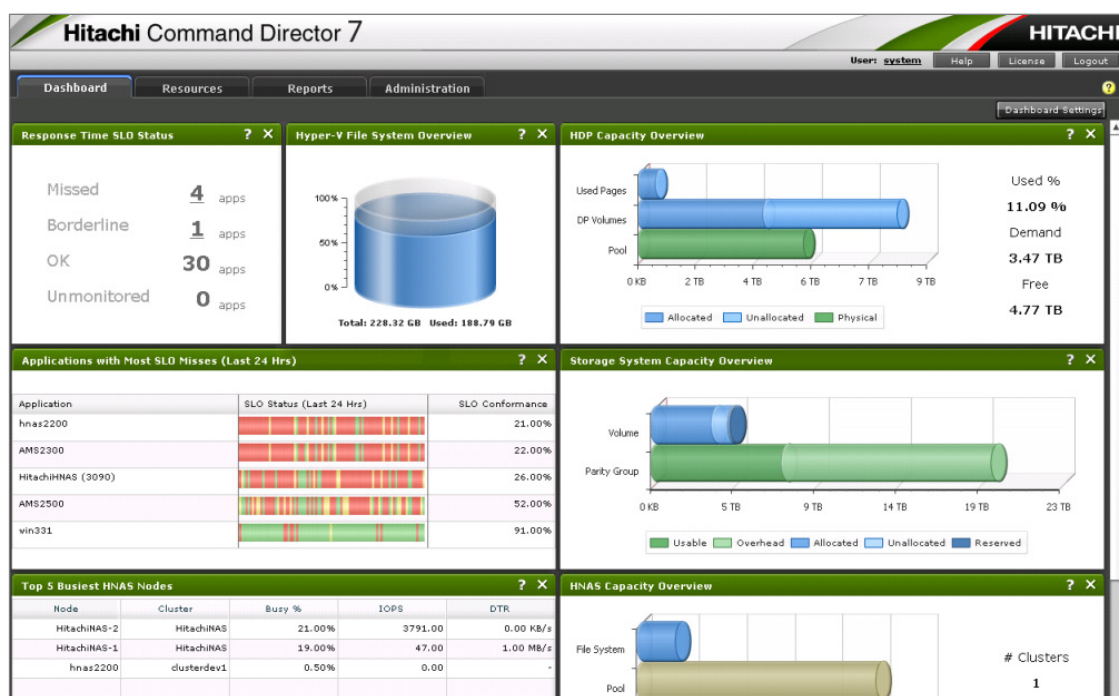
Global Dashboard

- Initial screen on login
- Quick overview
 - Application Status
 - Storage Health



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The initial dashboard provides fast and simple access to timely, accurate status of your applications and storage health. This allows immediate use of Command Director.



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The dashboard reports on your application health based on real-time service level objective (SLO) information. It gives a resource summary report that displays the capacity and performance data of your storage resources, and health of the datastores in your enterprise.

The dashboard displays status for all applications that are currently monitored against defined storage SLOs, which is an operation guideline set for the implementation of service negotiated under SLAs (service level agreements). An SLO profile groups storage SLOs, and associates the SLOs with an application. When an application is assigned an SLO profile, the performance of its storage is monitored to ensure compliance with every SLO threshold.

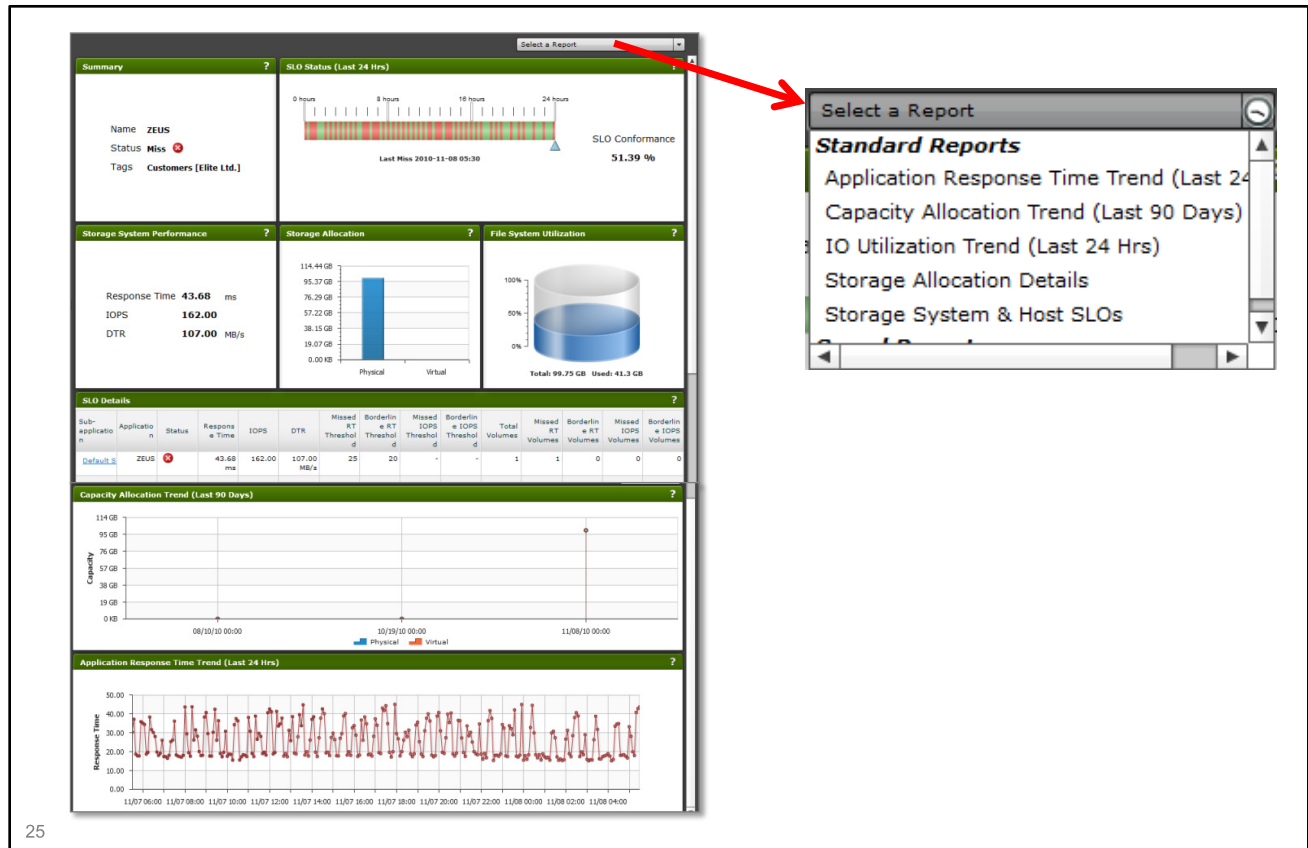
The dashboard provides a real-time look at enterprise wide storage system health. Application specified storage SLOs based on storage capacity and performance requirements can be established and proactively monitored to ensure that service levels are being met.

The dashboard also provides a quick view into the physical capacity overview across all storage systems within your company. It helps you gain insight into your storage capacity, identify unused capacity, and the ability to track how the storage is utilized.

Business Unit Dashboard



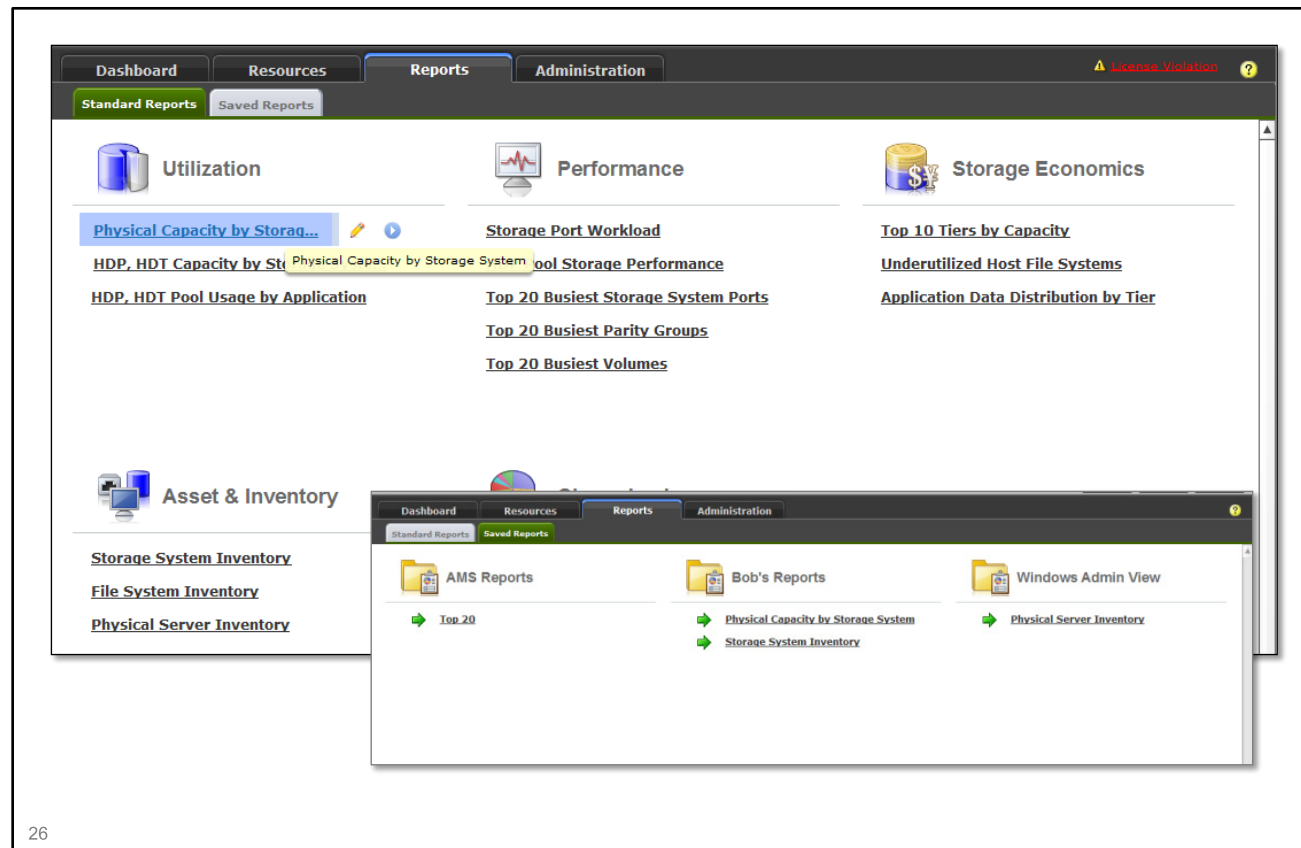
Application Dashboard



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You can monitor application storage SLOs and ensure that your storage infrastructure provides adequate service to your applications and take timely action when SLO violations occur.

Global Report Gallery



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Command Director provides a comprehensive collection of predefined reports designed to provide an analysis of the overall health of your enterprise. You can easily customize each of these reports by changing any of its parameters and saving the customized reports separately.

Overview of Functionality

- Applications
 - Group storage
 - Assign storage SLOs
 - Alerts
- Business Views
 - Organize applications
 - Multiple
 - Key Performance Indicators
- Customizable Reporting
- Storage Health
 - Per application

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Applications

- Group storage systems by applications that they service.
- Users can assign storage SLOs to applications.
- Command Director monitors performance of each application's storage and generates alerts when desired thresholds are not met.

Business Views

- Applications can be organized into Business Views.
- Users can define multiple Business Views.
- Key Performance Indicator reports can be generated.

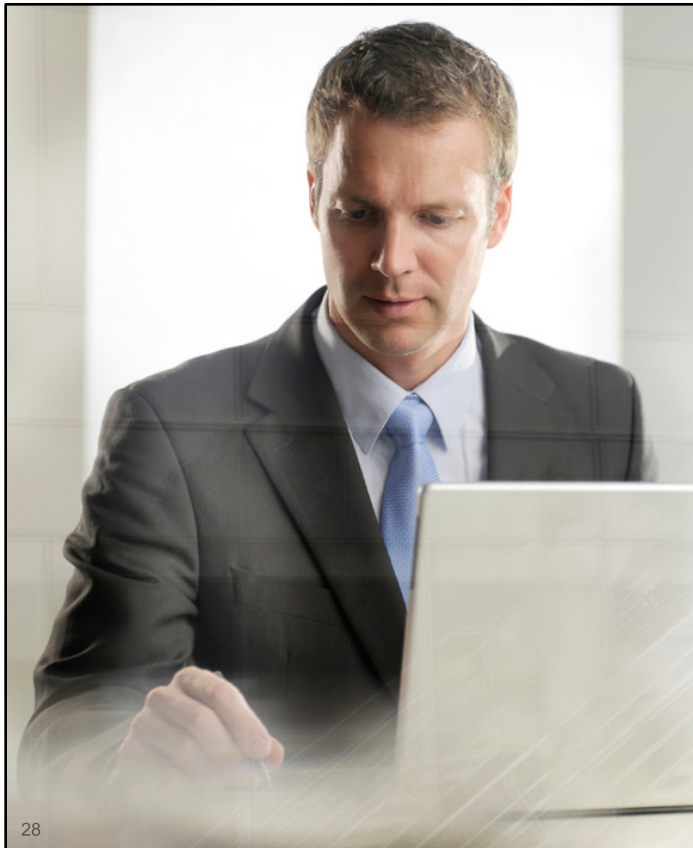
Customizable Reporting

- Reports can be customized.
- Reports can be generated and delivered on a schedule.

Storage Health

- Storage health can be automatically monitored for each application.

Instructor Demonstration



- GUI
- Dashboard
- Application
- Reports



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Module Summary

- Described Hitachi Command Director software features and functions

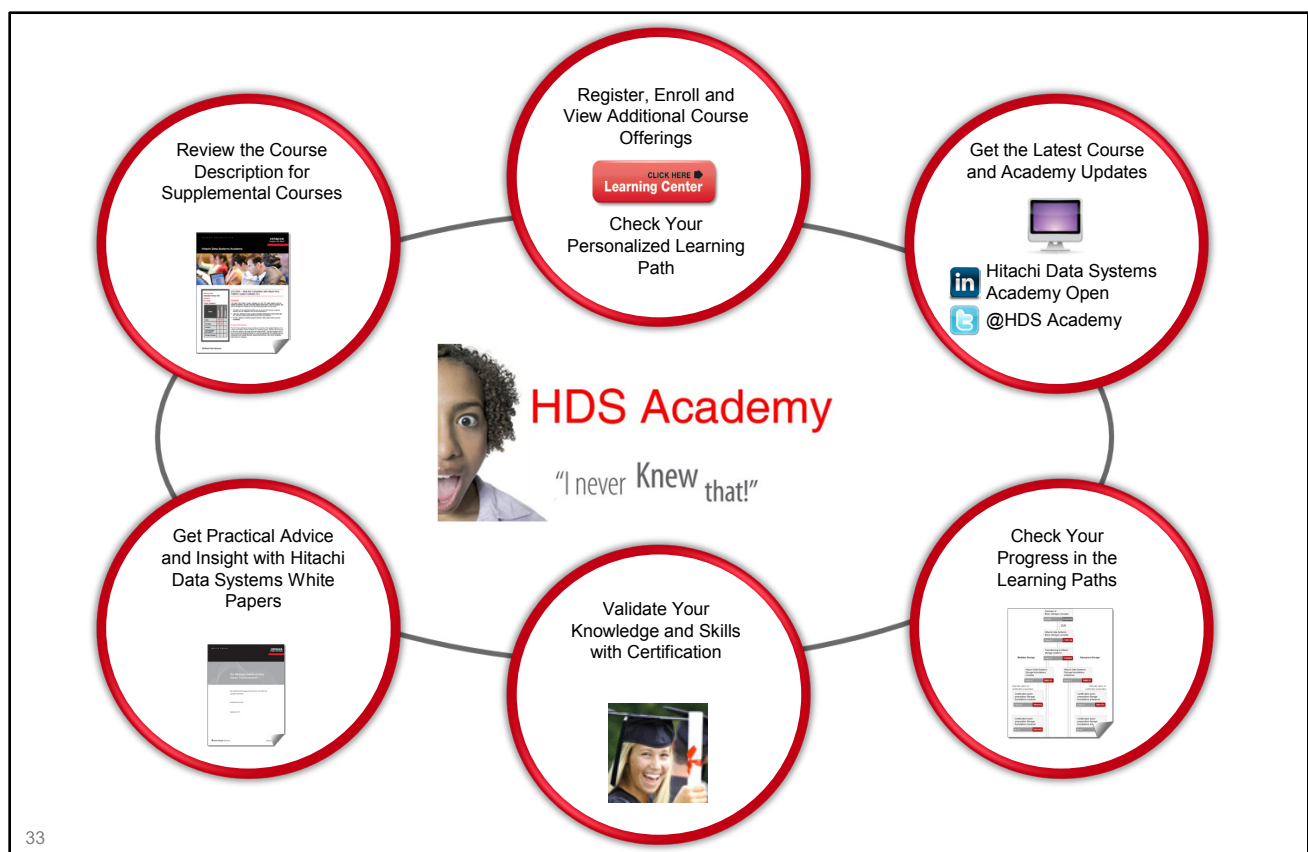
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Module Review

1. What is the purpose of Hitachi Command Director?

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Your Next Steps

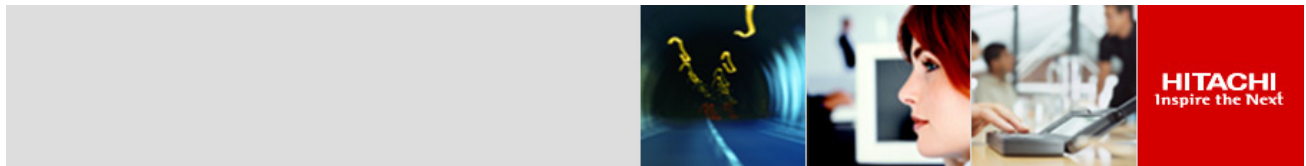


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Learning Center: <http://learningcenter.hds.com>

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>
- Certification: <http://www.hds.com/services/education/certification>
- White Papers: <http://www.hds.com/corporate/resources/>



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 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

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—B—

B4 — A group of 4 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)

BCM — Hitachi Business Continuity Manager

BCP — Base Control Program

BCPii — Base Control Program internal interface

BDW — Block Descriptor Word

BED — Back end director. Controls the paths to the HDDs.

Bind Mode — One of two modes available when using FlashAccess™, in which the FlashAccess™ extents hold read data for specific extents on volumes (see Priority Mode).

BLKSIZE — Block size

BMC — Baseline Management Controller

BOS — Basic Operating System

BOS V — Basic Operating System Virtualization

BPAM — Basic Partitioned Access Method

BPM — Business Process Management

BST — Binary Search Tree

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.

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—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 is 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.

CBU — Capacity Backup

CCHH — Common designation for Cylinder and Head

CCI — Command Control Interface

CDP — Continuous Data Protection

CDWP — Cumulative disk write throughput

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
CH S — 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	CoD — Capacity on Demand
CHN — CHannel adapter NAS	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.
CHP — Channel Processor or Channel Path	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
CHPID — Channel Path Identifier	Controller — A device that controls the transfer of data from a computer to a peripheral device (including a storage system) and vice versa.
CHSN or C-HSN — Cache Memory Hierarchical Star Network	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
CHT — Channel tachyon, a Fibre Channel protocol controller	
CICS — Customer Information Control System	
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.	
CIM — Common Information Model	
CKD — Count-key Data. A format for encoding data on hard disk drives; typically used in the mainframe environment.	
CKPT — Check Point	
CL — See Cluster	
CLI — Command Line Interface	

Corporate governance — Organizational compliance with government-mandated regulations

CoW — Copy-on-Write snapshot or software

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

CruiseControl — Now called Hitachi Volume Migration software

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

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.

CTE — Common Technology Engine. CommVault® is one branded CTE.

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).

CXRC — Coupled z/OS Global Mirror

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—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 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 Protection Suite platform — Designed to automate management of data by changing the approach from static to dynamic. Built on the CTE. See Hitachi Data Protection Suite.

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 simply data rate.

DBMS — Data Base Management System

DCA — Data Cache Adapter

DCR — Dynamic Cache Residency. See FlashAccess™

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

DFSMS SDM — Data Facility Storage Management Subsystem System Data Mover

DFSMSdftp — 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 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

DWL — Duplex Write Line or Dynamic Workspace Linking

Dynamic Link Manager — HDS software that ensures that no single path becomes overworked while others remain underused. Dynamic Link Manager does this by providing automatic load balancing, path failover, and recovery capabilities in case of a path failure.

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—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

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

ESD — Enterprise Systems Division

ESCD — ESCON Director

ESCON — Enterprise Systems Connection. An input/output (I/O) interface for mainframe computer connections to storage devices developed by IBM.

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

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—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(s) 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

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 Directors

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.

Flash ACC — Flash access. Placing an entire LUN into cache.

FlashAccess — HDS software used to maintain certain types of data in cache to ensure quicker access to that data.

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

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—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

Graph-Track™ — HDS software used to monitor the performance of the Hitachi storage subsystems. Graph-Track™ provides graphical displays, which give information on device usage and system performance.

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

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—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

HATP — Hitachi Assurance Test Program

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

HCAP — Hitachi Content Archive Platform

HCD — Hardware Configuration Definition

HCmD — Hitachi Command Director software.

HCP — Hitachi Content Platform

HCS — Hitachi Command Suite (formerly Hitachi Storage Command Suite)

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

HDDS — Hitachi Data Discovery Suite

HDev — Hidden devices. Hitachi Tuning Manager Main Console may not display some drive letters in its resource tree, and information such as performance and capacity is not available for such invisible drives. This problem occurs if there is a physical drive with lower Physical Drive number assigned that is in “damaged (SCSI Inquiry data cannot be obtained)” or “hidden by HDLM” status.

HDI — Hitachi Dynamic Ingestor

HDI Remote — HDI Cloud Storage & Computing

HDLM — Hitachi Dynamic Link Manager software

HDP — Hitachi Dynamic Provisioning

HDR — Hitachi Dynamic Replicator

HDS — Hitachi Data Systems

HDT — Hitachi Dynamic Tiering

HDU — Hard Disk Unit. A number of hard drives (HDDs) grouped together within a subsystem.

HDvM — Hitachi Device Manager; also referred to as Device Manager (DM)

Head — See read/write head

HENP — Hitachi Essential NAS Platform

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.

HFSM — Hitachi File Service Manager

HGLM — Hitachi Global Link Manager

Hi Track System — Automatic fault reporting system.

HIHSM — Hitachi Internal Hierarchy Storage Management

HiRDB — Hitachi Relational Database

HIS — High Speed Interconnect

HiStar — Multiple point-to-point data paths to cache

Hitachi Data Protection Suite — Unified platform comprising solutions for data backup and recovery, migration, archiving, and replication.

Hitachi TrueCopy Extended Distance Remote Replication Software

Hitachi Storage Capacity Reporter Software — provides end-to-end storage capacity reporting from applications and hosts to heterogeneous storage arrays without the use of host based agents.

HLQ — High-level Qualifier

HLU — Host Logical Unit. A LU that the Operating System and the HDLM recognizes. Each HLU includes the devices that comprise the storage LU.

H-LUN — Host Logical Unit Number. See LUN.

HMC — Hardware Management Console

HMDE — Hitachi Multiplatform Data Exchange

HMRC F — Hitachi Multiple Raid Coupling Feature

HMRS — Hitachi Multiplatform Resource Sharing

HNAS — Hitachi NAS Platform

HODM — Hitachi Online Data Migration

Homogeneous — Of the same or similar kind

HOMRCF — Hitachi Open Multiple Raid Coupling Feature. Shadow Image is the marketing name for HOMRCF.

HORC — Hitachi Open Remote Copy. See TrueCopy.

HORCM — Hitachi Open Raid Configuration Manager

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 or Hitachi Remote Copy (see TrueCopy)

HRpM — Hitachi Replication Manager is the software tool that configures, monitors and manages Hitachi replication products in both open and mainframe environments for enterprise and modular storage systems from *a single pane of glass*.

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

HTnM — Hitachi Tuning Manager

HTsM — Hitachi Tiered Storage Manager

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.

HUR — Hitachi Universal Replicator is an asynchronous, continuous, nondisruptive, host-independent remote data replication solution for disaster recovery or data migration over long distances.

HXRC — Hitachi Extended Remote Copy

HyperPAV — Hyper Parallel Access Volume (PAV)

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IDE — Integrated Drive Electronics Advanced Technology. A standard designed to connect hard and removable disk drives.

I/F — Interface

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

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

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—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

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—K—

KSDS — Key Sequence Data Set
 kVA— Kilovolt Ampere
 kW — Kilowatt

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—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. The LDKC is supported only on Universal Storage Platform V/VM class storage systems.

As of March 2008, only one LDKC is supported, LDKC 00. Refer to product documentation as Hitachi has announced their intent to expand this capacity in the future.

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.

LUN Manager — HDS software used to map Logical Unit Numbers (LUNs) to subsystem ports.

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

—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

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.

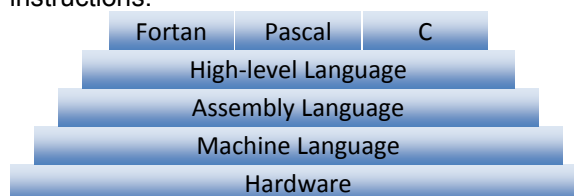
MFC — Main Failure Code

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.



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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

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—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

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—O—

OEM — Original Equipment Manufacturer
OFC — Open Fibre Control
OID — Object identifier
OLA — Operating Level Agreements
OLTP — On-Line Transaction Processing
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 on-going 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.

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—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

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

Priority Mode— Also PRIO mode, is one of the modes of FlashAccess™ in which the FlashAccess™ extents hold read and write data for specific extents on volumes. See Bind Mode.

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

PTAM — Pickup Truck Access Method

PTF — Program Temporary Fixes

PTR — Pointer

PU — Processing Unit

P-VOL — Primary Volume

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—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

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—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

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.

Resource Manager — Hitachi Resource Manager™ utility package is a software suite

that rolls into one package the following four pieces of software:

- Hitachi Cache Residency Manager feature (formerly FlashAccess) (uses cache to speed data reads and writes)
- Hitachi Graph-Track™ performance monitor feature
- LUN Manager (reconfiguration of LUNS, or logical unit numbers)
- Virtual Logical Volume Image (VLMI) Manager (optimizes capacity utilization)

Reliability — An attribute of any computer component (software, hardware, or a network) that consistently performs according to its specifications.

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.

RK — Rack. Acronym referring to the main “Rack” unit, which houses the core operational hardware components of the Thunder 9500V/9200 subsystem. See also: RKA, H1F, and H2F.

RKA (Rack Additional) — Acronym referring to “Rack Additional”, namely additional rack unit(s) that house additional hard drives exceeding the capacity of the core RK unit of the Thunder 9500V/9200 subsystem. See also: RK, RKA, H1F, and H2F.

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

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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.

SANtinel — HDS software that provides LUN security. SANtinel protects data from unauthorized access in SAN environments. It restricts server access by implementing boundaries around predefined zones and is used to map hosts in a host group to the appropriate LUNs.

SAP — System Assist Processor (for I/O Processing)

SARD — System Assurance Registration Document

SAS — SAN Attached Storage. Storage elements that connect directly to a storage area network (SAN) and provide data access services to computer systems. or Serial Attached SCSI. Disk drive configurations for Hitachi Simple Modular Storage 100 systems

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 — Simplex connector. Fibre Channel connector that is larger than a Lucent connector (LC). or 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.

ShadowImage® — HDS software used to duplicate large amounts of data within a

subsystem without affecting the service and performance levels or timing out. ShadowImage replicates data with high speed and reduces backup time.

SHSN — Shared memory Hierarchical Star Network

SI — Hitachi ShadowImage® Replication software

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

Siz — Hitachi ShadowImage® Replication Software

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 — Hitachi Simple Modular Storage or 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

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 — (ShadowImage) Source Volume for In-System Replication or (Universal Replicator) Secondary Volume or 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.

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—T—

T.S.C. — Technical Support Center. A chip developed by HP, and used in various devices. This chip has FC-0 through FC-2 on one chip.

Target — The system component that receives a SCSI I/O command, an open device that operates at the request of the initiator

TC — TrueCopy software

TCA — TrueCopy Asynchronous

TCO — Total Cost of Ownership

TCP/IP — Transmission Control Protocol over Internet Protocol

TCP/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.

TCS — TrueCopy Synchronous

TCz — Hitachi TrueCopy[®] Remote Replication (Synchronous) software is a continuous, nondisruptive, host independent remote data replication solution for disaster recovery or data migration for distances within the same metropolitan area.

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

TISC — The Hitachi Data Systems internal Technical Information Service Centre from which microcode, user guides, ECNs, and so on. can be downloaded.

TLS — Tape Library System

TLS — Transport Layer Security

TMP — Temporary or Test Management Program

TOC — Table Of Contents

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.

TRC — Technical Resource Center

TrueCopy — HDS software that replicates data between subsystems. These systems can be located within a data center or at geographically separated data centers. The 9900V adds the capability of using TrueCopy to make copies in two different locations simultaneously.

TSC — Technical Support Center

TSO — Time Sharing Option

TSO/E — Time Sharing Option/Extended

T-VOL — (ShadowImage) Target Volume for In-System Replication

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—U—

UA — Unified Agent
UBX — Large Box (Large Form Factor)
UCB — Unit Control Block
UFA — UNIX File Attributes
UID — User Identifier within the UNIX security model
Universal Volume Manager software — Provides the virtualization of a multi-tiered storage area network comprised of heterogeneous storage systems.
UPS — Uninterruptible Power Supply — A power supply that includes a battery to maintain power in the event of a power outage.
UR — Universal Replicator
UR P-VOL/S-VOL — Universal Replicator Primary or Secondary Volume
URz — Hitachi Universal Replicator software
USP — Universal Storage Platform™
USP V — (Hitachi) Universal Storage Platform™ V
USP VM — (Hitachi) Universal Storage Platform™ VM
UUID — Universally Unique Identifier
UVM — Universal Volume Manager

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—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, back up, 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).
VM — Virtual Machines
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
VTOC — Volume Table of Contents
VTOCIX — Volume Table of Contents Index
VVDS — Virtual Volume Data Set
V-VOL — Virtual Volume

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—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
WMS — Hitachi Workgroup Modular Storage system
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). The WWN is essential for defining the Hitachi Volume Security software (formerly SANtinel) parameters, because it determines whether the open-system host is to be allowed or denied access to a specified LU or a group of LUs.

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. Fibre Channel ports' WWPN are 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.

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—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

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—Y—

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—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.

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The screenshot shows the Learning Center interface. At the top, there is a navigation bar with tabs: Home, My Success Plan, My Learning (highlighted with a red box), My Skills and Competencies, My Network, and My Profile. Below this, on the left, is a sidebar menu with options: In-Progress Learning, Catalog, All Learning Activity, Learning Requests, Approvals Inbox, Evaluations & Surveys (highlighted with a red box), and Surveys. A red arrow points from the 'Evaluations & Surveys' menu item to the 'Evaluations' section in the main content area. The 'Evaluations' section has two tabs: Current (highlighted with a red box) and Completed. Below the tabs is a table of evaluations. The table has columns: Evaluation Name, Title, Date Submitted, and Action. A red arrow points from the 'Launch' link in the Action column to the 'Launch' button in the table row.

Evaluation Name	Title	Date Submitted	Action
WBT Evaluation	Preventing Sexual Harassment (WBT)	01-21-2010	Launch

