Hitachi Data Systems

Hitachi Adaptable Modular Storage 2000 Family Implementation and Support

TCI1835

Book 1 of 2

Courseware Version 2.1

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

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

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

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

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

Hitachi Data Systems Registered Trademarks

Hi-Track	ShadowImage	TrueCopy

Hitachi Data Systems Trademarks

Essential NAS Platform	HiCard	HiPass	Hi-PER Architecture	Hi-Star
Lightning 9900	Lightning 9980V	Lightning 9970V	Lightning 9960	Lightning 9910
NanoCopy	Resource Manager	SplitSecond	Thunder 9200	Thunder 9500
Thunder 9585V	Thunder 9580V	Thunder 9570V	Thunder 9530V	Thunder 9520V
Universal Star Network	Universal Storage Platform			

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

NOTICE:

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

HDS Academy 1080

Contact Hitachi Data Systems at www.hds.com.

Product Names mentioned in courseware:

Enterprise Storage Systems

- Hitachi Universal Storage Platform™ V
- Hitachi Universal Storage Platform™ VM
- Hitachi Universal Storage Platform™
- Hitachi Network Storage Controller

Legacy Products:

- Hitachi Lightning 9900™ Series enterprise storage systems
- Hitachi Lightning 9900™ Series enterprise storage systems

Modular Storage Systems

- Hitachi Adaptable Modular Storage system
- Hitachi Adaptable Modular Storage 200
- Hitachi Adaptable Modular Storage 500
- Hitachi Adaptable Modular Storage 1000
- Hitachi Adaptable Modular Storage 200 with iSCSI
- Hitachi Adaptable Modular Storage 200 with NAS Option
- Hitachi Adaptable Modular Storage 500 with iSCSI
- Hitachi Adaptable Modular Storage 500 with NAS Option
- Hitachi Adaptable Modular Storage 1000 with iSCSI
- Hitachi Adaptable Modular Storage 1000 with NAS Option
- Hitachi Adaptable Modular Storage 2000 Family
- Hitachi Adaptable Modular Storage 2100
- Hitachi Adaptable Modular Storage 2300
- Hitachi Adaptable Modular Storage 2500
- Hitachi Workgroup Modular Storage system
- Hitachi Workgroup Modular Storage 100
- Hitachi Workgroup Modular Storage 100 with iSCSI
- Hitachi Workgroup Modular Storage 100 with NAS Option
- Hitachi Simple Modular Storage

Legacy Products:

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

NAS Storage Systems

- Hitachi Essential NAS Platform®
- Hitachi Essential NAS Platform™
- Hitachi High-performance NAS Platform, powered by BlueArc®
- Hitachi NAS Blade for Universal Storage Platform™ and Network Storage Controller

- Hitachi High-performance NAS Platform, powered by BlueArc® 2000 family
  - Hitachi High-Performance NAS Platform 2000
  - Hitachi High-Performance NAS Platform 2100
  - Hitachi High-Performance NAS Platform 2200
- Hitachi High-performance NAS Platform, powered by BlueArc® 3000 family
  - Hitachi High-Performance NAS Platform 3100
  - Hitachi High-Performance NAS Platform 3200

Management Tools

- Hitachi Basic Operating System
- Hitachi Basic Operating System V
- 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
- Hitachi NAS Blade Manager software
- Hitachi NAS Manager Suite of software

Replication Software

Remote Replication:

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

Hitachi In-System Replication software bundle:

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

Hitachi Storage Command Software Suite

- Hitachi Chargeback software
- Hitachi Device Manager software

- Hitachi Dynamic Link Manager software
- Hitachi Global Link Manager software
- Hitachi Global Reporter software
- Hitachi Path Provisioning software
- Hitachi Protection Manager software
- Hitachi QoS for File Servers software
- Hitachi QoS for Oracle software
- Hitachi Replication Monitor software
- Hitachi Storage Services Manager software
- Hitachi Tiered Storage Manager software
- Hitachi Tuning Manager software

Other Software

- Hitachi Backup and Recovery software, powered by CommVault®
- Hitachi Backup Services Manager software, powered by APTARE®
- Hitachi Business Continuity Manager software
- Hitachi Command Control Interface (CCI) Software
- Hitachi Dynamic Provisioning software
- Hitachi Storage Resource Management Solutions
- Hitachi Volume Migration software
- Hi-Track® Monitor "call home" service/remote monitoring tool

Other Solutions and Terms

- Hitachi Content Platform
- Hi-Star™ crossbar switch architecture
- Hitachi Universal Star Network™ V

Contents
Book 1 of 2

Contents
Book 2 of 2

Introduction

Welcome and Introductions

- Introductions
  - Name
  - Position
  - Professional skills
  - Expectations from the course

2

Intended Audience

- Hitachi Data Systems Employees
  - Architect
  - Implementation and Support
  - Storage Manager
- Hitachi Channel Partners
  - Architect
  - Implementation and Support
  - Storage Manager

3

Course Description

This five day instructor-led course provides training on installation, configuration, implementation, customer-level support, and how to perform onsite service and support for customers who purchase support contracts with the Hitachi Adaptable Modular Storage 2000 Family (models 2100, 2300, and 2500).

4

Course Objectives

- Upon completion of this course, the learner should be able to:
  - Recognize Adaptable Modular Storage 2000 Family product positioning, product objectives, features, and benefits
  - Explain the hardware components and architectures
  - Describe the AMS2000 Rev 2 controller architecture and its multi-protocol capabilities
  - Describe the AMS2000 Rev 2 front end connectivity specifications
  - Install and configure AMS2500 iSCSI host ports
  - Explain active-active I/O pathing and identify the benefits that it offers in hardware performance
  - Identify the implementation specifications for Adaptable Modular Storage 2000 Family systems
  - Describe specific installation procedures
  - Install the Storage Navigator Modular 2 software
  - Implement IPv6 support on management and maintenance LAN ports for supported operating systems
  - Describe Secure Sockets Layer (SSL) support
  - Describe and implement Hitachi Dynamic Provisioning software

5

- Identify the process for contacting Hitachi Data Systems customer support
- Identify the tools and tasks necessary to maintain and troubleshoot the Adaptable Modular Storage 2000 Family system
- Perform detailed troubleshooting using the Maintenance Manual
- Use the following features and capabilities of Storage Navigator Modular 2 program, including:
  - Register an Adaptable Modular Storage 2000 Family system
  - Use account authentication to provide access control to management functions
  - Create RAID groups and LUNs
  - Create host groups, enable host group security, register the World Wide Names of attached host bus adapters (HBA), and map internal LUNs to host group LUNs
  - Create an expanded LU using the Change LU Capacity function
  - Enable specific features by installing corresponding product license keys
  - Customize cache utilization for applications using the Cache Partition Manager feature
  - Report failures and status to an SNMP server with SNMP Agent Support feature
  - Dynamically increase or reduce the capacity of LUNs by using the LU Grow/Shrink function
  - Dynamically expand RAID groups online by using the RAID Group Expansion function

6

Storage Navigator Modular 2 program, Cache Partition Manager feature, SNMP agent, LUSE, and LUN Manager and Expansion are all features of the **Hitachi Resource Manager utility package.**

AMS2000 Rev1 to Rev2 Transition and Positioning

- In June 2010, all AMS2000 models will start shipping with new revision 2 controllers.

What the new controllers **are**:

1. New 5th generation D-Ctl ASIC for improved sequential R/W performance on 2100, 2300 and 2500
2. Embedded 8Gbps FC ports on the 2100 and 2300
3. Host port FC and iSCSI intermix on the 2100 and 2300
4. 2x increase in supported RC ports for the 2100 and 2300
5. Sparing methodology changes from Composite to Component sparing

These new controllers **are NOT**:

1. New (next) generation of AMS2000; system specs remain the same
2. Product enhancements apply equally regardless of controller revision level
3. No change in pricing; like for like systems cost the same
4. No change in software licensing; same license keys and pricing

- New Rev2 AMS2000 controllers are referred to as “E” controllers in our technical documentation. However, customer facing docs (marketing collateral) will refer to these as rev2 controllers.

7

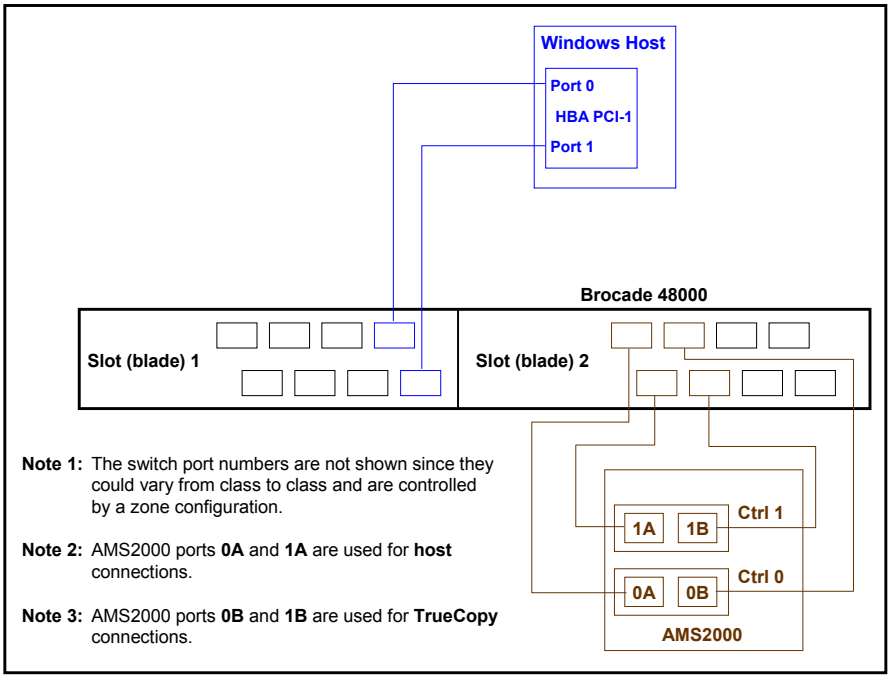
Product Names

- Adaptable Module Storage systems are sometimes referred to as DF800 systems. The following names may appear in documentation:
  - DF800S: AMS2100 Rev1 (RKS)
  - DF800ES: AMS2100 Rev2 (RKES)
  - DF800M: AMS 2300 Rev1 (RKM)
  - DF800EM: AMS2300 Rev2 (RKEM)
  - DF800H: AMS2500 Rev1 (RKH)
  - DF800EH: AMS2500 Rev2 (RKEH)
  - Expansion unit: RKAK
  - Dense Expansion unit: RKAKX

8

Lab Equipment Configuration

- This diagram shows the ***recommended*** connections of the assigned lab equipment for each lab team and the configuration used at all of the ***HDS Americas education centers.***
- Other HDS education centers and/or onsite customer classes may use a different switch or have direct-connect loop connections or use their own port configuration based on specific requirements of the client.



Note 1: The switch port numbers are not shown since they could vary from class to class and are controlled by a zone configuration.

Note 2: AMS2000 ports **0A** and **1A** are used for **host** connections.

Note 3: AMS2000 ports **0B** and **1B** are used for **TrueCopy** connections.

9

Course Agenda

Content	Learning Activities
Introduction	
Module 1: Product Overview	
Module 2: Hardware Components and Architecture	Lab 1: Component Location
Module 3: The Web Tool	Lab 2: Web Access: Normal Mode and Collect a Trace
Module 4: Active/Active I/O	
Module 5: Installation	
Module 6: Setup and Configuration of SNM2 GUI	Lab 3: SMN2 Installation and Initial Setup Lab 4: SNM2 Basic Operations: RAID Groups & LUNs Lab 5: Host Groups and LUN Mapping
Module 7: LU Grow/Shrink	Lab 6: LU Expansion and LU Grow/Shrink

10

Content	Learning Activities
Module 8: Online RAID Group Expansion	Lab 7: Online RAID Group Expansion
Module 9: Setup and Configuration of SNM2 CLI	Lab 8: SNM2 CLI
Module 10: Software Feature Overview	Lab 9: Cache Partition Manager Lab 10: Performance Monitor
Module 11: Maintenance and Troubleshooting	Lab 11: Remove and Add an Expansion Tray
Module 12: SNM2 Advanced Operations	Lab 12: SNM2 Advanced Operations (Constitute files, Firmware update, and Simple Trace)
Module 13: SNMP	
Module 14: Hardware replacement	Lab 13: Replace a Disk Drive, Control Unit, ENC, Interface Board, and SFP Host Connector
Module 15: Disruptive Microcode Update	Lab 14: Disruptive Microcode Update
Optional Appendix: Volume replication and Volume Migration Replication	
Exam	Exam for HDS Internals and HDS Installation and Configuration Partners

11

Learning Paths

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

12

- **HDS.com:** http://www.hds.com/services/education/
- **Partner Xchange:** https://extranet.hds.com/http://aim.hds.com/portal/dt/
- **HDSnet:** http://hdsnet.hds.com/hds_academy/

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

HDS Academy Is on Twitter and LinkedIn

Follow the HDS Academy on Twitter for regular training updates.

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

13

These are the URLs for Twitter and LinkedIn:

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

1. Product Overview

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Discuss the features of the Adaptable Modular Storage 2000 Family
  - List the models and benefits

2

AMS2000 Rev1 to Rev2 Transition and Positioning

In June 2010, all AMS2000 models will start shipping with new revision 2 controllers.

What the new controllers are:

1. **New 5th generation D-Ctl ASIC for improved sequential R/W performance on 2100, 2300 and 2500**
2. **Embedded 8Gbps FC ports on the 2100 and 2300**
3. **Host port FC and iSCSI intermix on the 2100 and 2300**
4. **2x increase in supported RC ports for the 2100 and 2300**
5. **Sparing methodology changes from Composite to Component sparing**

These new controllers are NOT:

1. **New (next) generation of AMS2000; system specs remain the same**
2. **Product enhancements apply equally regardless of controller revision level**
3. **No change in pricing; like for like systems cost the same**
4. **No change software licensing; same license keys and pricing**

New Rev2 AMS2000 controllers are referred to as "E" controllers **in our technical documentation. However, customer facing docs (marketing collateral) will** refer to these as rev2 controllers.

3

Product Description

- Dense, high-performance modular storage array
- Serial attached SCSI (SAS) back end architecture
  - **SAS** and **SATA II** drives
- Fibre Channel or iSCSI front end host ports
  - Single type of front end interface with models 2100 and 2300
  - Two concurrent types of front end interface with model 2500
- NAS through Fiber Channel *Gateway* offerings
  - Essential NAS
  - High-performance NAS
- Active-active symmetric high availability dual controller functionality
- Straightforward installation and configuration
- Intuitive storage management GUI (Hitachi Storage Navigator Modular 2 program)

4

- Simple maintenance and troubleshooting
  - Improved back end diagnostics due to new serial back end
- Online firmware upgrade (**No path failover software required**)
- Replication software:
  - Hitachi Copy-on-Write Snapshot software
  - Hitachi ShadowImage® Replication software
  - Hitachi TrueCopy® Remote Replication software bundle
  - Hitachi TrueCopy® Extended Distance software
- Easy data migration to and from previous Adaptable Modular Storage systems **using TrueCopy** software

5

Product Description – New in Version 2

- New controllers will be provided for all AMS2000 products.
  - Each controller will get a new revision of the D-CTL (5th generation) for improved sequential R/W performance.
- In addition, the AMS2100 and AMS2300 will receive embedded 8Gb/s FC interface ports, 2 ports per AMS2100 controller and 4 per AMS2300 controller.
  - Optional 8Gb/s and 1Gb/s iSCSI daughter cards will be available. iSCSI option cards will allow each controller to host both iSCSI and FC protocol.
  - System with version 2.0 controller can be either all FC or FC/iSCSI.
  - An all iSCSI controller will not be available.
- The new port structure will allow the AMS2300 with version 2.0 controllers to maintain up to 8 FC ports per controller as opposed to 4 ports per controller on the version 1.0 controllers.

6

The Hitachi Adaptable Modular Storage 2000 Family includes the following products:

- Hitachi Adaptable Modular Storage 2100 (AMS2100)
- Hitachi Adaptable Modular Storage 2300 (AMS2300)
- Hitachi Adaptable Modular Storage 2500 (AMS2500)

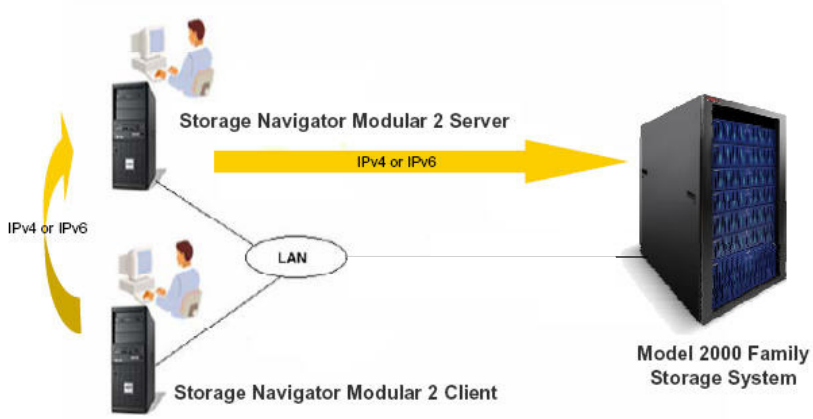
- AMS2100
  - Change from 4Gb/s to 8Gb/s FC.
  - 8Gb/s FC is included in all models. (iSCSI only is not available.)
  - Max # of FC ports increases from 4 to 8. (iSCSI remains the same.)
  - Increase sequential performance.
- AMS2300
  - 8Gb/s FC is included in all models. (iSCSI only is not available.)
  - Max # of FC ports increases from 8 to 16. (iSCSI remains the same.)
  - Increase in sequential performance.
- AMS2500
  - Increase in sequential performance.
  - 4Gb/s FC option will be not be offered; 8Gb/s FC will auto sense 2,4,8Gb/s infrastructure.

Model	Rev1	Rev2
AMS2100	CTL + 2x4Gb/s + Cache CTL + iSCSI + Cache N/A	CTL (w/2x8Gb/s) + Cache CTL (w/2x8Gb/s) + iSCSI + Cache CTL (w/2x8Gb/s) + 2x8Gb/s + Cache
AMS2300	CTL + 4x8Gb/s + Cache CTL + iSCSI + Cache N/A	CTL (w/4x8Gb/s) + Cache CTL (w/4x8Gb/s) + iSCSI + Cache CTL (w/4x8Gb/s) + 4x8Gb/s + Cache
AMS2500	CTL	CTL (w/8Gb/s) Auto senses 2,4,8 Gb/s infrastructure

7

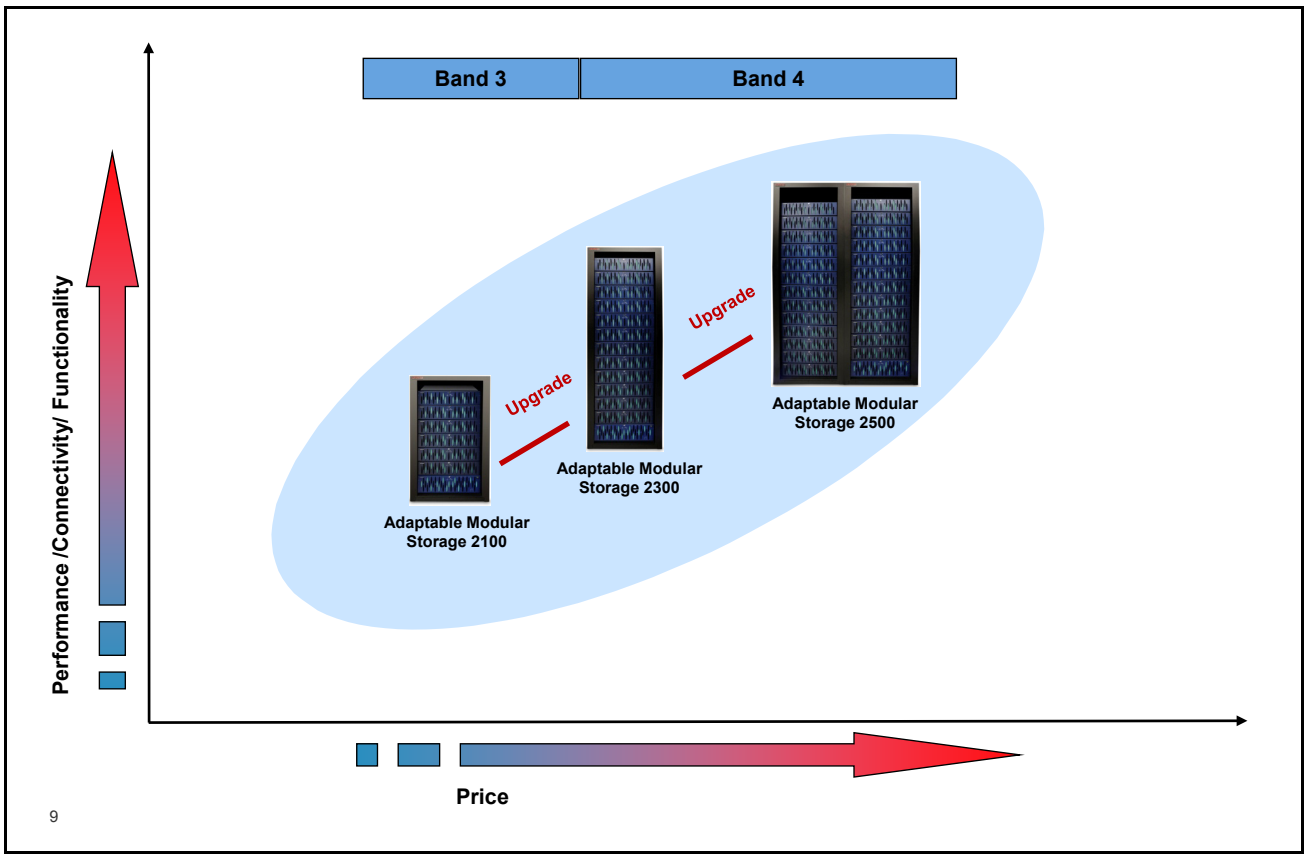
IPv6 Support

- IPv6 is short for *Internet Protocol Version 6.*
- IPv4 has been the standard for 20 + years.
- Shortage of IPv4 addresses, as new machines are added to the Internet.
- Expectation is the IPv4 and IPv6 will both remain in use for at least a few years.
- Microsoft TechNet article that gives specific Best Practices and configurations using IPv6: http://technet.microsoft.com/en-us/library/bb742622.aspx



8

Product Line Positioning



Upgrades are data-in-place upgrades. During an upgrade the system will be powered down. These are **OFFLINE** procedures.

Features

- Modular High-performance and Large-capacity Systems
  - Adaptable Modular Storage **2100**
    - 120 hard disk drives – **base unit** plus **7** expansion units
    - Front end ports: **4** Fibre Channel or **4** iSCSI ports
    - Back end: **16** SAS Links – **2** 4x4 SAS Wide links **per controller**
    - Maximum **50** RAID Groups with **2048** Logical Units
  - Adaptable Modular Storage **2300**
    - **240** hard disk drives – base unit plus **15** expansion units
    - Front end ports: **8** Fibre Channel or **4** iSCSI
    - Back end: **16** SAS Links – **2** 4x4 SAS Wide links **per controller**
    - Maximum **75** RAID Groups with **4096** Logical Units
  - Adaptable Modular Storage **2500**
    - **480** hard disk drives (***474*** *hard disk using intermix of standard and high density: see next slide for details*) – base unit plus **32** expansion units
    - Front end ports: **16** Fibre Channel or **8** iSCSI, or a mixture
    - Back end: **32** SAS links – **4** 4x4 SAS Wide links **per controller**
    - Maximum **100** RAID Groups with **4096** Logical Units

10

The Adaptable Module Storage systems are sometimes referred to as DF800 systems. The following names may appear in documentation:

- Model 2100: DF800 S or RKS or AMS 2100
- Model 2300: DF800 M or RKM or AMS 2300
- Model 2500: DF800 H or RKH or AMS 2500
- Expansion unit: RKAK
- Expansion unit: RKAKX

High-density Expansion Unit (Intermix)

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives
AMS 2500	0	10	480 [1]
	1	9	447
	2	9	462
	3	8	429
	4	8	444
	5	8	459
	6	8	474 [2]
	7	7	441
	8	7	456
	9	6	423
	10	6	438
	11	6	453
	12	6	468
	13	5	435
AMS 2500	14	5	450
	15	4	417
	16	4	432
	17	3	399
	18	3	414
	19	3	429
	20	3	444
	21	2	411
	22	2	426
	23	2	441
	24	2	456
	25	1	423
	26	1	438
	27	1	453
	28	1	468
	29	0	435
	30	0	450
	31	0	465
	32	0	480 [3]

1. **Maximum number of disk drives using only high-density expansion units.**
2. **Maximum number of disk drives using intermix of expansion units and high density expansion units.**
3. **Maximum number of disk drives using only expansion units.**

11

Expansion unit intermix:
You can set up a complex system by using the maximum of 480 disk drives by connecting a mixture of expansion units and high-density expansion units to the AMS 2500 base unit.

Base Unit			Expansion Unit				
	Disk Drives		Type	Units		Disk Drives	
	Min	Max		Min	Max	Min	Max
AMS 2500	0	0	Expansion Unit (RKAK)	1	32	1st unit: 4 All other units: 2	15 per unit
			High-density Expansion Unit (RKAKX)	1	10	2 in each section of the unit [1]	48 per unit

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives	Total Number of SAS Disk Drives
AMS 2500	0	10	480 [1]	380
	2	9	462	372
	6	8	474 [2]	394
	8	7	456	386
	12	6	468	408
AMS 2500	14	5	450	400
	16	4	432	392
	20	3	444	414
	24	2	456	436
	28	1	468	458
	32	0	480 [3]	480

1. **Maximum number of disk drives using only high-density expansion units.**
2. **Maximum number of disk drives using intermix of expansion units and high-density expansion units.**
3. **Maximum number of disk drives using only expansion units.**

Features

- All models provide:
  - High-speed response
  - Continuous data availability
  - Scalable connectivity
  - Expandable capacity
- Competitive Features and Functionality
  - Microsoft® environments such as Virtual Disk Service (**VDS**) and Microsoft Volume Shadow Copy Service (**VSS**) provider
  - Complete Longhorn Server support (Windows 2008 code name)
  - Native Multipath I/O (MPIO, MPxIO, and so on) support
    - Hitachi Dynamic Link Manager software can still be used.
  - Functional enhancements to the ShadowImage software features to enable competitive VSS behavior in Exchange environments
  - LUN Shrink/Grow feature
  - **60TB** LUN support

12

Specifications

Models	2100	2300	2500
Specs	• Dual Controller, 4 GB cache on each controller, 15 drives internal, Symmetric A/A, dual battery, dual redundant power supplies	• Dual Controller, 8 GB cache on each controller, 15 drives internal, Symmetric A/A, dual battery, dual redundant power supplies	• Dual Controller, 16 GB cache on each controller, 0 internal drives, Symmetric A/A, dual battery, dual redundant power supplies

Host Interface Options	• 4 Fibre Channel (FC) auto-sensing 1/2/4 Gb/s
	• 4 iSCSI 1000Base-T copper Ethernet
		• 8 Fibre Channel (FC) auto-sensing 2/4/8 Gb/s
		• 4 iSCSI 1000Base-T copper Ethernet
			• Multi-Protocol Interface
			  • 16 Fibre Channel (FC) auto-sensing 2/4/8 Gb/s (8 per control unit)
			  • 4 iSCSI (2 per controller)
			• 8 iSCSI 1000Base-T copper Ethernet (4 per controller)

Drive Interface	• 16 Serial Attached SCSI (SAS) • 4x4 wide link, 3 Gb/s switched	• 16 Serial Attached SCSI (SAS) • 4x4 wide links, 3 Gb/s switched	• 32 Serial Attached SCSI (SAS) • 4x4 wide links, 3 Gb/s switched

13

In version 1 - The maximum cache configuration assumes using the 4GB cache memory modules.

In version 1 - For the Adaptable Modular Storage 2000 Family 2GB and 4GB cache modules are available.

Specifications for Regular Expansion Unit

Models	2100	2300	2500
RAID Levels	RAID 1, 1+0, 5, 6 (SAS & SATAII drives), RAID 0 (SAS drives only)		
Max # of RAID Groups	50	75	100
Max # of Spare Drives	15	30	30
Max # of LUs	2048	4096	4096
Max LU size	60TB		
Supported Drives	300GB/15K, 400GB/10K SAS, 450GB/15K SAS, 500GB/7200, 1TB/7200 SATAII		
Upgrades	Model 2100 to 2300, and 2300 to 2500 model via Controller, Data In Place Remote Mirroring interoperable with Adaptable Modular Storage		
Expansion Unit / Disk Trays (Optional based on capacity)	15 HDD/Tray (SAS/SATAII Intermix) Up to 7 trays (120 Drives total)	15 HDD/Tray (SAS/SATAII Intermix) Up to 15 trays (240 Drives total)	15 HDD/Tray (SAS/SATAII intermix) no HDDs in the controllers Up to 32 trays (480 Drives total)
Maximum Capacity	118TB	236TB	472TB

14

Note:

- The Dense Expansion Unit does support only the RAID level-1, 1+0, 5 and 6!
- The Dense Expansion Unit supports only 1TB SATA disk drives with 7200 RPM!

Specifications for Dense Expansion Unit

Models	2100	2300	2500
RAID Levels	RAID-1, 1+0, 5, 6		
Max # of RAID Groups	50	75	100
Max # of Spare Drives	15	30	30
Max # of LUs	2048	4096	4096
Max LU size	60TB		
Supported Drives	Only 1TB/7200 SATA II		
Upgrades	Model 2100 to 2300, and 2300 to 2500 model via Controller, Data In Place Remote Mirroring interoperable with previous Adaptable Modular Storage (DF700)		
Dense Expansion Unit Disk Trays (Optional based on capacity)	Min. 4 – max. 48 HDD/Tray Max. 120 Drives total	Min. 4 – max. 48 HDD/Tray Max. 240 Drives total	Min. 4 – max. 48 HDD/Tray Max. 480 Drives total
Maximum Capacity	120TB	240TB	480TB

15

The firmware of the Adaptable Modular Storage (AMS) 2000 Family systems checks the numbers of disks (HDDs) connected to each back end SAS Wide link.

The maximums are as follows:

- AMS2100 – max. 60 HDDs per SAS Wide link
- AMS2300/2500 – max. 120 HDDs per SAS Wide link

Dense and Regular Expansion Unit Intermix

Model 2100

#of Expansion Units	#of Dense Units	#of Total HDDs
0	2	111(*)
0	1	63
1	1	78
2	1	93
3	1	108
4	0	75
5	0	90
6	0	105
7	0	120

16

Model 2300

#of Expansion Units	#of Dense Units	#of Total HDDs
0	4	207
1	4	222
2	3	189
3	3	204
4	3	219
5	3	234
6	2	201
7	2	216
8	1	183
9	1	198
10	1	213
11	1	228
12	0	195
13	0	210
14	0	225
15	0	240

17

Model 2500

#of Expansion Units	#of Dense Units	#of Total HDDs
0	10	480
1	9	447
2	9	462
3	8	429
4	8	444
5	8	459
6	8	474
7	7	441
8	7	456
9	6	423
10	6	438
11	6	453
12	6	468
13	5	435
14	5	450
15	4	417
16	4	432
17	3	399
18	3	414
19	3	429
20	3	444
21	2	411
22	2	426
23	2	441
24	2	456
25	1	423
26	1	438
27	1	453
28	1	468
29	0	435
30	0	450
31	0	465

18

Software and Firmware Offerings

- Storage Management Software
  - Hitachi Storage Navigator Modular 2 (GUI and/or CLI)
  - Hitachi Storage Command Suite
- Bundled Storage Functions (Basic Operating System – BOS M)
  - Account Authentication
  - Audit Logging
  - LUN Manager
  - LU Grow/Shrink
  - Online RAID Group Expansion
  - Cache Residency Manager
  - Cache Partition Manager
  - Modular Volume Migration
  - SNMP Agent Support Function
  - Performance Monitor

19

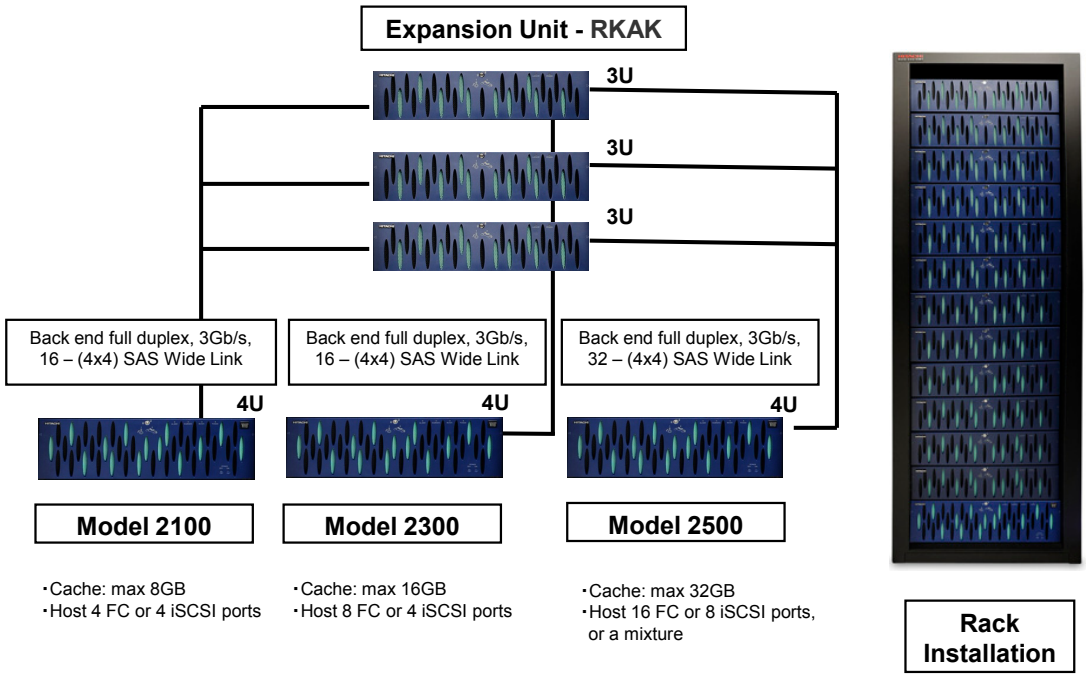
Optional Storage Features	2000 Family Product Line
ShadowImage (Clone)	1 Primary: 8 Secondary, 2048 Max, SNM2 GUI and CLI CCI RAID Manager management available
Copy-on-Write Snapshot	1 Primary: 32 Snaps, 2048 Max, SNM2 GUI and CLI CCI RAID Manager management available
TrueCopy (Sync Remote Mirroring)	1 Primary: 1 Secondary, SNM2 GUI and CLI CCI RAID Manager management available
TrueCopy Extended (Async Remote Mirroring)	1 Primary: 1 Secondary, SNM2 GUI and CLI CCI RAID Manager management available
Data Retention Utility (DRU)	Yes
Hitachi Dynamic Provisioning	Yes
Power Savings Feature (Spin Down RAID Groups)	Yes

Note: When using the SNM2 GUI or CLI, there is no HORCM file or Command Device required in order to manage the replication tasks or the Power Savings Feature.

20

* Requires professional service

External Design and Connections



Certified Platforms

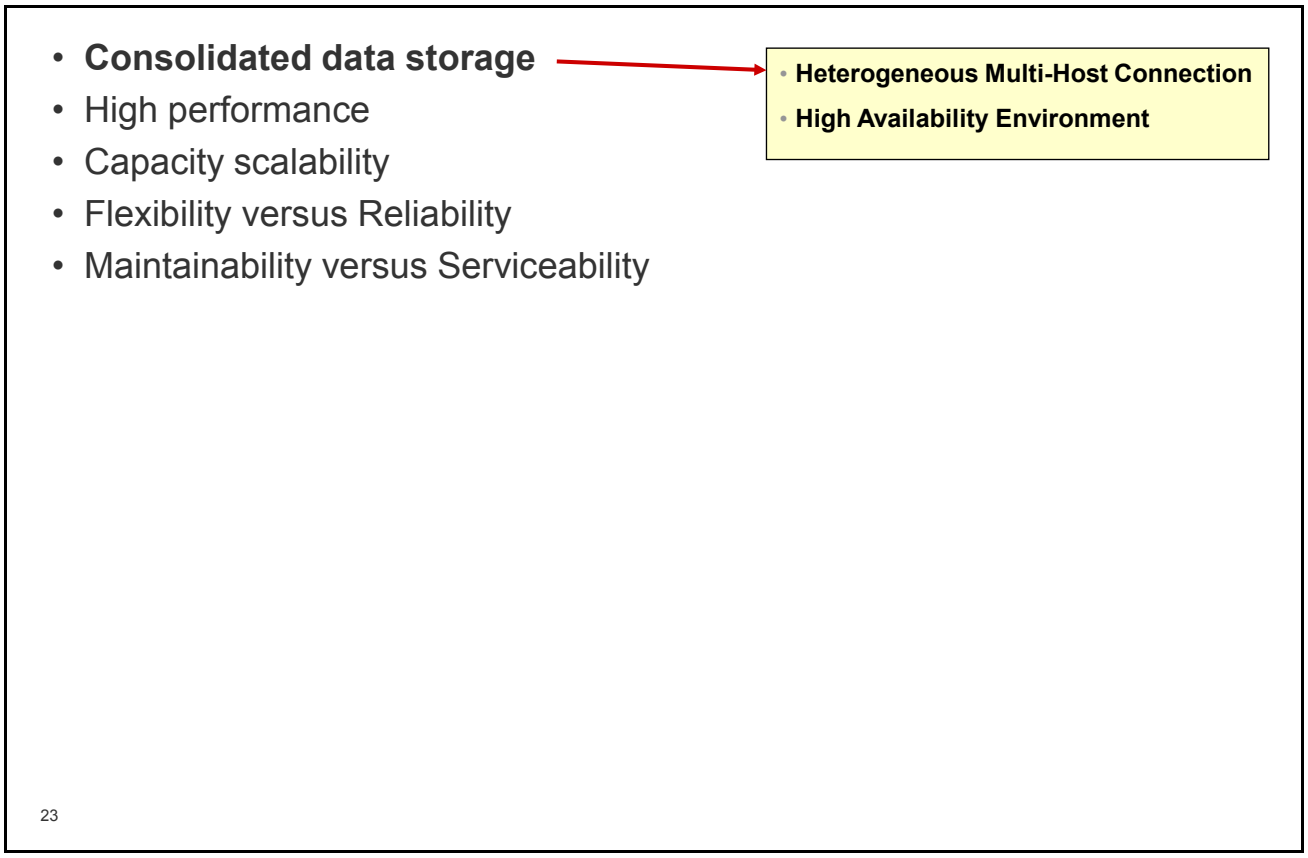
- True Multi-platform Intermix
  - Sun Solaris™ (Sparc and x64)
  - Microsoft® Windows Server® 2003 and 2008
  - HP-UX®
  - Linux® (RedHat®, SuSE™, Asianux, Oracle® EL, RedFlag Linux)
  - IBM® AIX
  - Novell® NetWare®
  - Apple® Mac OS® X
  - HP® OpenVMS®
  - HP Tru64
  - VMware®

22

- Full open systems intermix is possible and implemented by configuring **Host Groups**.
- The **Host Domain Group** concept allows for setting operating system or application software specific parameters as well as access security for Host Group individually.

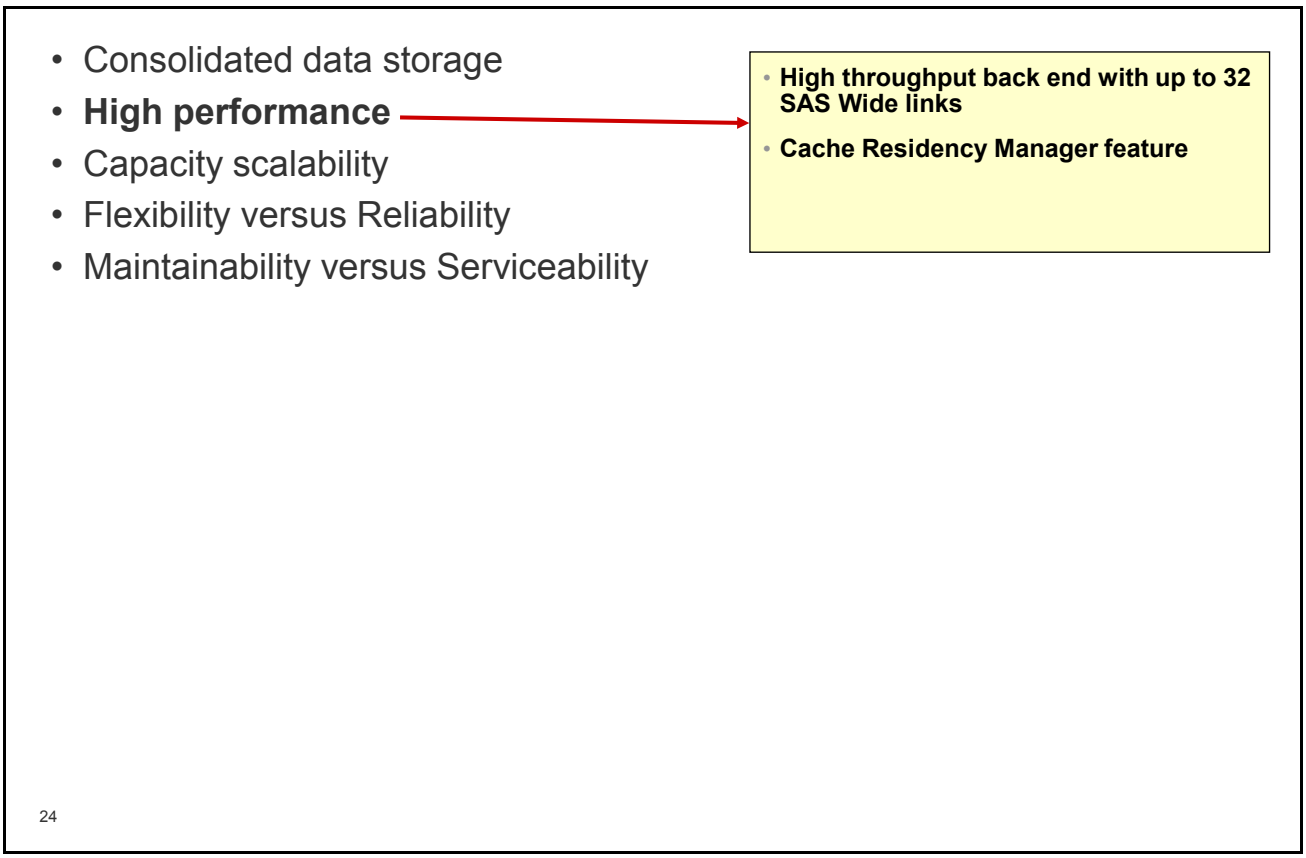
  A Host Group is a group of one or more LUNs and exists behind a Fibre Channel host port in the Model 2000 Family Modular Storage system.

Highlights

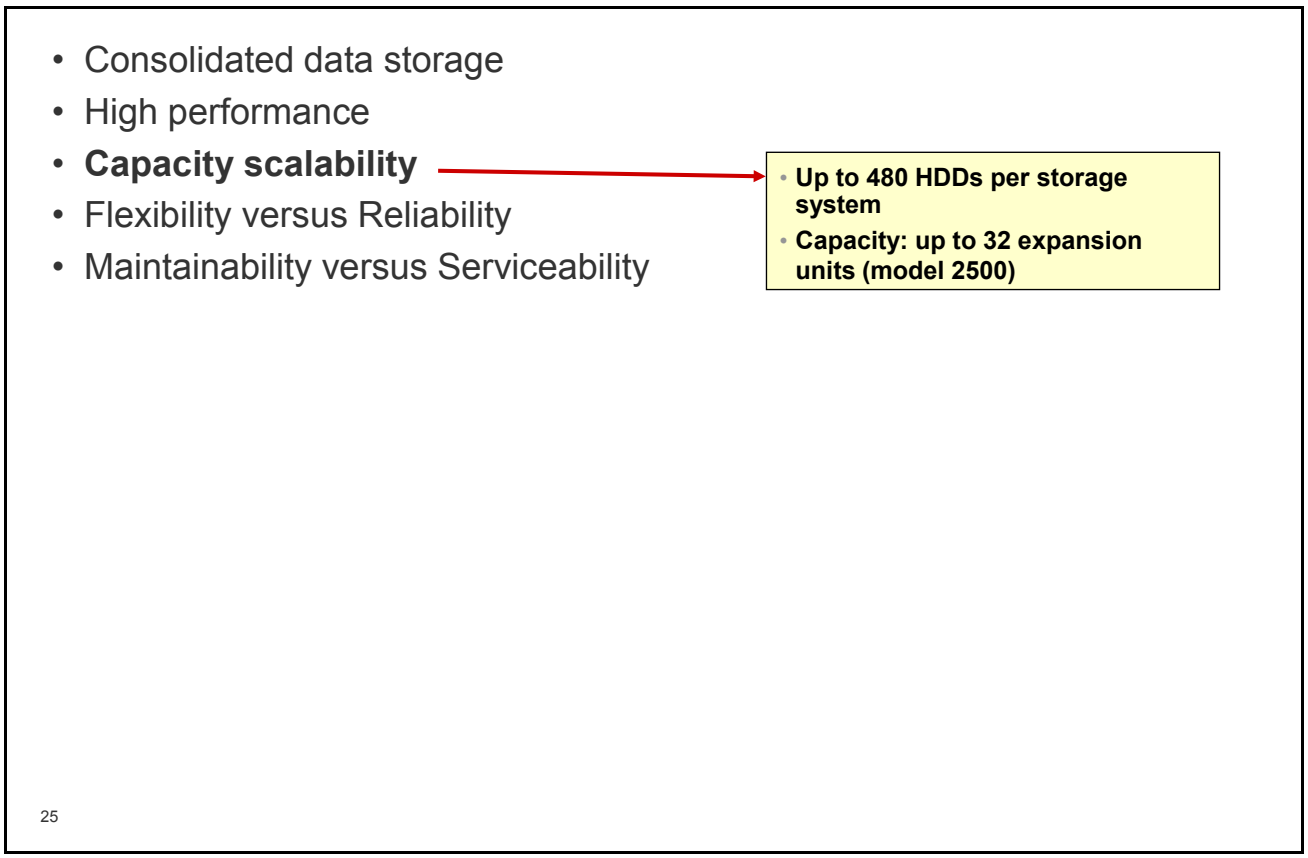


Support for Heterogeneous Multi-Host Connection is accomplished by setting Host-specific parameters for any individual group of LUNs (Host Group).

A High Availability environment (no single point of failure) requires the same level of redundancy in the Hosts, Storage Area Network, and in the Storage Device.



Two back end paths models 2100 and 2300. Also SAS Wide links to drives on the back end.



A system can hold a mix of both high-speed (usually more expensive) HDDs for performance, and slower (cheaper) drives for capacity.

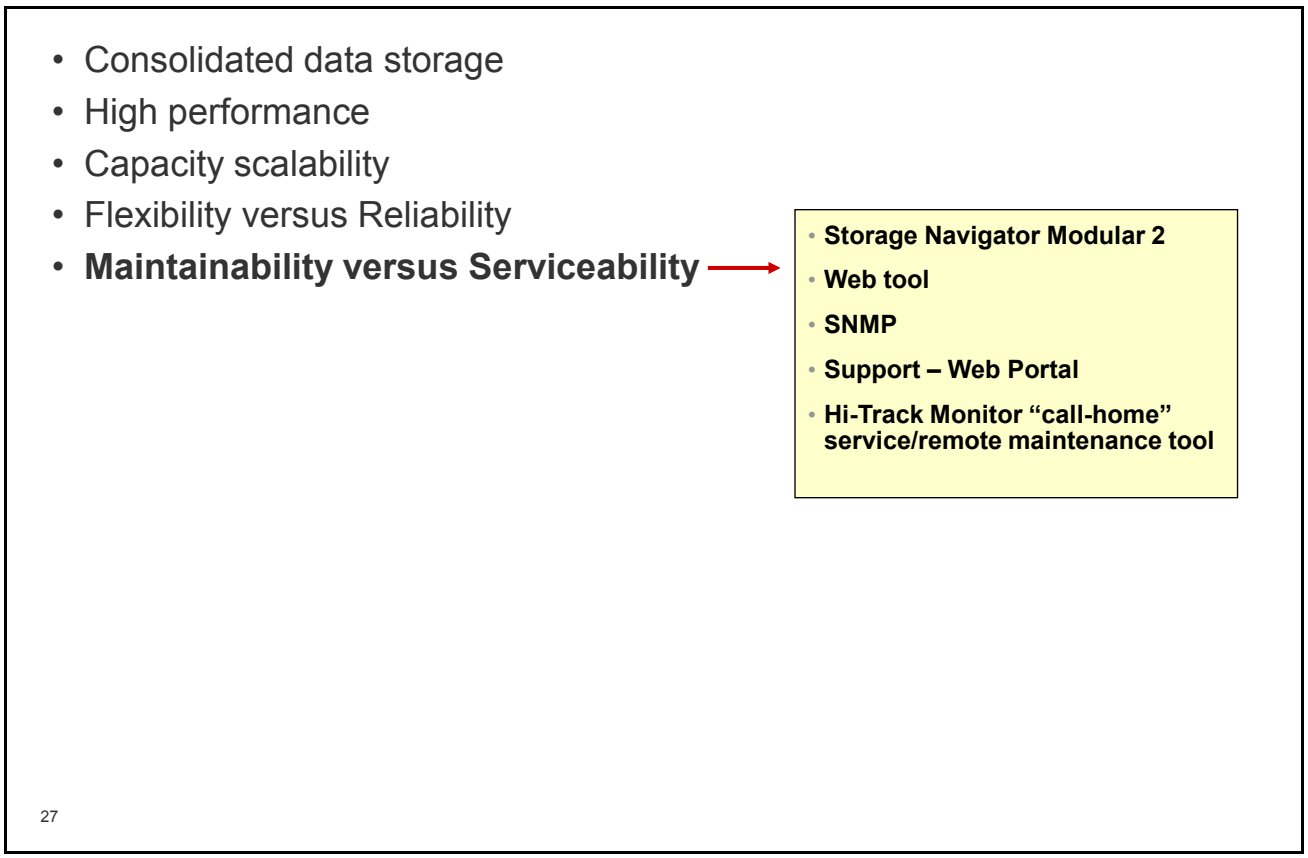
- **Performance:** Used for online transactions, and more
- **Capacity:** Used for audio and video streaming, backups and more

- Consolidated data storage
- High performance
- Capacity scalability
- **Flexibility versus Reliability**
- Maintainability versus Serviceability

- **Online capacity upgrade**
- **RAID levels supported 0, 1, 5, 6, 1+0**
- **Cache Partition Manager**
- **HDD Roaming**
- **Up to 30 global spare drives (models 2300, 2500)**
- **Online Verify and Dynamic Sparing**
- **LUN Mapping, Host Group Mode, and HG Security**
- **8-byte Data Assurance Code**

26

Online capacity upgrade: HDDs and expansion units can be added online; Controllers and Cache Memory cannot.



Storage Navigator Modular 2 is shipped with the array. The build center, or CTO, will install and enable feature keys for certain basic software features.

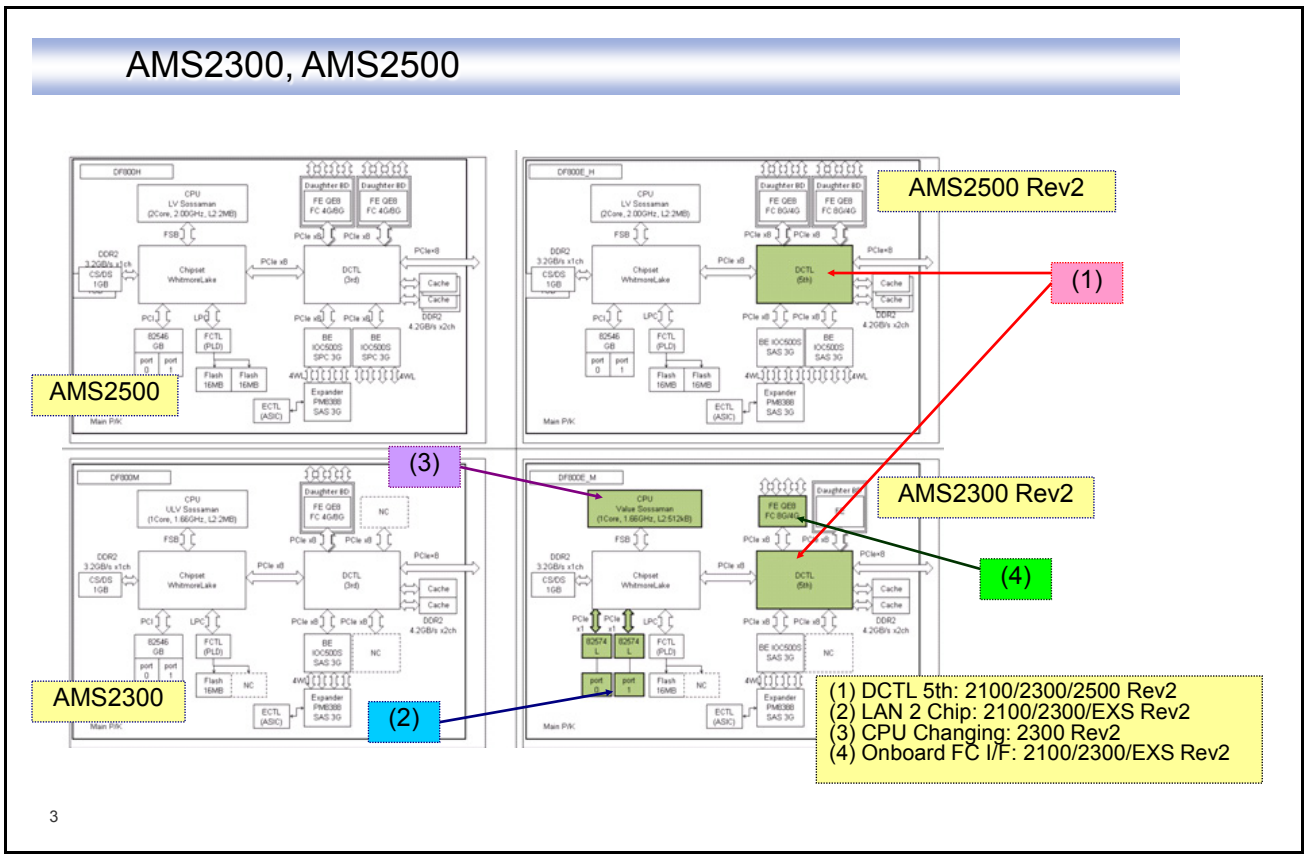
2. Hardware Components and Architecture

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Identify the hardware components of the Adaptable Modular Storage 2000 Family that affect installation, configuration, and troubleshooting
  - Explain the architecture that affects installation, configuration, and troubleshooting
  - Install and configure AMS2500 iSCSI HW ports
  - Describe the AMS21xx Rev2 controller architecture and its multi-protocol capabilities
  - Describe the AMS21xx Rev2 front end connectivity specifications

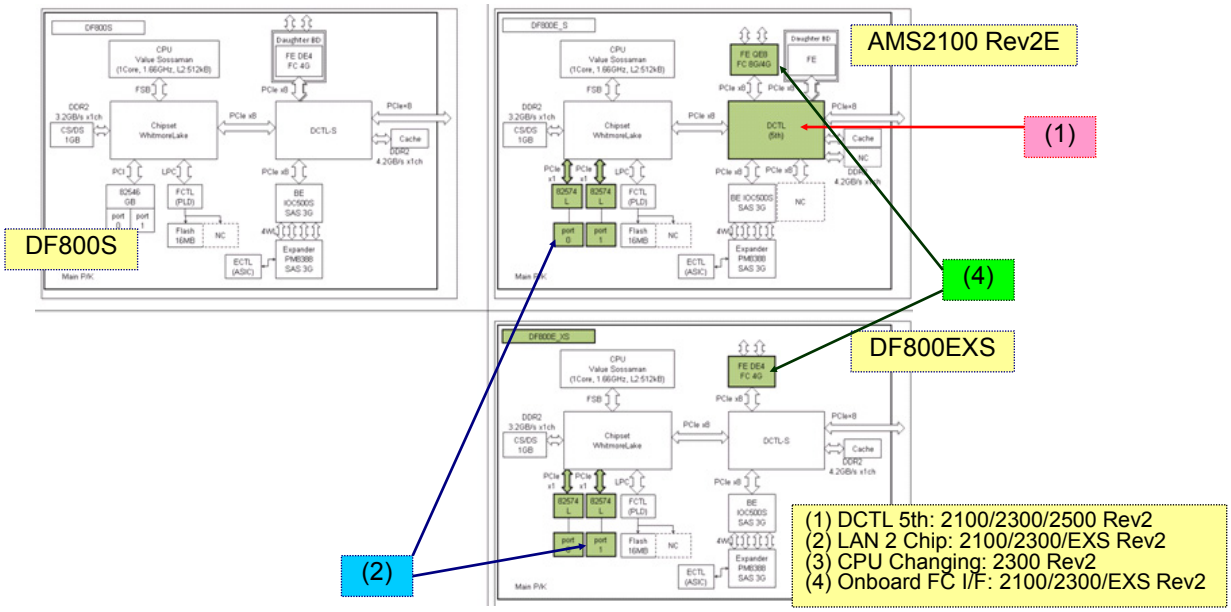
2

Specification Outline Hardware Rev2



Specification Outline Hardware

DF800ES, DF800EXS



4

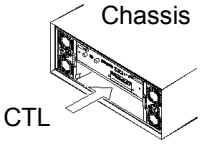
iSCSI Interface

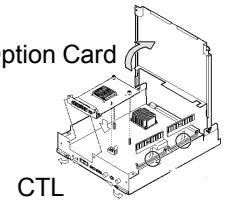
- The AMS 2500 provides 4 iSCSI ports per controller (eight per unit) for the iSCSI configuration or two ports per controller (four per base unit) with the multi-protocol (mix of Fibre Channel and iSCSI) configuration.
  - To convert a base unit from only Fibre Channel to only iSCSI or to a multi-protocol configuration, replace both controllers and install the firmware on them.
  - The same firmware supports both fibre channel and iSCSI units.
- With the 1 Gb/s Ethernet connection, the array provides high-speed data transfer to and from a host computer.
  - The maximum transfer speed is 100 MB/s per port. Higher throughput can be obtained, even when accessing multiple devices connected to the same network.
- The AMS 2500 supports iSCSI (1000 Base-T).
  - With the HBA for iSCSI, generic NIC and software initiator, and network switch, the AMS 2500 can be located up to 100 meters from the host.

5

Specification Outline Hardware

✓AMS2000 Rev2 and AMS2000, chassis is common.
✓AMS2000 Rev2 CTL will be changed.
✓Option Card is common.





AMS 2000	Multi Protocol	FC [speed] [Max ports / System] iSCSI [speed] [Max ports/System]		AMS 2000 Rev2	Multi Protocol	FC [speed] [Max ports / System] iSCSI [speed] [Max ports/System]	
H-CTL	OK	1,2,4,8 Gb/s	16 ports	2500E-CTL	OK	1,2,4,8 Gb/s	16 ports
		1 Gb/s	8 ports			1 Gb/s	8 ports
M-CTL	N/A	1,2,4,8 Gb/s	8 ports	2300E-CTL	OK	1,2,4,8 Gb/s	16 ports
		1 Gb/s	4 ports			1 Gb/s	4 ports
S-CTL	N/A	1,2,4 Gb/s	4 ports	2100E-CTL	OK	1,2,4,8 Gb/s	8 ports
						1 Gb/s	4 ports
		1 Gb/s	4 ports	EXS-CTL	N/A	1,2,4 Gb/s	4 ports
						N/A	N/A

6

Specification Outline Firmware

#	Items		Specifications						
			AMS2100	DF800EXS	AMS2100 Rev2	AMS2300	AMS2300 Rev2	AMS2500	AMS2500 Rev2
1	Support Unit	Base Unit	RKS	RKEXS	RKES	RKM	RKEM	RKH	RKEH
2		Expansion Unit	RKAK(SAS/SATA/SSD), RKAKX(SATA)			RKAK, RKAKX		RKAK, RKAKX	
3	Controller	Single / Dual	Single / Dual			Single / Dual		Dual	
4		CPU clock	Value Sossaman 1.67GHz (Single Core)			ULV Sossaman 1.67GHz (Single Core)	Value Sossaman 1.67GHz (Single Core)	LV Sossaman 2GHz (Dual Core)	
5		L2 Cache capacity	512KB			2MB	512KB	2MB	
6		DCTL	DCTL-S		DCTL(5th)	DCTL(3rd)	DCTL(5th)	DCTL(3rd)	DCTL(5th)
7	Cache	Support capacity	1GB, 2GB, 4GB /CTL			1, 2, 4, 8GB /CTL		2, 4, 6, 8, 10, 12, 16GB /CTL	
8		Slot #	1 /CTL			2 /CTL		4 /CTL	
9	RAID	RAID 5	2D+1P ~ 15D+1P			2D+1P ~ 15D+1P		2D+1P ~ 15D+1P	
10		RAID 6	2D+2P ~ 28D+2P			2D+2P ~ 28D+2P		2D+2P ~ 28D+2P	
11		RAID 1	1D+1D			1D+1D		1D+1D	
12		RAID 1+0	2D+2D ~ 8D+8D			2D+2D ~ 8D+8D		2D+2D ~ 8D+8D	
13		RAID 0	2D ~ 16D (SATA=N/A)			2D ~ 16D (SATA=N/A)		2D ~ 16D (SATA=N/A)	
14		Max RG#	50			75		100	

7

#	Items		Specifications						
			AMS2100	DF800EXS	AMS2100 Rev2E	AMS2300	AMS2300 Rev2	AMS2500	AMS2500 Rev2
15	LU	Max LU#	2048			4096		4096	
16		Max LU size	60TB			60TB		60TB	
17		Max LU / HG	2048			2048		2048	
18		Max LU / RG	1024			1024		1024	
19	HDP	Max DPVol	2047			4095		4095	
20		Max DP Pool#	50			64		64	
21		Max DPVol size	60TB			60TB		60TB	
22		DPVol / DP Pool	2047			4095		4095	
23	Spare Disk	Max Spare Disk #	15			30		30	
24	FC I/F	Speed	1, 2, 4 Gb/s		1,2,4,8Gb/s	1, 2, 4, 8 Gb/s		1, 2, 4, 8 Gb/s	
25		Max Port # / system	4		8	8	16	16	
26		CMD multiple rate	512CMD / port			512CMD / port		512CMD / port	
27		Max Host #	128 / port			128 / port		128 / port	
28	iSCSI I/F	Speed	1Gb/s	N/A	1Gb/s	1Gb/s		1Gb/s	
29		Max Port # / system	4		4	4		8	
30		CMD multiple rate	512CMD / port		512CMD / port	512CMD / port		512CMD / port	
31		Max Host #	255 / port		255 / port	255 / port		255 / port	
32	Multi-Protocol	FC/iSCSI intermix in one CTL	N/A		Available	N/A	Available	Available	

8

#	Items		Specifications						
			AMS2100	DF800EXS	AMS2100 Rev2	AMS2300	AMS2300 Rev2	AMS2500	AMS2500 Rev2
33	Backend	Path# / system	4			4		8	
34		Basic Unit	15HDDs, 4Paths			15HDDs, 4Paths		0HDD, 8Paths	
35		Expansion Unit	15HDDs, 2Paths			15HDDs, 2Paths		15HDDs, 2Paths	
36			Max 7RKAKs			Max 15RKAKs		Max32RKAKs	
37		Dense Unit	48HDDs, 4Paths			48HDDs, 4Paths		48HDDs, 4Paths	
38		(SATA Dense, SAS Dense)	Max 3RKAKXs			Max 4RKAKXs	Max 5RKAKXs	Max 10RKAKXs	
39		Max HDD#	159			240	255	480	
40	HDD (SAS)	I/F	SAS (3Gb/s)			SAS (3Gb/s)		SAS (3Gb/s)	
41		Model	Seagate, HGST / 146G, 300G, 450G, 600G: 15Krpm / 400G: 10Krpm			Seagate, HGST / 146G, 300G, 450G, 600G: 15Krpm / 400G: 10Krpm		Seagate, HGST / 146G, 300G, 450G, 600G: 15Krpm / 400G: 10Krpm	
42	HDD (SATA)	I/F	CTL-HDD:SAS (3Gb/s), HDD-HDD: SATA (3Gb/s)			CTL-HDD:SAS (3Gb/s), HDD-HDD: SATA (3Gb/s)		CTL-HDD:SAS (3Gb/s), HDD-HDD: SATA (3Gb/s)	
43		Model	Seagate, HGST / 500G, 750G, 1TB, 2TB: 7.2Krpm			Seagate, HGST / 500G, 750G, 1TB, 2TB: 7.2Krpm		Seagate, HGST / 500G, 750G, 1TB, 2TB: 7.2Krpm	
44	SSD (SAS)	I/F	SAS (3Gb/s)			SAS (3Gb/s)		SAS (3Gb/s)	
45		Model	STEC / 100G, 200G			STEC / 100G, 200G		STEC / 100G, 200G	
46	Number of PGR keys		32	128	128	32	128	32	128

9

Detail Specification Enhancement Outline

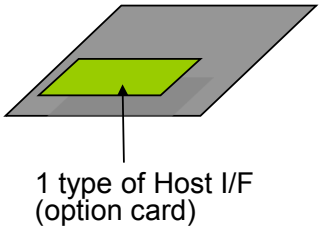
#	Items		Contents	Notes
1	Hardware Enhancement	DCTL 5th	Enhancement for new DCTL 5th	--
2		LAN 2Chip/CTL	Hardware changing for LAN 2Chip/CTL	--
3		CPU Enhancement	CPU enhancement in EM	--
4		Onboard FC I/F	- Onboard FC I/F in EM, ES and EXS - Removing previous logic for I/F#0	See 4.3
5	Firmware Enhancement	Multi-Protocol	- Multi-Protocol (FC/iSCSI) in EM and ES - Onboard (FC) + Option Card (FC or iSCSI)	See 4.2
6		Max Dense# improvement	- EM supports max 255HDDs (RKEM + 5RKAKX) - No enhancement in M (max 240HDDs)	See 4.4
7		Guarding Logic	Combination between Controller and Firmware Rev.	See 4.5
8		Upgrading	- Model upgrading between DF800 and DF800E - Model upgrading in DF800E (eg: ES→EM/EH)	See 4.6

10

Detail Specification Multi Protocol-Rev2 (AMS2100, AMS2300)

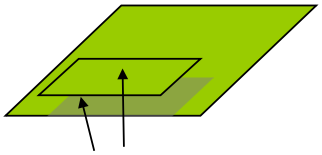
Current AMS2000 Single-Protocol

- Current AMS2100/AMS2300 are single-protocol.
- The controller can be installed with only one type of Host I/F, because it has 1 slot for option I/F card for Host I/F.
- (No host I/F is embedded on the controller.)



AMS2000 Rev2 Multi-Protocol

- AMS2100/2300 Rev2 support multi-protocol.
  - This multi-protocol can provide:
    1) More FC ports for Rev2 AMS2100/AMS2300 (Onboard FC 4(2) ports + optional FC 4(2) ports)
    2) Combined Host I/F for AMS2100E/AMS2300E (FC + iSCSI)
- More ports on Rev2 AMS2100/AMS2300.
- The controller can be installed with TWO TYPES of Host I/F, because it has embedded host I/F on board, in addition to the option I/F card for Host I/F.



11

Detail Specification Multi Protocol – Rev2 (AMS2100E AMS2300E)

Combination of Onboard and Option I/F Card

I/F, ports/CTL	AMS2500 Rev2			AMS2300 Rev2			AMS2100 Rev2			DF800EXS
Default (Onboard)				FC 8G x 4 (QE8)			FC 8G x 2 (QE8)			FC 4G x 2 (DE4)
Option (I/F Card)	2 of below			1 of below			1 of below			
	FC 8G x 4 (QE8)	FC 4G x 4 (QE4)	iSCSI 1G x 2	FC 8G x 4 (QE8)	FC 4G x 4 (QE4)	iSCSI 1G x 2	FC 8G x 2 (QE8)	FC 4G x 2 (DE4)	iSCSI 1G x 2	

#	Hardware (Onboard, Option I/F Card)			2100	EXS	2100 Rev2	2300	2300 Rev2	2500	2500 Rev2
1	Onboard	FC 8Gx4 (QE8)	NEW!!	--	N/A	N/A	--	Support	--	--
2		FC 8Gx2 (QE8)	NEW!!	--	N/A	Support	--	N/A	--	--
3		FC 4Gx2 (DE4)	NEW!!	--	Support	N/A	--	N/A	--	--
4	Option I/F Card	FC 8Gx4 (QE8)		N/A	--	N/A	Support	Support	Support	Support
5		FC 4Gx4 (QE4)		N/A	--	N/A	Support	Support	Support	Support
6		FC 8Gx2 (QE8)	NEW!!	N/A	--	Support	N/A	N/A	N/A	N/A
7		FC 4Gx2 (DE4)		Support	--	Support	N/A	N/A	N/A	N/A
8		iSCSI 1Gx2		Support	--	Support	Support	Support	Support	Support

12

Detail Specification Multi Protocol – Rev2 (AMS2100, AMS2300)

Option I/F Card combination between CTL0 and CTL1

As same as current DF800H multi-protocol, intermix between CTL0 and CTL1 is NOT available.

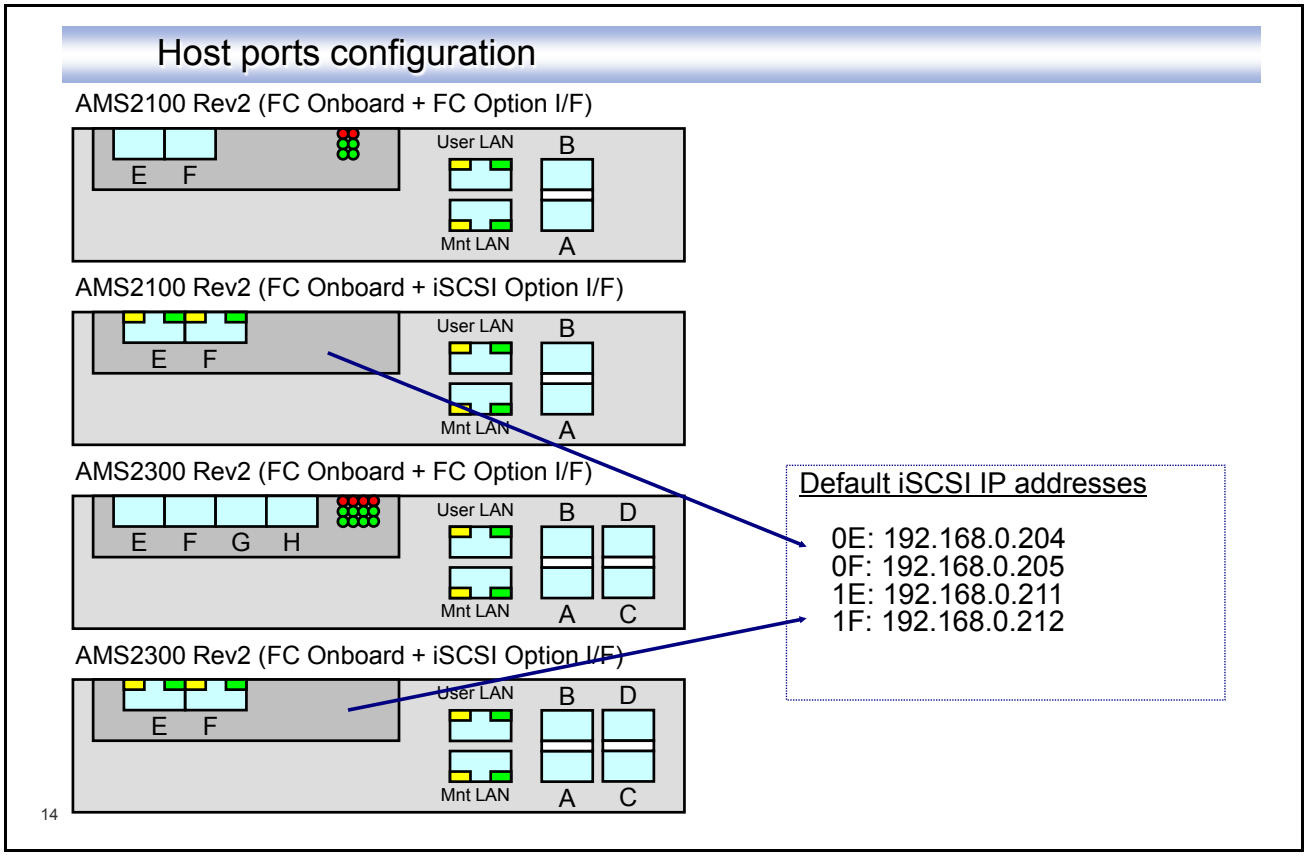
AMS2300 Rev2

			CTL1			
			Onboard	I/F#1 (Option I/F Card)		
				FC 8Gx4 (QE8)	FC 4Gx4 (QE4)	iSCSI 1Gx2	None
CTL0	Onboard			FC 8Gx4 (QE8)			
	I/F#1 (Option I/F Card)	FC 8Gx4 (QE8)	FC 8Gx4 (QE8)	Support	Support	N/A	Support
		FC 4Gx4 (QE4)		Support	Support	N/A	Support
		iSCSI 1Gx2		N/A	N/A	Support	Support
		None		Support	Support	Support	Support

AMS2100 Rev2

			CTL1			
			Onboard	I/F#1 (Option I/F Card)		
				FC 8Gx2 (QE8)	FC 4Gx2 (DE4)	iSCSI 1Gx2	None
CTL0	Onboard			FC 8Gx2 (QE8)			
	I/F#1 (Option I/F Card)	FC 8Gx2 (QE8)	FC 8Gx2 (QE8)	Support	Support	N/A	Support
		FC 4Gx2 (DE4)		Support	Support	N/A	Support
		iSCSI 1Gx2		N/A	N/A	Support	Support
		None		Support	Support	Support	Support

13

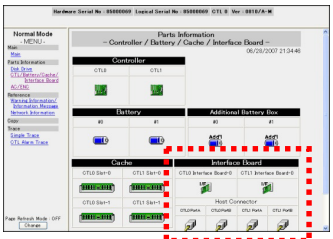

Host ports configuration
AMS2100 Rev2 (FC Onboard + FC Option I/F)
E F
User LAN
Mnt LAN
B
A
AMS2100 Rev2 (FC Onboard + iSCSI Option I/F)
E F
User LAN
Mnt LAN
B
A
AMS2300 Rev2 (FC Onboard + FC Option I/F)
E F G H
User LAN
Mnt LAN
B D
A C
AMS2300 Rev2 (FC Onboard + iSCSI Option I/F)
E F
User LAN
Mnt LAN
B D
A C
Default iSCSI IP addresses
0E: 192.168.0.204
0F: 192.168.0.205
1E: 192.168.0.211
1F: 192.168.0.212
14

Detail Specification Onboard Controller with FC Interface

Parts displaying spec

- Onboard: No “I/F#0 Board”, but there are “Host Connectors”.
- Option I/F Card: There are “I/F#1 Board” and “Host Connectors”.

Image of DF800ES



CTL0 Interface Board 0		CTL1 Interface Board 0	
(None!!)		(None!!)	
CTL0 PortA	CTL0 PortB	CTL1 PortA	CTL1 PortB
			
CTL0 Interface Board 1		CTL1 Interface Board 1	
			
CTL0 PortE	CTL0 PortF	CTL1 PortE	CTL1 PortF
			

15

Detail Specification Onboard Controller with FC Interface

Failure reporting spec

- Onboard failure: No “I/F#0 Board” failure, but only “CTLx” failure.
- Option I/F Card failure: Both “I/F#1 Board” failure and “CTLx” failure.

Image of DF800ES Onboard failure

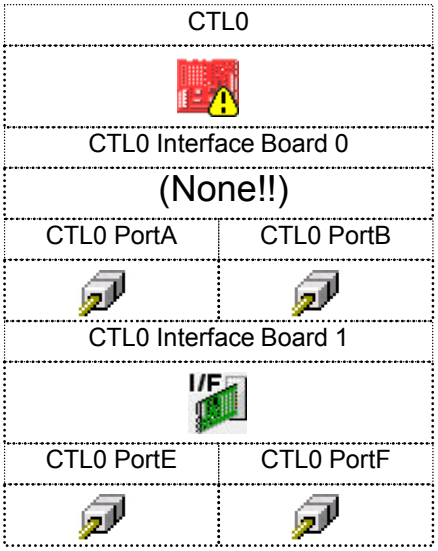
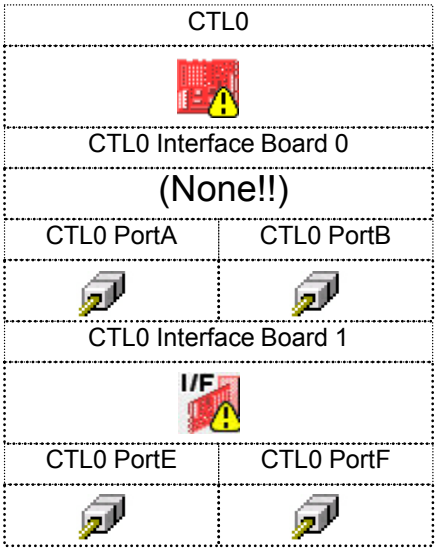


Image of DF800ES Option I/F Card failure



16

Detail Specification Max HDD Number Improving in AMS2300 Rev2

Overview

- AMS2300 Rev2 supports Max 4 RKAKXs(Dense) connection supported. (Max HDD=252)
  - Some other combinations are also newly supported.
  - 255 HDDs configuration without RKAKX (1 RKEM + 16 RKAKS = 255) are NOT supported.
- No spec change in AMS2300 (still supports Max 4 RKAKXs connection).

Condition for considering the max support HDD

- All following conditions must be fulfilled.

A) Total HDD number is 255 or less.
B) Total HDD number in each Path is 135 or less.
(RKAK=15, RKAKX(SATA)=24, RKAKX(SAS)=24 (Not 19) **Note1*)
C) Total Unit number in each Path is 8 or less. (The Base-Unit is counted as Path1.)

Note1: RKAKX(SATA) and RKAKX(SAS) use same Management Table internally, so one RKAKX(SAS) must be counted as 24HDDs in one Path, not as 19HDDs which is the actual number.

17

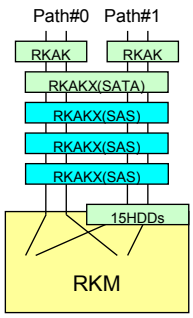
Detail table for AMS2300 Rev2 support HDD number

#	Combinations for AMS2300 Rev2			Total HDDs	Note
	RKEM (15HDDs)	RKAK (15HDDs)	RKAKX (48HDDs)		
1	1	14	0	225	Supported
2	1	15	0	240	Supported
3	1	16	0	255	Not supported → C)
4	1	11	1	228	Supported
5	1	12	1	243	Newly supported
6	1	13	1	258	Not supported → A)
7	1	8	2	231	Supported
8	1	9	2	246	Newly supported
9	1	10	2	261	Not supported → A)
10	1	5	3	234	Supported
11	1	6	3	249	Newly supported
12	1	7	3	264	Not supported → A)
13	1	2	4	237	Supported
14	1	3	4	252	Newly supported
15	1	4	4	267	Not supported → A)

18

Detail table for AMS2300 Rev2 support HDD number **with SAS Dense**

#	Combinations for AMS2300				Total HDDs	Note
	RKM (15HDDs)	RKAK (15HDDs)	RKAKX (48 SATA HDDs)	RKAKX (38 SAS HDDs)		
1	1	0	0	5	205	Support
2	1	1	0	5	220	Support
3	1	2	0	5	235	N/A for **Condition2**
4	1	1	1	4	230	Support
5	1	2	1	4	245	N/A for **Condition2**
6	1	3	0	4	212	Support
7	1	4	0	4	227	N/A for **Condition2**



Following all conditions must be satisfied for the configuration.

- Condition1: Max 8 units / Path
- Condition2: Max 135 HDDs / Path
  (RKAK=15, RKAKX(SATA)=24, RKAKX(SAS)=24 (Not 19) *Note1)
- Condition3: Max 240 HDDs / System

*Note1: RKAKX(SATA) and RKAKX(SAS) use same Management Table internally, so one RKAKX(SAS) must be counted as 24HDDs in one Path, not as 19HDDs which is the actual number.

19

Detail Specification Guarding Logic

Array booting up (Combination between Controller and Firmware)

#	Controller kinds	Firmware version	
		Before V9.0	V9.0 or later (Note)
1	AMS2100 controller	Available (Ready)	Available (Ready)
2	AMS2300 controller	Available (Ready)	Available (Ready)
3	AMS2500 controller	Available (Ready)	Available (Ready)
4	DF800EXS controller	N/A (Subsystem Down)	Available (Ready)
5	AMS2100 Rev2 controller	N/A (Subsystem Down)	Available (Ready)
6	AMS2300 Rev2 controller	N/A (Subsystem Down)	Available (Ready)
7	AMS2500 Rev2 controller	N/A (Subsystem Down)	Available (Ready)

Note:
- AMS2000 Firmware cannot be installed on AMS2000 Rev2 Hardware.
- AMS2000 Rev2 Firmware cannot be installed on AMS2000 Hardware.

20

Array booting up (Combination between CTL0 and CTL1)

#	Controller kinds		Result	Note
	CTL0	CTL1		
1	DF800EXS	DF800EXS	Available (Ready)	--
2		Other than DF800EXS	N/A (Subsystem Down)	RA7600: CTL unit type is different between the controllers
3	AMS2100 Rev2	AMS2100 Rev2	Available (Ready)	--
4		Other than AMS2100 Rev2	N/A (Subsystem Down)	RA7600: CTL unit type is different between the controllers
5	AMS2300 Rev2	AMS2300 Rev2	Available (Ready)	--
6		Other than AMS2300 Rev2	N/A (Subsystem Down)	RA7600: CTL unit type is different between the controllers
7	AMS2500 Rev2	AMS2500 Rev2	Available (Ready)	--
8		Other than AMS2500 Rev2	N/A (Subsystem Down)	RA7600: CTL unit type is different between the controllers

21

Online controller replacement (combination between controller and firmware)

#	Current configuration		Upgrading controller kinds	Result
	Controller kinds	Firmware version		
1	AMS2100/2300/2500	Before V9.0	AMS2100/2300/2500	Available (Ready)
2			AMS2100/2300/2500 Rev2	N/A (CTL Alarm)
3		V9.0 or later	AMS2100/2300/2500	Available (Ready)
4			AMS2100/2300/2500 Rev2	N/A (CTL Alarm)
5	DF800EXS/ AMS2100/AMS2300/ AMS2500 Rev2	Before V9.0	--	--
6		V9.0 or later	AMS2100/2300/2500	N/A (CTL Alarm)
7			DF800EXS/AMS2100/ AMS2300/AMS2500 rev2	Available (Ready)

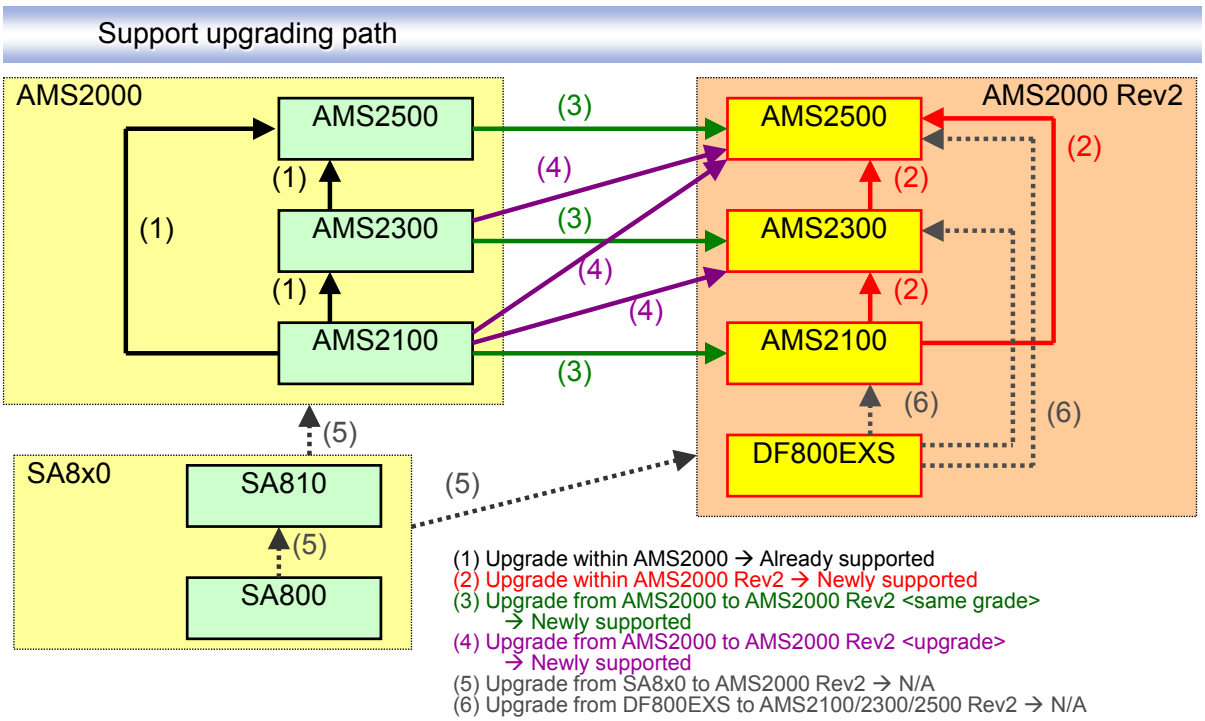
22

Online firmware upgrading (combination between controller and firmware)

#	Current configuration		Upgrading Firmware version	Result
	Controller kinds	Firmware version		
1	AMS2100/2300/2500	Before V9.0	Before V9.0	Available (Ready)
2			V9.0 or later	Available (Ready)
3		V9.0 or later	Before V9.0	Available (Ready)
4			V9.0 or later	Available (Ready)
5	DF800EXS/AMS2100/ AMS2300/AMS2500 Rev2	Before V9.0	--	--
6		V9.0 or later	Before V9.0	N/A (Install guarding)
7			V9.0 or later	Available (Ready)

23

Detail Specification Upgrading



Model upgrading procedures

- Upgrading procedures in AMS2000 Rev2 are almost same as current AMS2000's.
- Some cases are simpler than the current ones because the Product Number is not changed in this upgrading.

#	Upgrading procedures type		Upgrade kinds							
			(1) Within AMS2000		(2) Within AMS2000 Rev2			(3) AMS2000→AMS 2000 <same grade>	(4)AMS2000 to AMS2000 Rev2 <Upgrade>	
			2100→ 2300	2300→ 2500	(6) EXS→ 2100 Rev2	2100 Rev2→ 2300 Rev2	EXS/2100 Rev2/2300 Rev2→ 2500 Rev2		S→2300 Rev2	S/M→2500 Rev2
1	Controller upgrading		X		N/A	X			X	
2	Chassis and Controller upgrading with Drive transferring			X	N/A		X			X
3	Controller upgrading (without Product ID changes)	NEW!!			N/A			X		

25

Model upgrading spec for PP information

- In conventional procedures of Model Upgrading, each PP must be un-installed before the Model Upgrading, then be installed again after the Upgrading.
- From V9.0/A, only HDP and DRU can be allowed to take over their PP information in Model Upgrading procedures, so there are not necessary the un-install and re-install procedures before and after Model Upgrading.

#	PP	Model Upgrading during PP key Enable	Impact for the Product
1	LUN Manager	N/A	None (Setting information can be taken over.)
2	Performance Monitor	N/A	None (No information must be taken over.)
3	SNMP Agent Support	N/A	None (Setting information can be taken over.)
4	Cache Residency Manager	N/A	Medium (Setting information can NOT be taken over.)
5	Cache Partition Manager	N/A	Medium (Setting information can NOT be taken over.)
6	Account Authentication	N/A	Medium (Setting information can NOT be taken over.)
7	Audit Logging	N/A	None (Setting information can be taken over.)
8	Data Retention Utility	Support in V9.0	(User cannot un-install the key during indicated term, so the Model Upgrading also cannot be executed.)
9	Copy-on-Write Snapshot	N/A	Big (All V-Vols and Pool are deleted at the PP un-installing.)
10	ShadowImage	N/A	Big (All pair information are deleted at the PP un-installing.)
11	TrueCopy remote replication	N/A	Big (All path and pair information are deleted at the PP un-installing.)

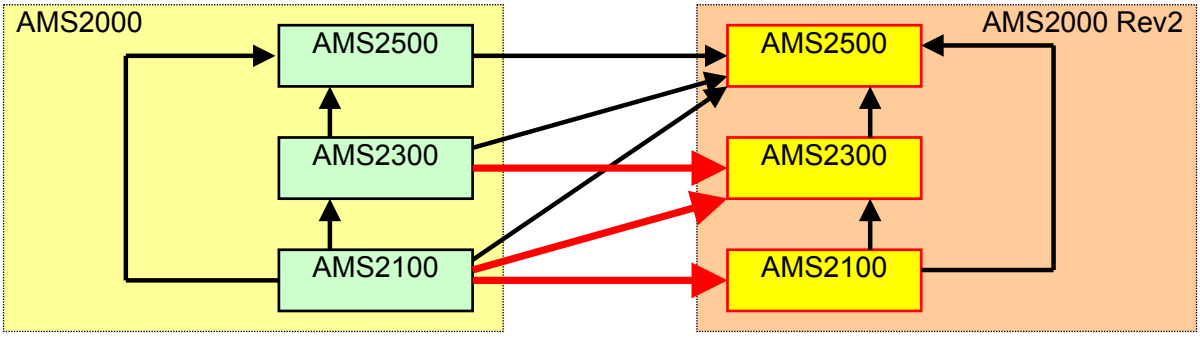
26

Model upgrading spec for PP information

#	PP	Model Upgrading during PP key Enable	Impact for the Product
12	TCMD	N/A	Big (All path and pair information are deleted at the PP un-installing.)
13	TCED	N/A	Big (All path, pair and Pool information are deleted at the PP un-installing.)
14	Modular Volume Migration	N/A	Small (Model Upgrading should be executed after Migration.)
15	Power Saving	N/A	None (User should reconsider the setting contents after Model Upgrading.)
16	HDP	Support in V9.0	(All DP-Vols and DP Pools must be deleted at the PP un-installing.)

27

Notice for model upgrading procedures from AMS2000 iSCSI model



- In any upgrading cases, iSCSI specific information (IP address, iSCSI Name) is taken over to the destination Array, so that user does not take care some additional setting in the Host side.
- Above three Red ➔ cases, although iSCSI specific information is taken over to the destination Array, just their Port locations are changed from original Array because of FC Onboard Controller spec.
  Ex) Before: Port0A,0B,1A,1B → After: Port0E,0F,1E,1F

28

Detail Specification Firmware Version Architecture

Ver	Firmware Version (Full description)								
	Sealed Array		AMS2000			AMS2000 Rev2			
	SA800	SA810	2100	2300	2500	EXS	2100	2300	2500
V4.0	1840/A-A	1840/A-B	0840/A-S	0840/A-M	0840/A-H	--	--	--	--
V5.0	1850/A-A	1850/A-B	0850/A-S	0850/A-M	0850/A-H	--	--	--	--
V6.0	1860/A-A	1860/A-B	0860/A-S	0860/A-M	0860/A-H	--	--	--	--
V7.0	1870/A-A	1870/A-B	0870/A-S	0870/A-M	0870/A-H	--	--	--	--
V8.0	1880/A-A	--	0880/A-S	0880/A-M	0880/A-H	--	--	--	--
V9.0	1890/A-A	--	0890/A-S	0890/A-M	0890/A-H	**0890/A-W**	**0890/A-X**	**0890/A-Y**	**0890/A-Z**

Note:

- AMS2000 Firmware cannot be installed on AMS2000 Rev2 Hardware.
- AMS2000 Rev2 Firmware cannot be installed on AMS2000 Hardware.

29

Detail Specification Product Number

Figure8	Figure7	Figure6	Figure5	Figure4	Figure3	Figure2	Figure1
Array kind	Model kind	Serial number					

Array kind: Fixed '8' in SA8x0, AMS2000 and AMS2000 Rev2

Model Kind	Model
1	SA800
2	SA810
3	AMS2100/**EXS/AMS2100 Rev2**
5	AMS2300/**AMS2300 Rev2**
7	AMS2500/**AMS2500 Rev2**

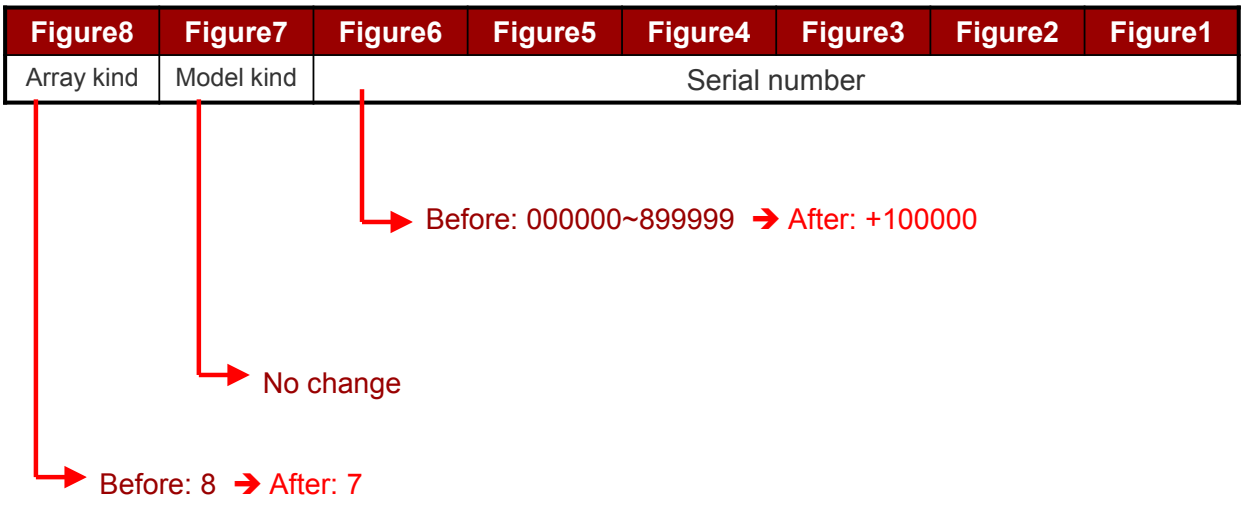
No special Product Number for DF800EXS/2100/2300/2500 Rev2, but common for current AMS2000's one !!

Model	Serial number
SA800	000000 ~ 899999
SA810	000000 ~ 899999
AMS2100/**EXS/2100 Rev2E**	000000 ~ 899999
AMS2300/**2300 Rev2**	000000 ~ 899999
AMS2500/**2500 Rev2**	000000 ~ 899999

30

Detail Specification Inquiry Serial Number Conversion Mode

- This mode is the one for the customer who uses the old version of Symantec VxVM which supports only DF700, not AMS2000.
- When enabling the mode, the Array Product ID which is just for the response of Inquiry command is converted by following the rule of DF700.
- AMS2000 Rev2 supports this mode as same as AMS2000.



31

Detail Specification Inquiry page E0

Byte \ Bit	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code (0xE0)							
2	Reserved							
3	Page Length							
4	P/S Vld	P/S	Vendor Unique					
5	SWVld	A/PG	A/P	A/A	Rpt	Cnv	Reserved	
6 - 15	Vendor Unique							
16 - 31	Product Identifier (ASCII)							
32 - 39	Drive Type (ASCII)							
40	Additional Product Identifier							
41 - 127	Vendor Unique							

#	Model	Byte16-31: Product Identifier (ASCII)	Additional Product Identifier
1	AMS2100	“DF800S “ : (10 spaces)	0x00 (No change)
2	AMS2300	“DF800M “ : (10 spaces)	0x00 (No change)
3	AMS2500	“DF800H “ : (10 spaces)	0x00 (No change)
4	**DF800EXS**	“DF800S “ : (10 spaces)	**0x10 (NEW!!)**
5	**AMS2100 Rev2**	“DF800S “ : (10 spaces)	**0x20 (NEW!!)**
6	**AMS2300 Rev2**	“DF800M “ : (10 spaces)	**0x40 (NEW!!)**
7	**AMS2500 Rev2**	“DF800H “ : (10 spaces)	**0x80 (NEW!!)**

32

Detail Specification Incompatibility between AMS2000 Rev2 and SNM2 Old Version

- Because the old version of SNM2 (Ver.8.xx or before) cannot show full spec configuration for AMS2000 Rev2, especially about the parts which are newly supported from V9.0, old version of SNM2 restricts to register AMS2000 Rev2 Array with following Error message.

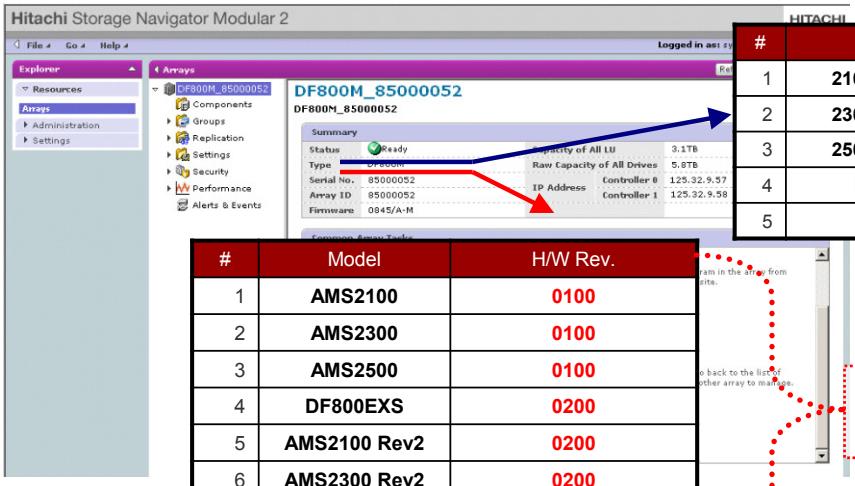
  DMEA001079: Cannot use this function for the specified device.

#	Model	SNM2 Ver.8.xx or before	SNM2 Ver.9.00 or later
1	**AMS2100**	No problem	No problem
2	**AMS2300**	No problem	No problem
3	**AMS2500**	No problem	No problem
4	**DF800EXS**	**N/A (DMEA001079)**	No problem
5	**AMS2100 Rev2**	**N/A (DMEA001079)**	No problem
6	**AMS2300 Rev2**	**N/A (DMEA001079)**	No problem
7	**AMS2500 Rev2**	**N/A (DMEA001079)**	No problem

33

Detail Specification Model Identifier

- Since there are some spec differences between AMS2000 and AMS2000 Rev2, we must be able to identify each Model in SNM2. Also, this Model identifier is necessary from maintenance point of view. Therefore, SNM2 supports one new category as “H/W Rev." in Array Components Screen, shown as “0100" for current AMS2100/2300/2500 and SA800, “0200" for new AMS2100/2300/2500 Rev2 and DF800EXS.



#	Model	Type
1	2100/2100 Rev2	AMS2100
2	2300/2300 Rev2	AMS2300
3	2500/2500 Rev2	AMS2500
4	DF800EXS	MSS (*note)
5	SA800	SMS100

#	Model	H/W Rev.
1	AMS2100	0100
2	AMS2300	0100
3	AMS2500	0100
4	DF800EXS	0200
5	AMS2100 Rev2	0200
6	AMS2300 Rev2	0200
7	AMS2500 Rev2	0200
8	SA800	0100

*note: Abbreviation for “Modular Storage System”.

4 digits can allow more flexible usage for future enhancement.

34

AMS 47U Rack Assembly Overview

- **Purpose:**
  - To satisfy customer requirements for more efficient use of floor space
  - Our first rack config offering a 2 PDU design (requires 3 phase power)
  - An alternative to the Solutions Rack

- **Design Notes:**
  - Additional 5U height allows for a total of 10 Dense Trays within a single frame (one more than solutions capacity).
  - 2 PDU Options:
    - 30A single phase 24 Outlet PDU x 4 (used in Solutions Rack)
    - New 60A 3-phase 22 Outlet PDU x 2
  - The pair of 60A 3-Phase PDU's fit a "0U" form factor, maximizing cabling space within the rack.

35

- HDS will populate the rack up to half-height for shipping (consistent with previous AMS configurations).
- Customers must ensure this rack will fit through Data Center doors and in their transportation vehicles (if planning to ship).
- Must have height/weight appropriate lifts on-site to allow for completion of tray installation/maintenance and staff qualified to operate.
- Units will ship with a stabilizing plate and baying kit to assist with free-standing stability; however, bolting these units to the ground or ceiling is ideal (if possible).

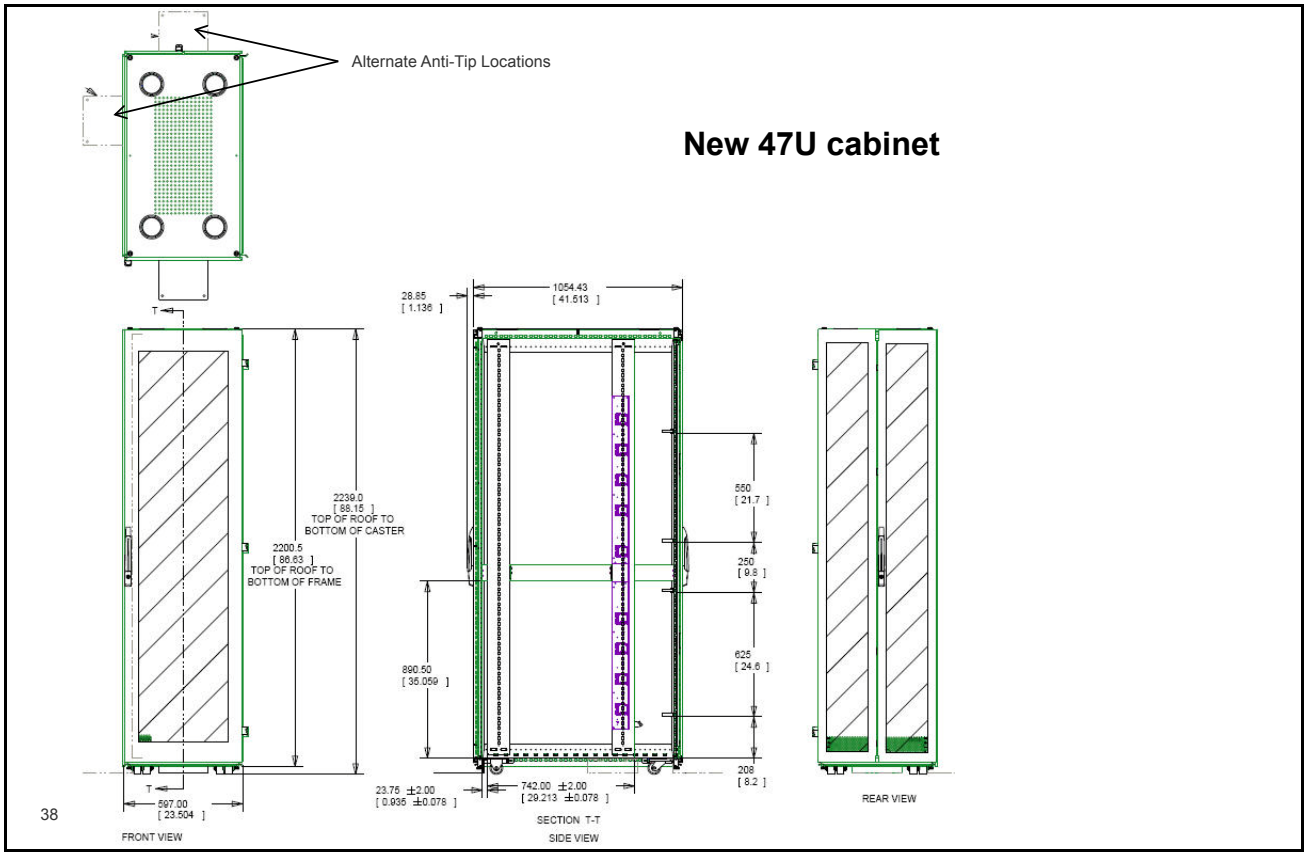
36

AMS 47U Rack Assembly Quick Specs

Item	Specification	Item	Specification
P-code	7846475	Front Door	Perforated, with lock, black
Dimensions (HxWxD)	88.13 x 23.5 x 41.5 inches 2238.6 x 597 x 105.43 mm	Rear Door	Split with Master/Slave, Lock
Usable Volume (HxWxD)	6.85 x 1.6 x 2.63 feet 2088 x 488 x 802 mm	Side Panels	Solid, with screws
Weight (approx)	410 lbs / 186 kg	Mounting	Four 19" vertical rails, with "U" markings
Static Weight Capacity*	3200 lbs / 1451 kg	Casters	2 fixed in the front 2 swivel casters in the rear Each caster rated at 249 kg (550 lbs) each (dynamic capacity)*
Power	208VAC, 3 Phase Delta, (2) 60 Amp PDUs	Dynamic Load	2250 lbs / 1021 kg
PDU	Power Cord: Rated 60A, 208V, 50/60Hz	Leveling Feet	4
Component Power Cords	Power cord 2 feet, 250V, 15 amps, C14/C13 connector	Cable Management	Cable ring guides in the rear
Indicator		Grounding	Black ground straps (door/ sides/roof)
PDU Source Power Cord	10' (3m) (8G/4C) 3W+PE	Blanking Panels	A sufficient number of 3U solid blanking panels to satisfy a configuration
Temperature	32° to 122°F (0° to 50°C)	Support Rails	None
Humidity	0 – 95%, non-condensing	Front Stabilizer Plate	One "L" shaped stabilizer plate included with the rack for front use
Color	Black	Side Stabilizer Plate	Required for stand-alone configurations
Mounting Height in EIA Units	47U	Safety Approvals (rack with power strips)	UL/cUL UL60950-1
Frame	Welded steel	Options	Temperature and humidity probe
Roof	Solid with 4 cable entry holes	Baying Interconnect Kits	8800490

37

AMS 47U Rack Assembly Dimensions



AMS 47U Rack Assembly PDU Specifics

A. Input Characteristics:
- 1) Voltage: 208VAC, 3 PHASE DELTA
- 2) Frequency: 50/60 Hz.
- 3) Current: 60 AMP LINE CURRENT
  34.6A PHASE CURRENT
- 4) Load Capacity: 21.6 KVA
- 5) Overload Protection: 2P/15A x9 UL489 Circuit Breaker
- 6) Power Cord: 10' (3m) (8G/4C) 3W+PE
- 7) Connector: IEC309 60A PIN AND SLEEVE

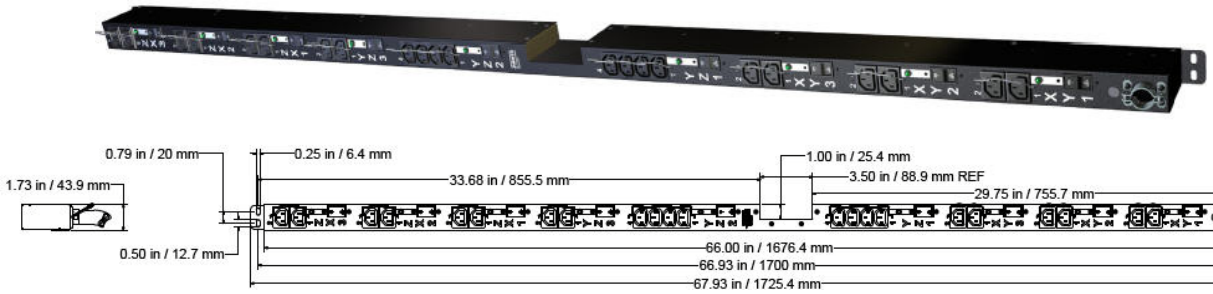
B. Output Characteristics:
- 1) Voltage: 208VAC
- 2) Current: 12A PER OUTLET, 12A PER BREAKER GROUP (DERATED FOR NORTH AMERICA)
- 3) Outlets: C13 x22

C. Mechanical Characteristics:
- 1) Material: CRS/G40
- 2) Finish: Powder Coat, Black, Fine Texture
- 3) Lettering: Silk-Screen, White/Epoxy
- 4) Storage Temp.: -13 to 149C (-25 to 65C)

D. Operating Environment:
- 1) Temperature: 32 TO 122F (0 - 50C)
- 2) Relative Humidity: 0 - 95% (Non-Condensing)
- 3) Elevation: 0 - 10,000FT (0 - 3000 m)

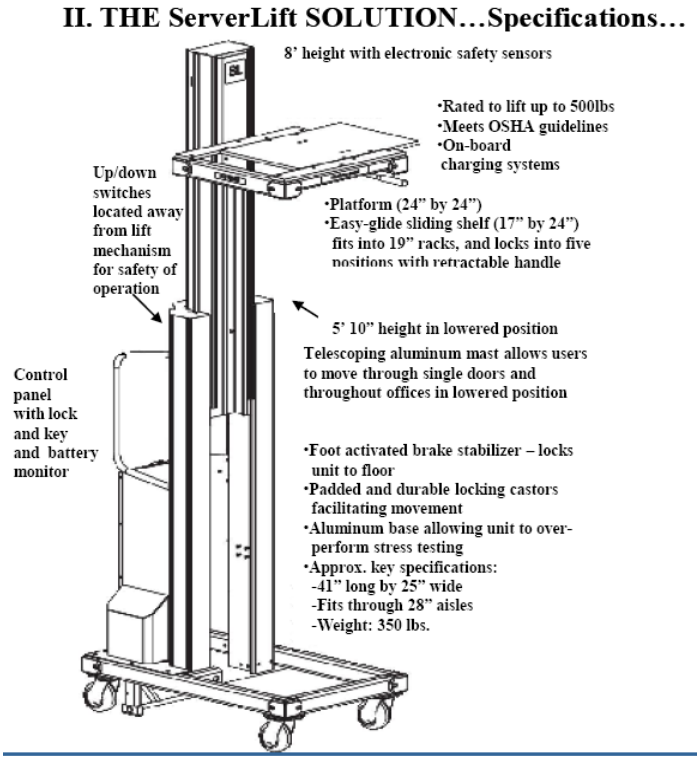
E. Regulatory Conformance:
- 1) Safety Agency: UL/cUL, UL60950-1 (PENDING)
- 2) RoHS: Compliant to Directive 2002/95/EC

New style of PDU (left side and right side)



39

AMS 47U Rack Assembly Lift Specs



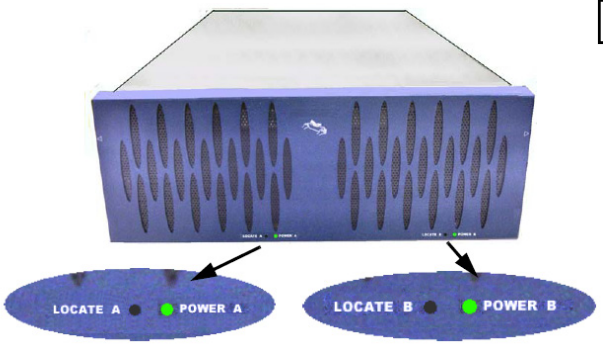
High-density Expansion Unit

- A high-density expansion storage unit (factory designation RKAKX) provides significant additional storage capabilities for the base units. It contains from 6 to 48 SATA disk drives, four redundant power supplies, and four ENC adapter units (cards). The ENC units manage the drives and are also used to connect the expansion unit to the base unit and other expansion units.
- There are no switches on a high-density expansion unit. Power is turned on and off with a control signal that is routed from the base unit via the ENC cables that are connected to the ENC unit in the high-density expansion unit. An AMS 2500 base unit supports up to 10 high-density expansion units.
- A high-density expansion unit has 48 drive slots in the drive section of the unit. Each slot can accommodate one SATA drive or one drive filler. A drive filler is a solid but lightweight box that fills the slot to maintain airflow within the high-density expansion unit if 48 drives are not installed.
- The following are requirements for the high-density expansion unit:
  - All disk drives in this unit must be SATA drives.
  - The Hitachi Data Systems minimum supported number of drives that must be installed in the high-density expansion unit is two in Unit A (slots 0-1) and two in Unit B (slots 0-1).
  - After the minimum configuration is met, you can add up to two SATA drives in each unit (which makes a RAID 1 configuration) at a time, or other combinations of drives as required to meet the RAID configurations specified in Chapter 1.

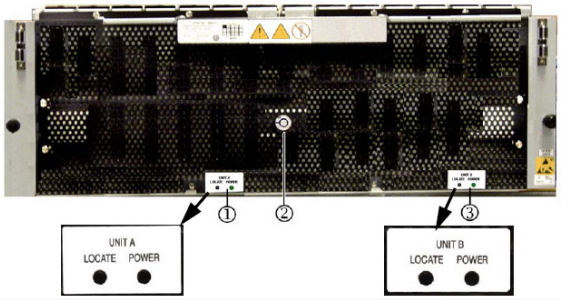
41

High-density Expansion Unit Front View

- The front panel of the high-density expansion unit (Shown below left) includes two sets of Power and Locate status LEDs that show the status of each section (A and B) in the unit and identify the unit in case of a failure. The installation location should provide an unobstructed view of these LEDs.
- The front panel of a high-density expansion unit with the front bezel removed (Shown below right). The Locate and Power LEDS are visible with the front bezel off as sell as when it is installed.



Item	Description	Item	Description	Item	Description
①	Unit A Status LEDs	②	Drive Cover Lock	③	Unit B Status LEDs

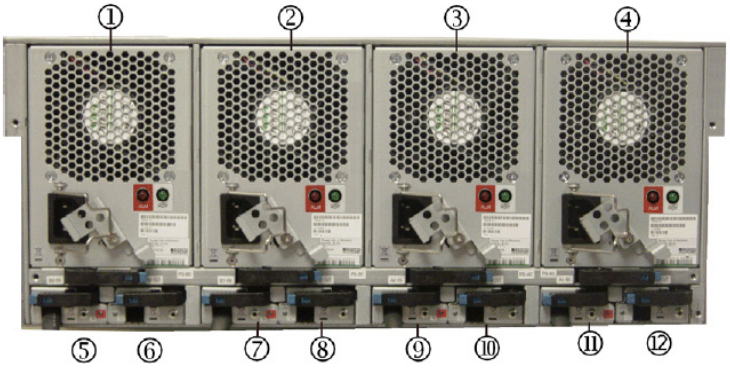


Item	Name/ Color	Status	Description
①	LOCATE ORANGE	OFF	Normal operation.
		ON	A serious error has occurred in the unit. Please contact Hitachi Data Systems Technical Support. See the Getting Help section in the Preface of this manual.
②	POWER GREEN	ON	Normal operation; the section is fully operational.
		Slow Blink	The firmware download is complete.
		Fast Blink	The firmware is downloading (do not turn off the array).

42

High-density Expansion Unit Rear View

- The rear panel of a high-density expansion unit includes four power supplies, four ENC-IN ports, and four ENC-OUT ports. The ports provide the connections to daisy-chain high-density expansion units in the system.
- The rear panel also provides LEDs that show the status of the ENC units and the power supplies.



Item	Description	Item	Description	Item	Description
①	Power Supply B0	⑤	ENC Unit B0 IN	⑨	ENC Unit A0 IN
②	Power Supply B1	⑥	ENC Unit B0 OUT	⑩	ENC Unit A0 OUT
③	Power Supply A0	⑦	ENC Unit B1 IN	⑪	ENC Unit A1 IN
④	Power Supply A1	⑧	ENC Unit B1 OUT	⑫	ENC Unit A1 OUT

43

High-density Expansion Unit Power Supplies

- The high-density expansion unit has two fully redundant power supplies for each section in the unit (total of four power supplies). If one power supply in a section fails, the other one can supply sufficient power and cooling to the section until the failed power supply is replaced.

Item	Description
①	**Alarm LED (red)**. This LED indicates that the power supply has failed. Although the other power supply can supply sufficient power and cooling for the array, Hitachi Data Systems recommends that you replace the failed power supply as soon as possible. Contact Hitachi Data SystemsTechnical Support for instructions.
②	**Ready LED (green)**. **OFF** when the power supply is not connected to power. **Blinks** when the corresponding power receptacle is connected to a working AC outlet, and is running the power on self test (POST). **ON** when the poser supply is operational, even if the AMS 2500 array is not turned on.
③	Power Receptacle (see next section).
④	Lock Lever.

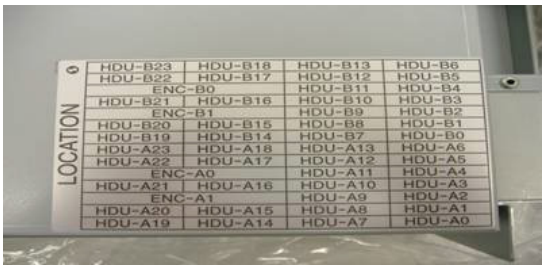
44

High-density Expansion Unit Top View

- The top view of high-density expansion unit with the drive cover removed. The disk drives and ENC cards can be seen along with the drive fillers where disk drives are not installed. These are required to prevent loss of cooling air to the drives.

Item	Description	Item	Description
①	Power Supplies (4) 0	③	Disk Drive Filler (must be in all slots that do not have disk drives installed).
②	ENC Unit (four required)	④	Disk Drive. See Disk Drive Configurations following this table.

HDD location label (located on top of RKAKX)



45

Dense SAS in the RKAKX

Configuration: (0890/B or higher)

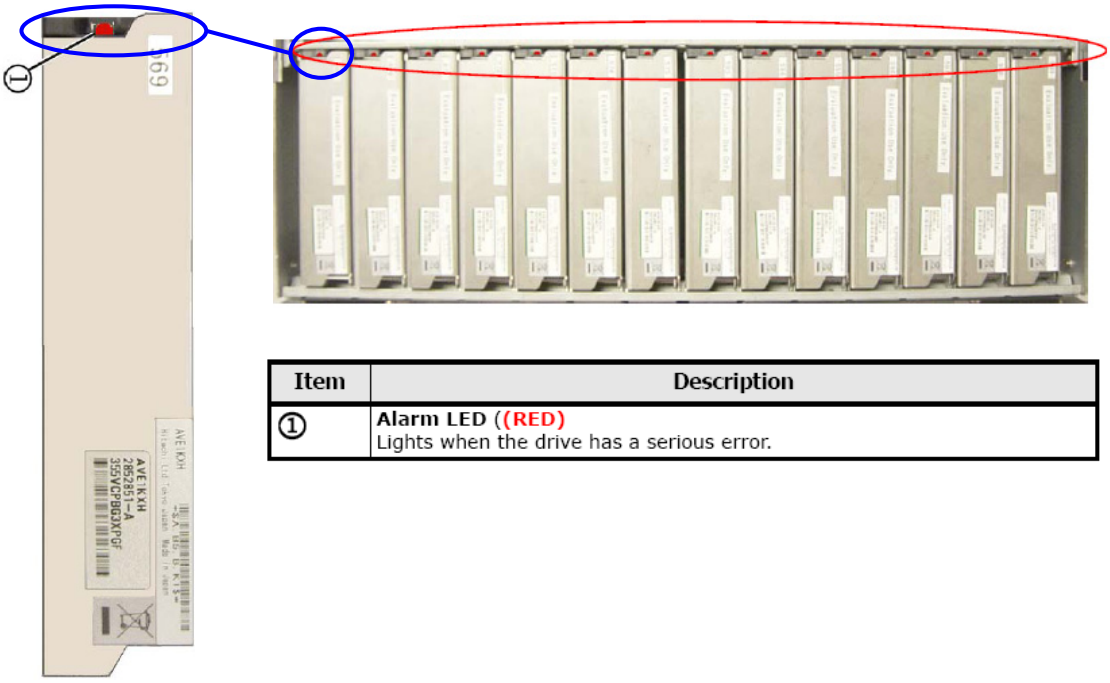
AMS2500 (RKHE2)	**RKAK (15)**	**RKAKX**	**SAS Drives (38 per RKAKX)**	**SATA Drives (48 per RKAKX)**
	0	**10**	**380**	**480**
	2	**9**		**462**
	6	**8**	**394**	**474**
	8	**7**		**456**
	12	**6**		**468**
	14	**5**		**450**
	16	**4**		**432**
	20	**3**		**444**
	24	**2**		**456**
	28	**1**		**468**
	32	**0**		**480**
AMS2300 (RKM)			**SAS Drives (38 per RKAKX)**	**SATA Drives (48 per RKAKX)**
	0	**4**	**167**	**192**
	1	**4**	**182**	**222**
	3	**4**	**212 - Rev 0200 CTL**	
	5	**3**	**204**	**234**
	7	**2**		**216**
	11	**1**		**228**
	15	**0**		**240**
AMS2100 (RKS)			**SAS Drives (38 per RKAKX)**	**SATA Drives (48 per RKAKX)**
	0	**3**	**129**	**159**
	3	**2**	**136**	**156**
	5	**1**		**138**
	7	**0**		**120**

Note:
When installing SAS HDDs into the RKAKX drive tray, HDDs cannot be installed in slots A19~A23 or B19~B23, these slots are logically blocked in microcode. This is due to the power requirements of the SAS drives, which is higher than the SATA drives.

46

High-density Expansion Unit Disk Drive Status LEDs

- Each disk drive in the high-density expansion unit has an ALM (alarm) LED on the top edge of the drive that shows the status of the disk drive.

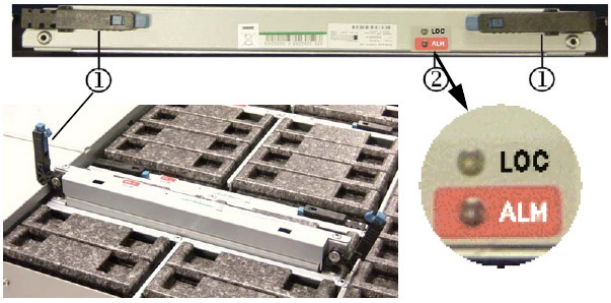


Item	Description
①	**Alarm LED ((RED)** Lights when the drive has a serious error.

47

High-density Expansion Unit ENC Card

- Four ENC units (cards) are mounted in the disk drive area of the high-density expansion unit. The ENC cards are the interfaces between the high-density expansion unit in which they are mounted and the controller in a base unit or the ENC unit in a standard expansion unit or another high-density expansion unit. Each ENC card has a LO (locate) LED and an ALM (alarm) LED.



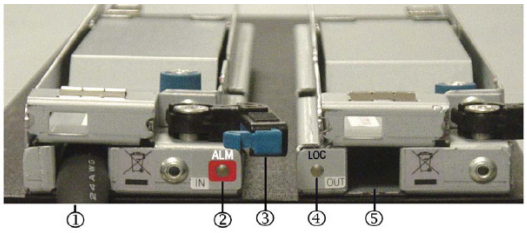
Item	Description			
①	Lock Lever	Secures the ENC unit in the chassis.		
②	Status LEDs	Alarm **RED**	This LED indicates that the ENC unit has failed.	
		LOCATE **ORANGE**	**OFF**	Normal operation
			Blinking 6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
			1 (fast)[1]	SRAM error.
			2 (fast)	ENC hard error.
			3 (fast)	Firmware error in flash memory.
			4 (fast)	CUDG error in ENC.
			6 (slow)	Voltage on the control unit is abnormal. (Reset of the control unit is not canceled)
			ON	Boot section error in the ENC firmware, a RAM error, or ENC hard configuration error.

Note 1:
When blinking fast, the LED is on for 400ms and off for 200ms for each fast blink. After the number of fast blinks has completed, the LED goes off for one second.

48

High-density Expansion Unit ENC Connectors

- The ENC cards in the high-density expansion unit are mounted inside the unit and do not have direct access to the outside of the unit. Each ENC card is connected to two ENC connector extension units (IN and OUT) that connect the ENC cables to the ENC card.
- The ENC IN connector includes an ALM (alarm) LED that turns on when the ENC card to which it is connected fails.



Item	Description	Item	Description
①	ENC Port (IN). Connects to the OUT port on either the base unit controller the IN port on the ENC unit in an expansion unit or high-density expansion unit.	②	ALM (alarm) LED **RED** This LED indicates that the ENC unit has failed.
③	Lock Lever	④	LOC (locate) LED **ORANGE** See Table 4-21 on page 4-24.
⑤	ENC Port (OUT). Connects to IN on either the controller on a base unit or the IN port on the ENC unit in an expansion unit or high-density expansion unit.		

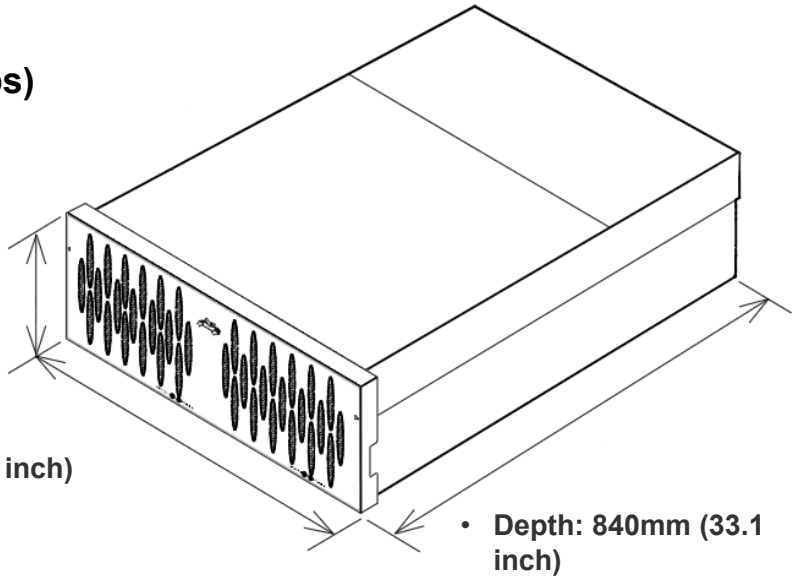
49

Specifications Dense Expansion Unit

- Physical dimensions:

  Weight : **81kg (180 lbs)**

  (fully-populated)



Height: 176mm - 7 inch

4U

Width: 482.6mm (19 inch)
Standard 19 inch

- **Depth: 840mm (33.1 inch)**

50

Power and heat specifications:

- Input Voltage (V): 100/200 AC
- Frequency: 50/60
- Number of Phases / Cabling: Single Phase with protective grounding
- Steady State current (AC 100V/200V): 3.7 A x 4 / 1.9 A x 2
- Breaking Current: 16 A
- Required Power Steady State (VA/W) (AC 100V/200V): 1480/1440
- Required Power Starting State (VA/W) (AC 100V/200V): 1480/1440
- Heat Output (kJ/h): 5190

High-density Expansion Unit Intermix

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives
AMS 2500	0	10	480 [1]
	1	9	447
	2	9	462
	3	8	429
	4	8	444
	5	8	459
	6	8	474 [2]
	7	7	441
	8	7	456
	9	6	423
	10	6	438
	11	6	453
	12	6	468
	13	5	435
AMS 2500	14	5	450
	15	4	417
	16	4	432
	17	3	399
	18	3	414
	19	3	429
	20	3	444
	21	2	411
	22	2	426
	23	2	441
	24	2	456
	25	1	423
	26	1	438
	27	1	453
	28	1	468
	29	0	435
	30	0	450
	31	0	465
	32	0	480 [3]

1. Maximum number of disk drives using only high-density expansion units.
2. Maximum number of disk drives using intermix of expansion units and high density expansion units.
3. Maximum number of disk drives using only expansion units.

51

Expansion unit intermix:

You can set up a complex system by using the maximum of 480 disk drives to connect a mixture of expansion units and high-density expansion units to the AMS 2500 base unit.

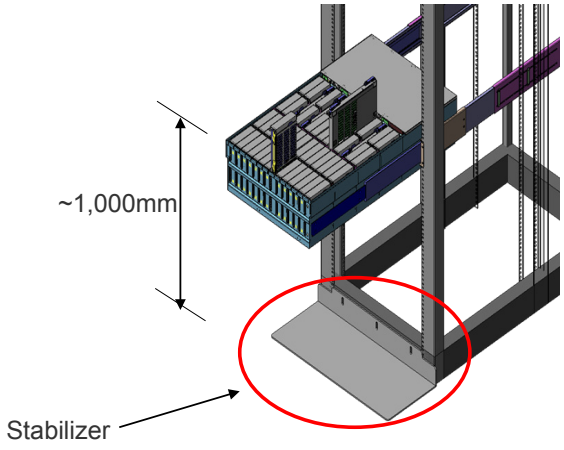
Base Unit			Expansion Unit				
	Disk Drives		Type	Units		Disk Drives	
	Min	Max		Min	Max	Min	Max
AMS 2500	0	0	Expansion Unit (RKAK)	1	32	1st unit: 4 All other units: 2	15 per unit
			High-density Expansion Unit (RKAKX)	1	10	2 in each section of the unit [1]	48 per unit

Unit	Expansion Units 15 Disk Drives	High-density Expansion Units 48 disk Drives	Total Number of Disk Drives	Total Number of SAS Disk Drives
AMS 2500	0	10	480 [1]	380
	2	9	462	372
	6	8	474 [2]	394
	8	7	456	386
	12	6	468	408
AMS 2500	14	5	450	400
	16	4	432	392
	20	3	444	414
	24	2	456	436
	28	1	468	458
	32	0	480 [3]	480

1. Maximum number of disk drives using only high-density expansion units.
2. Maximum number of disk drives using intermix of expansion units and high-density expansion units.
3. Maximum number of disk drives using only expansion units.

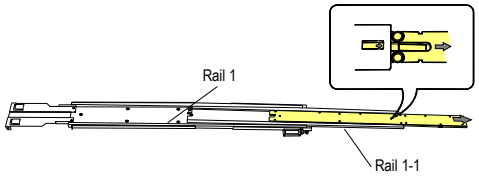
Dense RKAKX Installation

- **Caution:**
  - Need Stabilizer on the Rack (See below Fig.)
  - When installing RKAKX, due to weight of the tray this operation should not be performed by a single person.
  - Dense_RKA must be mounted within 1,000mm height.
  - Make a blank space (2U) in the bottom of the Rack, to put ENC cable



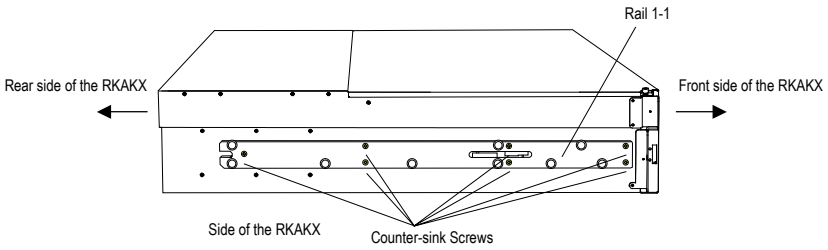
52

- Mounting the RKAKX on Rack Frame
  - Installing the rails:
    - Remove the rail 1-1 from the rail 1 (R) and rail 1(L) by sliding it.



- Release the latch

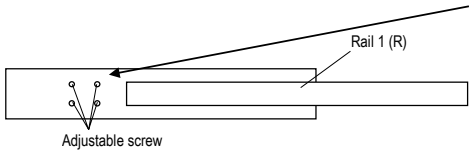
    - Install the rail 1-1 in the both sides of RKAKX, and fix it with the counter-sink screws (seven places each at right and left).

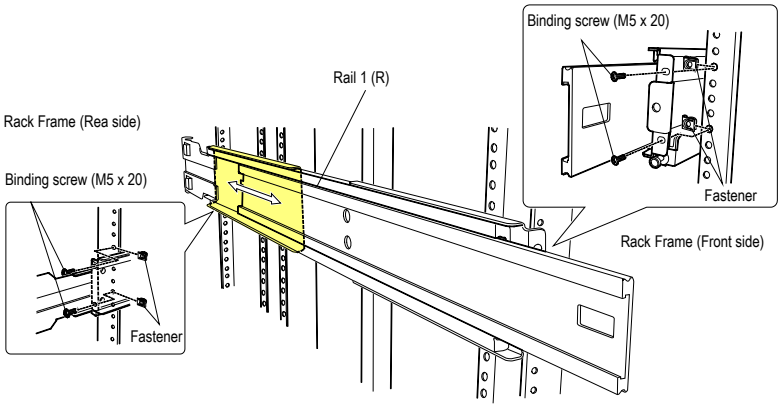


53

- Mounting the RKAKX on Rack Frame (continued)
  - Installing the rails (cont'd)
    - Installing the Rail 1

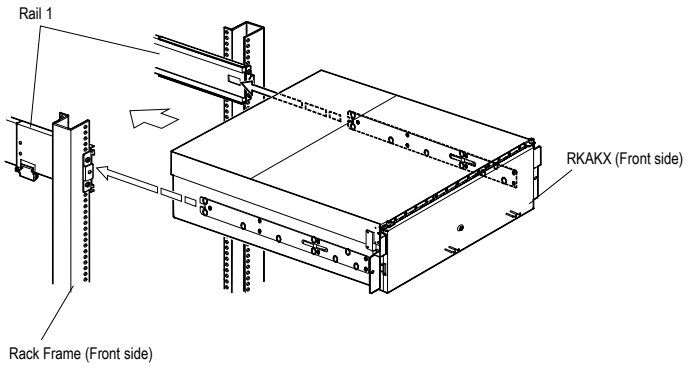
- Loosen the adjustable screw





54

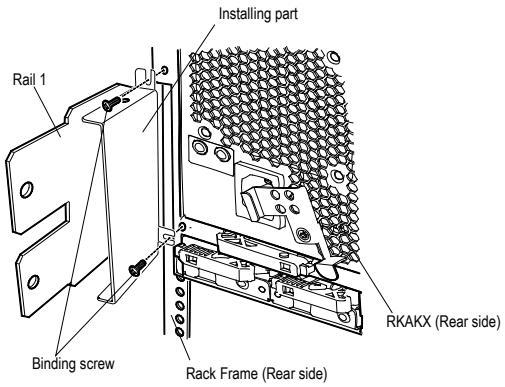
- Mounting the RKAKX on Rack Frame (continued)
  - Installing the RKAKX

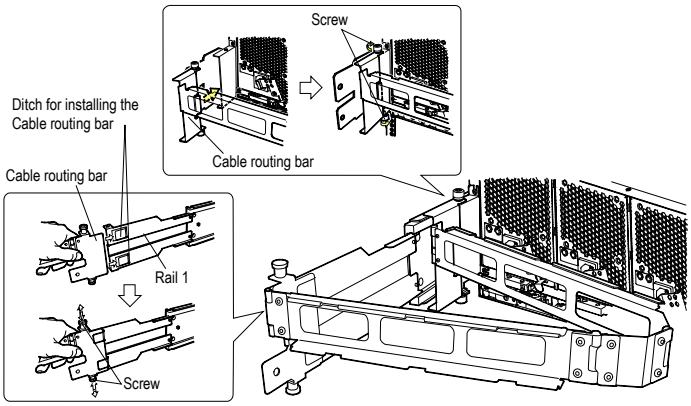


◆ **Caution:**
- Installing RKAKX requires a two person operation plus proper lifting device.
- Dense_RKA must be mounted within 1,000mm height.
- Make a blank space (2U) in the bottom of the Rack

55

- Mounting the RKAKX on Rack Frame (continued)
  - Installing the cable routing bar

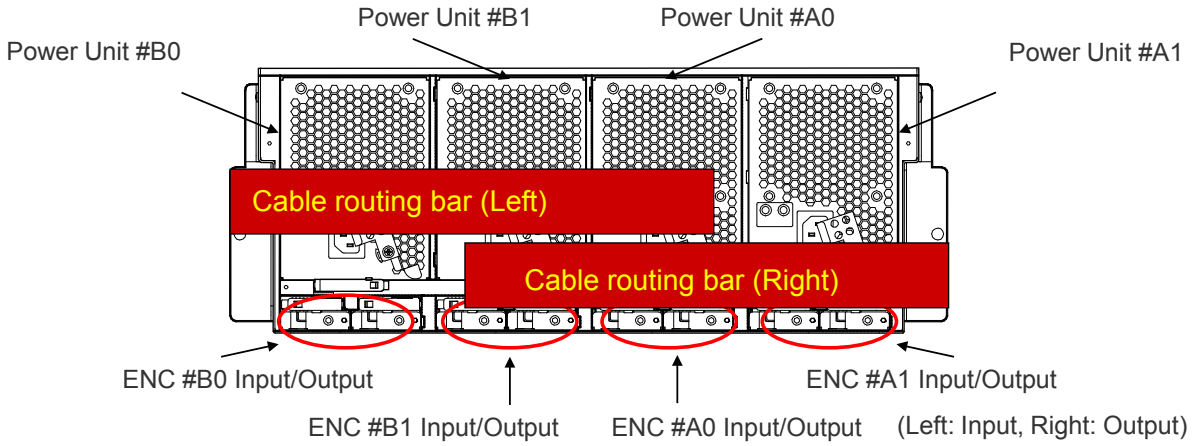




  - Fixing the front side of RKAKX

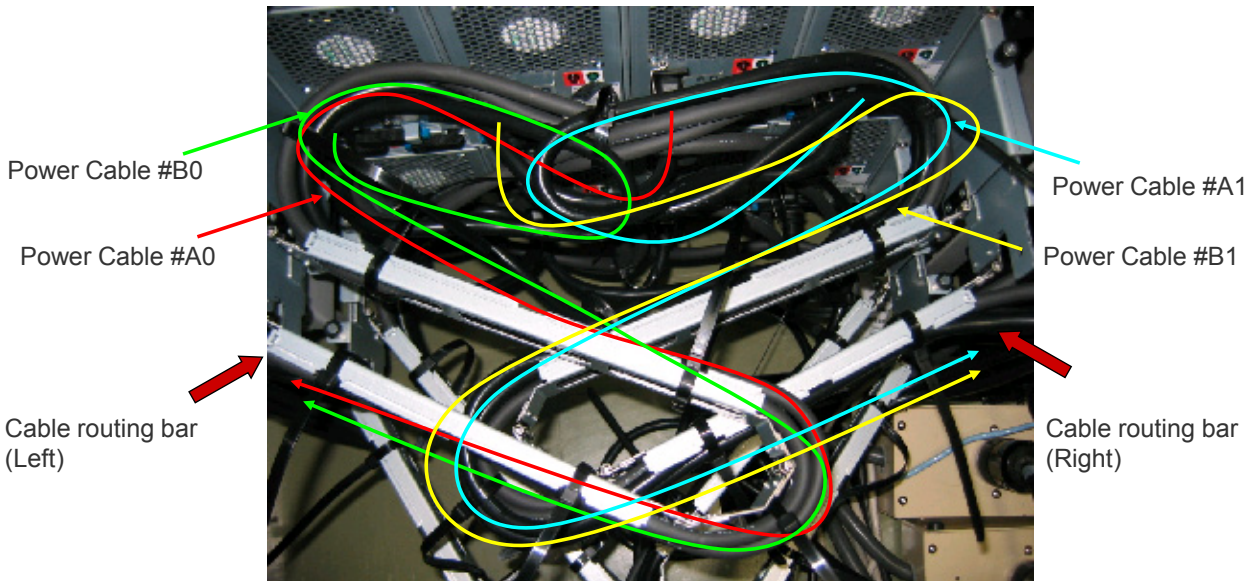
56

- Connecting PS Cable/ENC cables
  - Fix PS #A0/B0 cable and ENC #A0/#A1 input/output cable to cable routing bar (left).
  - Fix PS #A1/#B1 cable and ENC #B0/#B1 input/output cable to cable routing bar (right).
  - All cables must be within the own RKAKX 4U height.



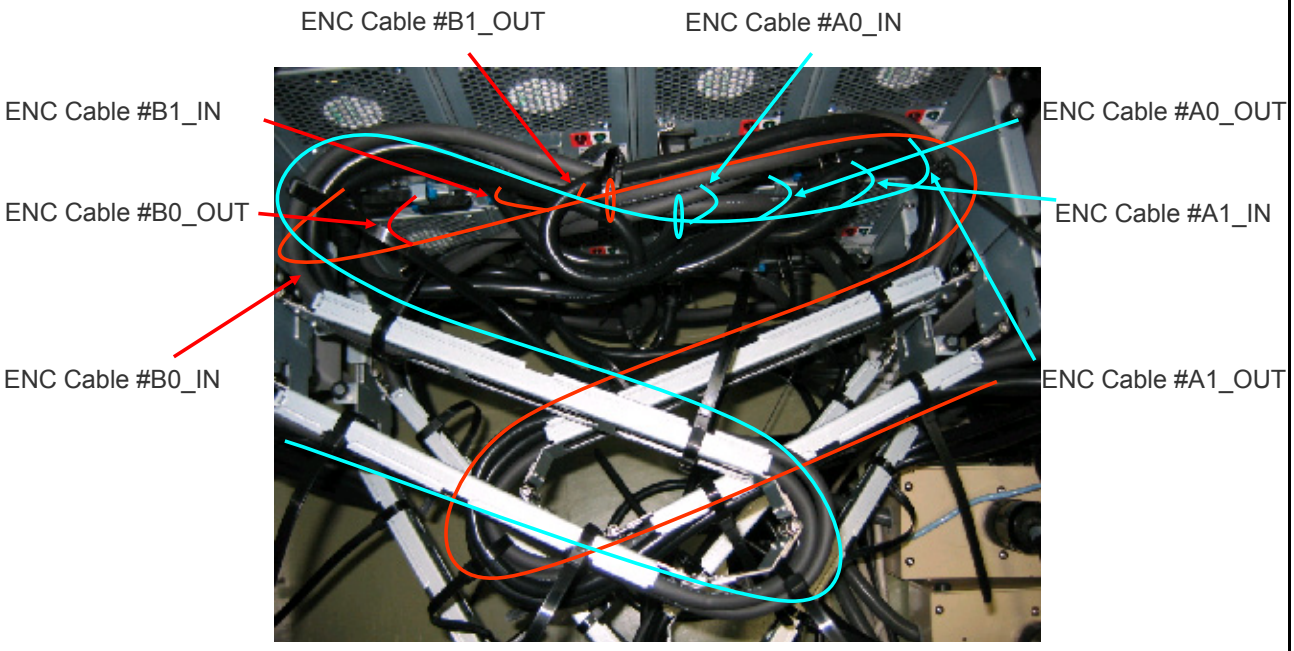
57

- Connecting PS Cable/ENC cables (cont'd)
  - PS Cable



58

- Connecting PS Cable/ENC cables (cont'd)
  - ENC Cable



59

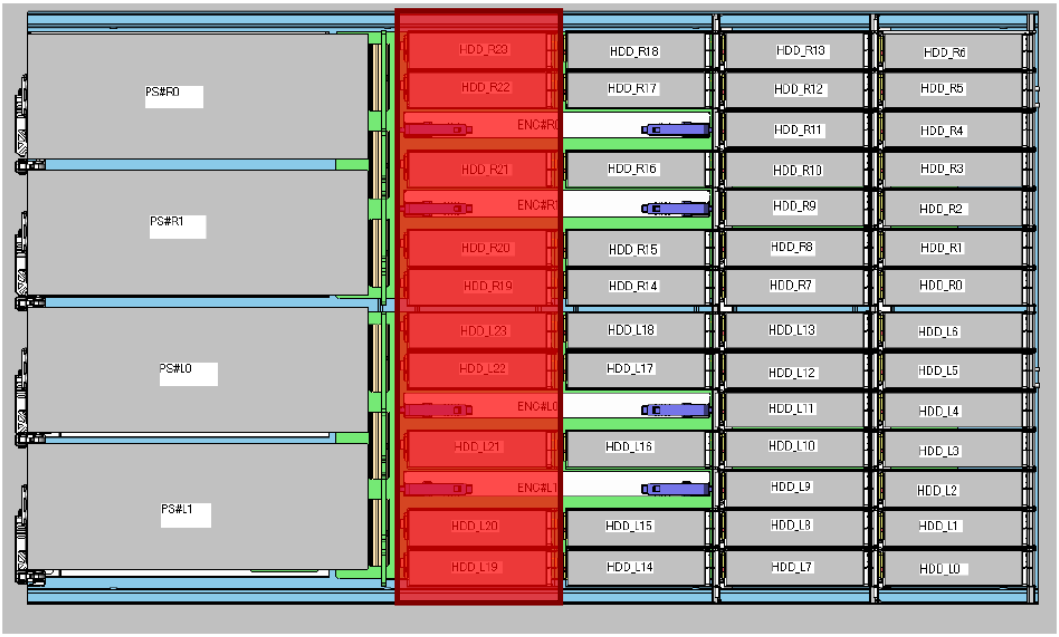
Specifications Dense Expansion Unit

			SAS Dense 3.5”SAS x 38sp/4U	SATA Dense 3.5”SATA x 48sp/4U
Chassis Name			RKAKX (**Note1**)	RKAKX (***Note 1***)
Spec.	Maintenance parts (ENC,PS)		Common	
	Support Drive	3.5”SATA	N/A	Support (1TB: 7.2Krpm)
		3.5”SAS	Support (450GB:15Krpm, 600GB: 15Krpm) (***Note 2***)	N/A
		2.5”SAS	Not supplied	Not supplied
		SSD	Not supplied	Not supplied
	# of HDD (Unit)		38sp	48sp
	# of HDD (system)	DF800H	**380** (38HDDx**10**)	**480** (48HDDx**10**)
		DF800M	**167** (38HDDx**4** +15HDD)	**207** (48HDDx**4** +15HDD)
		DF800S	**129** (38HDDx**3** +15HDD)	**159** (48HDDx**3** + 15HDD)
	Noise		65dB(raw62dB)	
	Power supply		AC100/200V	
	Size(W x H x D)		483 x 176 x 840	

- ***Note 1***: SATA Dense and SAS Dense are common Hardware Chassis as RKAKX.
- ***Note 2***: 450GB HDD and 600GB HDD can be intermixed in one Dense tray.
- The max number of Dense Trays (RKAKX + RKAKX) for one AMS is the same as the current specification.

60

SATA Dense and SAS Dense are common Hardware Chassis!

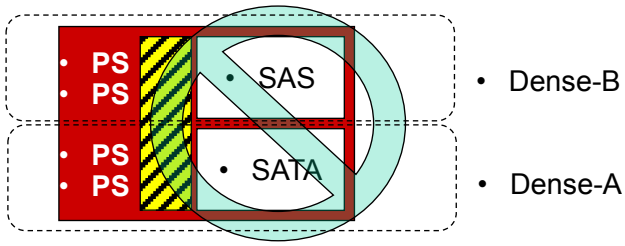


- Physically NOT covered, but logically restricted!!
- *SAS HDDs cannot be installed in this area.*
- *The Firmware will check and notify with error message if the rule is not observed.*

61

Specifications Dense Expansion Unit (Detailed)

- Unable to mix SAS HDD and SATA HDD in the same Dense RKA.
  - ("Dense-A for SAS and Dense-B for SATA" is also unavailable.)
- The Firmware will check and notify with error message if the rule is not observed.



- One AMS can have Dense RKA with SAS HDDs and Dense RKA with SATA HDDs at the same configuration.
- SSD is not supported for Dense RKA.

62

HDD Configurations

- Total support HDD number for AMS2500

#	Combinations for AMS2500				Total HDDs	Note
	RKH (0HDD)	RKAK (15HDDs)	RKAKX (48 SATA HDDs)	RKAKX (38 SAS HDDs)		
1	1	0	0	10	380	Support
2	1	1	0	10	395	N/A for **Condition2**
3	1	2	0	9	372	Support
4	1	3	0	9	387	N/A for **Condition2**
5	1	0	1	9	390	Support
6	1	1	1	9	405	N/A for **Condition2**
7	1	6	0	8	394	Support
8	1	7	0	8	409	N/A for **Condition2**
9	1	0	2	8	400	Support
10	1	1	2	8	415	N/A for **Condition2**

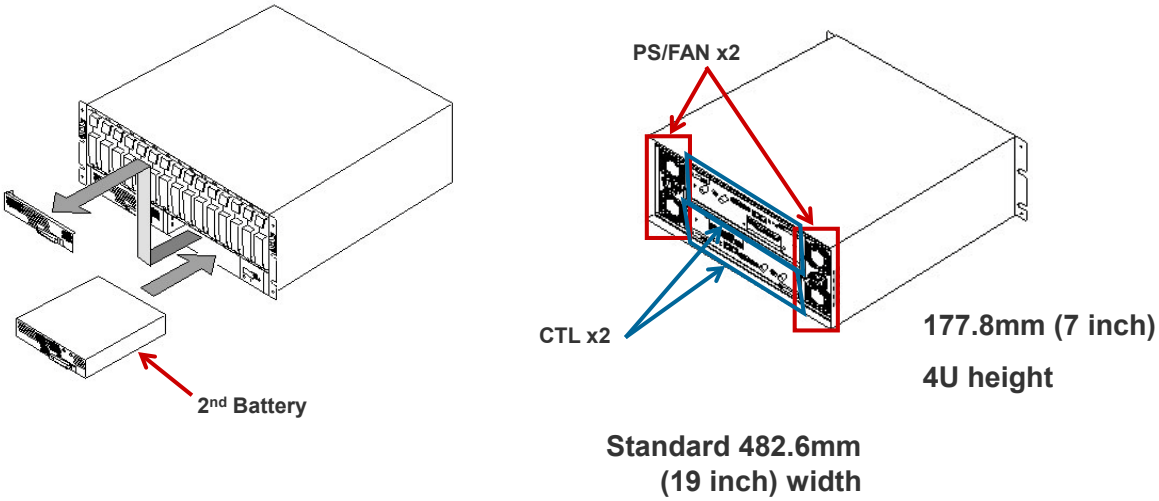
- All of the following conditions must be satisfied for the configuration:
  - Condition1: Max 8 units / Path
  - Condition2: Max 120 HDDs / Path
    (RKAK=15, RKAKX(SATA)=24, RKAKX(SAS)=24 (Not 19) *Note1)
  - Condition3: Max 480 HDDs / System

*Note1: RKAKX(SATA) and RKAKX(SAS) use same Management Table internally, so one RKAKX(SAS) must be counted as 24HDDs in one Path, not as 19HDDs which is the actual number.

63

Specifications Models 2100 and 2300

- Physical dimensions
  - Weight: 51kg (112 lbs)



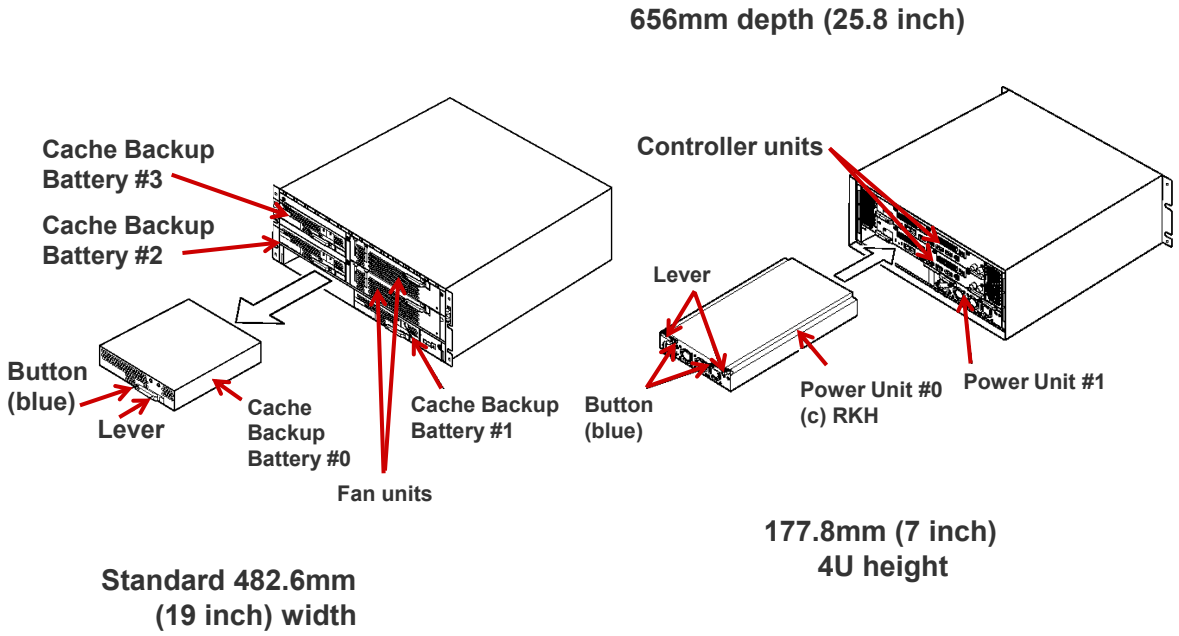
64

Power and heat specifications:

- Input Voltage (V): 100/200 AC
- Frequency: 50/60
- Number of Phases / Cabling: Single Phase with protective grounding
- Steady State current (AC 100V/200V): 3.8 A x 2 / 1.9 A x 2
- Breaking Current: 16 A
- Required Power Steady State (VA/W) (AC 100V/200V): 760/740
- Required Power Starting State (VA/W) (AC 100V/200V): 760/740
- Heat Output (kJ/h): 2670

Specifications Model 2500

- Physical dimensions
  - Weight – 46kg (101 lbs)



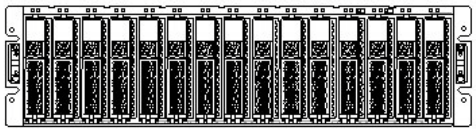
65

Power and heat specifications:

- Input Voltage (V): 100/200 AC
- Frequency: 50/60
- Number of Phases / Cabling: Single Phase with protective grounding
- Steady State current (AC 100V/200V): 2.6 A x 2 / 1.3 A x 2
- Breaking Current: 16 A
- Required Power Steady State (VA/W) (AC 100V/200V): 440/400
- Required Power Starting State (VA/W) (AC 100V/200V): 440/400
- Heat Output (kJ/h): 1400

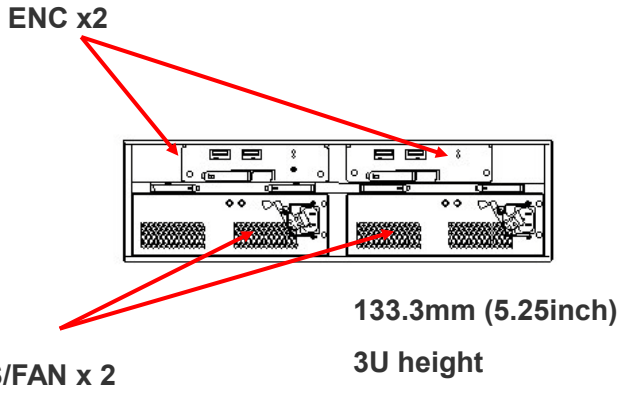
Specifications Expansion Unit

- Physical dimensions
  - Weight – 40kg (88 lbs) (fully-configured)



656mm depth (25.8 inch)

Standard 482.6mm (19 inch) width



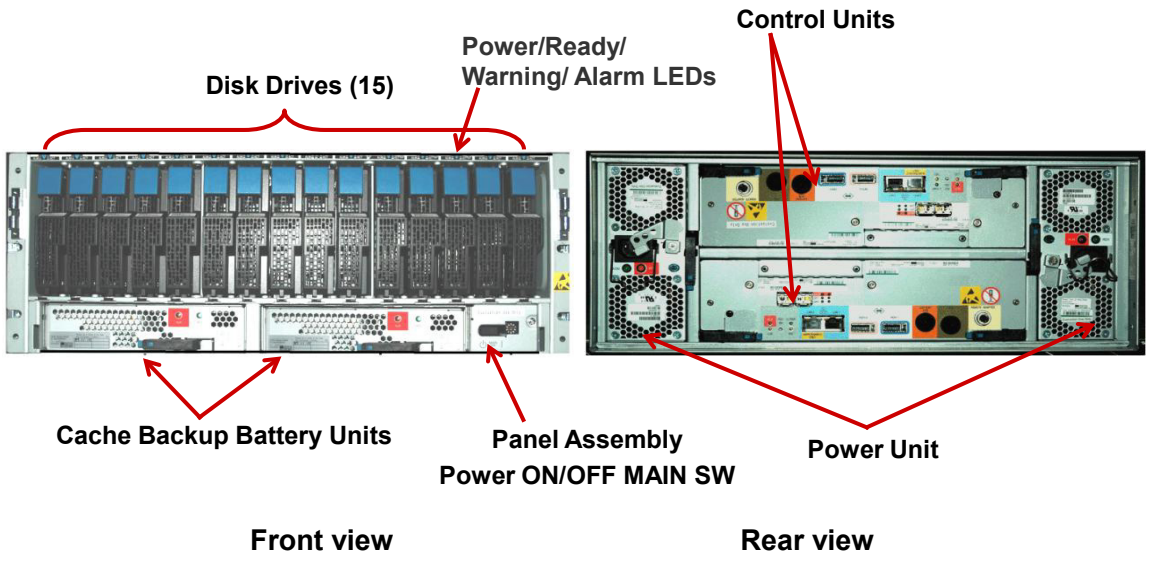
66

Power and heat specifications:

- Input Voltage (V): 100/200 AC
- Frequency: 50/60
- Number of Phases / Cabling: Single Phase with protective grounding
- Steady State current (AC 100V/200V): 2.4 A x 2 / 1.2 A x 2
- Breaking Current: 16 A
- Required Power Steady State (VA/W) (AC 100V/200V): 480/460
- Required Power Starting State (VA/W) (AC 100V/200V): 480/460
- Heat Output (kJ/h): 1660

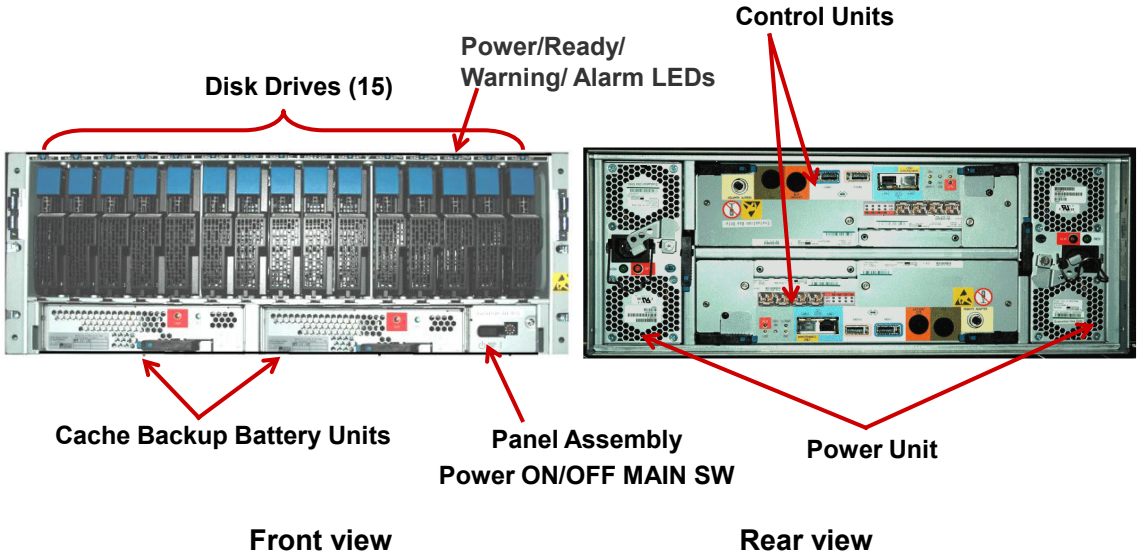
Hardware Components

- Adaptable Modular Storage 2100



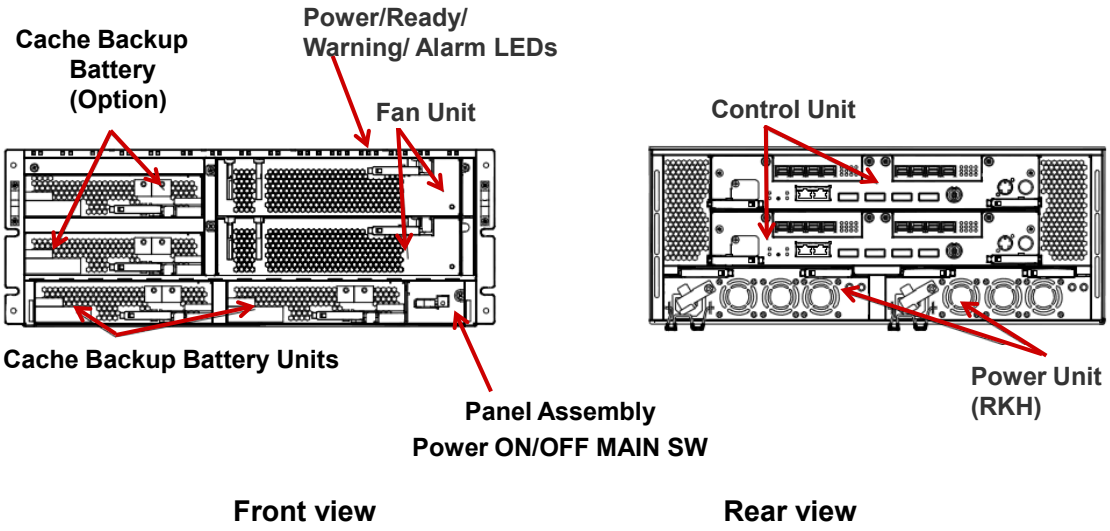
67

- Adaptable Modular Storage 2300



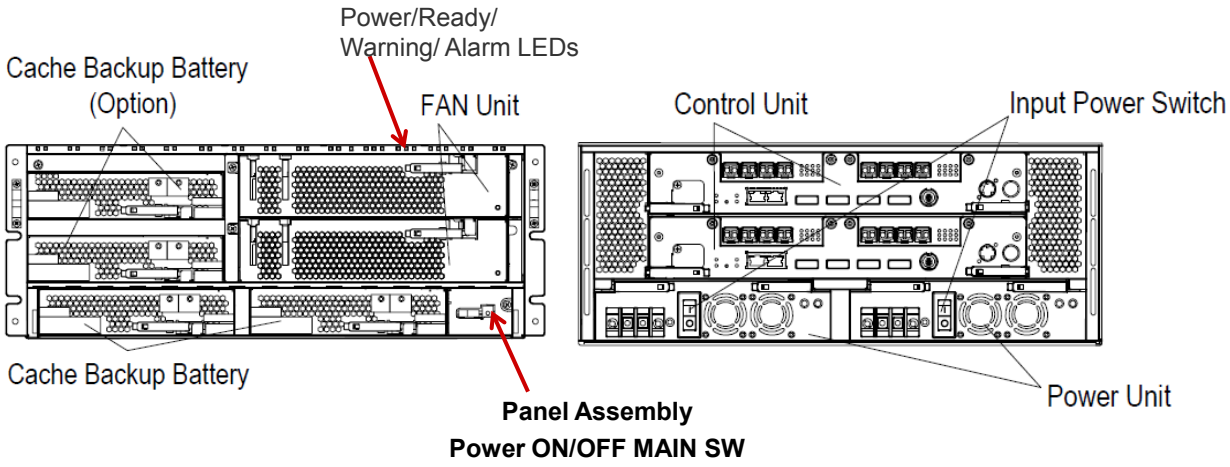
68

- Adaptable Modular Storage 2500



69

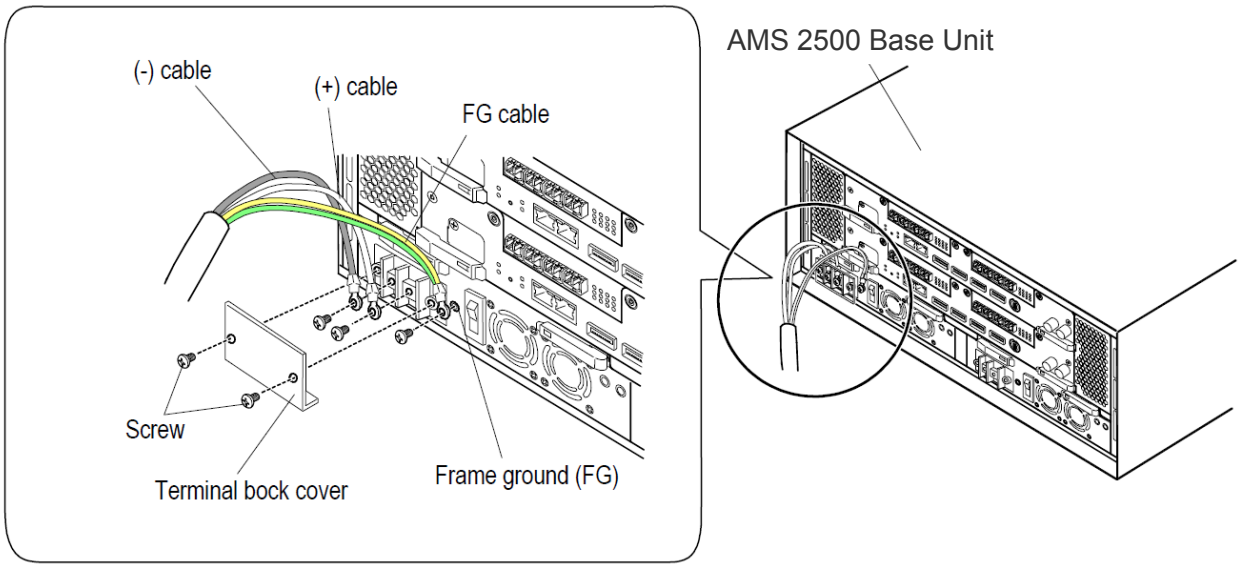
- Adaptable Modular Storage **2500 – with DC power option**



Front view **Rear view**

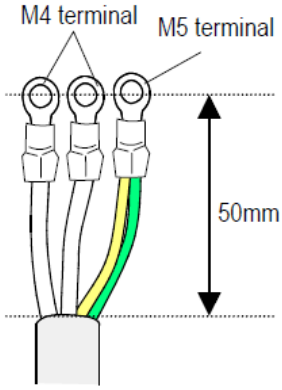
70

- Adaptable Modular Storage **2500 – with DC power option**



71

- Adaptable Modular Storage **2500 – with DC power option**



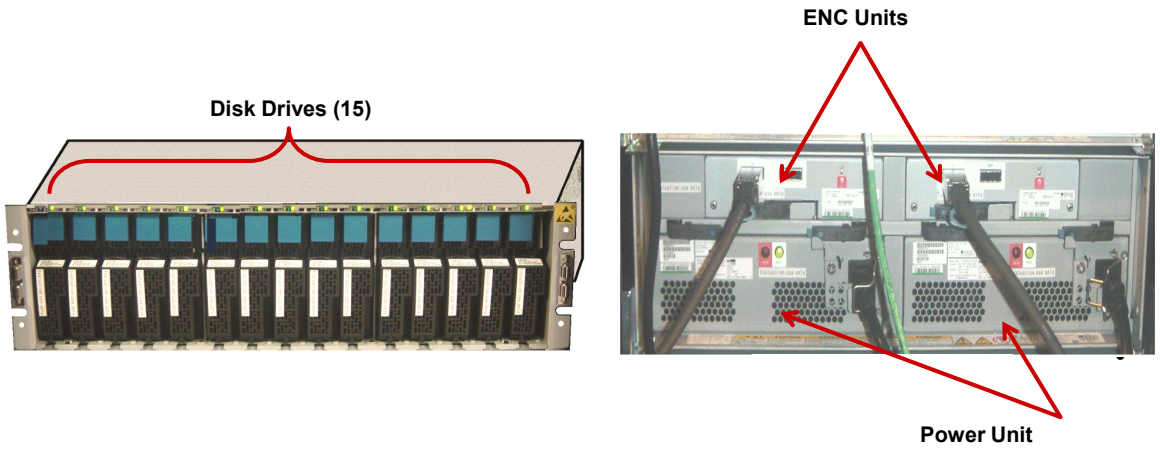
	3-core	Single core
Wire Description	1015/1431 rating temperature=105° C	1015/1431 rating temperature=105° C
Size AWG	AWG12	AWG16
Stranding	65/0.26 mm	54/0.18mm
Breaker	20 A	

72

HDS delivers power cables if a Hitachi rack is used. Otherwise, cable specifications are provided.

The power distribution unit (PDU) will be connected to the unit by HDS service personnel. HDS will not connect the source DC power to the PDU—the customer must do that.

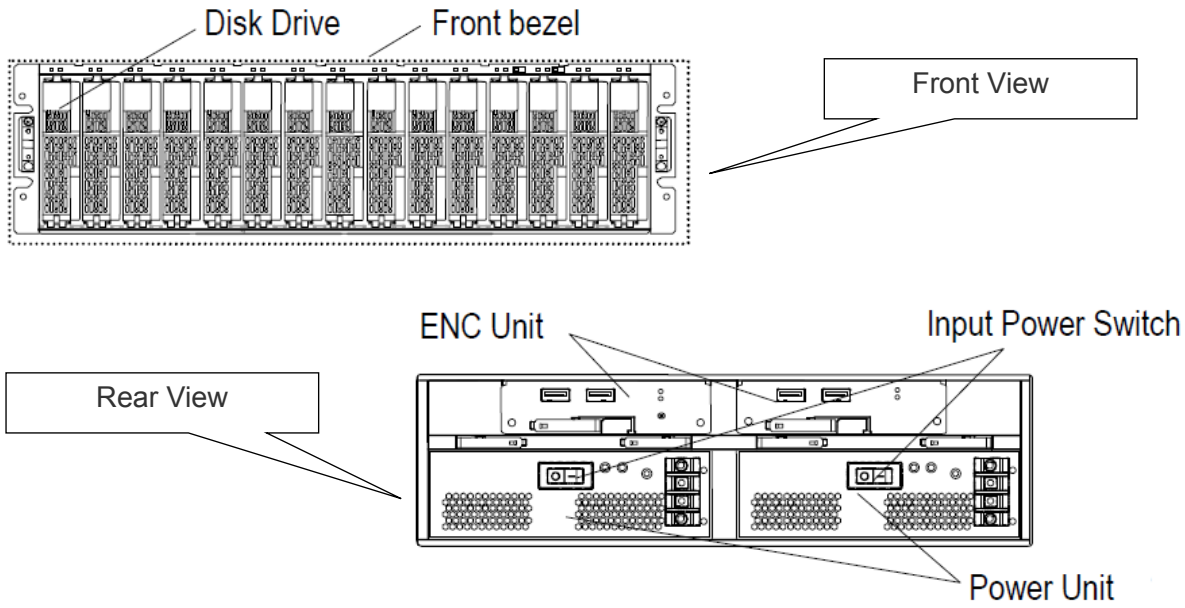
- Expansion Unit



73

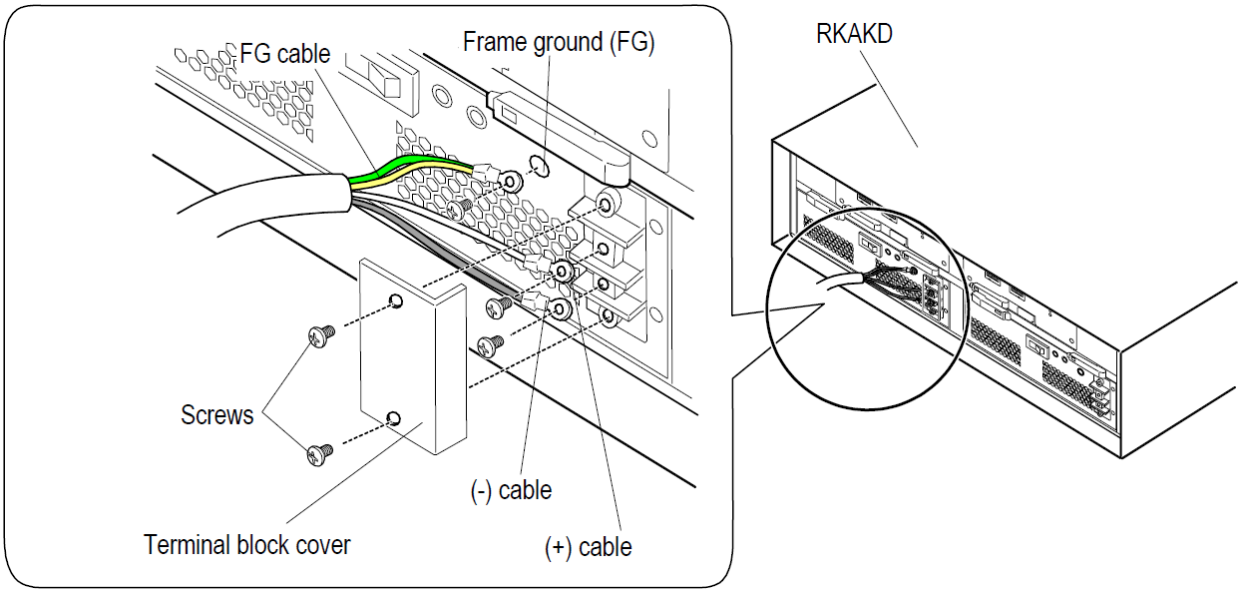
- HDD LEDs
- Power Ready, Warning and Alarm LEDs

- Expansion Unit for Adaptable Modular Storage **2500 – with DC power option**



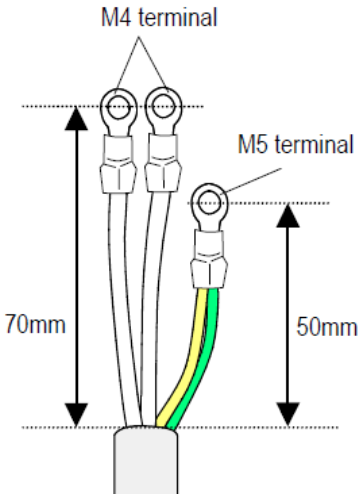
74

- Expansion Unit for Adaptable Modular Storage **2500 – with DC power option**



75

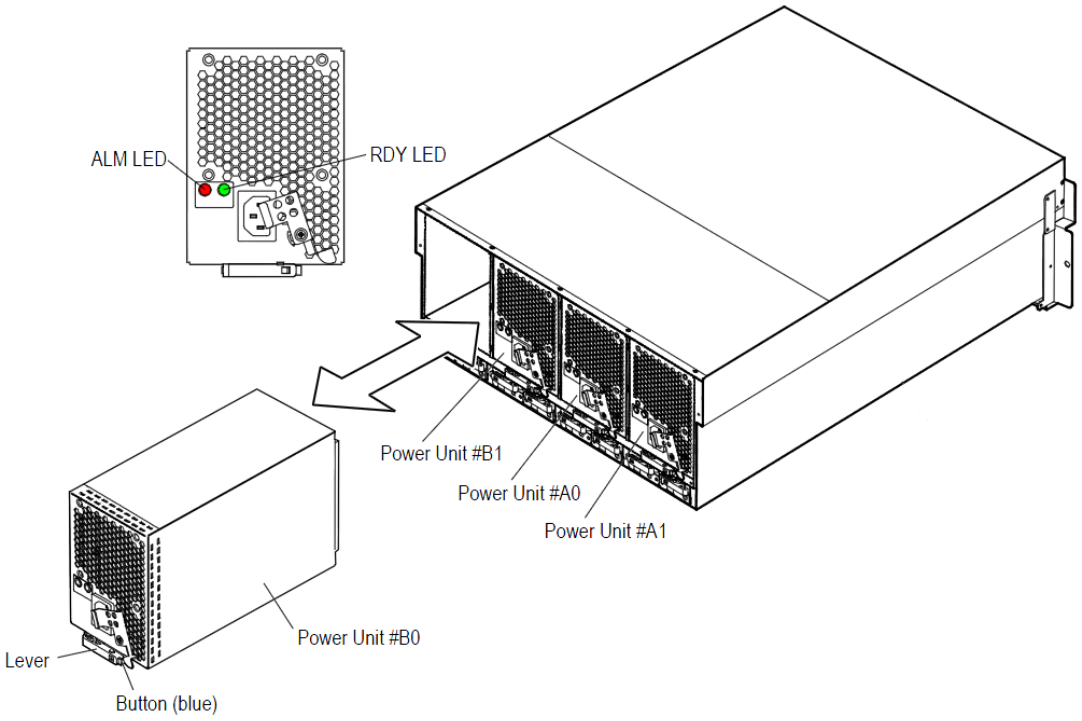
- Expansion Unit for Adaptable Modular Storage **2500 – with DC power option**



	3-core	**Single core**
Wire Description	1015/1431 rating temperature=105° C	1015/1431 rating temperature=105° C
Size AWG	AWG10	AWG14
Stranding	104/0.26mm	41/0.26mm
Breaker	30 A	

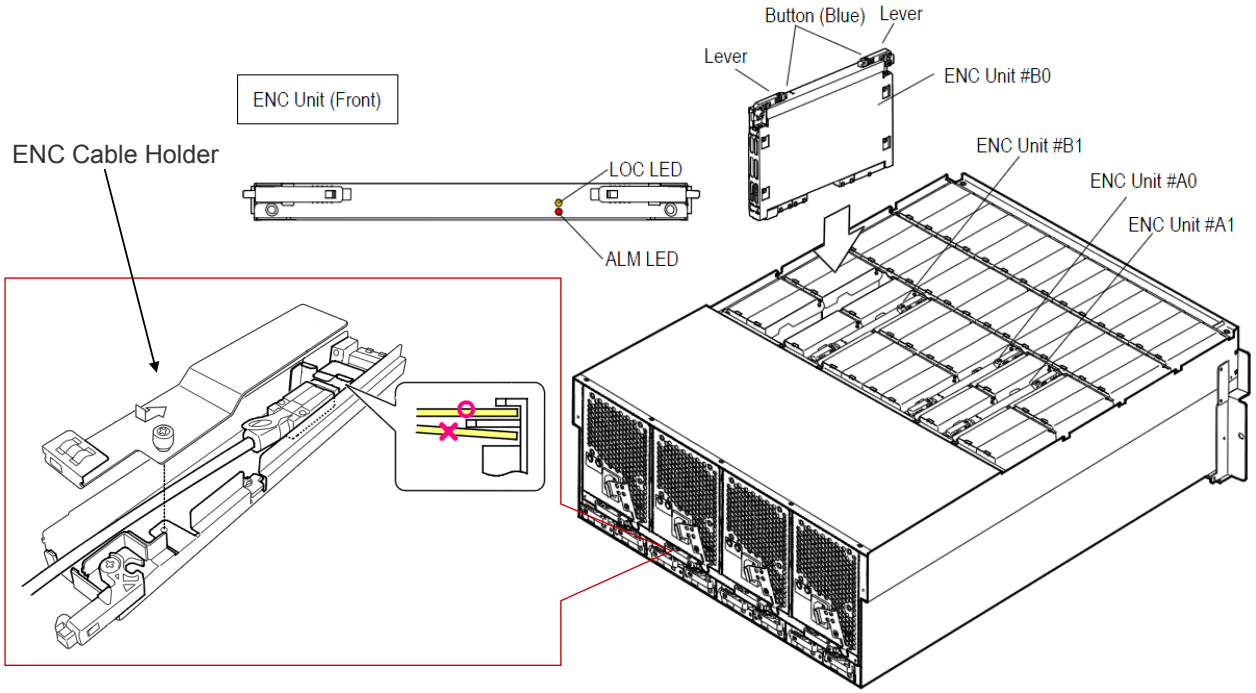
76

- High Capacity Expansion Unit – Power Units



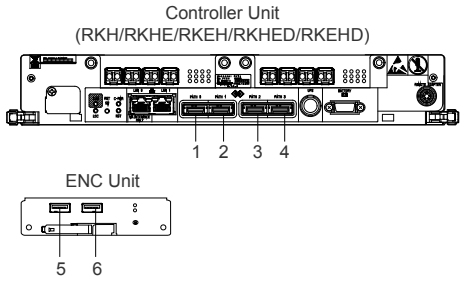
77

- High Capacity Expansion Unit – ENC Units



78

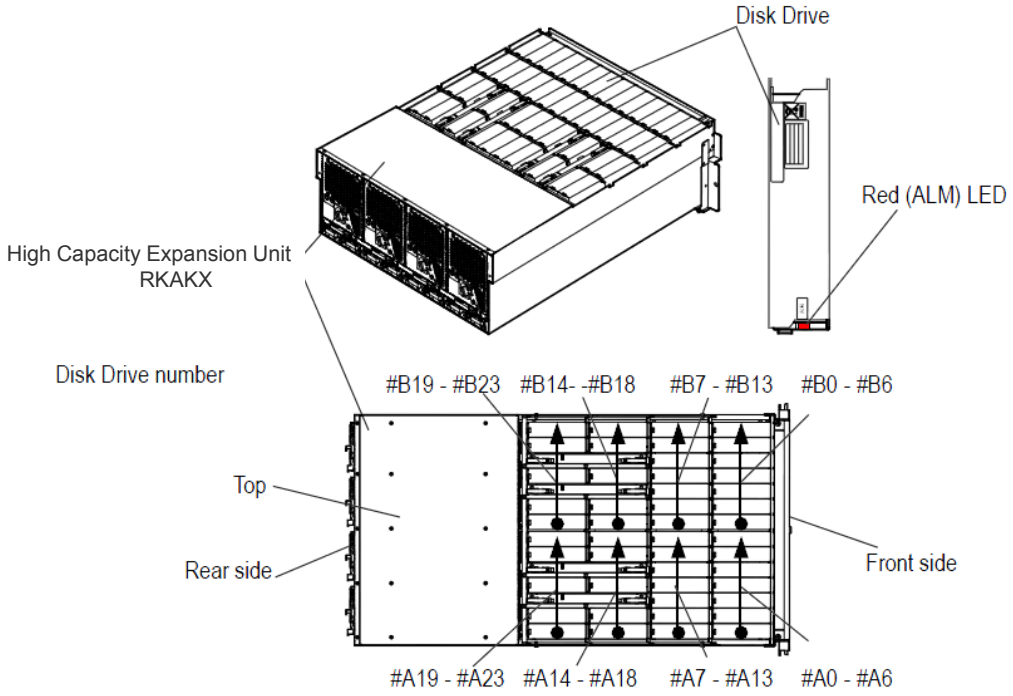
- **ENC Unit**



No.	Connector	Function
1	PATH 0 (To RKAK/RKAKD/RKAKX IN)	Connection connector for RKAK/RKAKD/RKAKX Unit
2	PATH 1 (To RKAK/RKAKD/RKAKX IN)	Connection connector for RKAK/RKAKD/RKAKX Unit
3	PATH 2 (To RKAK/RKAKD/RKAKX IN)	Connection connector for RKAK/RKAKD/RKAKX Unit
4	PATH 3 (To RKAK/RKAKD/RKAKX IN)	Connection connector for RKAK/RKAKD/RKAKX Unit
5	IN	Connection connector for RKH/RKHE/RKEH/RKHED/RKEHD, RKAK/RKAKD/RKAKX Unit
6	OUT	Connection connector for RKAK/RKAKD//RKAKX Unit

79

- High Capacity Expansion Unit – Disk Drives



80

- DC Power Distribution Unit (DC-PDU)
  - It is used to connect power to the DC power supplies in the controller and expansion unit with DC option.
  - It is the customer's responsibility to connect the DC-PDU to their power grid.
  - The DC-PDUs are preconfigured and connected to the controller and the expansion units at the HDS Distribution Center and are shipped to the customer with cable in place.
  - In case of an upgrade or replacement, the HDS technician connects the DC-PDUs to the affected controller and expansion units.

81

- DC-PDU

Sample configuration — front view

Sample configuration — rear view

82

- DC-PDU specifications

Electrical

Nominal voltage	±24V, -48V
Input rating	100A per bus
Max. input interrupt device	125A
Max. output protection device	20A
Power dissipation (full load)	20W per bus

83

- DC-PDU specifications

Mechanical

Dimensions	17.25" W x 1.75" H x 8" D (438 mm x 45 mm x 203 mm)
Weight	12 lbs. (5.44 kg)
Material	Cold-rolled steel
Finish	Black, powder coat
Mounting	19" or 23"

Environmental

Temperature range	-10° to 55° C
Humidity	0 to 90%, non-condensing

84

The unit height is 1U.

Back End Architecture

- The Adaptable Modular Storage 2000 Family uses a new back end architecture that is very different from the one used by earlier Adaptable Modular Storage systems.
- On the earlier systems, the DCTL RAID chip was directly connected to the back end Tachyon DX2 (2Gb/sec Fibre Channel – Arbitrated Loop or FC-AL) interface chips.
- On the Adaptable Modular Storage 2000 Family controller board, the enhanced DCTL chip sends commands to a powerful companion *SAS I/O Controller processor (IOC).*

85

Processors Change

- The earlier modular storage systems use a PowerPC 7447a processor and chipset. All paths within the controller were PCI-X, a 533MB/sec protocol (wire speed). The Adaptable Modular Storage 2000 Family has moved up to an Intel “Sossaman” (core duo) CPU and chipset that uses PCI-express (PCI-e) 8-lane busses operating at an aggregate of 2GB/sec (wire speed). Though the PowerPC and Intel CPUs have similar clock speeds, the Intel design has far more power due to:
  - A much faster system bus (667MHz versus 166MHz, controlling access to local RAM and the Intel *MCH Memory and I/O Controller chip)*
  - Single or dual CPU cores per chip
  - A much higher degree of execution parallelism within each core.
- The DCTL processor has also been improved (eighth generation Hitachi ASIC), and now uses the PCI-express eight-lane busses (2GB/sec) instead of the PCI-X busses (533MB/sec). The DCTL processor is the I/O “pump” for each controller. It works in conjunction with the Intel CPU, which runs the microcode and makes all determinations about I/O processing. The DCTL has two basic functions:
  - It is a RAID XOR (parity) processor that creates all parity for RAID-5 or RAID-6 writes.
  - It is also the DMA path from the front end components (Xeon CPU, Tachyon chips) to the data cache.
  - The two DCTL processors in a system use two private 2GB/sec bidirectional communications bus (PCIe eight-lane) to communicate status, pass certain I/O request commands, and copy the mirrored write blocks.

86

Enclosure Change

- Another major change is that the Adaptable Modular Storage 2000 Family has a single type of enclosure common to both SAS and SATA disks. On the earlier generation of modular systems, there were separate enclosure types needed for Fibre Channel and SATA disks. In the Adaptable Modular Storage 2000 Family, both disk types may be intermixed in the same enclosure.
- The two *expander units* in each external enclosure for the 2100 and 2300 are part of the new back end disk matrix system.
- Also, the Adaptable Modular Storage 2000 Family enclosure no longer has address switches – something that could cause installation headaches on the earlier generation of modular storage when not properly set.
- As a last note, in the earlier generation systems, care had to be taken to put Fibre Channel disks (HDDs) in certain slots within the tray (for dispersed disk selection). Also, one needed to disperse the member drives of a SATA RAID Group across the enclosures (1 per tray typically) in order to avoid the serialization of SATA disks within the same tray. These requirements are completely eliminated in the 2000 Family.

87

Architecture

- The table below lists the major differences within the 2000 Family.

Model	Maximum Disks	Cache Sizes (GB)	Fibre Channel Host Paths	SAS Disk Links	Bandwidth to Cach (Overall)
2100	120	4/8	4	16	8GB/Sec
2300	240	8/16	8	16	16GB/Sec
2500	480	16/32	16	32	16GB/Sec

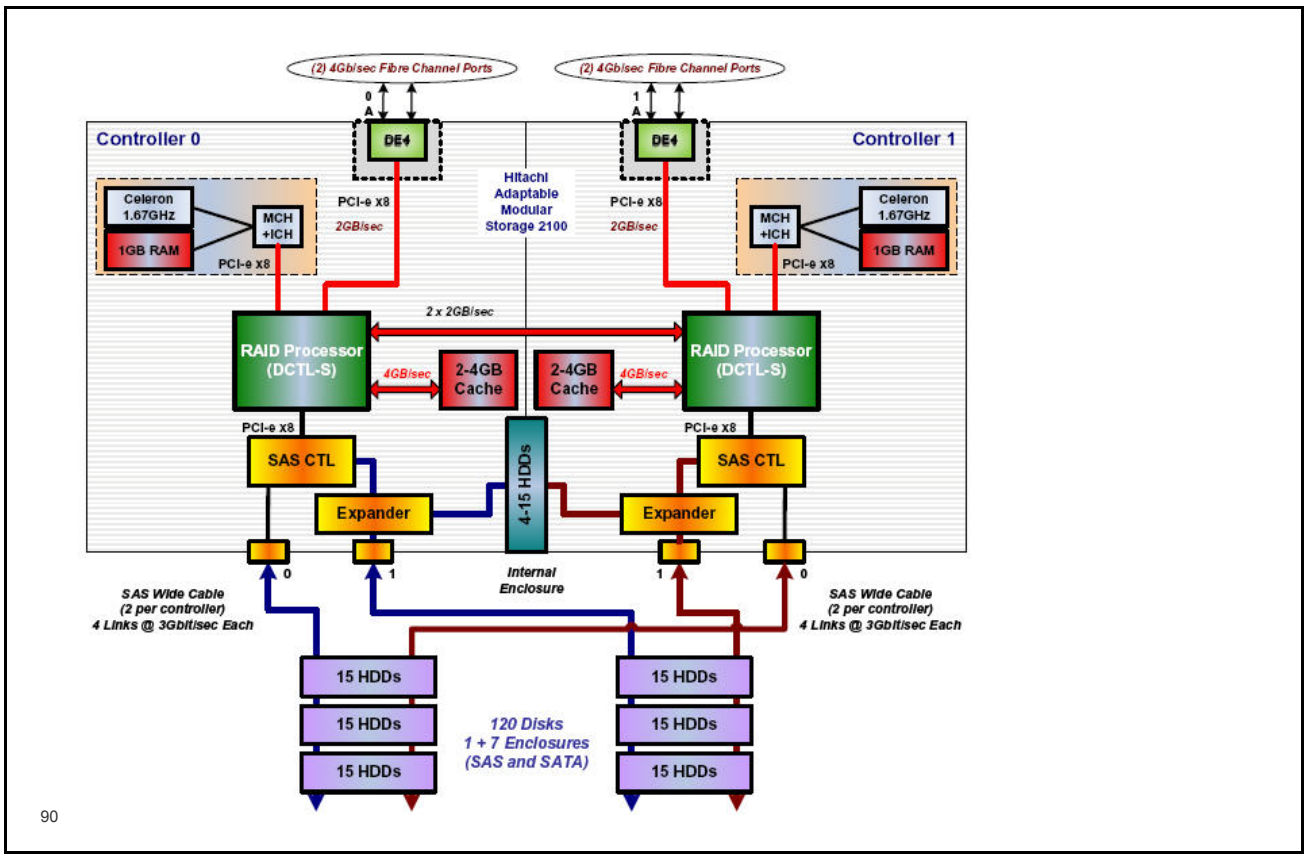
88

AMS 2100 Architecture

- Each Adaptable Modular Storage 2100 controller includes:
  - A DCTL-S processor (the I/O *pump* with RAID XOR functions).
  - A 1.67GHz Intel *Sossaman* Celeron Value series (low voltage) processor and 1GB of memory; this processor is the microcode engine or the I/O management *brains.*
  - 4GB (2GB DIMMs) or 8GB (4GB DIMMs) of cache per system.
  - Two high-performance Tachyon DE4 two-port 4Gb/sec Fibre Channel processors controlling the front end host connections.
  - Two SAS controllers servicing the 16 active back end SAS disk links.
  - All internal busses are now 2GB/sec eight-lane PCI Express (PCIe) instead of the previous 533MB/sec PCI-x bus.

89

Architecture – Model 2100E Controller Version 2



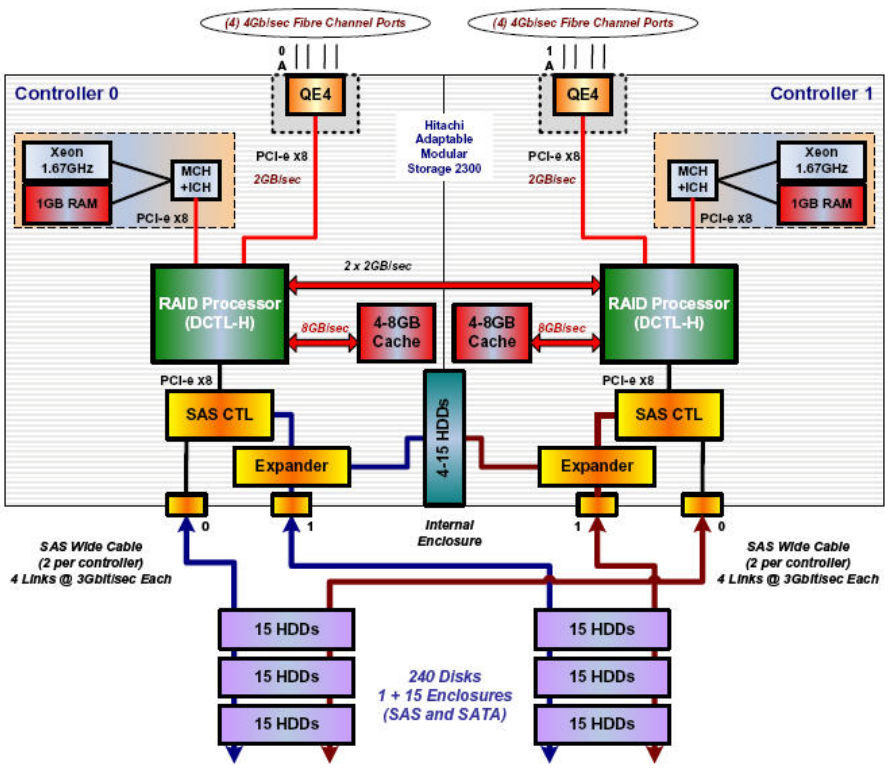
90

AMS 2300 Architecture

- Each Adaptable Modular Storage 2300 controller includes:
  - A DCTL-H processor (the I/O *pump* with RAID XOR functions).
  - A 1.67GHz Intel *Sossaman* Xeon LV series (low voltage) processor (single core) and 1GB of local memory; this processor is the microcode engine or the I/O management *brains.*
  - 8GB (2GB DIMMs) or 16GB (4GB DIMMs) of cache per system.
  - Two high-performance Tachyon QE4 four-port 4Gb Fibre Channel processors controlling the eight front end host connections.
  - Two SAS controllers servicing the 16 active back end SAS disk links.
  - All internal busses are now 2GB/sec eight-lane PCI Express (PCIe) instead of the previous 533MB/sec PCI-x bus.

91

Architecture – Model 2300E Controller Version 2



92

AMS 2300 Architecture (2100-2300 Delta)

- The Adaptable Modular Storage 2100 uses the Celeron processor instead of a Xeon (both are the Sossaman family).
  - The Adaptable Modular Storage 2100 uses DCTL-S (RAID and I/O processor) instead of the DCTL-H used on the 2300.
  - The Adaptable Modular Storage 2100 uses two banks of cache with one DIMM slot each (8GB) versus four banks of cache used on the 2300. This is with optional cache installed with one DIMM slot each (16GB).
  - The Adaptable Modular Storage 2100 uses the two-port DE4 Tachyon processor (four ports) instead of the four-port QE4 Tachyon processor (eight ports) used on the 2300.
  - The Adaptable Modular Storage 2100 has 120 disks versus 240 disks on the 2300.

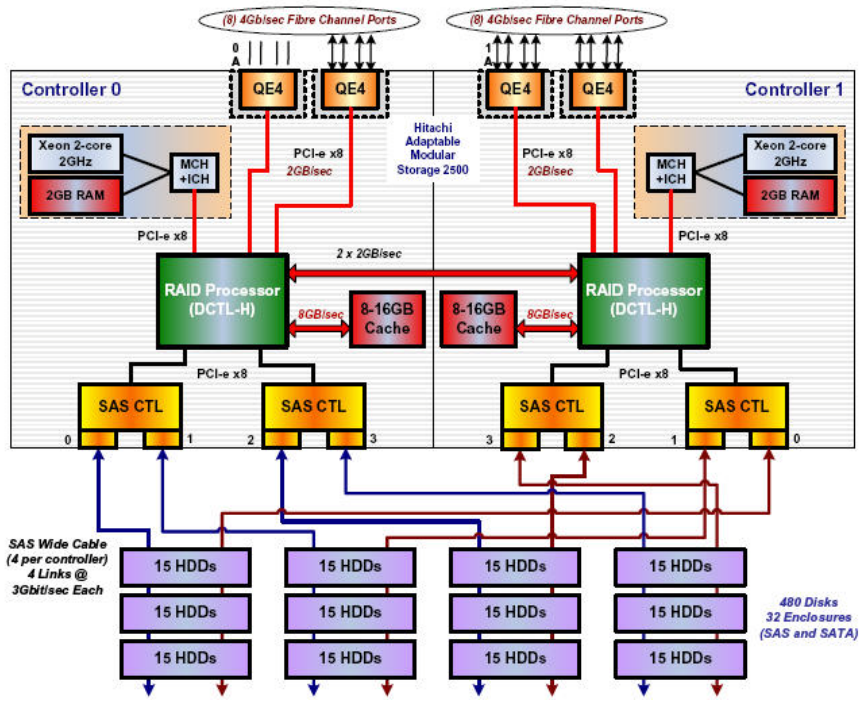
93

AMS 2500 Architecture

- Each Adaptable Modular Storage 2500 controller includes:
  - A DCTL-H processor (the I/O *pump* with RAID XOR functions)
  - A 2GHz Intel *Sossaman* Dual Core Xeon LV series (low voltage) processor and 2GB of local memory; this processor is the microcode engine or the I/O management *brains*.
  - 16GB (2GB DIMMs) or 32GB (4GB DIMMs) of cache per system.
  - Four high-performance Tachyon QE4 four-port 4Gb/sec Fibre Channel processors controlling the 16 front end host connections.
  - Four SAS controllers servicing the 32 active back end SAS disk links.
  - All internal busses are now 2GB/sec eight-lane PCI Express (PCIe) instead of the previous 533MB/sec PCI-x bus.

94

Architecture – Model 2500 Controller Version 2



95

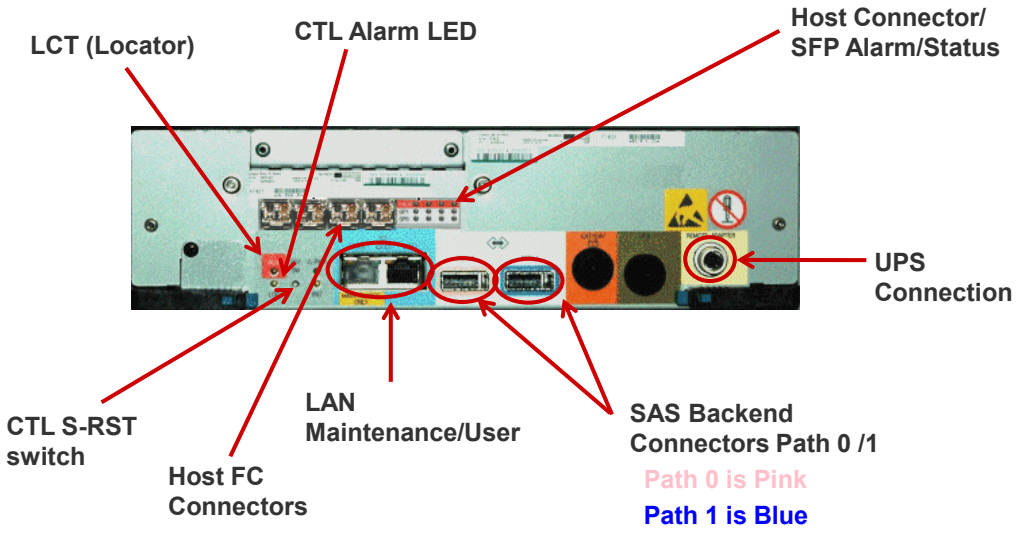
AMS 2500 Architecture (2300-2500 Delta)

- The Adaptable Modular Storage 2500 is a significant upgrade from the 2300. The actual differences (2300 versus 2500) are as follows:
  - The 2300 uses 1.67GHz single core Xeons and 1GB of RAM versus 2GHz dual core Xeons with 2GB of RAM on the 2500.
  - The 2300 has four banks of cache with one DIMM slot each (16GB max) versus four banks of cache with two DIMM slots each (32GB max) on the 2500.
  - The 2300 has one four-port QE4 Tachyon processor per controller (eight host ports total) versus dual four-port QE4 Tachyon processors (16 host ports) per controller on the 2500.
  - The 2300 has two SAS I/O engines (16 disk links) per system versus four SAS I/O engines (32 SAS links) per system on the 2500.
  - 240 disks versus 480 disks.

96

Hardware Components

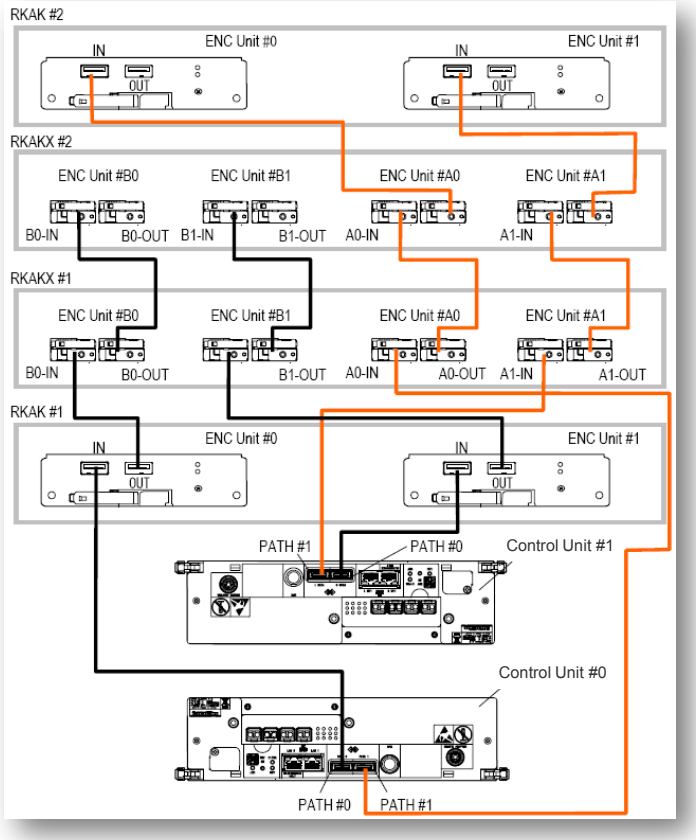
- Controller labeling
  - Easy-to-read symbols
  - Color coded components indicates function



97

LCT is a new locator LED. This is also located on the expansion units (front and rear) to identify and locate with Storage Navigator Modular 2.

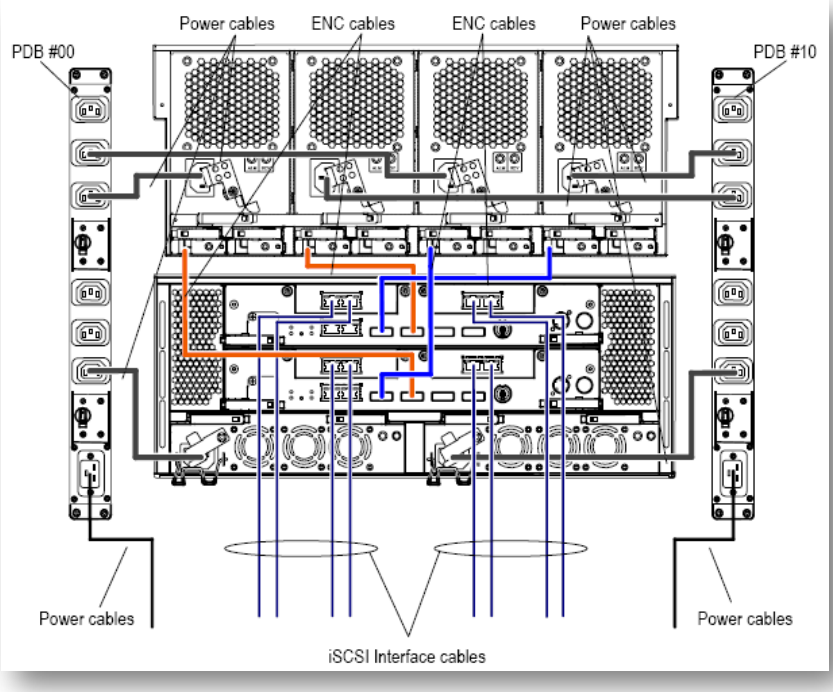
Connecting ENC Cables RKM/RKS+RKAK+RKAKX×2+RKAK



Sample ENC cabling

Diagram with Dual Controller and RKAK and RKAKX mix

Connecting iSCSI Cables RKH+RKAKX



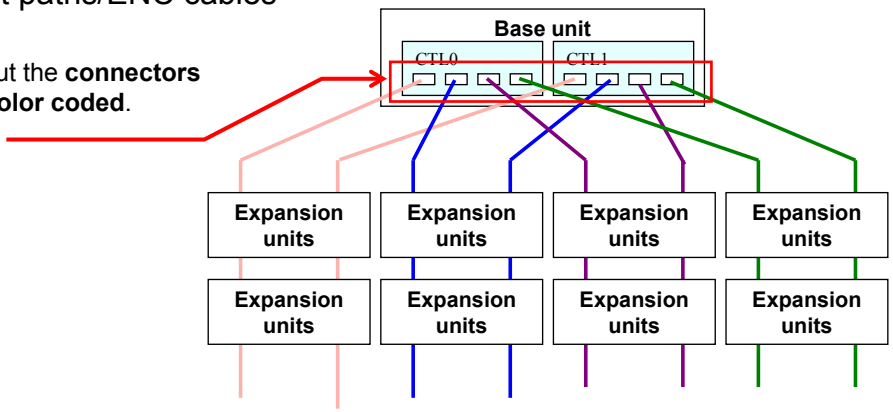
Sample iSCSI cabling Diagram with Dual Controller showing RKH and RKAKX

99

Back End SAS Connections

- Expansion Unit Drive Tray Connection
  - New ENC Cables – Simple and easy back end cabling
    - Single **keyed** cable type for all connections
  - Common HDD tray for **SAS** and **SATA**
  - **All** SAS back end paths **active**
  - ACE tool not required
  - Model 2500 most paths/ENC cables

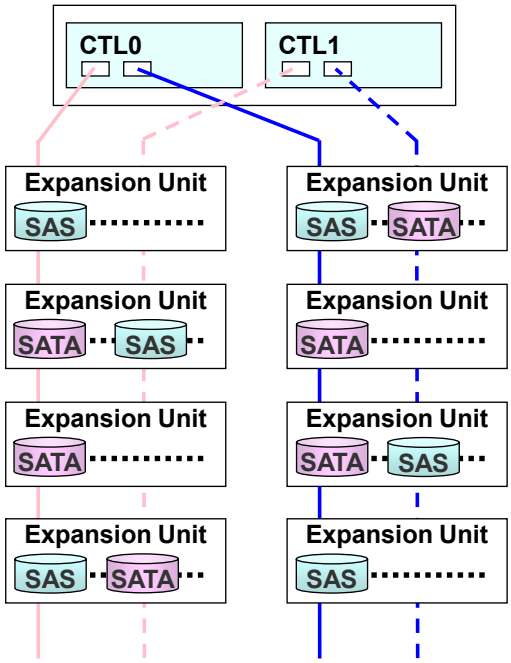
Note: Cables are one color, but the **connectors of the controller are color coded**.



100

ENC stands for enclosure.

- Typical Cabling Diagram of Model 2100 and 2300



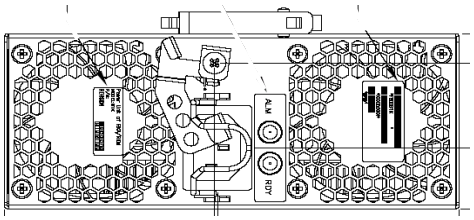
See section **2.4.10** of the **Installation chapter** of the *Maintenance Manual* for actual cabling instructions and diagrams.

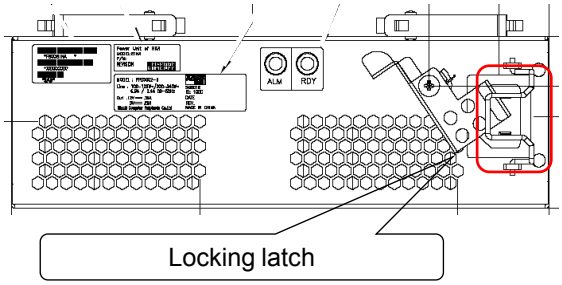
101

Simple cabling no longer requires ACE tool in Storage Navigator Modular 2.

Power Supply

- Power supply does not have a switch.
- To turn power off, remove power supply cable.
- Power supply has been improved to allow power-off by cable removal.
  - Power supply swap can be performed by end-user.
- Locking latch component added to secure power supply cable.
  - Power supply unit cannot be removed from unit frame while connected.

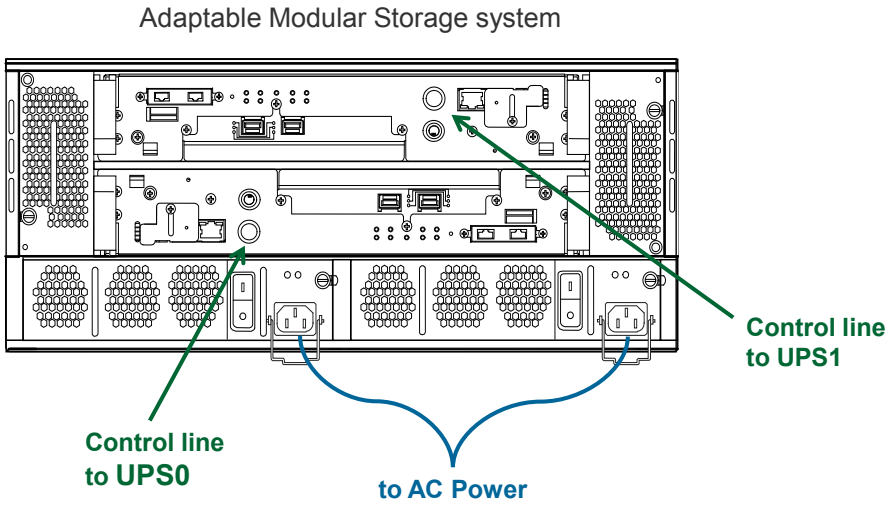




102

Uninterruptible Power Supply Connections

- Uninterruptible power supply (**UPS**)
  - No UPS support at GA (coming at a later date)



103

UPS systems from APC and Powerware are qualified for other Hitachi Adaptable Modular Storage models and they are probably qualified for Adaptable Modular Storage 2000 Family system as well. Check with Product Management.

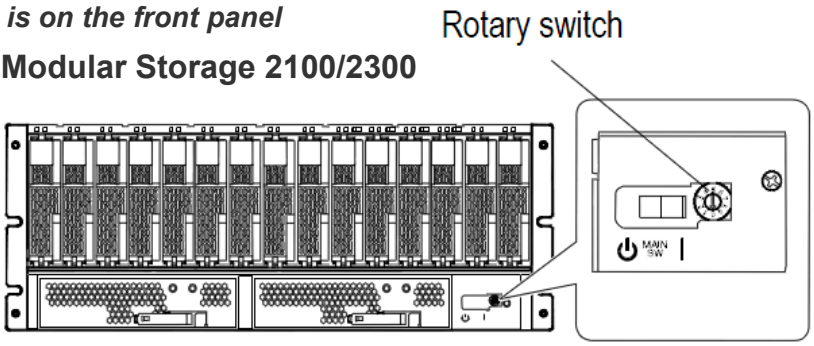
The UPS interface can detect high or low voltages, and more on the Adaptable Modular Storage 2000 Family system.

Install manuals can be found on the Internet vendor Web page, such as Powerware and APC Web sites.

Rotary Switch Power Connection Mode Settings

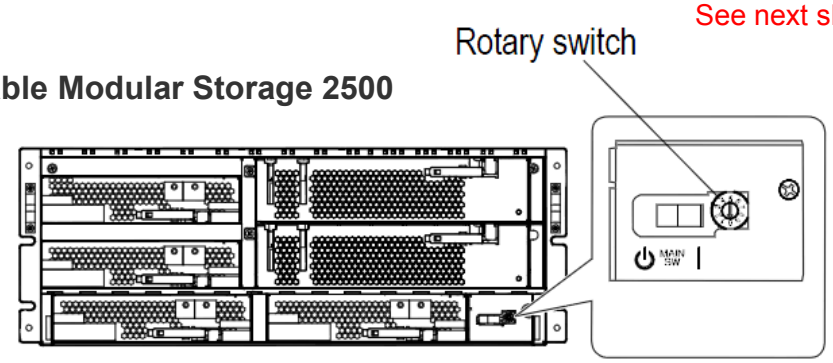
Rotary switch is on the front panel

Adaptable Modular Storage 2100/2300



See next slide for settings.

Adaptable Modular Storage 2500



104

Rotary Switch Settings

Mode of power control is decided the settings when the subsystem start up.
In the Ready state, Rotary switch #8 is used to enable the access to web special pages.

Rotary switch	Operation mode name	Operation mode
0	LOCAL	Local mode (Before shipment. When the remote adaptor is not used.)
1	–	–
2	REMOTE	Remote mode by means of the HOST AC (using a remote adapter)
3	–	–
4	UPS Interlock mode 1	Interlock mode 1 with an UPS exclusive for the subsystem. To set the mode, connect AC #0 and AC #1 to the UPS and an external and an external AC power supply or the PDB of the RK40 rack frame respectively.
5	UPS Interlock mode 2	Interlocking mode 2 with an UPS exclusive for the subsystem To set the mode connect AC #0 and AC #1 to the one UPS.(*1)
6	UPS Interlock mode 3	Interlocking mode 3 with an UPS exclusive for the subsystem To set the mode, connect each of AC #0 and AC #1 to the different UPSs. (*2)
7	–	– Added at AMS2000V6.2~
8	Enable the access to Web special pages	Access to web special pages is Enabled. This is available in the Ready state.
9	–	–

*1 : The duplication of the power supply system becomes unable to be done.
*2 : This cannot be used in the case of the single controller configuration.

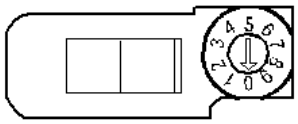
Maintenance Manual (INST 01-0180-00)

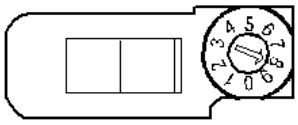
105

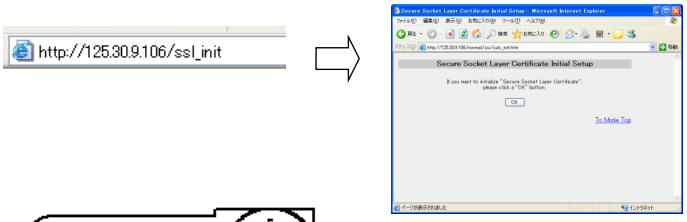
Operations

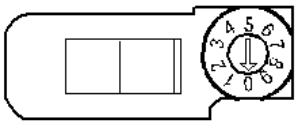
- Following operations are required DF800V6.2 or later, to access to the special Web pages.

1. Be sure to record which number is set on the rotary switch to document the current setting.
2. Set the rotary switch to number position 8.
   (This does not change the Mode of power control.)
3. After 10 seconds from step 2, access http://(address of the subsystem)/sslc_init to access special Web pages for SSL Initial Setup.
4. Click OK button.
5. Set the rotary switch back to the value recorded at step 1 above.





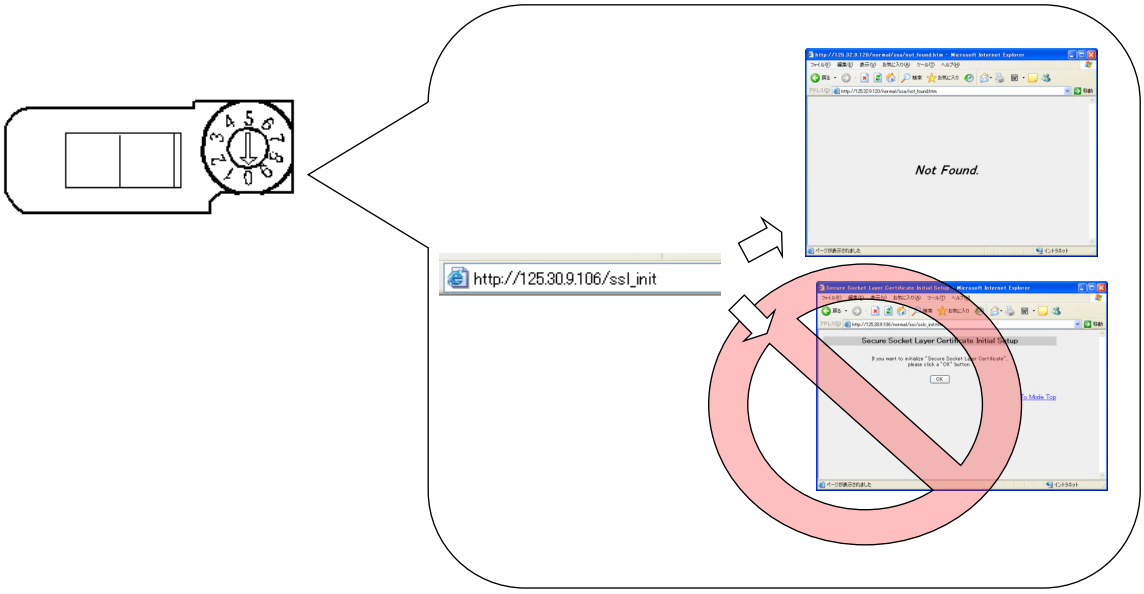




106

Access Control Without Rotary Switch

- When Rotary switch is NOT #8, special web page is NOT accessible. (To keep the DF800 hardware secure, unauthorized accesses are not allowed.)



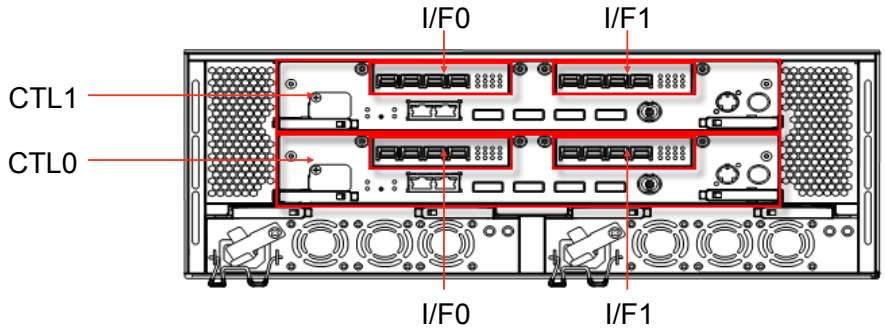
107

iSCSI Interface

- The AMS 2500 provides 4 iSCSI ports per controller (eight per unit) for the iSCSI configuration or two ports per controller (four per base unit) with the multi-protocol (mix of Fibre Channel and iSCSI) configuration.
  - To convert a base unit from only Fibre Channel to only iSCSI or to a multi-protocol configuration, replace both controllers and install the firmware on them. The same firmware supports both fibre channel and iSCSI units.
- With the 1 Gb/s Ethernet connection, the array provides high-speed data transfer to and from a host computer.
  - The maximum transfer speed is 100 MB/s per port. Higher throughput can be obtained, even when accessing multiple devices connected to the same network.
- The AMS 2500 supports iSCSI (1000 Base-T).
  - With the HBA for iSCSI, generic NIC and software initiator, and network switch, the AMS 2500 can be located up to 100 meters from the host.

108

Model 2500 FC/iSCSI Host Interface Intermix



- Each I/F board on CTL0 and CTL1 must be the same type of I/F board or **None**.
  If not, the storage system will not go into the **Ready** status.

  Exception:
  If the Interface board type of I/F0 on **CTL0** is **iSCSI**, the Interface board I/F0 on **CTL1** must be either **iSCSI** or **None**.

109

Notes:

- The FC/iSCSI Host Interface intermix on an AMS2500 storage system will be supported with the v.6 firmware.
- I/F0 and I/F1 in this picture are images for FC Interface board, not for iSCSI Interface board (iSCSI has only 2 ports per Interface board).

Model 2500 Interface Combinations

No	CTL#0		CTL#1		Status
	I/F#0	I/F#1	I/F#0	I/F#1	
1	FC	FC	FC	FC	Ready
2			FC	iSCSI	Subsystem Down
3			FC	None	Ready
4			iSCSI	FC	Subsystem Down
5			iSCSI	iSCSI	Subsystem Down
6			iSCSI	None	Subsystem Down
7			None	FC	Ready
8			None	iSCSI	Subsystem Down
9			None	None	CTL Warning
10	FC	iSCSI	FC	FC	Subsystem Down
11			FC	iSCSI	Ready
12			FC	None	Ready
13			iSCSI	FC	Subsystem Down
14			iSCSI	iSCSI	Subsystem Down
15			iSCSI	None	Subsystem Down
16			None	FC	Subsystem Down
17			None	iSCSI	Ready
18			None	None	CTL Warning
19	FC	None	FC	FC	Ready
20			FC	iSCSI	Ready
21			FC	None	Ready
22			iSCSI	FC	Subsystem Down
23			iSCSI	iSCSI	Subsystem Down
24			iSCSI	None	Subsystem Down
25			None	FC	Ready
26			None	iSCSI	Ready
27			None	None	CTL Warning

110

No	CTL#0		CTL#1		Status
	I/F#0	I/F#1	I/F#0	I/F#1	
28	iSCSI	FC	FC	FC	Subsystem Down
29			FC	iSCSI	Subsystem Down
30			FC	None	Subsystem Down
31			iSCSI	FC	Ready
32			iSCSI	iSCSI	Subsystem Down
33			iSCSI	None	Ready
34			None	FC	Ready
35			None	iSCSI	Subsystem Down
36			None	None	CTL Warning
37	iSCSI	iSCSI	FC	FC	Subsystem Down
38			FC	iSCSI	Subsystem Down
39			FC	None	Subsystem Down
40			iSCSI	FC	Subsystem Down
41			iSCSI	iSCSI	Ready
42			iSCSI	None	Ready
43			None	FC	Subsystem Down
44			None	iSCSI	Ready
45			None	None	CTL Warning
46	iSCSI	None	FC	FC	Subsystem Down
47			FC	iSCSI	Subsystem Down
48			FC	None	Subsystem Down
49			iSCSI	FC	Ready
50			iSCSI	iSCSI	Ready
51			iSCSI	None	Ready
52			**None**	**FC**	Ready
53			None	iSCSI	Ready
54			None	None	CTL Warning

111

Model 2500 Interface Combinations

No	CTL#0		CTL#1		Status
	I/F#0	I/F#1	I/F#0	I/F#1	
55	None	FC	FC	FC	Ready
56			FC	iSCSI	Subsystem Down
57			FC	None	Ready
58			iSCSI	FC	Ready
59			iSCSI	iSCSI	Subsystem Down
60			**iSCSI**	**None**	Ready
61			None	FC	Ready
62			None	iSCSI	Subsystem Down
63			None	None	CTL Warning
64	None	iSCSI	FC	FC	Subsystem Down
65			FC	iSCSI	Ready
66			**FC**	**None**	Ready
67			iSCSI	FC	Subsystem Down
68			iSCSI	iSCSI	Ready
69			iSCSI	None	Ready
70			None	FC	Subsystem Down
71			None	iSCSI	Ready
72			None	None	CTL Warning
73	None	None	FC	FC	CTL Warning
74			FC	iSCSI	CTL Warning
75			FC	None	CTL Warning
76			iSCSI	FC	CTL Warning
77			iSCSI	iSCSI	CTL Warning
78			iSCSI	None	CTL Warning
79			None	FC	CTL Warning
80			None	iSCSI	CTL Warning
81			None	None	Subsystem Down

112

Specifications

- Memory and Unit Height Specifications

		2100	2300	2500
Height base unit		4U	4U	4U
Height expansion unit		3U		
Dual Controller		Default	Default	Default
Cache (4GB DIMM)	**Slot**	**1**/CTL	**2**/CTL	**4**/CTL
	Capacity	**4GB**/CTL **8GB**/system	**8GB**/CTL **16GB**/system	**16GB**/CTL **32GB**/system

- Chart assumes **4GB DIMMs** (capacity is half if 2GB DIMMs)

113

- Battery Life

		2100	2300	2500
Maximum Cache	2GB DIMMs	4GB per array	8GB per array	16GB per array
	4GB DIMMs	8GB per array	16GB per array	32GB per array
Internal Batteries		2	2	2 (default) 2 (optional)
Internal Battery Backup Time	2GB/4GB DIMMs	72/48 hours	36/24 hours	24/48/96 hours
External Batteries		N.A.	N.A.	1 or 2
External Battery Backup Time (with maximum internal batteries)	One	N.A.	N.A.	90 hours
	Two	N.A.	N.A.	168 hours

114

Note: This is applicable with maximum internal Batteries installed and Batteries fully loaded and working properly.

Controller Architecture

- Model **2100** CTL Architecture
  - MPU:IA32 (Celeron) 1.67GHz
  - Internal data bus: PCI-express
  - Back end: SAS
  - Fibre Channel interface – 2 Ports
  - iSCSI interface – 2 Ports
- Model **2300** CTL Architecture
  - MPU: IA32 (Xeon) 1.67GHz
  - Internal data bus: PCI-express
  - Back end: SAS
  - Fibre Channel interface – 4 Ports
  - iSCSI interface – 2 Ports
- Model **2500** CTL Architecture
  - MPU: IA32 (Xeon) 2.0GHz Dual Core
  - Internal data bus: PCI-express
  - Back end: SAS
  - Fibre Channel interface – 8 Ports
  - iSCSI interface – 4 Ports

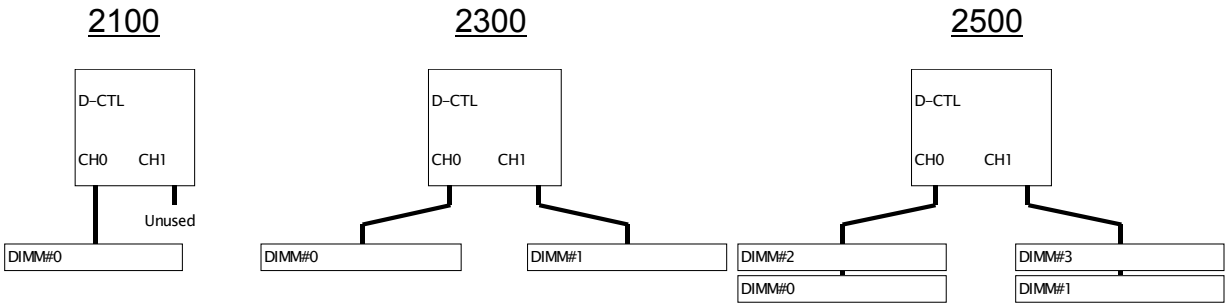
115

Notes:

- On models 2100 and 2300 you cannot intermix Fibre Channel and iSCSI.
- On the 2500 model you can intermix Fibre Channel and iSCSI. In this case you will have 4 Fibre Channel ports per controller and 2 iSCSI ports per controller.

Cache Architecture

- Cache composition in each model's controller

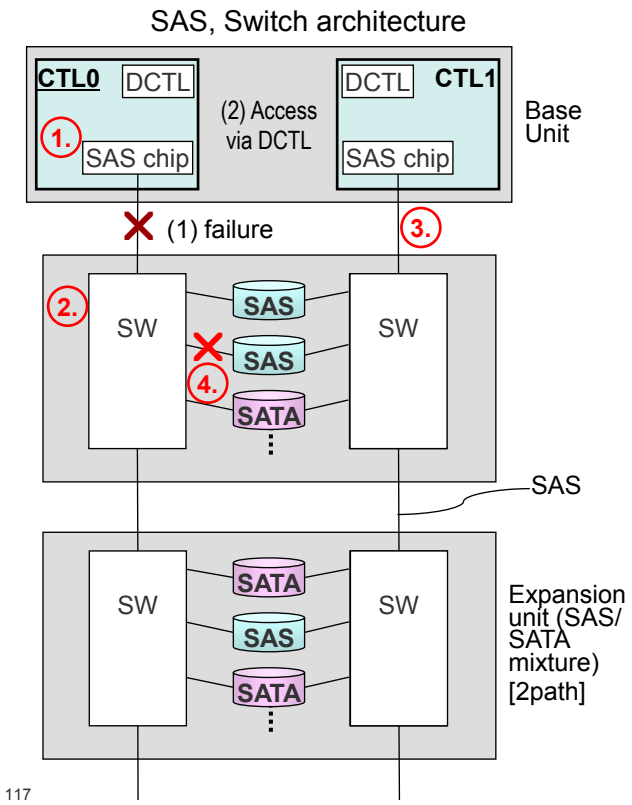


	2100	2300	2500
Maximum Cache per CTL	1	2	4
Additional #	n/a	1	2

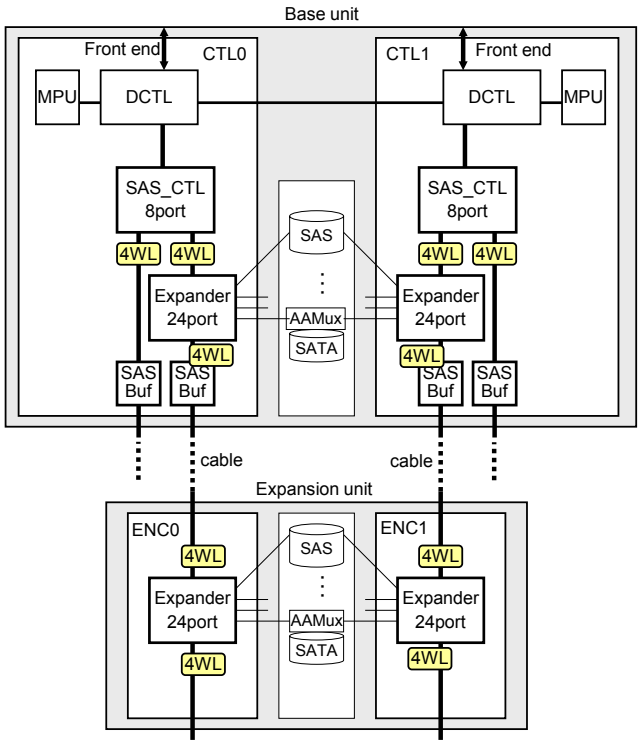
116

Note: Model 2500 – Cache units should be installed in PAIRS.

Back End Architecture



2000 Advantage	Contents
1. New Topology (Loop –>Switch)	
SAS Switch Architecture	Point to Point connection between SAS protocol chip and each drive. 4-Wide Links are configured in one SAS back end path.
2. Simple and Easy cabling (common expansion unit for SAS/SATA)	
Simple & Easy back end cabling configuration	Back end cabling can be simplified by SAS/SATA coexistence in the same expansion unit chassis.
3. Back end Path failover (through back end path –> DCTL)	
Steady transaction by changing the back end access path	When the back end path failure occurs, the access path failover is executed using DCTL interface.
4. Improvement of Failure diagnostics (Loop –> Switch)	
Improvement of back end failure diagnostics	The failure parts detection is improved by switch device (Expander) functions.



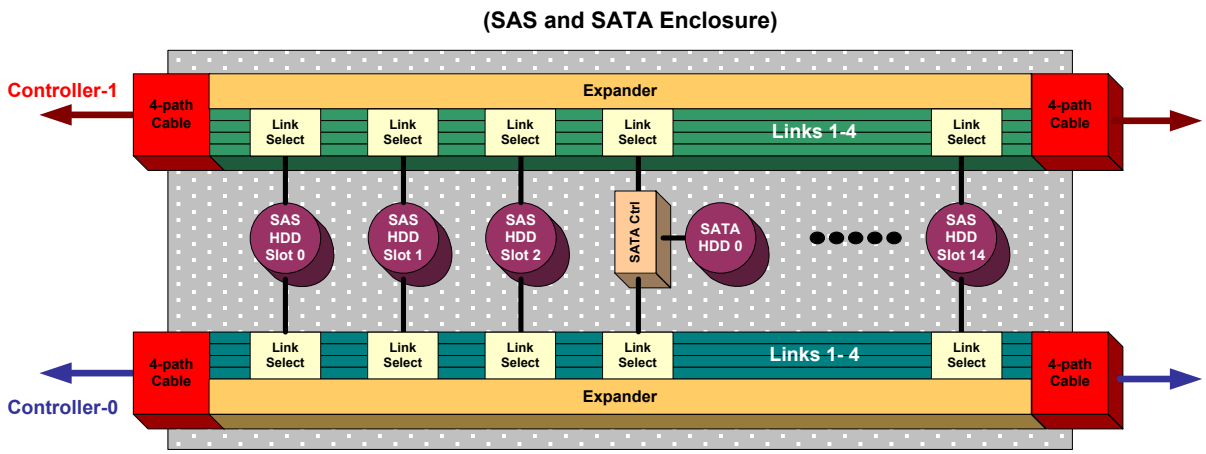
Field Replaceable Unit (**FRU**)

No	Failure Parts	FRU
1	Controller (including SAS protocol chip, Expander, etc)	Controller (new CTL CRU consists of cache, and host interfaces)
2	ENC (including Expander)	ENC and Cable
3	Cable between chassis	ENC and Cable
4	SAS Drive	SAS Drive
5	SATA Drive (includes AAMux)	SATA Drive (includes AAMux)

WL: Wide Link

AAMux: Active-Active Multiplexer

Disk Expansion Tray



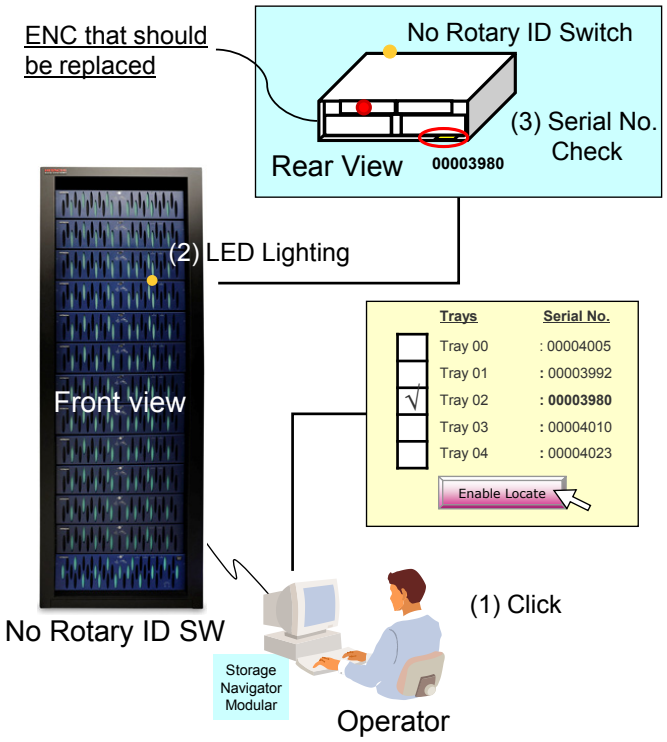
119

Note that the SATA enclosures use a different connection method from the FC enclosures.

An AAmux (SATA Ctrl) chip is installed on every SATA Disk.

Back End Logical Configuration

- Expansion units do not have a Rotary Address Switch.
- Storage Navigator Modular 2 shows the Logical Configuration and serial number of each expansion unit.
- Users can recognize a target expansion unit by illuminating an LED using Storage Navigator Modular 2 and executing a **Check with Serial No. of RKAK.**
- Users can recognize a failed component (ENC, PS, etc.) by LED.



120

RKAK refers to the expansion unit.

System Management Options Interface

- Out of band

  Hitachi Storage Navigator Modular 2 – CLI and GUI

  – SNMP (trap for failure information only)

  – Maintenance

  – Embedded Web Server for Field Maintenance

- Inband (not required)

  RAID Manager CCI for

  – Hitachi ShadowImage Heterogeneous Replication software

  – Hitachi TrueCopy Heterogeneous Remote Replication Software

  – Hitachi Copy-on-Write Snapshot software

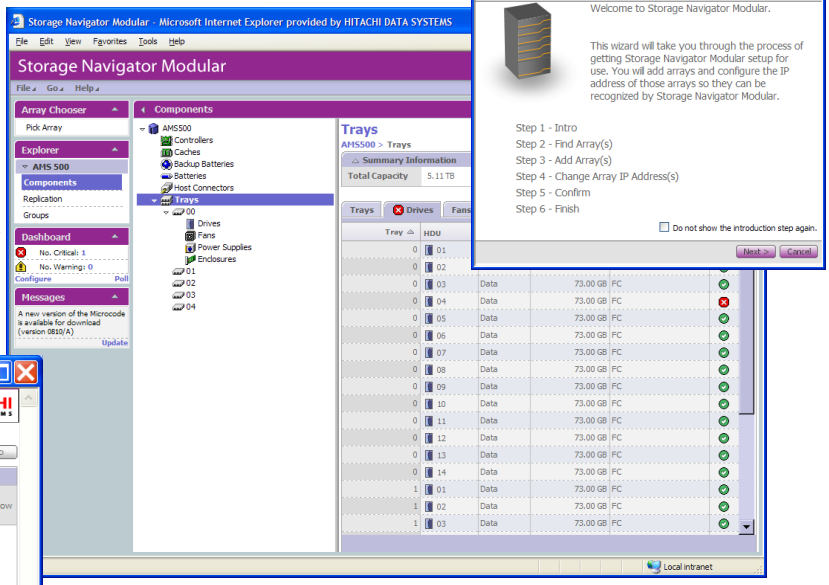
121

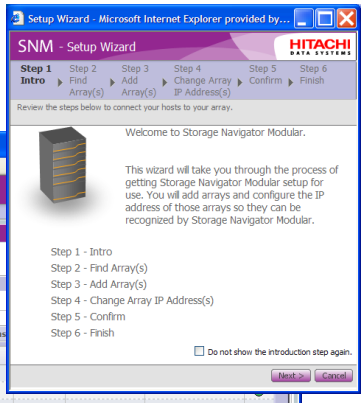
The management interface Storage Navigator Modular 2 is a new, easy to use GUI utility developed for the Adaptable Modular Storage 2000 and Simple Modular Storage product lines. It is based on HBase. It replaces Storage Navigator Modular.

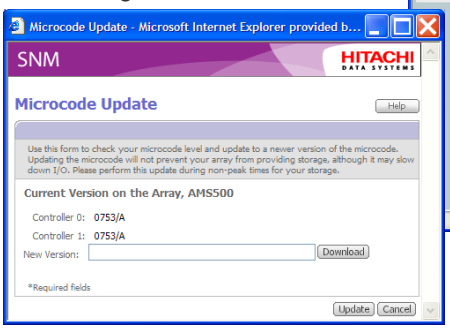
There is also a CLI version of Storage Navigator Modular 2 but has not changed significantly from Storage Navigator Modular.

New Management Tool

- Focus on Usability and Maintainability
- Wizard-based setup and configuration
- Simplified Licensing
- Host attachment
- Adding LUs
- Replication setup and management
- Optional Feature management
- Multi-array Management
- Common GUI for Simple Modular Storage 100 and Adaptable Modular Storage 2000
- Matching CLI and API







122

System and Data Security

- Account Authentication
  - System management access based on one of three roles (account administrator, storage administrator, or auditor)
  - Unique login and password for each user
- System Audit Logging
  - Records all system changes and all power ups and downs
  - Sends all changes to Syslog server
  - Enables IT managers to meet compliance requirements including auditable trails
- Data Retention Utility
  - Makes selected data non-erasable and non-rewriteable
  - Read access can be limited
- Common Criteria Evaluation Assurance Level 2 Certification in process

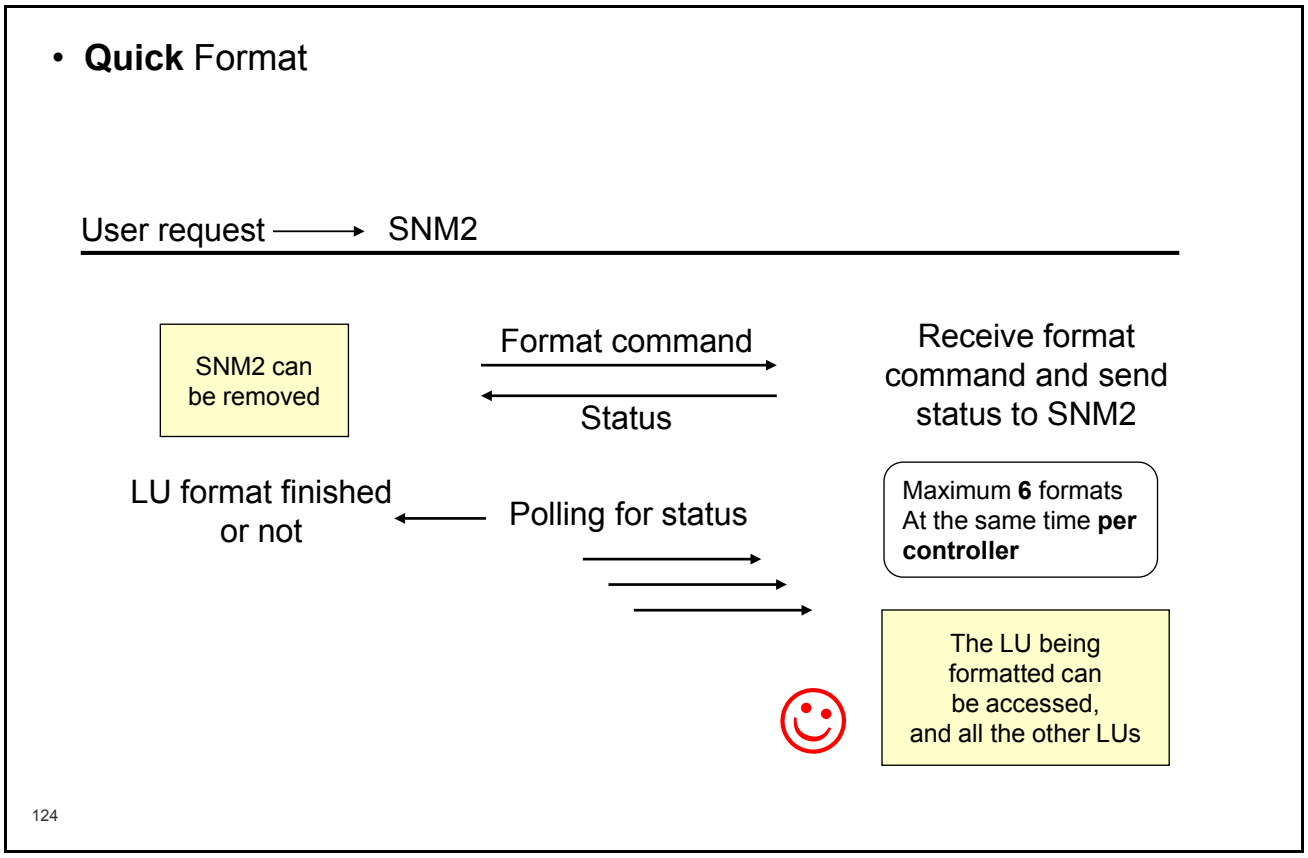
123

The Evaluation Assurance Level (EAL1 through EAL7) of an IT product or system is a numerical grade assigned following the completion of a Common Criteria security evaluation, an international standard in effect since 1999. The increasing assurance levels reflect added assurance requirements that must be met to achieve Common Criteria certification. The intent of the higher levels is to provide higher confidence that the system's principle security features are reliably implemented. The EAL level does not measure the security of the system itself, it simply states at what level the system was tested to see if it meets all the requirements of its Protection Profile.

EAL2: Structurally Tested

EAL2 requires the cooperation of the developer in terms of the delivery of design information and test results, but should not demand more effort on the part of the developer than is consistent with good commercial practice. As such, it should not require a substantially increased investment of cost or time. EAL2 is therefore applicable in those circumstances where developers or users require a low to moderate level of independently assured security in the absence of ready availability of the complete development record. Such a situation may arise when securing legacy systems.

LUN Formatting

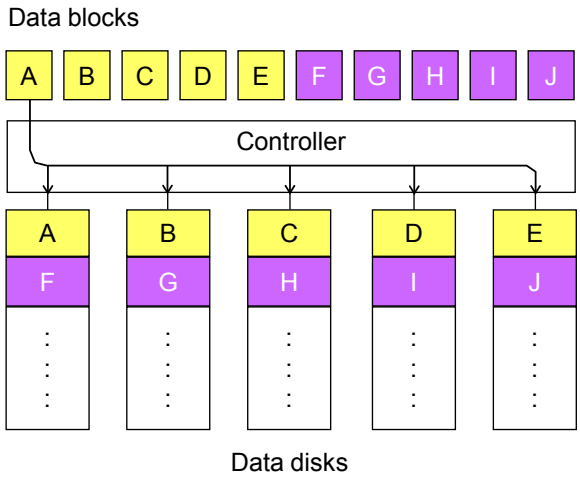


QuickFormat is the only formatting method available on Adaptable Modular Storage 2000 Family. It allows issuing format commands for up to 512 LUNs. The queue is maintained in the storage system allowing the engineer's laptop to be disconnected. An Adaptable Modular Storage 2000 Family, however, will only format a maximum of 6 LUNs concurrently per controller. The format is running in the background and the LUNs can almost immediately be accessed without the need of waiting for the full format to finish. (**Caution** – Do not POWER down the array before you check that the format is truly complete, otherwise the format will not finish.)

In the diagram, **SNM2** stands for Storage Navigator Modular 2.

Supported RAID Levels

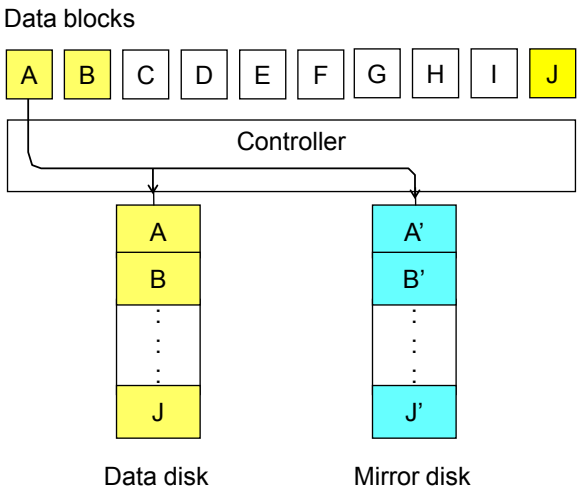
- RAID 0



Outline:	RAID 0 stripes the data across disk drives for higher throughput.
Pro:	Offers most available disk space to the user.
Con:	All data is lost in case of a disk failure.

125

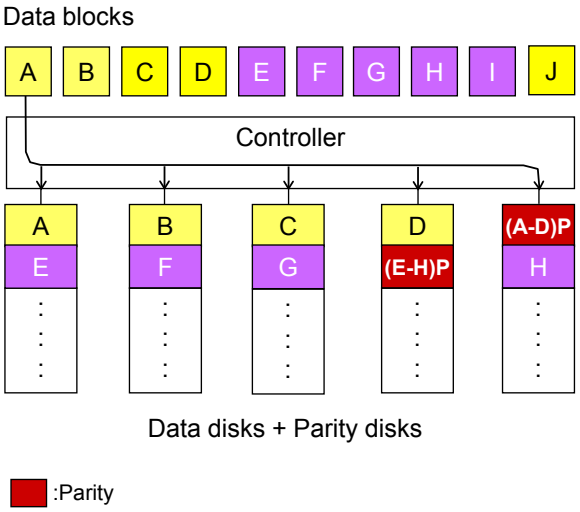
- RAID 1



Outline:	RAID 1 mirrors the data.
Pro:	If a disk drive fails the data is not lost and the performance is not affected.
Con:	More expensive.

126

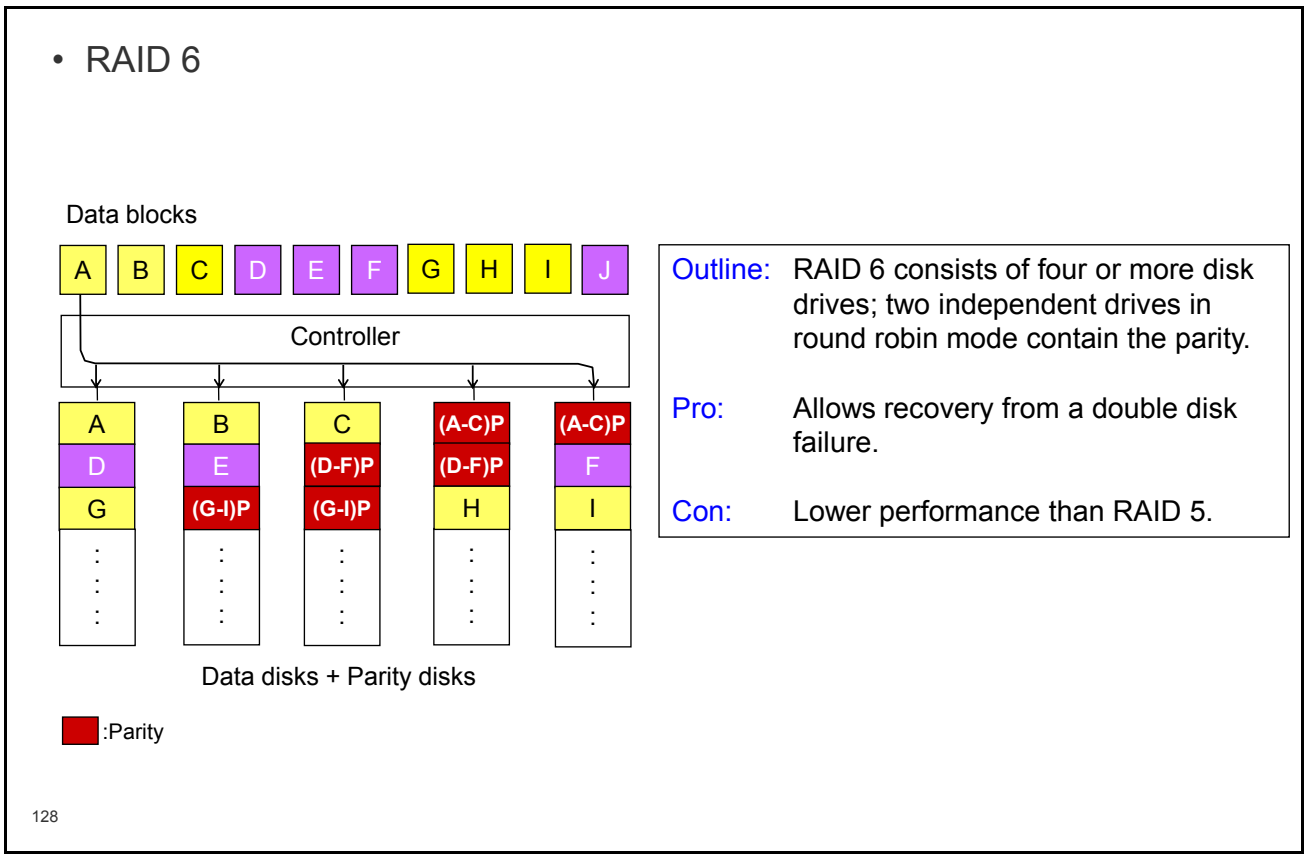
- RAID 5



Outline:	RAID 5 consists of three or more disk drives; one drive in round robin mode contains the parity.
Pro:	Striping offers higher reading throughput.
Con:	Lower performance on (small) random writes and in case a drive fails.

127

RAID 5: At least three disks are required to implement RAID 5. RAID 5 will not sustain a double-disk failure and is more likely to occur with SATA drives.

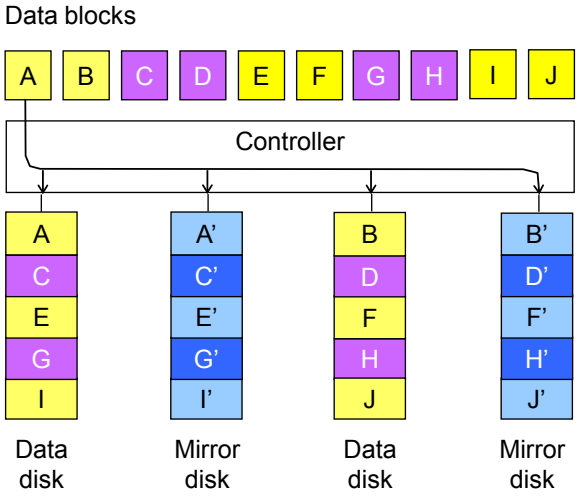


RAID 6: At least four disks are required to implement RAID 6. This configuration is very similar to RAID 5, with an additional parity block, allowing block level striping with two parity blocks. The advantages and disadvantages are the same as the RAID 5, except the additional parity disk protects the system against double-disk failure. This feature was implemented to ensure the reliability of the SATA drives.

Key value: Two parity drives allow a customer to lose up to two hard disk drives (HDDs) in a RAID group without losing data. RAID groups configured for RAID 6 are less likely to lose data in the event of a failure. RAID 6 performs nearly as well as RAID 5 for similar usable capacity. RAID 6 also gives the customer options as to when to rebuild the RAID group. When an HDD is damaged, the RAID group must be rebuilt immediately (since a second failure may result in lost data). During a rebuild, applications using the volumes on the damaged RAID group can expect severely diminished performance. A customer using RAID 6 may elect to wait to rebuild until a more opportune time (night or weekend) when applications will not require stringent performance.

HDD roaming allows the spare to become a part of the RAID group; no copy back is required saving rebuild time.

- RAID 1+0



Outline: RAID 1+0 (four or more disk drives) is similar to RAID 1 but now the data is striped.

Pro: Striping offers higher random write access performance compared to RAID 1, 5 or 6.

Con: More expensive.

129

- Overview

RAID Level	Supported Range Models 2100, 2300, and 2500
0	2D to 16D (RAID-0 only supported on SAS HDDs)
1	1D + 1P
5	2D + 1P to 15D + 1P
6	2D + 2P to 28D + 2P
1+0	2D + 2P to 8D + 8P

130

Relative RAID Performance

- Relative Performance

  The table shows the performance levels for different RAID configurations **relative to RAID 1+0 (2D+2P)**, which is assumed to be 100% for reads and writes.

  The illustration is **not** meant to be a recommendation or imply that one RAID Group is better than another RAID Group, but to illustrate how performance of a RAID Group should be matched to the type of performance that an application needs.

RAID Level	Random Read, Sequential Read	Sequential Write	Random Write
RAID 1+0 (2D+2P)	100%	100%	100%
RAID 5 (3D+1P)	100%	150%	50%
RAID 5 (7D+1P)	200%	350%	100%
RAID 6 (6D+2P)	200%	300%	66.7%
Note	Proportional to the number of disks	Proportional to the number of data disks	See notes

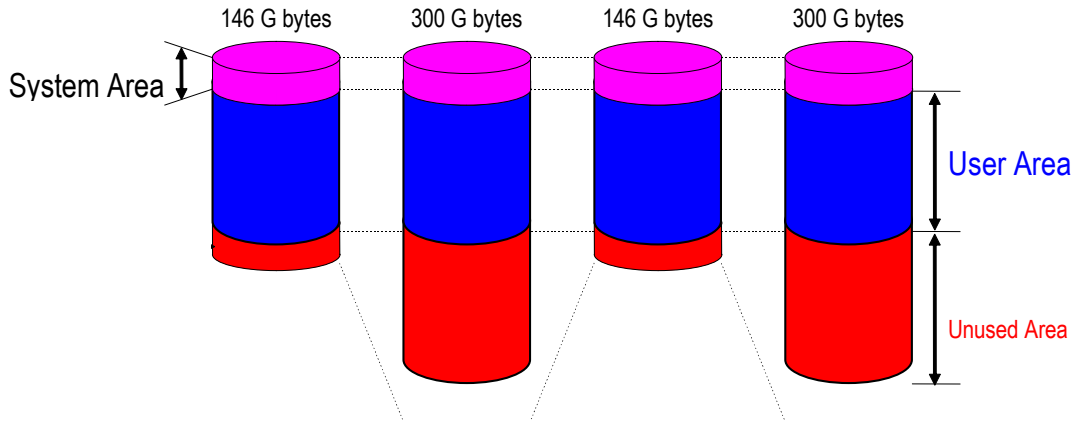
131

Note: The values listed in the table were not collected using an AMS 2000, but using an earlier AMS 500. The table is meant to illustrate that different applications may require different performance characteristics from its RAID Group.

- This table shows the performance levels for different RAID configurations relative to RAID 1+0 (2D+2P), which is assumed to be 100% for reads and writes.
- The second column shows that the random read and sequential write performance is proportional to the number of disks, because the disks can be accessed simultaneously.
- With sequential writes, there are no reads involved, as with random writes, therefore the performance is proportional to the number of data disks.
- Random writes. The reason for the performance difference between RAID 6 (6D+2P) and RAID 5 (7D+1P) is that RAID 6 (6D+2P) must process 1.5 times (see below) more disk I/Os than RAID 5 (7D+1P), therefore the random write performance in RAID 6 (6D+2P) is 33% lower than with RAID5 (7D+1P).
- The number of disk I/Os in RAID 5 random writes: Four (old data/old parity reads, new data/new parity writes).
- The number of disk I/Os in RAID 6 random writes: Six (old data/old parity (P)/old parity (Q) reads, new data/new parity (P)/new parity (Q) writes).

Disk Drive System and User Data Areas

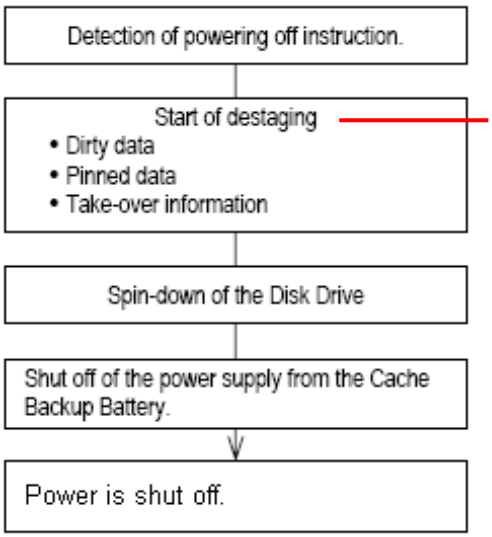
- RAID Group storage is divided into two data areas: **System** and **User.**
  - **System Area**: Approximately **1GB** of space on each disk.
  - **System Disks**: The **first five** disks in the system use the **system area** to store trace data, configuration data, microcode, and cache data (see next slide).
  - User Area: User data is stored here.
- If unequal disk sizes are used, space is lost on the larger disks.



132

- This graphic shows that a part of the physical capacity is reserved as system area. The area is only used as system area on the very first five disks of a system, for example, disk 0~4 in the RK unit. The system area contains microcode, trace and log data and the configuration data.
- A disk is always bigger than what is offered to the user. The example shows that if a RAID group would exist with disks of different capacity, on the bigger drives a substantial part can be left unused. The user data area part must be the same for all disks in a RAID group.

System Sequential Shutdown

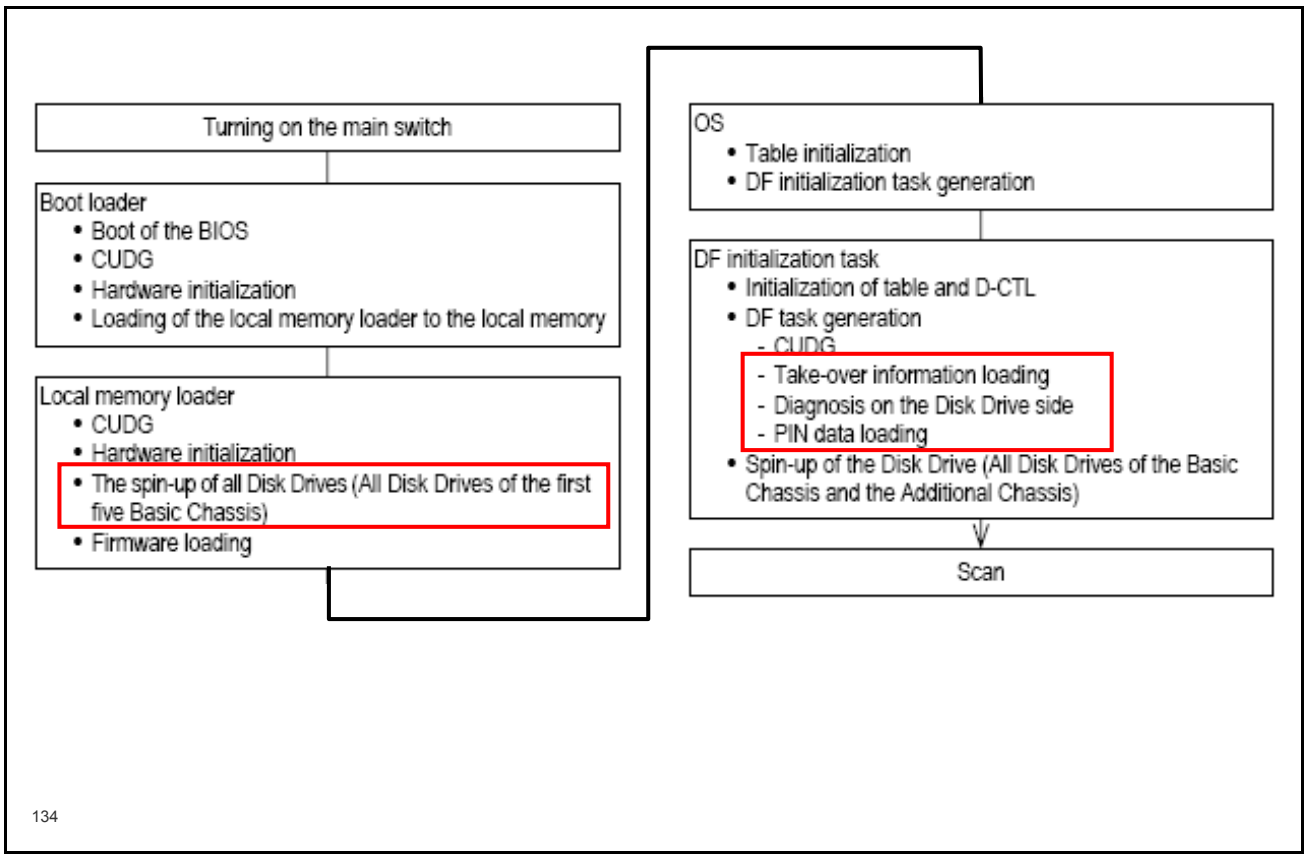


- Dirty cache data is **destaged** to the **logical devices.**
- If a **track fails to be destaged**, the pin information is written to the **system disks.**

- **Dirty Data** is cache data that has **not** been written to disk.
- **Pinned Data** is data that **could not be written** to disk for some reason.

133

Power On and Sequential Startup



Lab Project 1: Component Location

- Timing and Organization
  - Time allotted to complete the project: **30 minutes**
  - The lab project contains two sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **10 minutes**
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by their instructor.

135

Lab Project 1: Objectives

- Upon completion of the lab project, the learner should be able to:
  - Identify and locate hardware components
  - Identify management and maintenance LAN connections
  - Identify Fibre Channel connections
  - Verify the connections of the ENC cables from the base unit to the accompanying expansion units
  - Apply power to the rack Power Distribution Units (PDUs)
  - Power up the storage system and verify its Ready status

136

3. Web Tool

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Explain the purpose and function of the Web Tool
  - Demonstrate the operation of the Web Tool
  - Discuss network issues
  - Activate the different modes of operation
  - Demonstrate the use of special functions

2

Functions of the Web Tool

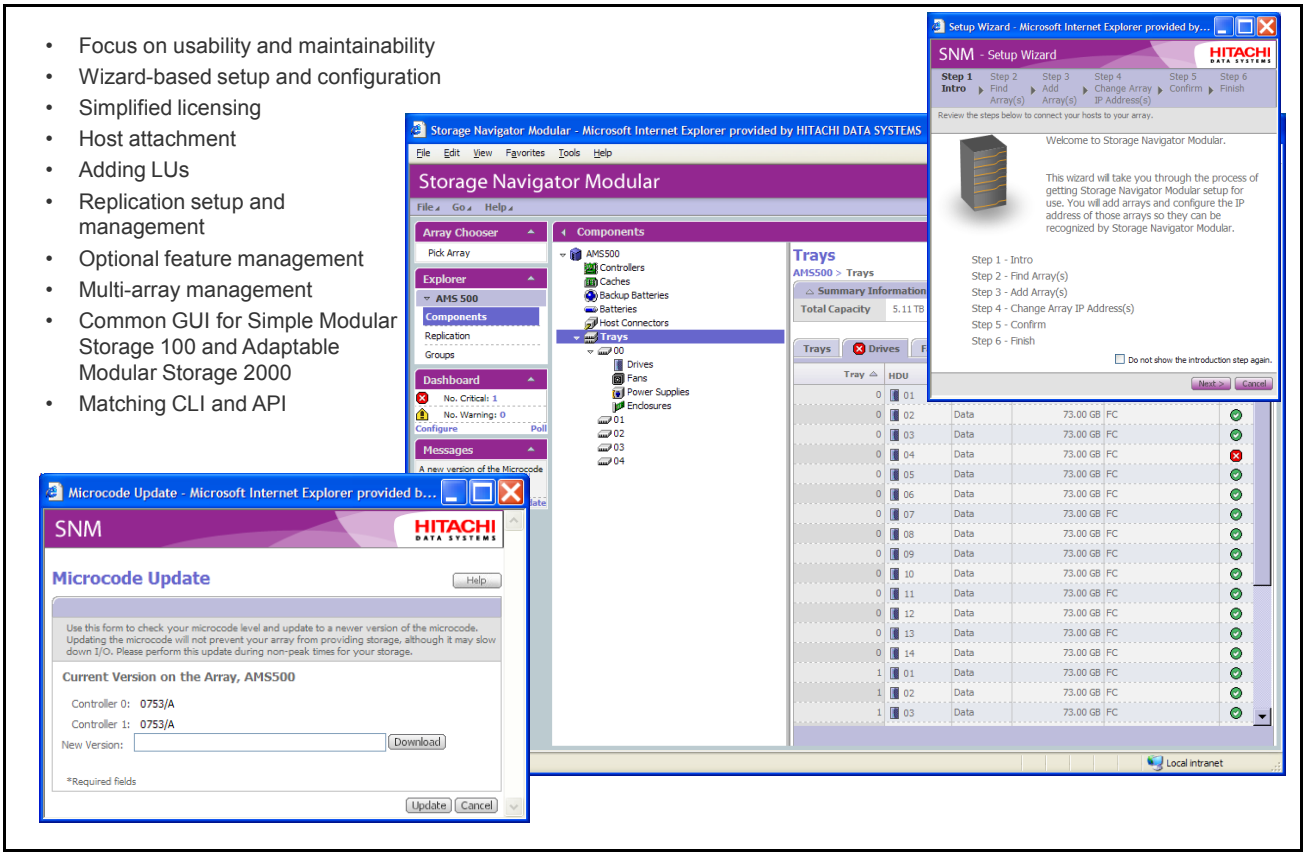
- Provides a convenient browser type interface
- Communicates to an HTTP server in Adaptable Modular Storage system and becomes operational shortly after powering on the system
- Can operate with the system in Normal or Maintenance mode
  - Normal Mode: Mainly monitoring (online) in read-only mode
  - Maintenance Mode: Allows some basic configuration changes to be made
- Requires a User ID and Password to operate in Maintenance mode
- Functionally overlaps with Storage Navigator program
- Required for initial setup, initial IP address, and Serial Number setting
- Used for loading microcode
  - The correct Java Runtime Environment (JRE) is required.

3

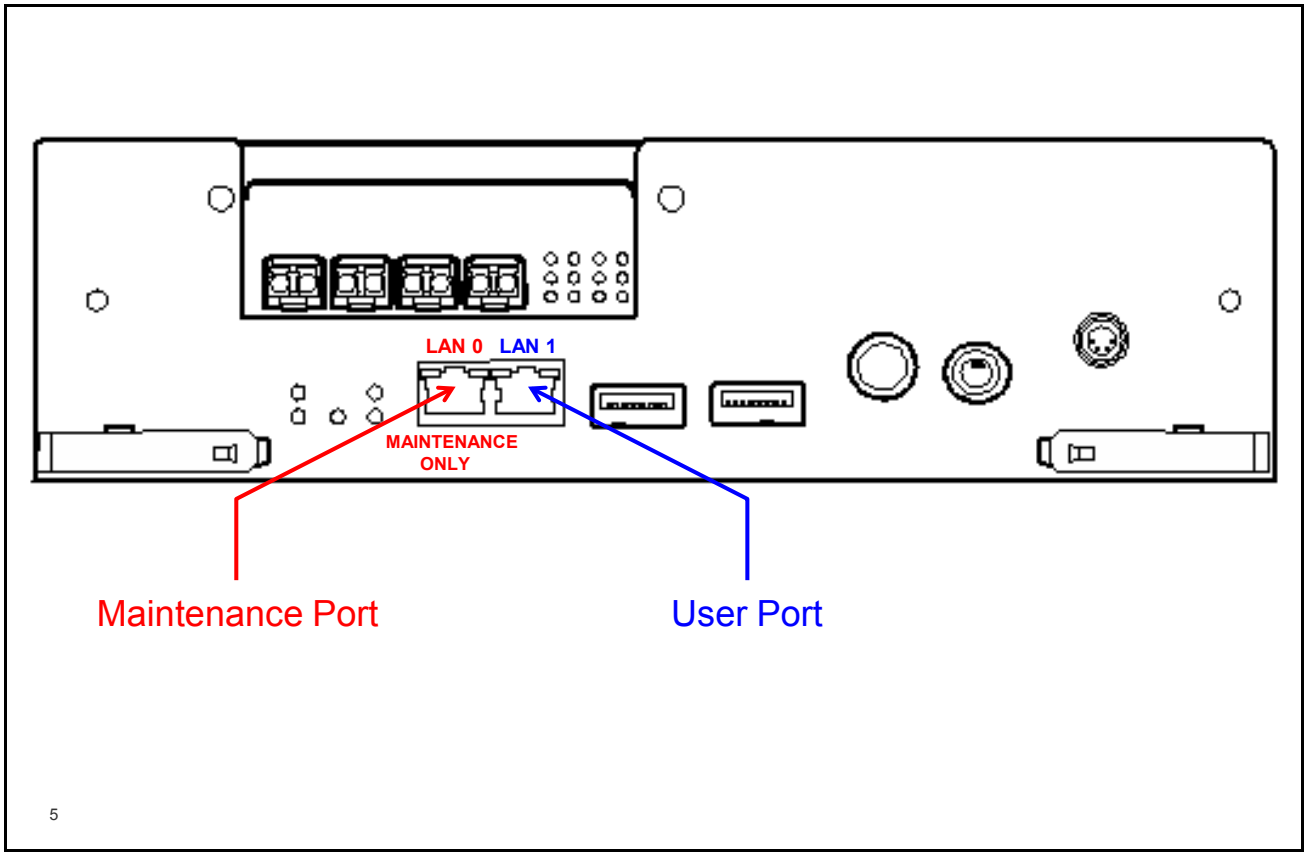
Microsoft® Internet Explorer™ is recommended.

New Management Tool

- Focus on usability and maintainability
- Wizard-based setup and configuration
- Simplified licensing
- Host attachment
- Adding LUs
- Replication setup and management
- Optional feature management
- Multi-array management
- Common GUI for Simple Modular Storage 100 and Adaptable Modular Storage 2000
- Matching CLI and API



Location and Function of Ethernet Ports



The Maintenance port is typically for Customer Engineer access.

The User port is the port that can be assigned any IP address and is normally connected to the customer's network.

The functionality of both ports is the same.

IP Addresses on LAN Ports

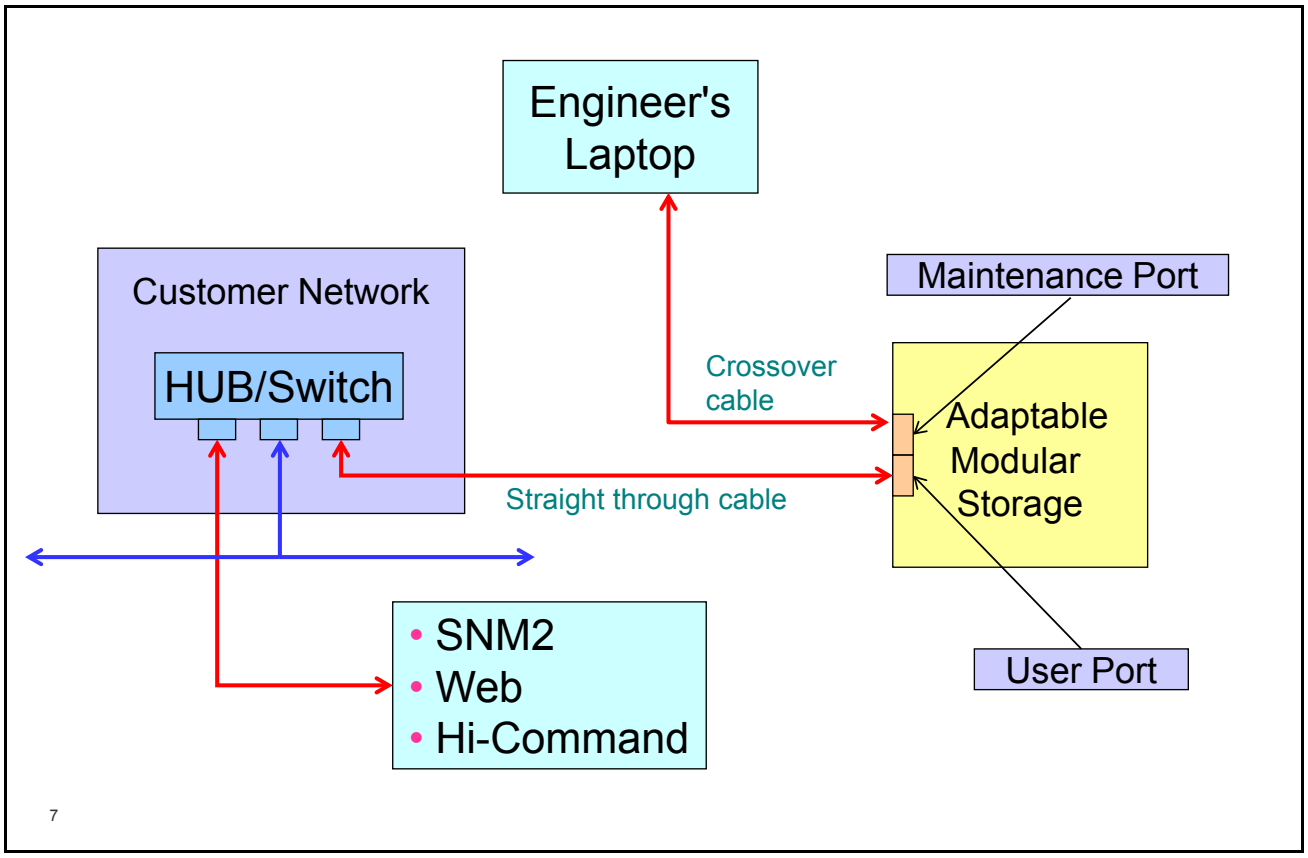
	Controller 0		Controller 1	
	Port 0 **Maintenance** (fixed)	Port 1 **User** (variable)	Port 0 **Maintenance** (fixed)	Port 1 **User** (variable)
Default IP Address	10.0.0.16	192.168.0.16	10.0.0.17	192.168.0.17
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Default Gateway	0.0.0.0	0.0.0.0	0.0.0.0	0.0.0.0
DHCP	Off	Off	Off	Off

6

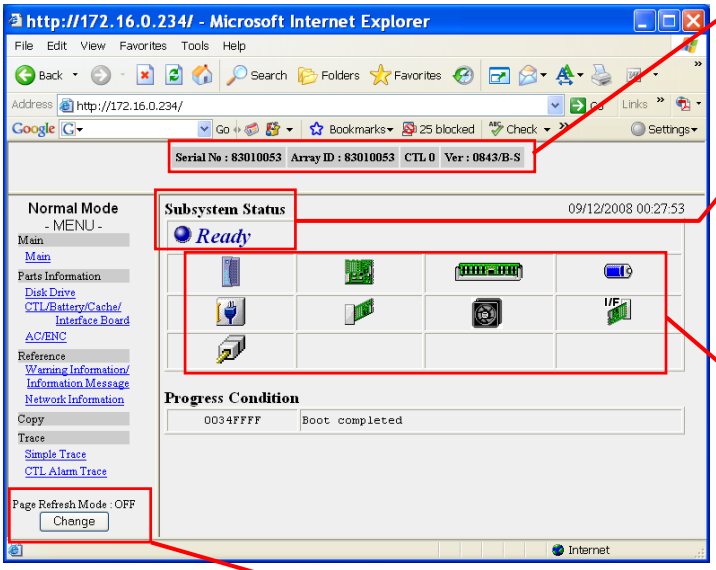
The IP address for the Maintenance port is either 10.0.0.16/17 (default) or 192.168.0.16. It depends on what the address configuration is on the User Port. The underlying idea is to guarantee that, in case the Maintenance port and the User port are connected to the same network, there will never be a (duplicate) IP address conflict.

Refer to the Web section in the *Maintenance Manual* for more information.

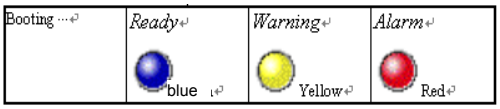
Preferred Way of Connecting



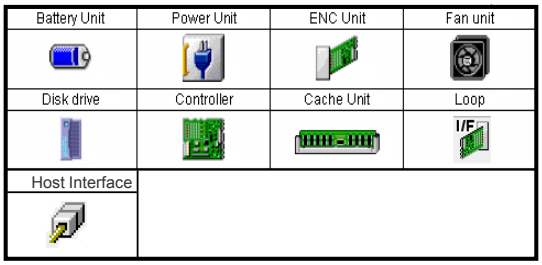
Normal Mode Summary Information



- Array unit information
  - Serial number
  - Controller number (CTL0/1)
  - IP address of the controller
  - Microcode version information
- Array unit condition (corresponds to the front LED)



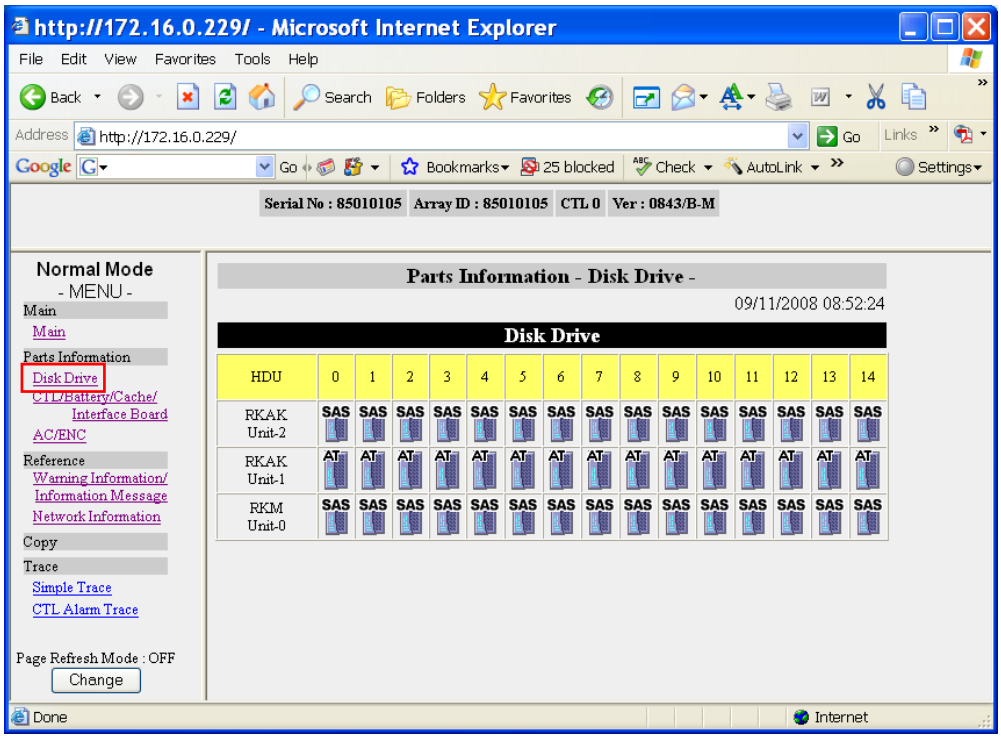
- Summary information of parts condition (displayed with Red at failure)



- Automatic Display Update Button

8

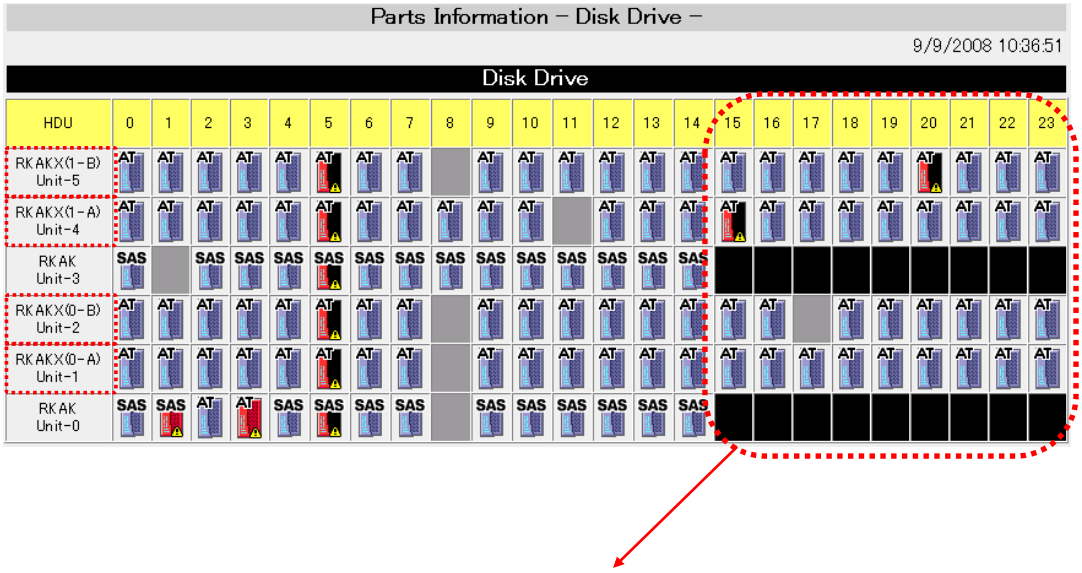
Normal Mode Parts Information



9

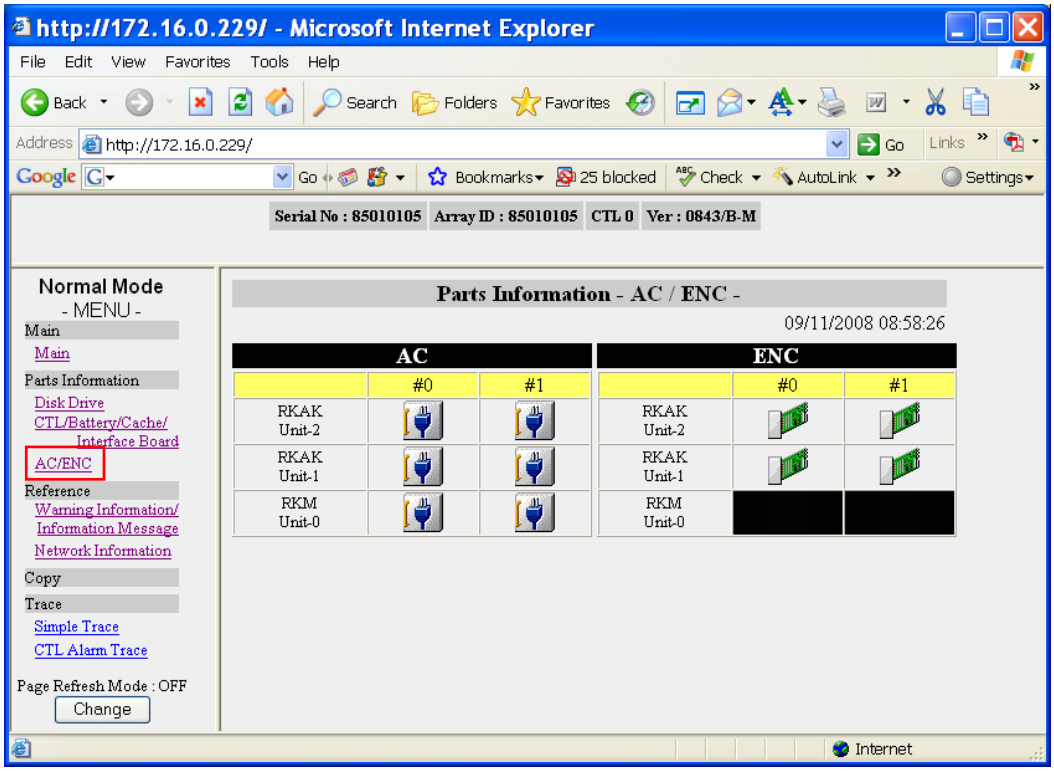
Disk Drive Parts Information

- HDD information (including Dense Tray)

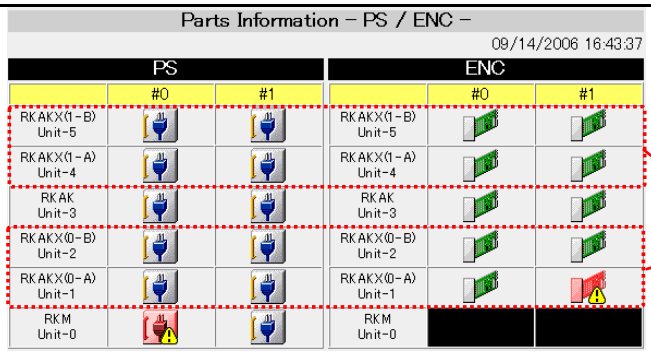


HDU#15 to #23 are newly added.

10

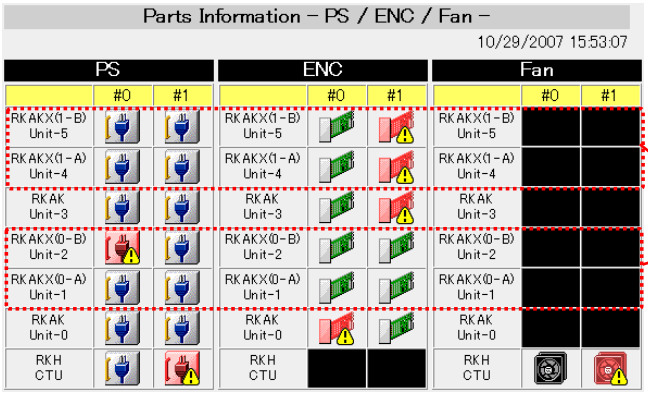


Power Units (AC) and ENC modules



- Including Dense Tray
- PS and ENC for DF800S/M

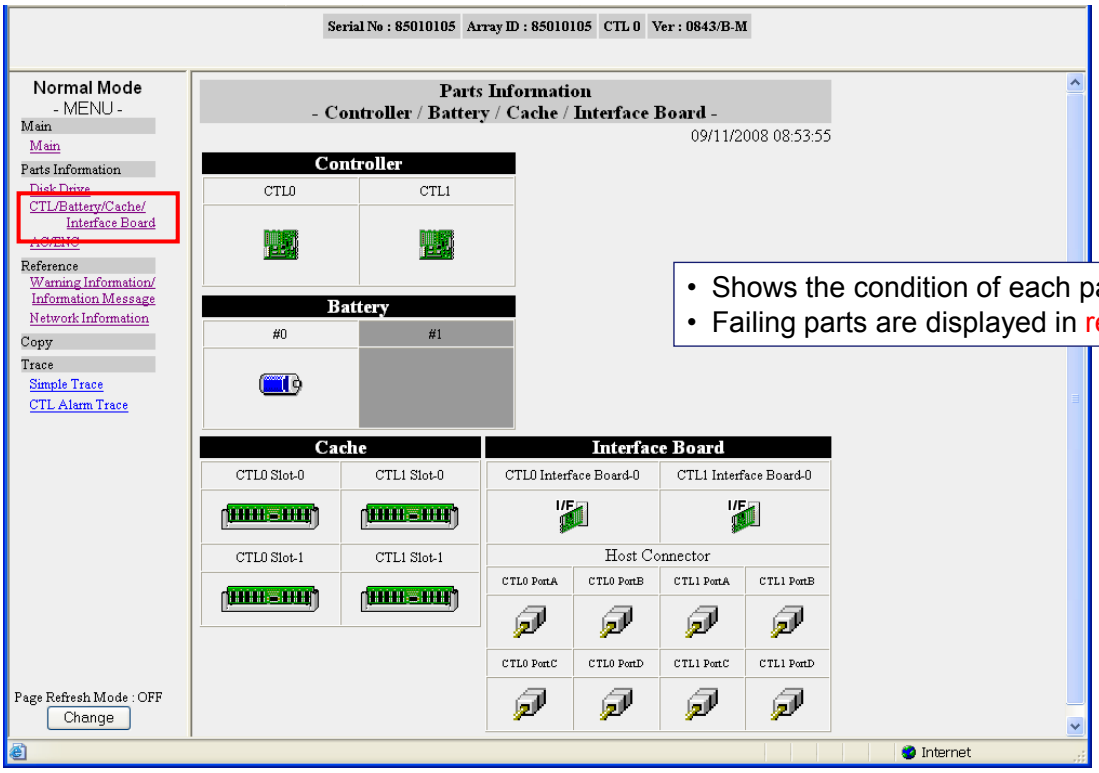
You can find out their Dense RKA components failure very easily.



- PS, ENC and Fan for DF800H

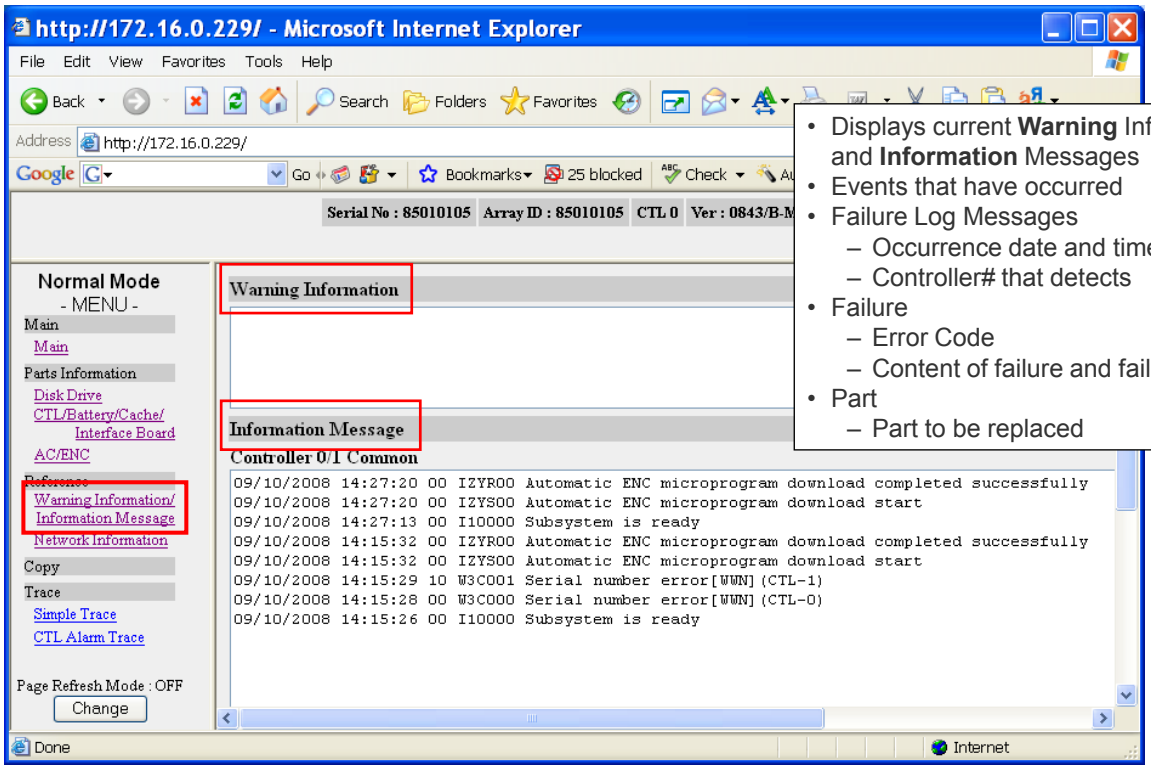
You can find out their Dense RKA components failure very easily.

12



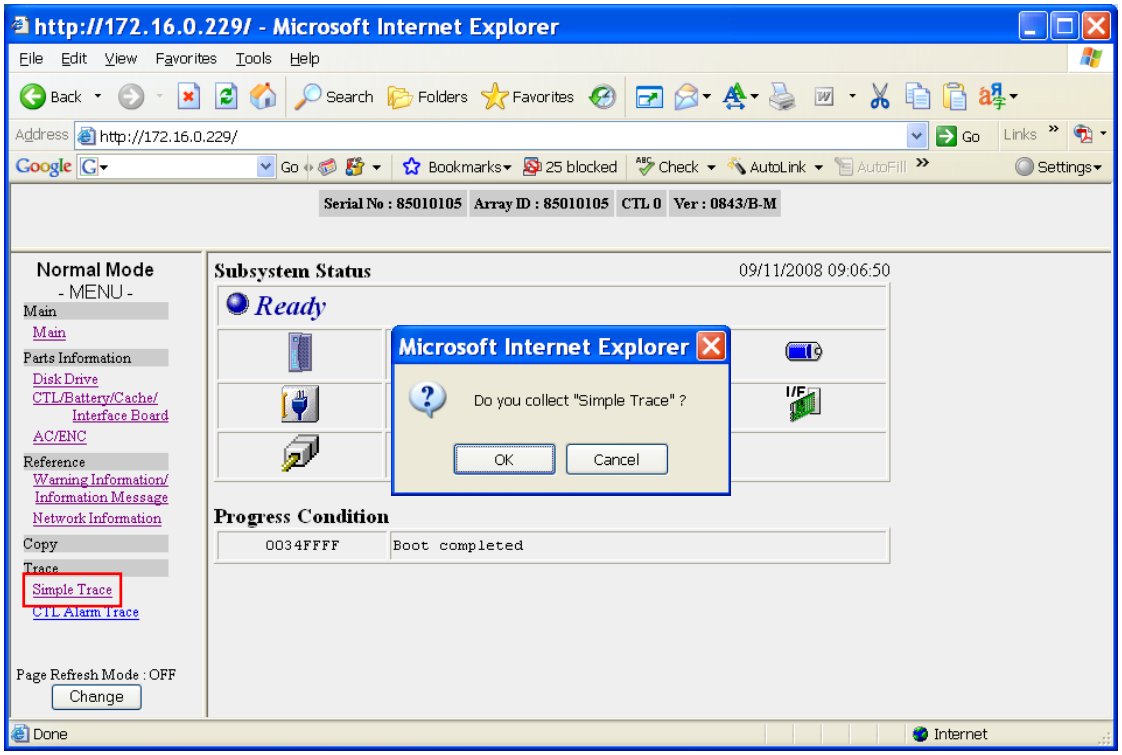
Controller, Battery, Cache, and Host Interface information

Normal Mode Error Messages



After the error has been fixed, you may need to click on **Information Message** to clear the Subsystem Status LED.

Normal Mode Trace Dumps



15

Simple Trace: Perform this step only if the maintenance manual indicates this or HDS technical support asks you to do so. It may take up to an hour to complete.

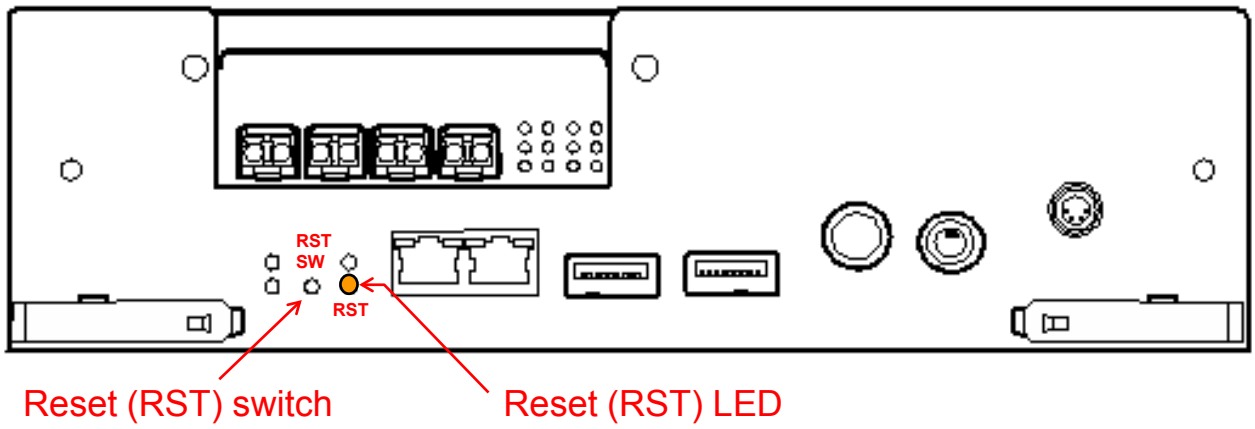
Maintenance Mode

- Used by a service person to perform maintenance related tasks.
  - Set system parameters
  - Download microcode
  - Collect detailed information about the system (Full Dump)
  - Set system serial number
- Maintenance Mode is entered by performing a soft reset at each controller.
  - Host ports are **blocked** (I/O traffic is disrupted).
  - User ID and Password are required to enter Maintenance Mode.

16

Enter Maintenance Mode

- Maintenance Mode is entered by resetting *both* controllers.
  - Reset Controller 0 **first.**
  - Reset Controller 1 **second** (wait 3–5 seconds after the reset of Controller 0).
    - Remember, Controller 1 is upside down for 2100 and 2300 models.
  - Open a browser and connect to the system (see next slide).



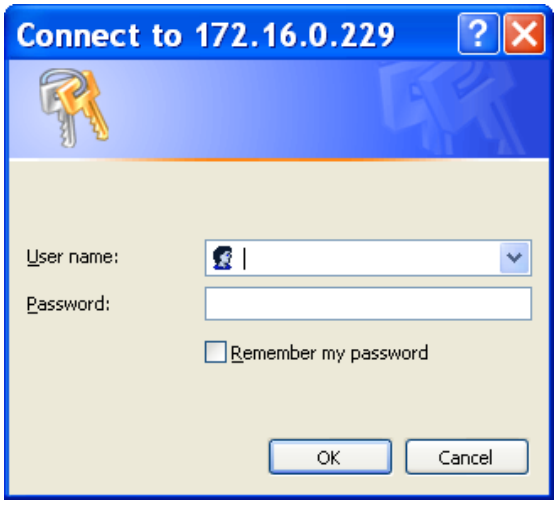
17

To enter Maintenance Mode, you must press the **Soft Reset** button on the back of Controller 0, and then repeat the step for Controller 1.

When the reset button is pressed for the first time, the buzzer will start. It stops when the second controller is reset.

Full dumps can be performed in Maintenance Mode.

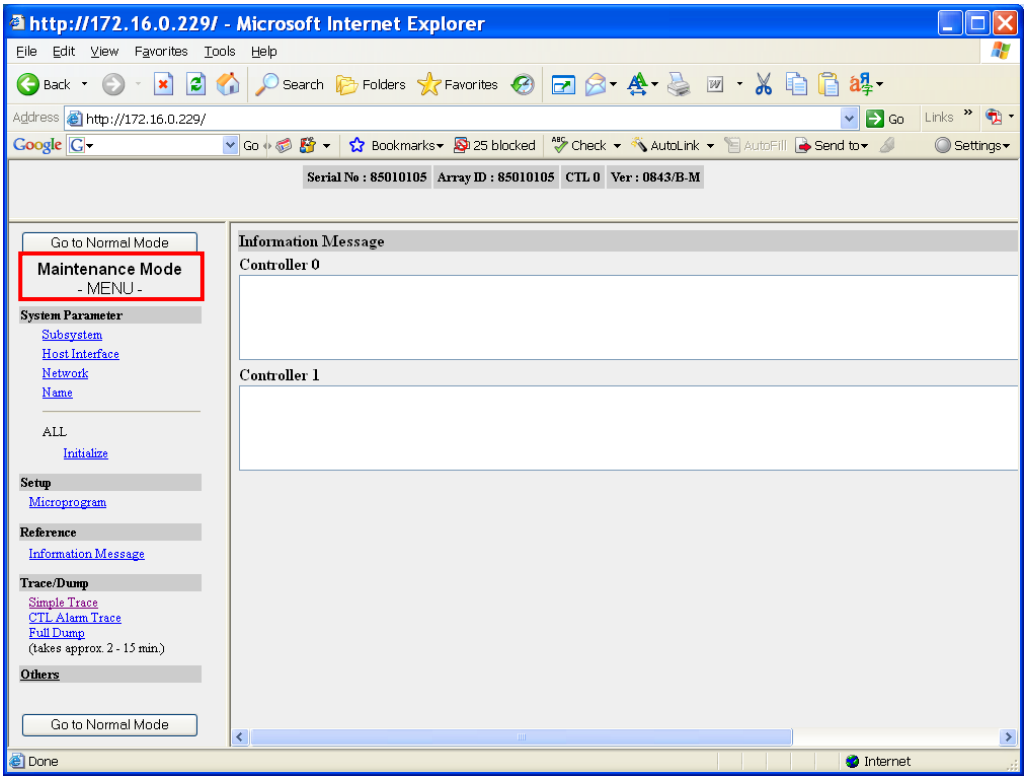
Maintenance Mode User ID and Password



User Name: maintenance
Password: hosyu9500

18

Maintenance Mode Initial Window



19

Lab Project 2 Web Access Normal Mode and Collect a Trace

- Timing and Organization
  - Time allotted to complete the project: **45 minutes**
  - The lab project contains three sections:
    - **Section 1** is the lab activity.
    - **Section 2** contains the answers to the embedded lab questions.
    - **Section 3** contains the review questions.
  - Time allotted to go over the review questions: **10 minutes**
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by their instructor.

20

Lab Project 2 Objectives

- Upon completion of the lab project, the learner will be able to do the following:
  - Use a web browser such as Microsoft Windows Internet Explorer or Netscape to connect to the Adaptable Modular Storage in *Normal Mode*
  - Display status of the individual components of the Adaptable Modular Storage
  - Display *Warning Information*
  - Use the ***Simple Trace*** function of the Web Browser, and dump trace information of an Adaptable Modular Storage controller to a file on the connected host system

21

4. Active-Active I/O Architecture

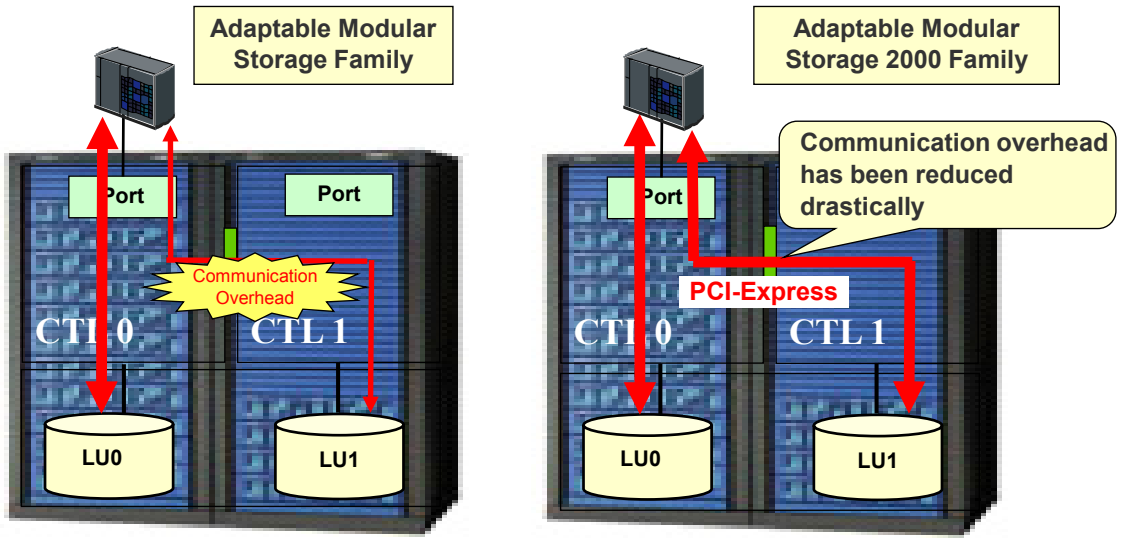
Module Objectives

- Upon completion of this module, the learner should be able to:
  - Explain Active-Active controller architecture
  - Identify the benefits in the Adaptable Modular Storage 2000 Family in terms of hardware performance

2

Cross-controller Communication

- Previous modular systems use **data-share** mode
- Adaptable Modular Storage 2000 Family **cross-path** communication is improved



3

Previous Adaptable Modular Storage systems and Workgroup Modular Storage system use the *data-share mode* which enables non-owner controller to receive I/Os for the target logical unit (LU). But the I/O performance is greatly reduced compared to the owner controller, so it is used only temporarily, for example as an alternate path if the main path fails.

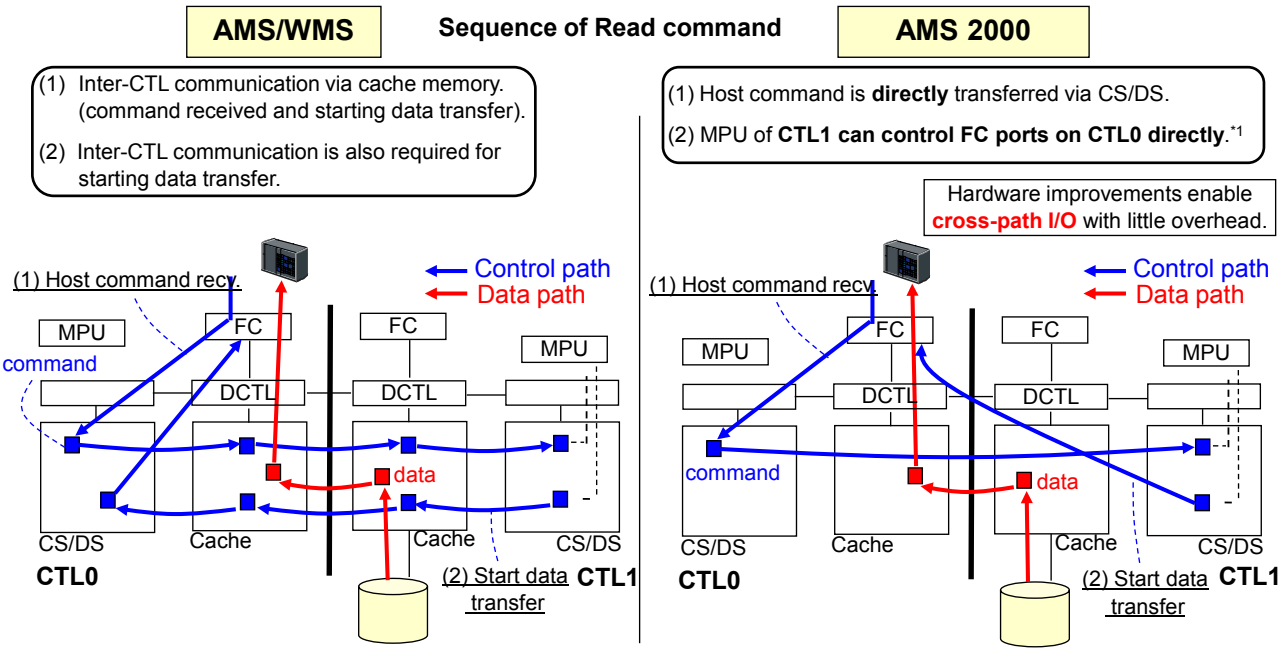
In the Adaptable Modular Storage 2000 family, I/O performance directed to non-owner controller is drastically improved. This *cross-path* can be used as the normal I/O path with regards to performance.

In the diagram and following slides, **Adaptable Modular Storage Family** represents previous Hitachi modular storage, including the following:

- Workgroup Modular Storage system 100 (WMS 100)
- Adaptable Modular Storage system 200 (AMS 200)
- Adaptable Modular Storage system 500 (AMS 500)
- Adaptable Modular Storage system 1000 (AMS 1000)

Internal Transaction

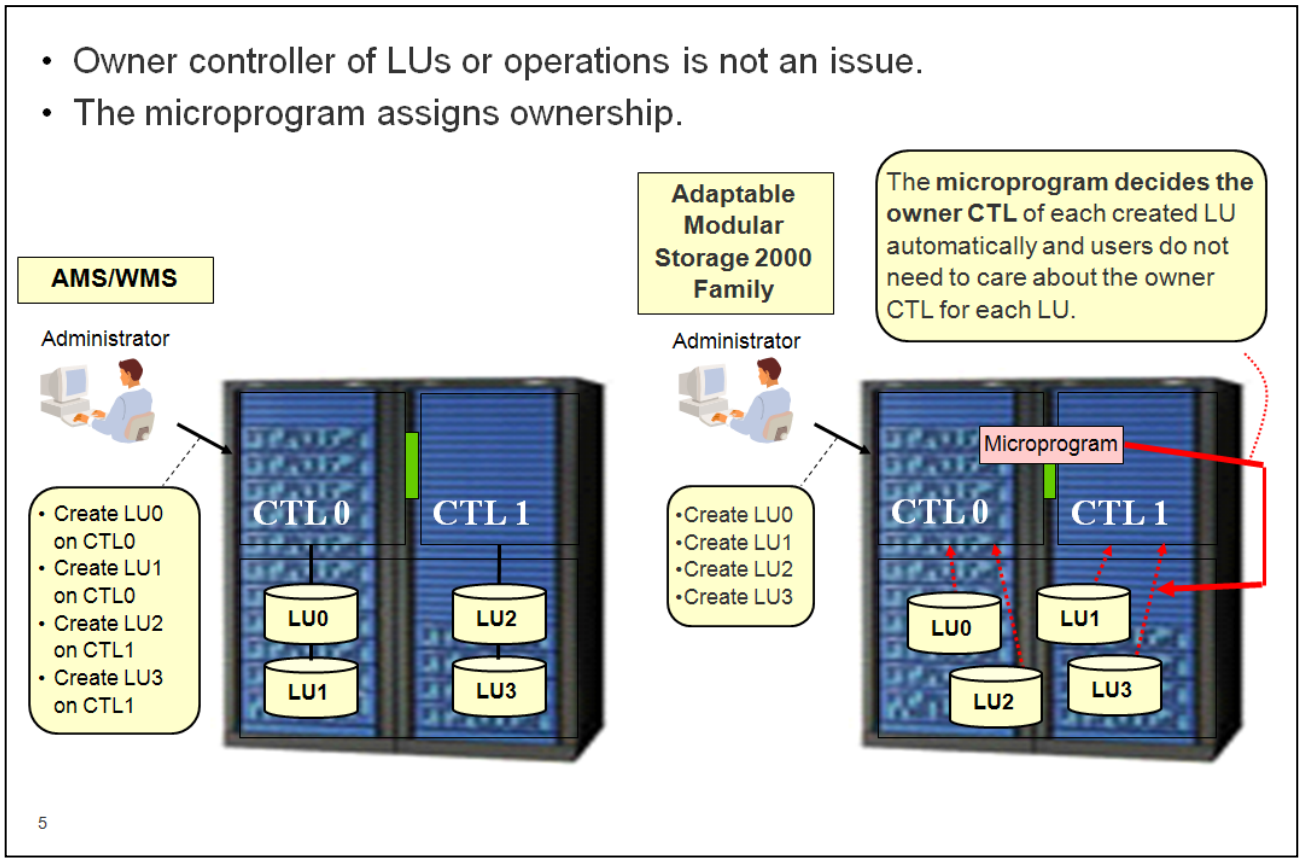
- Enables the MPU of one controller to access the cache, disk drives, and other devices of the other controller **directly.**
- Cross-path I/O is greatly improved.



In the diagram:

- **AMS/WMS** stands for previous Hitachi modular storage systems
- **CS/DS** stands for Local Memory of the controller

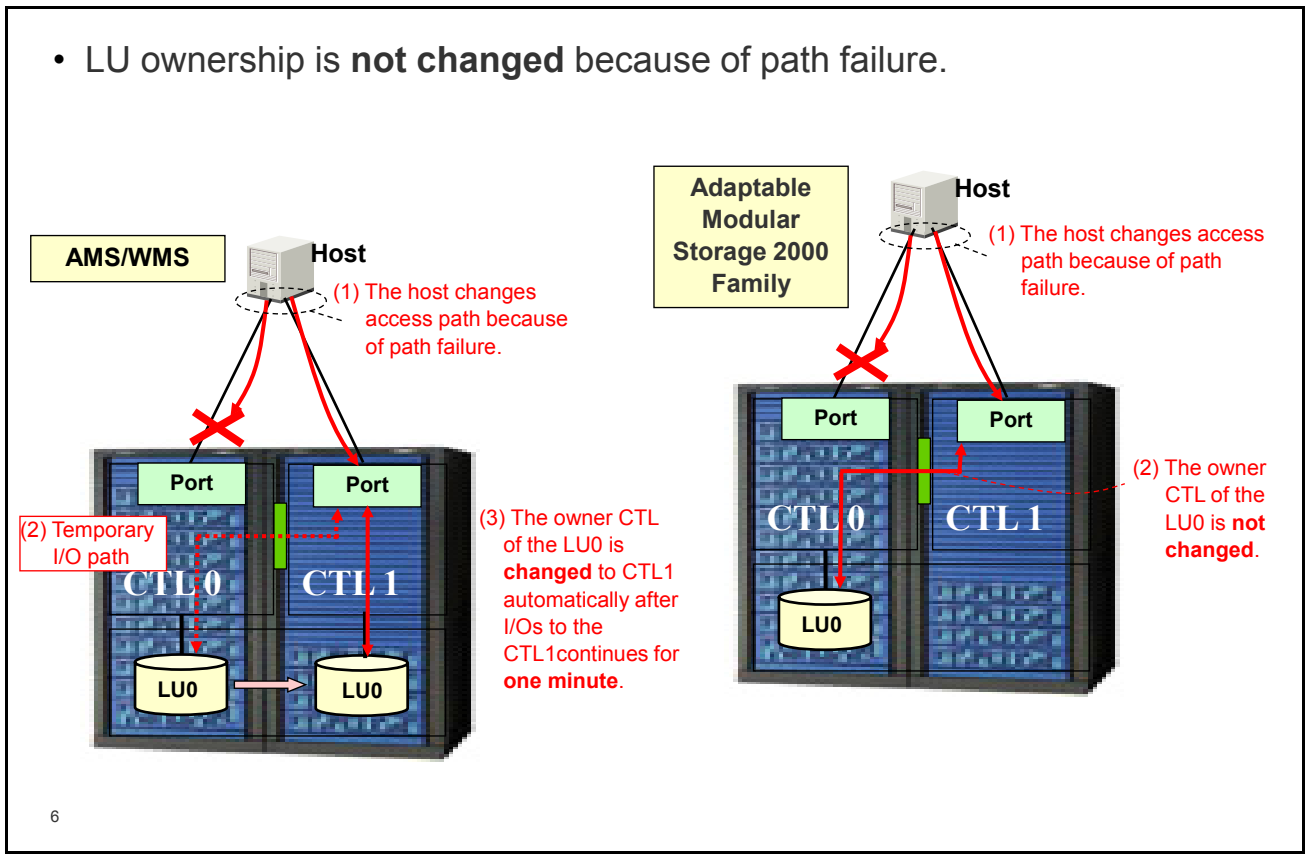
LU Ownership



The user need not consider which controller should be the owner when he creates each LU or for all operations of the array.

Therefore the non-owner controller of the target LU may receive I/O commands from hosts. But it is not a problem because such commands are processed by high performance cross-path.

The manual setting mode (like previous modular systems) is also available in the Storage Navigator Modular 2 GUI.

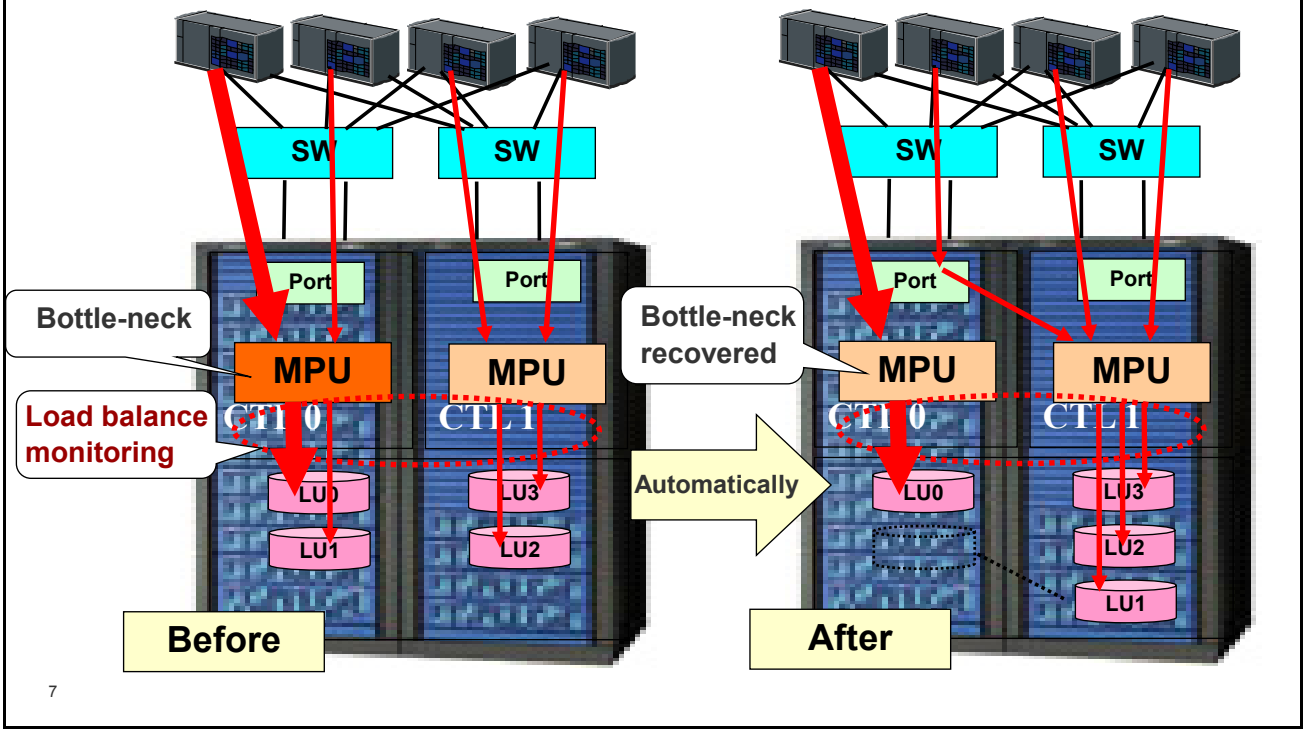


Hosts can send commands to storage via any path of any controller for the purpose of path load balancing. This is possible because cross-path I/O is high performance and ownership of each LU is stable.

In previous modular systems ownership moved move back and forth. If a path failed, a temporary cross-controller path was established for a predetermined period, like one minute. After that, ownership changed to the other controller, sometimes described as *LU ping-pong*.

Controller Load Balancing

- The owner controller of each LU may be changed automatically for the purpose of load balancing of processors on two controllers.



The load balancing function can be enabled and disabled. It should be disabled this when using the Cache Partition Manager to avoid changing the partition setting for each LU automatically.

Active-Active versus Data Sharing

Items	Data sharing (AMS/WMS)	Active-Active (AMS 2000)
Support way	Default function	Default function
Setting the LU ownership	Necessary to set the LU ownership when creating the LU.	Automatically assigned to each LU based on **round-robin order**: 1. CTL1 core1 2. CTL0 core1 3. CTL1 core0 4. CTL0 core0 (1. 2. : dual core only)
Exceptional commands for cross-path I/O	There are some specific commands to change the owner controller, such as the Verify command.	None
TrueCopy or TrueCopy Extended	- No P-VOL on the non-owner controller can be the copy pair. - When the pair is created, P-VOL and S-VOL must be owned by the same controller. - When a path failure occurs, the P-VOL owner controller is changed to the other controller automatically to continue the copy.	- **Any** P-VOL and S-VOL can be a pair, so there is no need to change owner controller when a pair is created.

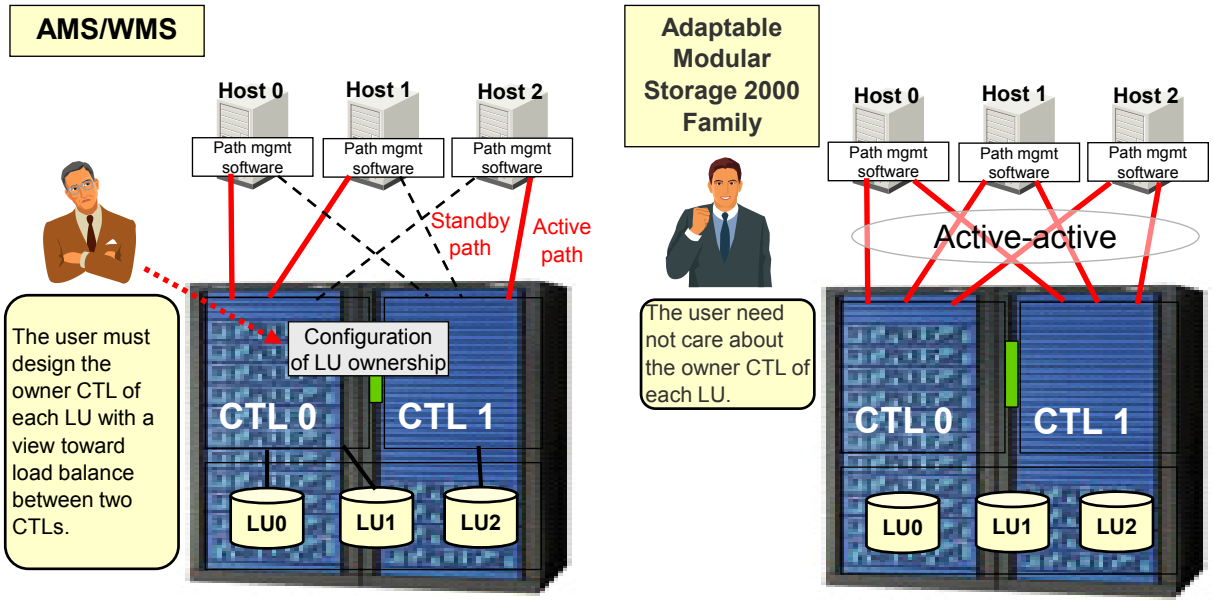
8

Items	Data sharing (AMS/WMS)	Active-Active (AMS 2000)
ShadowImage or Modular Volume Migration	P-VOL and S-VOL must be in the same owner controller.	The owner controller of the S-VOL is automatically changed to the same controller as P-VOL.
Copy-on-Write or TrueCopy Extended	POOL should be the only one in the controller and it will not be changed the owner controller. P-VOL and POOL must be in the same owner controller.	Though P-VOL and POOL must be in the same owner controller internally, the owner of the P-VOL is automatically changed to the same controller as the POOL.

9

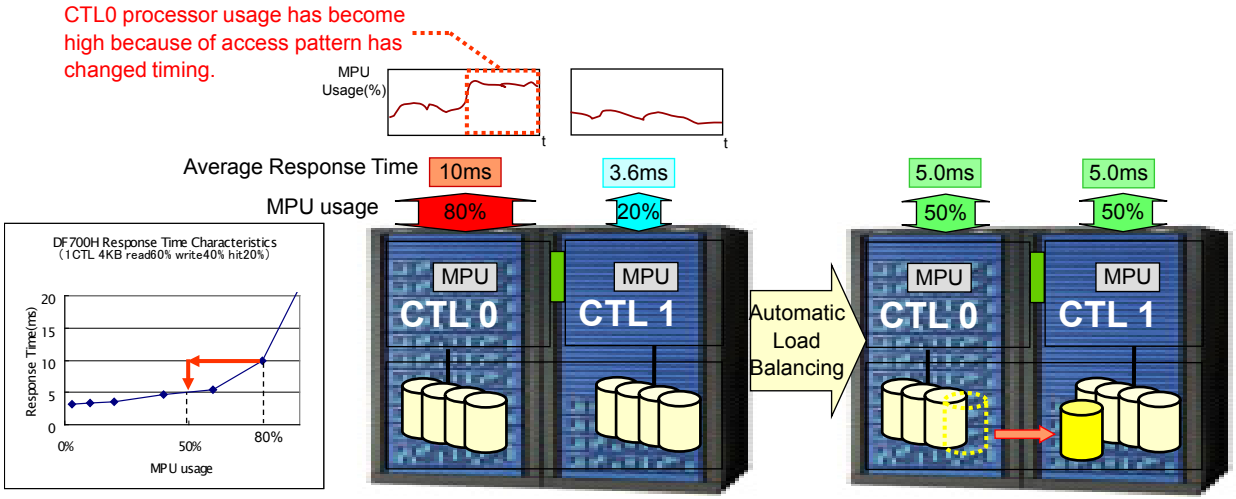
Performance Design

- Load balancing automatic with Active-Active mode



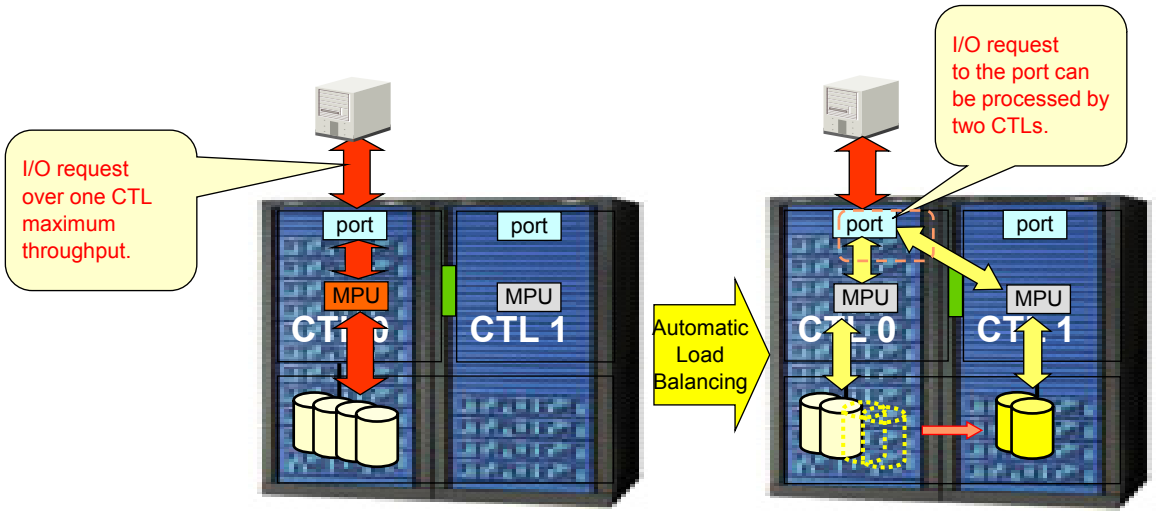
The user does not need to consider the load balance of controllers and ports when doing the performance design. The user should set just the path management software of all hosts as the **Active-Active** mode, and then the load of controllers is automatically balanced.

- Automatic optimization for performance:
  - When the rate of access for the processor of one controller becomes high, the average of response time for the controller becomes long.
  - If the processor usage of the two controllers is balanced by automatic load balancing, the response time remains good.



11

- Performance aggregation:
  - I/O is processed on two controllers.
  - Port performance can equal maximum for **both** controllers.

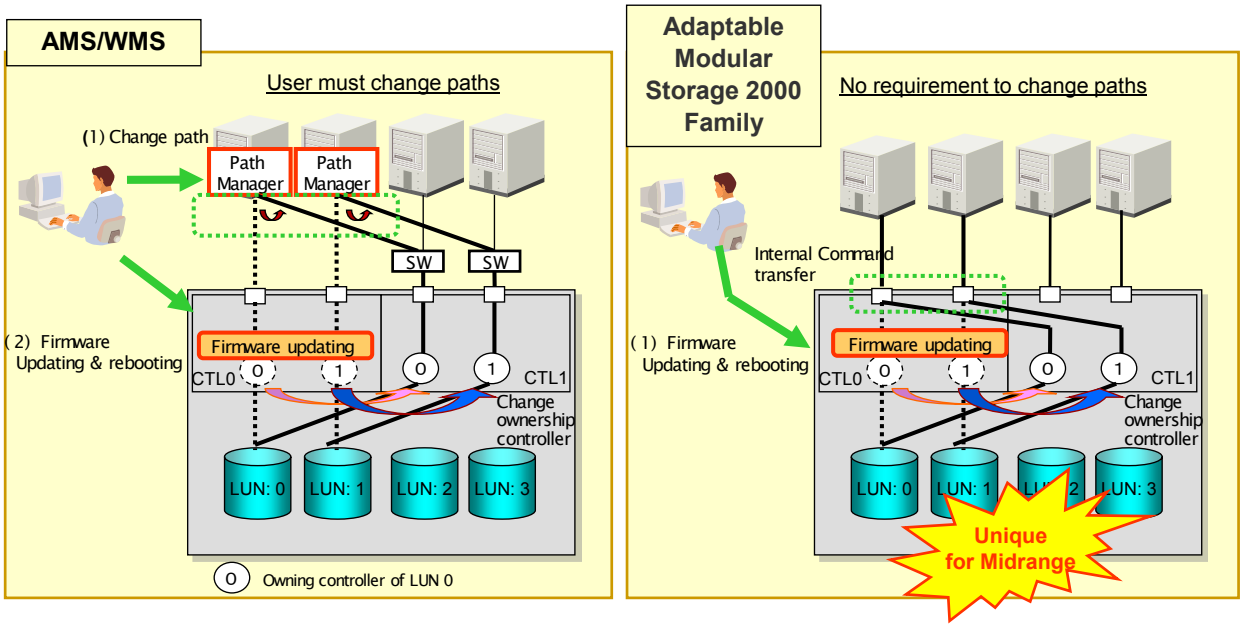


12

I/O requests to the port can be processed on two controllers by using a *cross-path* mechanism. So the port performance can exceed the maximum performance of a single controller, and it can be expanded to the maximum performance for both controllers.

Microcode Updates

- Benefits:
  - Non-disruptive firmware updates are easily and quickly accomplished.
  - Firmware can be updated **without interrupting I/O**.

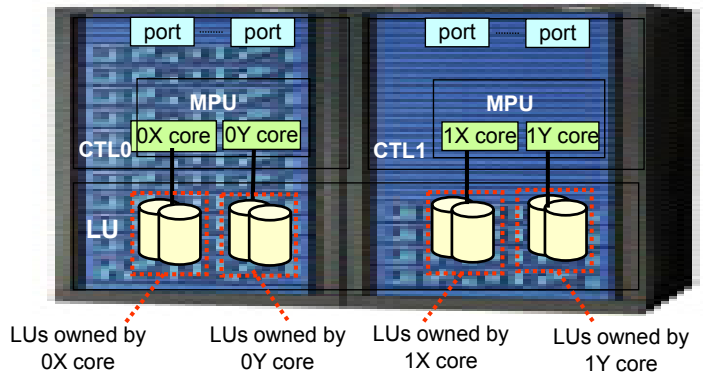


For firmware updates:

- No need to use host path management software
- No need to change path from firmware-updating CTL to other CTLs

Dual Core Support

- Adaptable Modular Storage 2500 contains dual-core MPU on each controller.
- Designed with little shared resources.
- Each LU is owned by either one of two MPU cores, and each MPU core can access any LUs owned by it without any exclusion control.



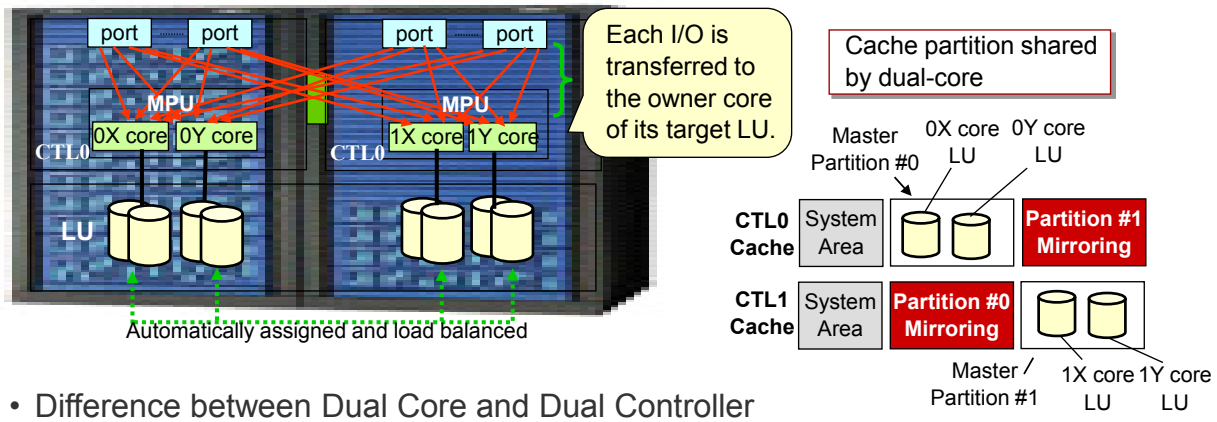
14

Options 3 and 4 for models 2100 or 2300, and 1, 2, 3, 4 for model 2500 – Adaptable Modular Storage 2500 will support the dual core MPUs.

Automatically assigned to each LU based on round-robin order:

1. CTL1core1
2. CTL0core1
3. CTL1core0
4. CTL0core0 (1. 2.: only dual core)

- Users are unaware of the owner core of each LU.
- Any MPU core can process I/Os received by any port on the storage system with same mechanism as active-active.



- Difference between Dual Core and Dual Controller
  - Cache area is not divided into two areas for two cores externally. Although each core has independent cache directory, any free segments in the cache area of the controller are shared by two cores.
  - Each core is not represented as an independent component, that is, there is no status such as *one core partial stoppage*.

15

5. Installation

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Install and set up a storage system from the Adaptable Modular Storage 2000 Family
  - Describe the AMS2000 Rev2 controller architecture and its multi-protocol capabilities
  - Describe the AMS2000 Rev2 front end connectivity specifications
  - Install and configure AMS2500 iSCSI host ports

2

Installation Resources

- *Maintenance Manual*
- *User Manual*
- *Quickstart Guide*

The User Manual and the Quick Start Guide are included with purchase of an Adaptable Modular Storage 2000 Family system.

3

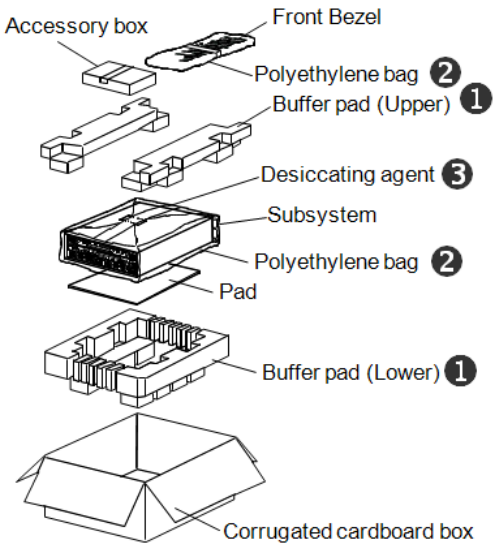
Installation Steps

1. Unpack the storage system.
2. Install base unit and expansion units.
3. Connect cables:
   a. ENC cables (expansion unit SAS back end connection)
   b. Host interface cables
   c. LAN cables
   d. Power cables
4. Test host server connectivity.

4

Unpack Storage System

1. Loosen the polyester bands.
2. Remove the outer package and various packing materials.
3. Take out the array from the polyethylene bag.
4. Remove tape and wrapping attached to the array.



5

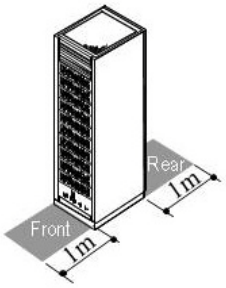
- Precautions
  - Be extremely careful when moving, tipping, and unpacking the unit.
    - Work with **two or more people** to move the units.
      The weights are:
      - **51 kg (112 pounds)** for the base unit
      - **40 kg (88 pounds)** for the expansion units
      - **94 kg (209 pounds)** for the dense expansion units
  - Be careful of condensation.
    - Condensation may develop if you unpack the units in extreme temperatures.
  - Place the peripherals in a safe location.
    - Various cables and keys are included. Store them carefully.
    - The keys supplied with the base unit are prepared for data security.
      - Check before connecting to the system.
    - Name tags are attached to ENC cables.

6

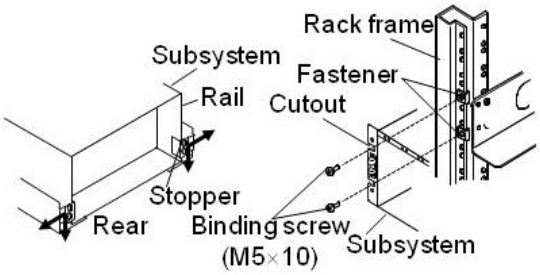
Install Units

1. Check that the installation space is secured.
2. For a basic configuration, remove the power unit and the battery unit from the base unit. (Do not remove them if connecting additional units.)
3. Open the rear door.
4. Put the unit on the rails in the rack, and delicately push it all the way in.

❶ Securing the installation space

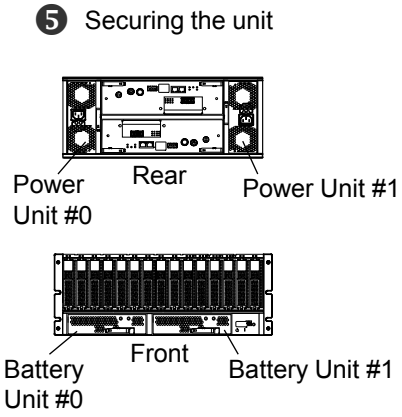


❹ Securing the subsystem



7

5. Secure the unit.
   - Connect the front of the storage system to the rack frame with binding screws (M5×10).
   - Push the stoppers (at the lower left and right) to the rear of the unit, make them touch the frame, and tighten them with the binding screws.
6. Install the Power Unit and Battery Unit.
   - For a basic configuration, install the power unit and the backup battery unit in the storage system.



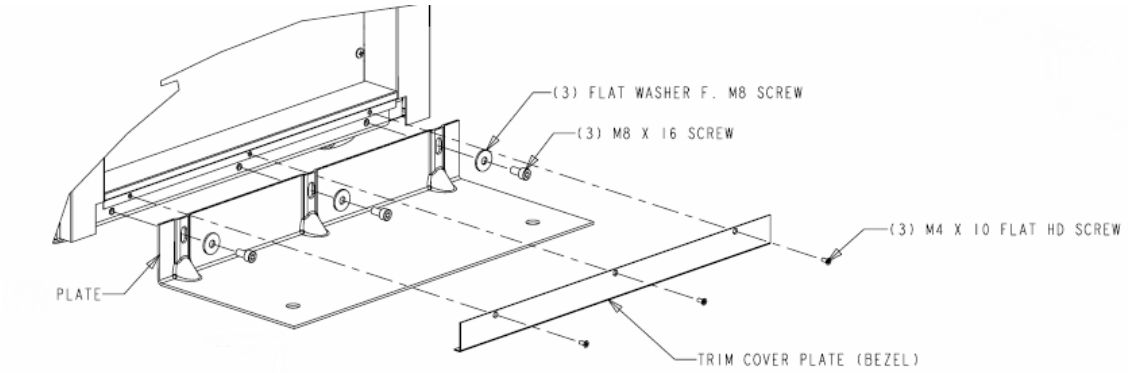
8

- Precautions
  - Clear the installation space.
    - When installing the unit, clear the installation area to allow ventilation of the front and rear.
    - Never block the vent holes because this can cause a failure or fire.
  - Make the work space wide enough for the service personnel to work on the rack rails.
    - The rack and the rack rails should be installed in advance.
  - Work with **two or more people**, the units are heavy.

9

Installing a Dense Expansion Unit

- Before installing the Dense Expansion Units, RKAKX, make sure that the rack stabilizers have been installed and the rack cannot tip over. In case of a single cabinet, check the side stabilizers as well!
- If you install the Dense Expansion Unit, anchor the plates on the ground.
- If you have more than one rack, connect the racks in order to maximize the stability.

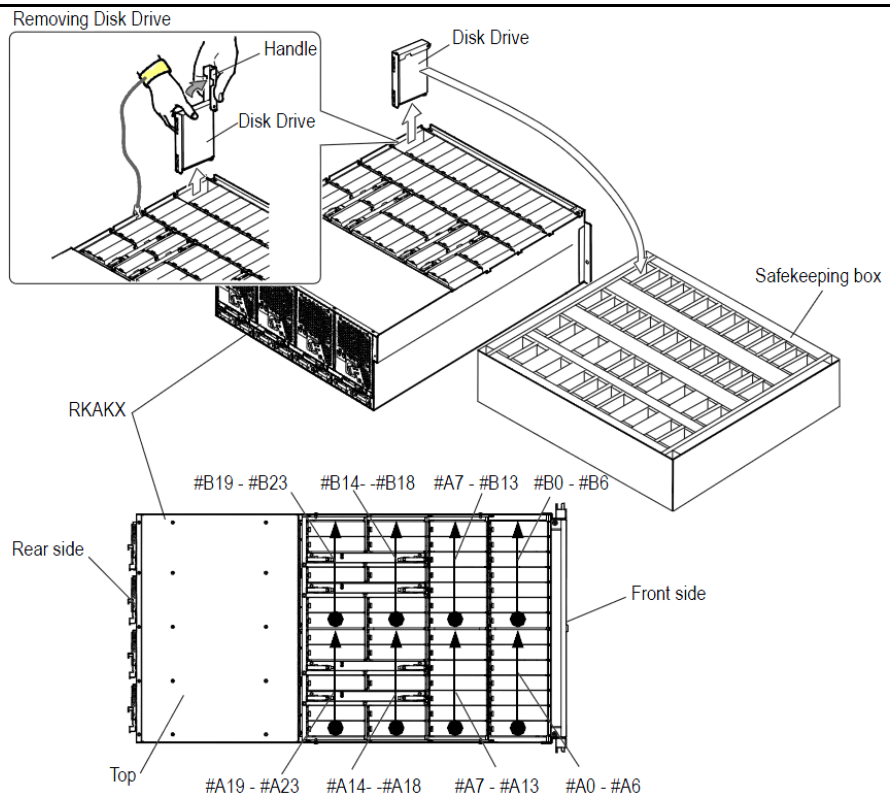


10

Note: HDS strongly recommends anchoring to the floor. Before installing, check for additional local safety regulations!

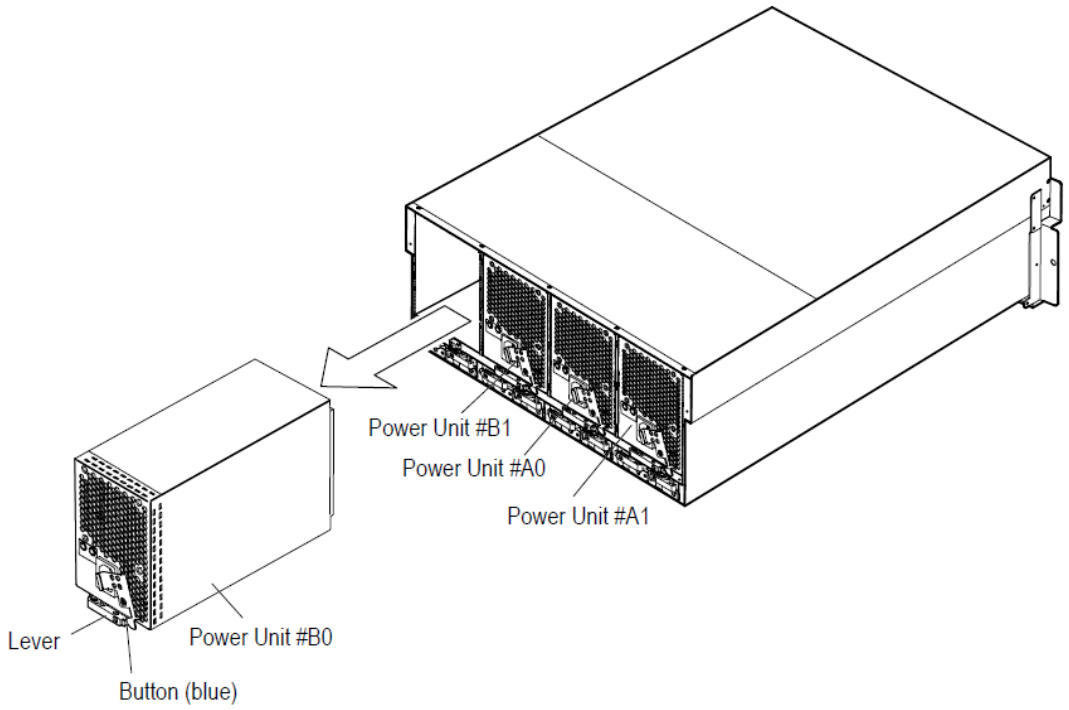
Installing a Dense Expansion Unit RKAKX

1. Remove all Drives from the Unit and put them into the Safekeeping box.



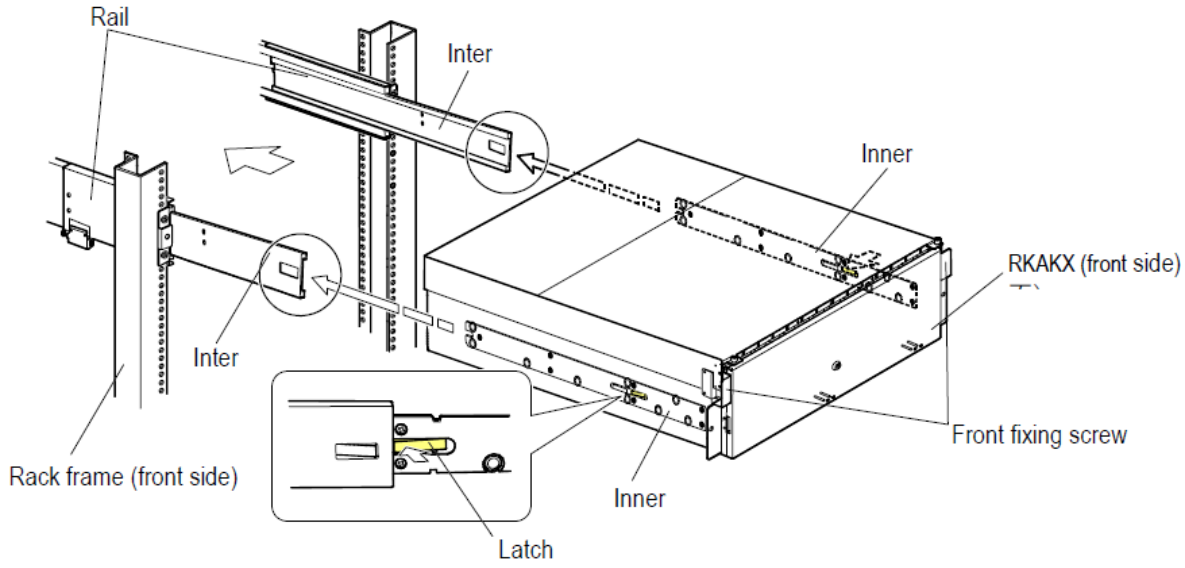
11

2. Remove all Power Units and put them in a safe place.



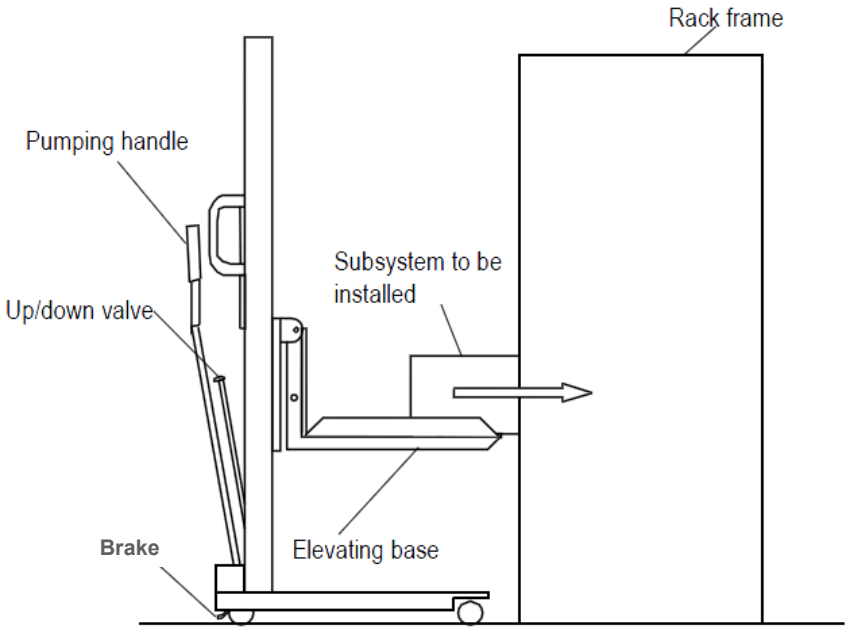
12

3. Install the empty unit into the rack.



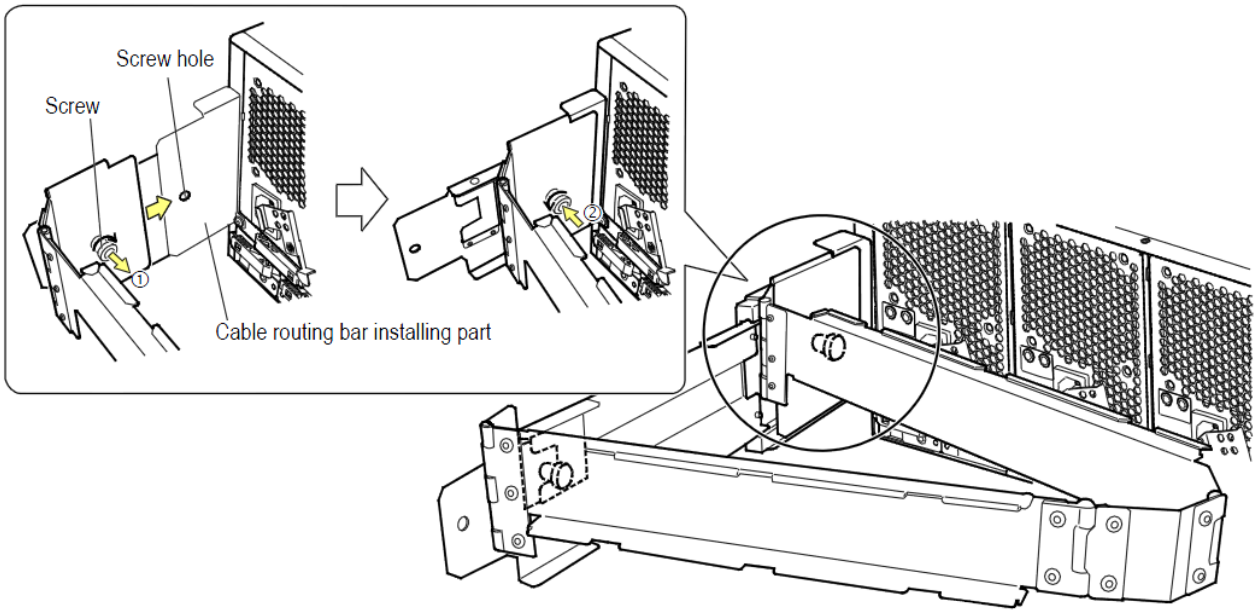
13

- Use a lifter to install the Dense Expansion Unit or whenever you move it in the rack.



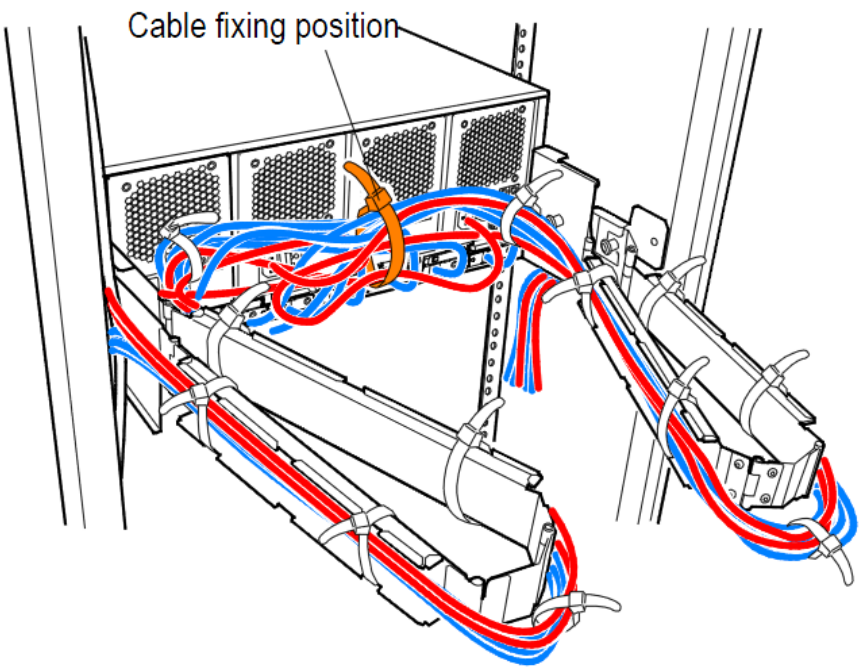
14

- Cable routing bar



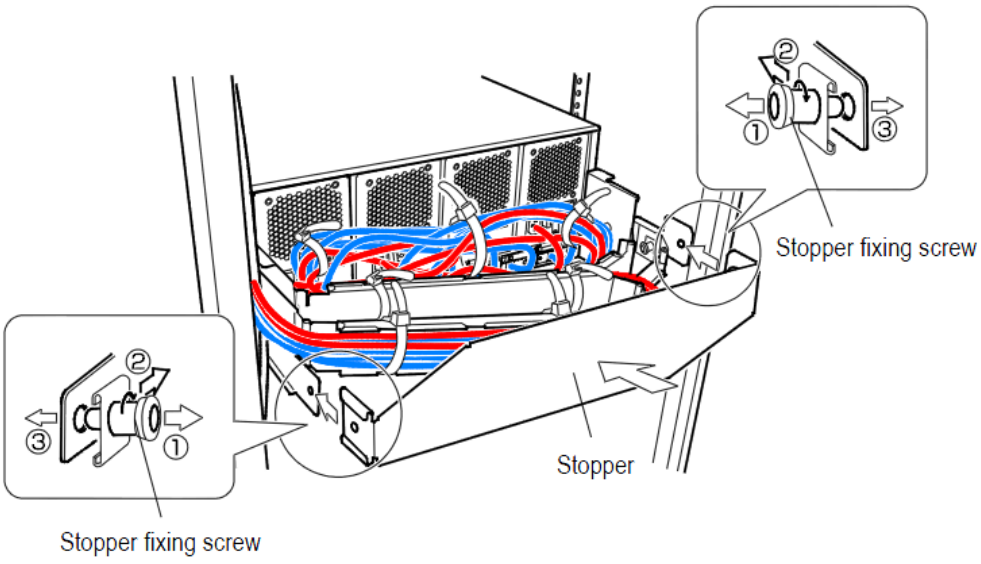
15

- Cable routing bar



16

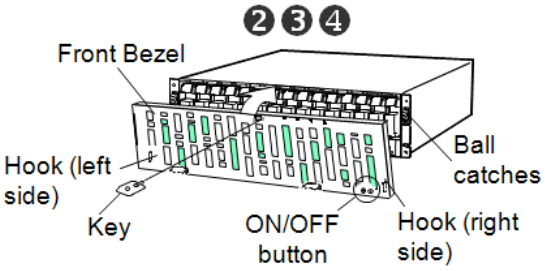
- Cable routing bar



17

Front Bezel

- To mount the front bezel:
  1. Hold the sides of the front bezel with your hands.
  2. Engage the right and left hooks (bottom) of the bezel in the hole at the lower right part of the base unit.
  3. Engage the ball catches at the right and left of the bezel, push them, and attach the bezel.
  4. Insert the key into the keyhole, and lock the bezel.



❹ 

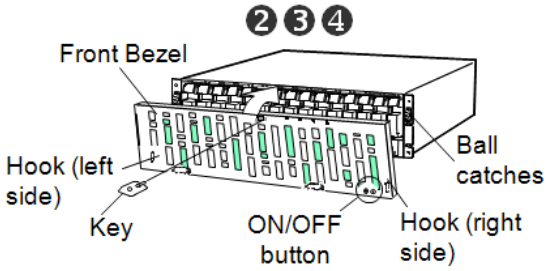
When you attach both Front Bezels, turn the key to the left, and lock the Front Bezel.

Pull the key out after aligning the groove with the positioning mark on the lock. (The key can only be inserted or pulled out in this position.)

The key cannot be pulled out when the groove is not aligned with the positioning mark on the lock.

18

- To mount the front bezel:
  1. Hold the sides of the front bezel with your hands.
  2. Engage the right and left hooks (bottom) of the bezel in the hole at the lower right part of the base unit.
  3. Engage the ball catches at the right and left of the bezel, push them, and attach the bezel.
  4. Insert the key into the keyhole, and lock the bezel.



❹ 

When you attach both Front Bezels, turn the key to the left, and lock the Front Bezel.

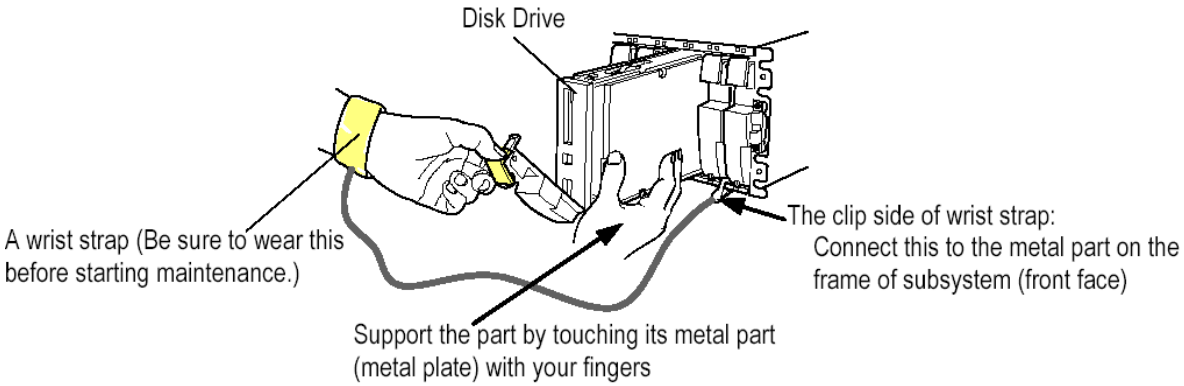
Pull the key out after aligning the groove with the positioning mark on the lock. (The key can only be inserted or pulled out in this position.)

The key cannot be pulled out when the groove is not aligned with the positioning mark on the lock.

18

Parts

- Precautions
  - Be sure to wear an electrostatic discharge (ESD) wristband.
    - Connect wristband lead wire to the storage system enclosure before starting the work, and do not remove it until the work is completed.
    - When installing a disk drive, hold the part with the hand wearing the wristband.



20

Protect parts from electrostatic discharge (ESD).

- To prevent part failures caused by static electrical charge built up on your own body
- Be sure to wear a wrist strap connected to the chassis
  - Before starting.
  - Whenever you unpack parts from a case.
  - Do not take it off until you finish.

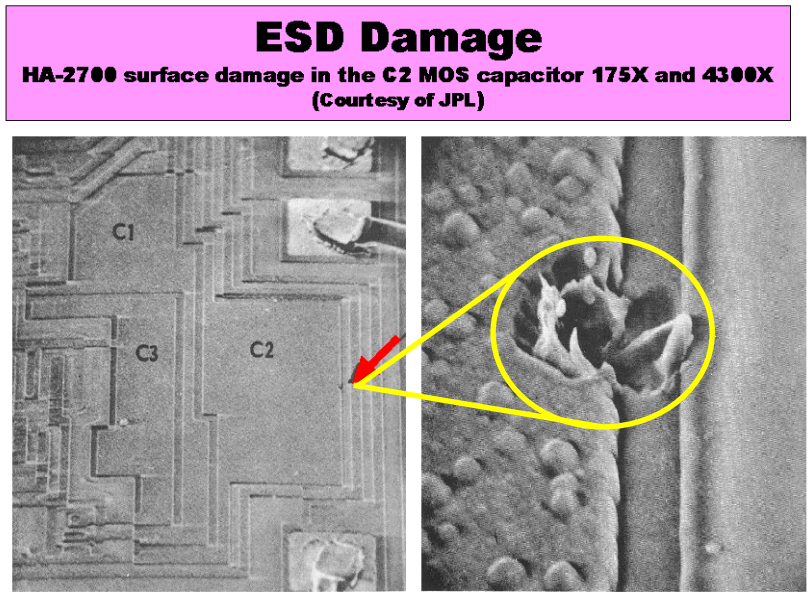
  Otherwise, the static electrical charge on your body may damage the parts.
- When you install a disk drive, support its metal part with your hand that has the wrist strap. You can discharge static electricity by touching the metal plate.
- The diagram shows how to properly wear a wristband when working with the array.

- ESD Precautions
  - Always use ESD wrist straps and antistatic mats when handling components.
  - Put components in ESD bags for transport.
  - Components are damaged almost every time when handled without ESD protection.
    - Components damaged today may fail sometime in the future.

21

ESD Damage Example

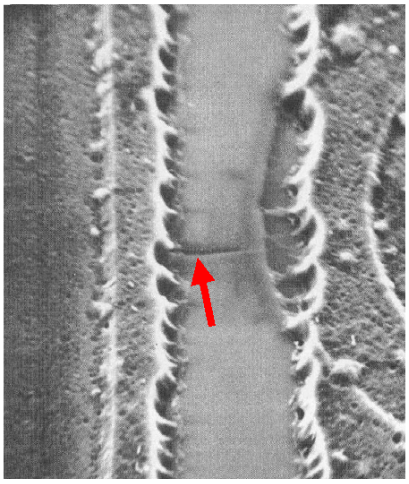
Microscopic view of damaged caused by improper ESD protection



22

ESD Damage

(Courtesy of JPL)

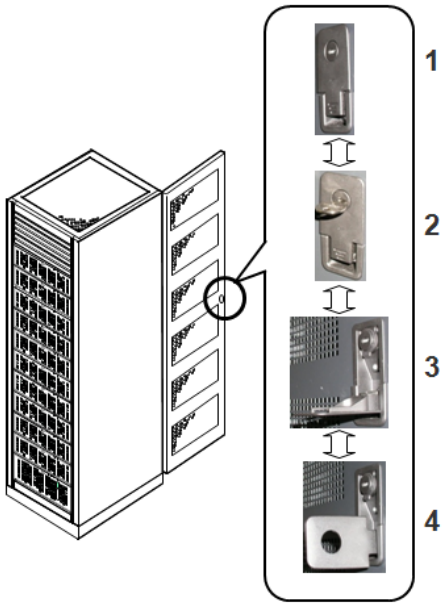


- Scanning electron microscope (SEM) view clearly showing the surface oxide crack produced by ESD.

23

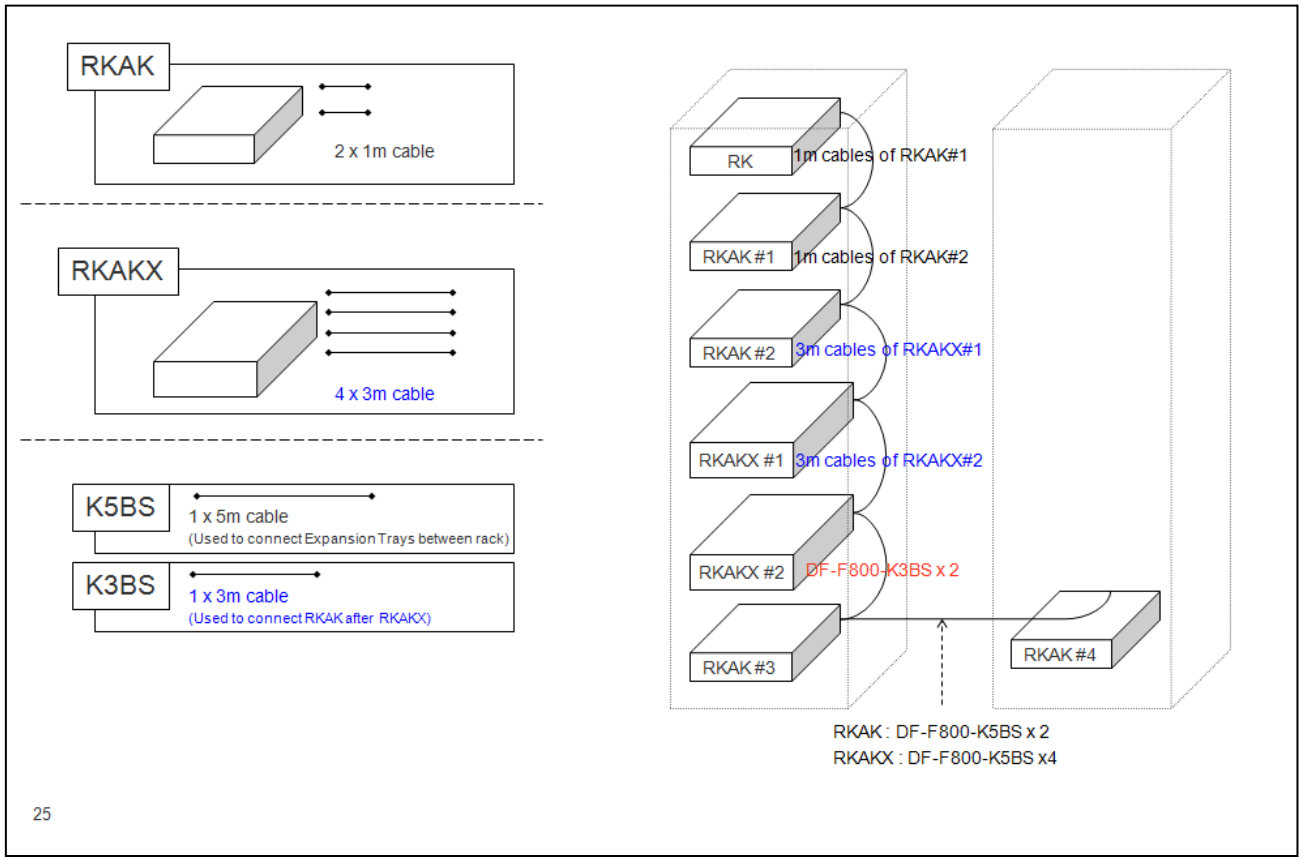
Rear Door

- Precautions
  - Be careful of catching cables when attaching the rear door.
  - Fingers can be caught in the door, causing injury.



24

Expansion Unit Cabling

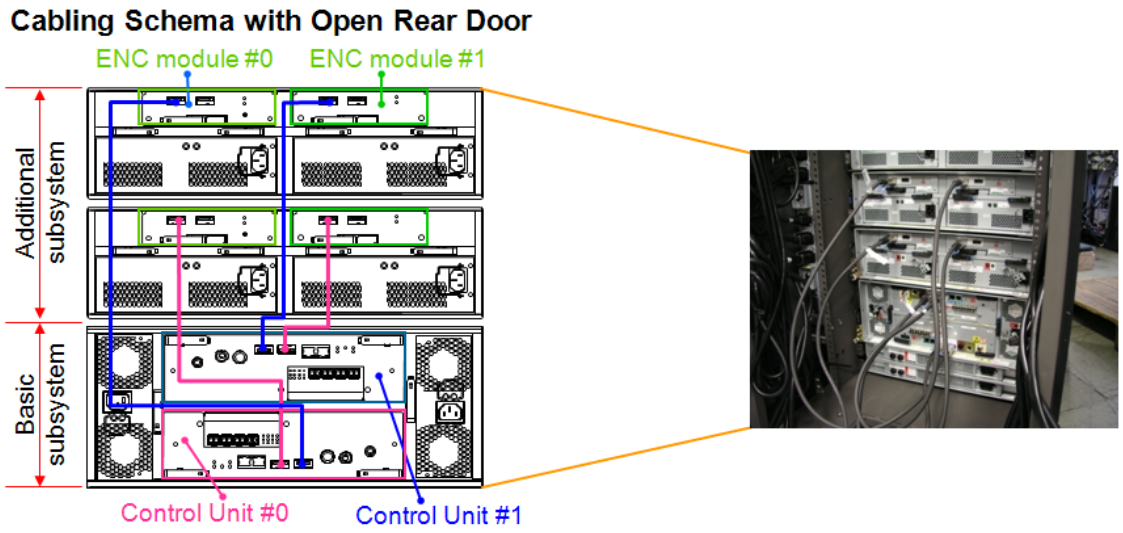


Connect ENC Cables

1. Connect **PATH #0** (pink) of Control Unit #0 and ENC module #0 (IN). (The first additional subsystem).
2. Connect **PATH #0** (pink) of Control Unit #1 and ENC module #1 (IN). (The first additional subsystem).
3. Connect **PATH #1** (blue) of Control Unit #0 and ENC module #0 (IN). (The second additional subsystem).
4. Connect **PATH #1** (blue) of Control Unit #1 and ENC module #1 (IN). (The second additional subsystem).
5. After connecting ENC cables, roll up the excess part of the cables in a circle, tighten them lightly with the repeat binder, and put them inside the enclosure.
6. Affix labels: Affix **PATH #0** (pink) and **PATH #1** (blue) on the tags.

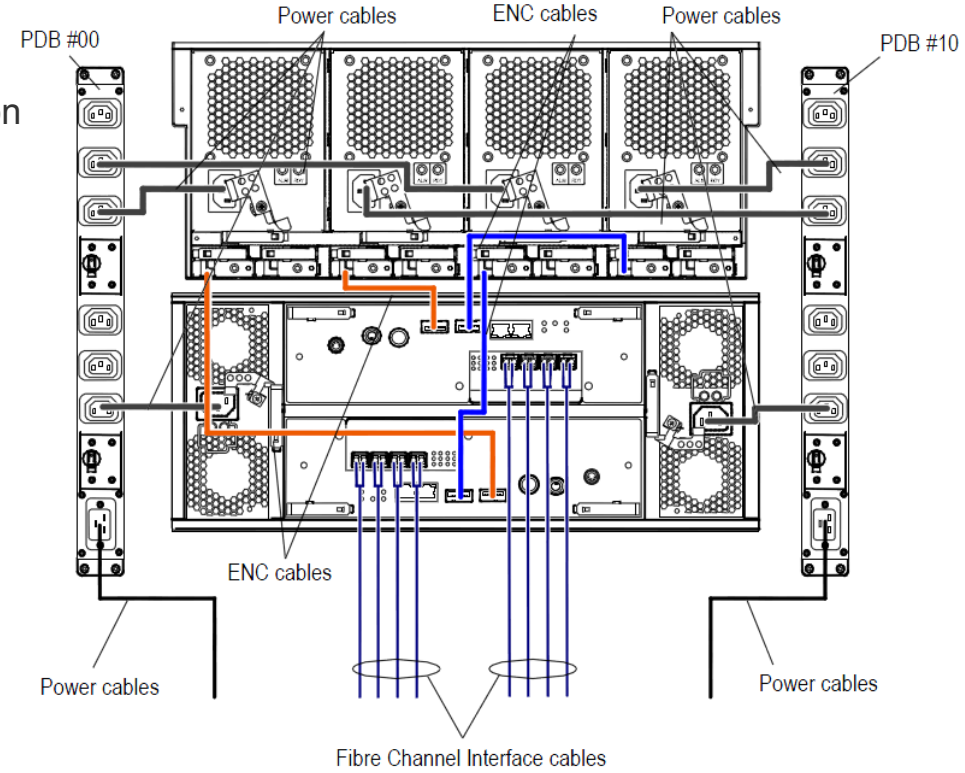
When coiling cables, maintain a radius greater than 30mm to avoid straining the cables or connectors.

26



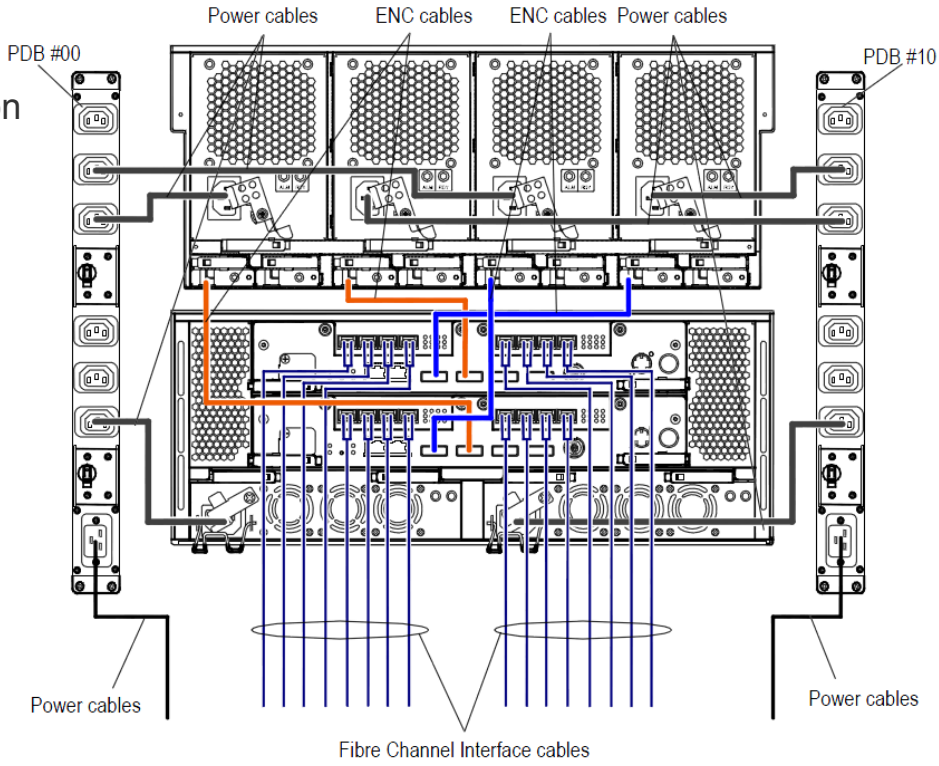
27

Dense Expansion Unit on models 2100 and 2300



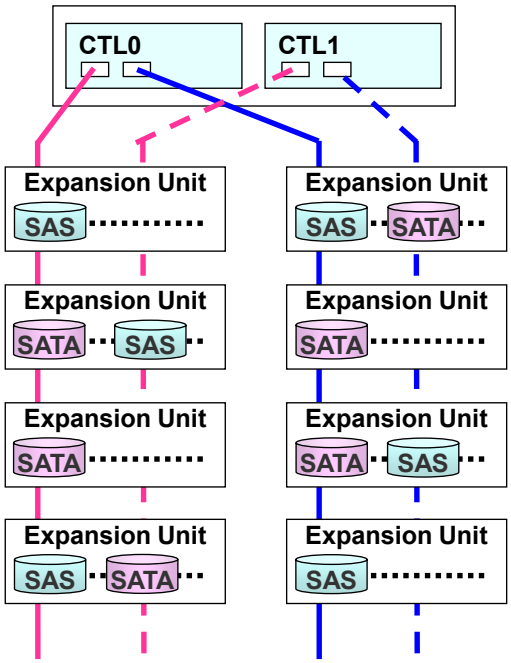
28

Dense Expansion Unit on model 2500



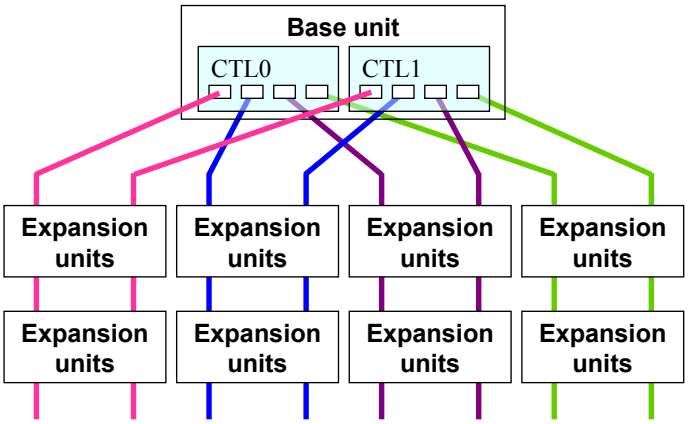
29

- Typical cabling diagram of model 2100 or 2300
  - Simple cabling no longer requires ACE tool in Storage Navigator Modular 2.



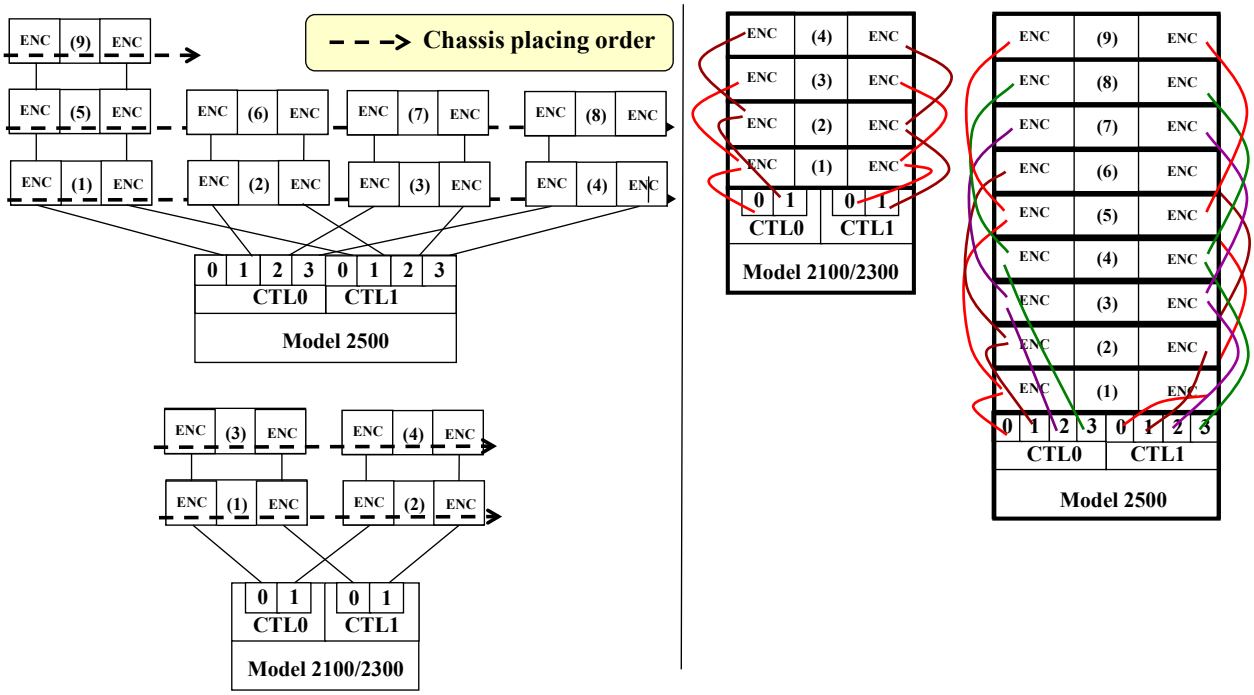
30

- Typical cabling diagram of model 2500



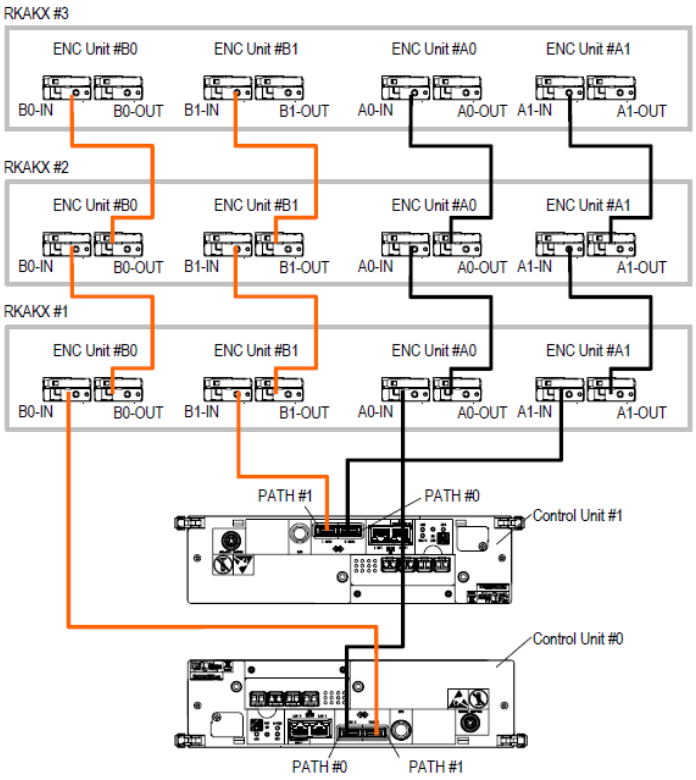
31

Racking and Cabling



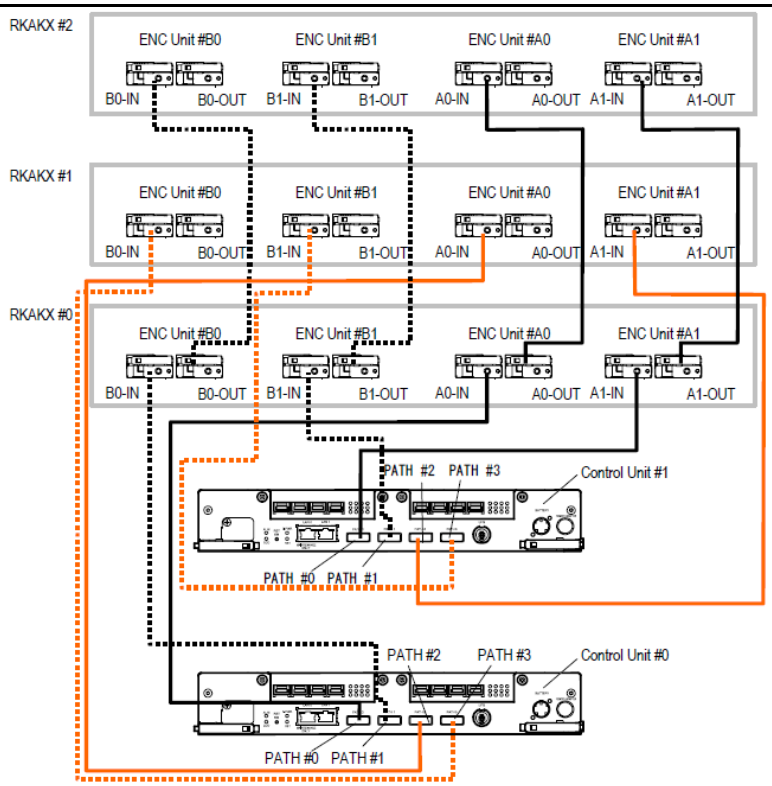
32

- Dense Expansion Unit cabling models 2100 and 2300



33

- Dense Expansion Unit cabling model 2500



34

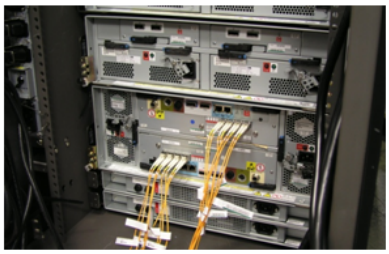
Connect Host Interface Cables

Operating procedure

❶ What devices are connected?

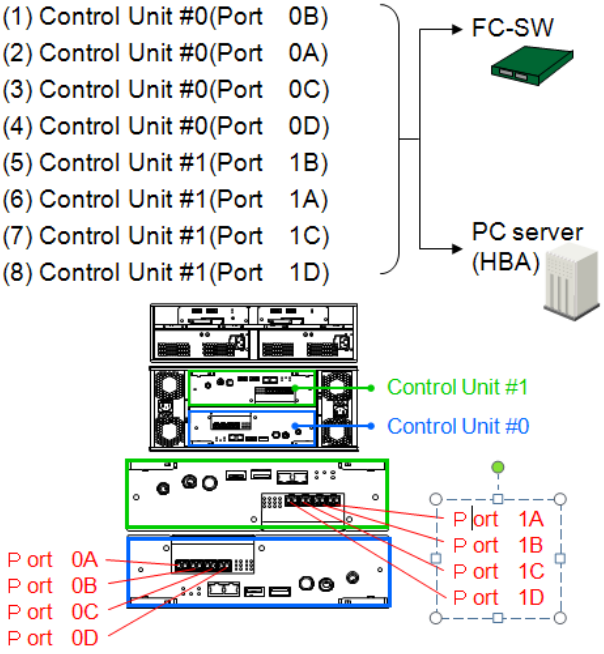
When the customer provides Fibre Channel, connect the control unit (each port) and the FC-SW, or the PC server (HBA).

- Be careful when connecting the Control Unit.
- Two Control Units are symmetrical. Connect them carefully.



Connect them to either the FC-SW or the PC server (HBA) according to the specifications of the customer.

(1) Control Unit #0(Port 0B)
(2) Control Unit #0(Port 0A)
(3) Control Unit #0(Port 0C)
(4) Control Unit #0(Port 0D)
(5) Control Unit #1(Port 1B)
(6) Control Unit #1(Port 1A)
(7) Control Unit #1(Port 1C)
(8) Control Unit #1(Port 1D)



35

Connect LAN Cables

Operating procedure

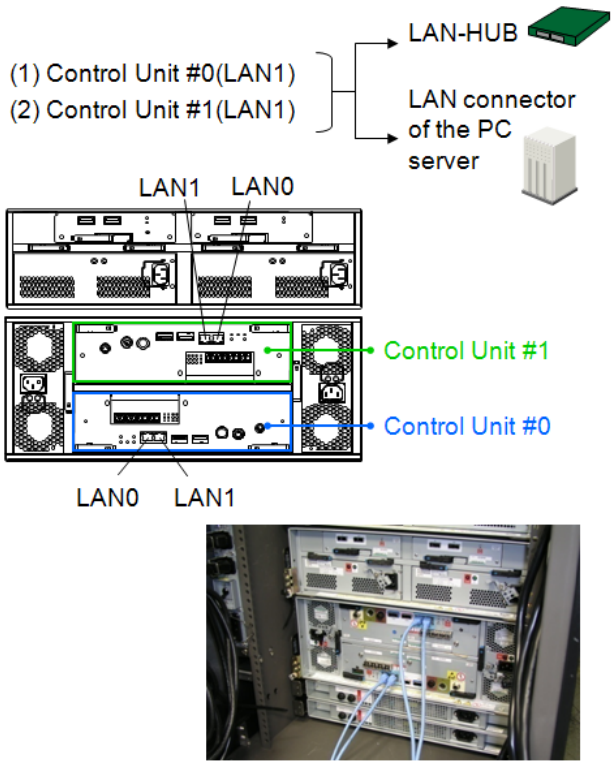
❶ What devices are connected?

Connect the Control Unit #0(LAN1) or #1(LAN1) and the LAN connector of the PC server or the LAN-HUB.

- Cable connection is performed with one or two cables according to the specifications of the customer.
- Unless otherwise specified, the IP address at the time of shipment is:
  - Control Unit #0(LAN1):192.168.0.16
    #0: For maintenance
  - Control Unit #1(LAN1):192.168.0.17
    #1: For End user

❷ What is connected where?

Connect the Control Unit #1 and the LAN connector of the PC server or the LAN-HUB.



36

User LAN port (CTL0/1)

LAN1 – 192.168.0.16/17

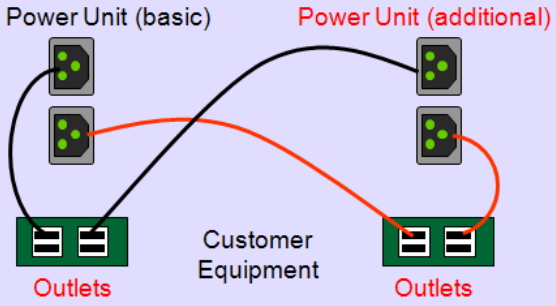
Maintenance LAN port (CTL0/1) – Service Personnel only

LAN0 – 10.0.0.16/17

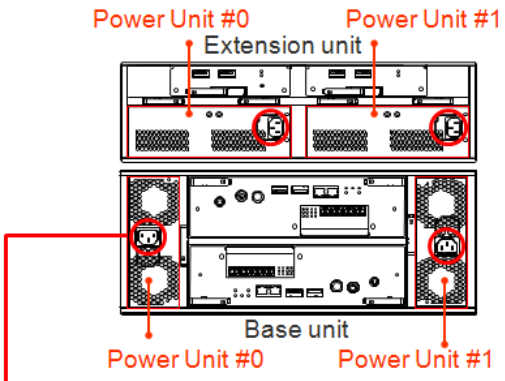
Connect Power Cables

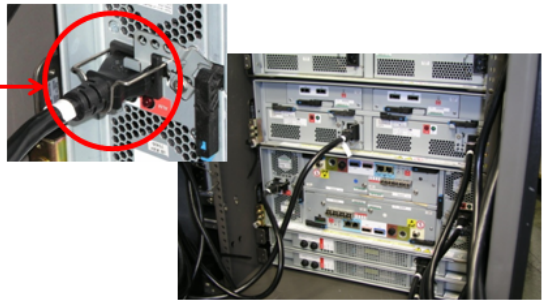
Operating procedure

1. What devices are connected?
   Connect the Power Unit and the outlet (customer side).
2. Where should they be connected?



When power cables are connected to the equipment, a little electric current flows and gives the ready status indication.



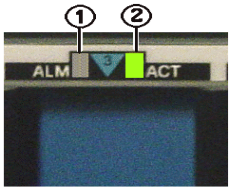


37

Power Up the Storage System

- Confirm that both power receptacles on the rear of the base unit are connected to working outlets.
  - The green LEDs above each receptacle should be ON and the green front panel **RDY** LED should blink.
- To turn power on, locate the button on the front bezel and press the ON button.

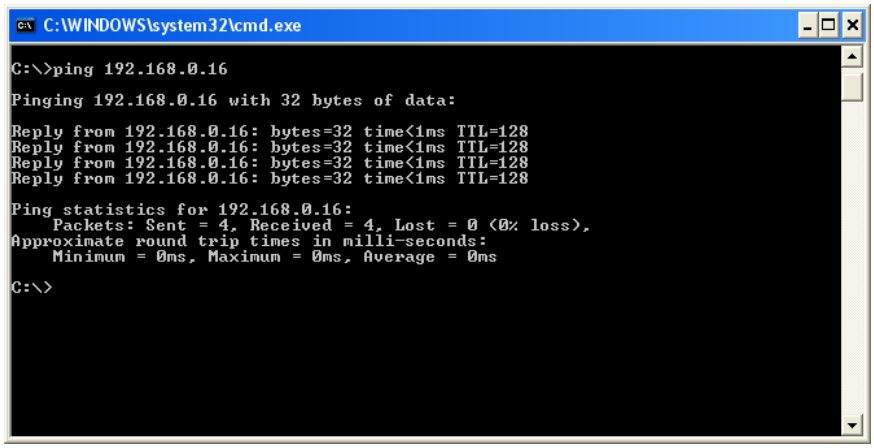
- The unit should power up as follows:
  - Expansion Trays (if any)
  - System disks in base unit
  - Remaining Disks in base unit
- Ensure the HDD LEDs (ACT) are lit as the unit powers up.



38

Test Maintenance PC Server Connectivity

- Test maintenance PC server connectivity to the storage system through the IP network.
- Use the **ping** command to verify the IP address of the LAN port.
- Default IP address for **User** LAN ports is **192.168.0.16/17**
- Default IP address for **Maintenance** LAN is **10.0.0.16/17**



39

Make sure that your storage management array can communicate with your client machine by pinging the IP address of the LAN port as specified in your AMS 2100/2300 Quick Start Guide.

Installing Management Software

Storage management software

●Storage Navigator Modular 2 (SNM2)

The management software called Storage Navigator Modular 2 (SNM2) is used for the initial setting the management of the storage subsystem.

●Preparation for the server for the storage management

For installing SNM2, prepare the computer of the following specifications as a server for the management in advance.

OS and Web browser	Windows Server 2003, Windows XP Pro SP1 (Internet Explorer 7.0) RedHat Enterprise Linux AS4, Solaris 10 (Mozilla x.x)	**Hard disk**	Free capacity of 1GB or more
		Network	It should be connected to the storage subsystem of the management target through LAN
Memory	1GB or more are recommended	**Optical drive**	CD-R can be read.

Installation procedure

1. Insert the supplied CD in the prepared server for the storage management. The program for installation starts automatically.
2. Follow the instruction on the window, and perform the installation by entering necessary items.

40

6. Setup and Configuration of Hitachi Storage Navigator Modular 2

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Explain the purpose and benefits of Storage Navigator Modular 2 (**SNM2**) program
  - Describe Secure Sockets Layer (SSL) support
  - Implement IPv6 support on management and maintenance LAN ports for supported operating systems
  - Register an Adaptable Modular Storage 2000 family system in SNM2
  - Use Add Array wizard
  - Use Initial Setup wizard
  - Create RAID Groups and use LU Wizard to create and format logical units (LUs)
  - Create Host Groups, enable Host Group Security and register the World Wide Name (WWN) of attached host bus adapters
  - Map internal LUNs to Host Group LUNs
  - Describe and implement Hitachi Data Provisioning software

2

Features

- Hitachi Storage Navigator Modular 2 allows you to:
  - Centralize storage management
  - Configure the storage system using:
    - Add Array wizard
    - Initial Setup wizard
    - Create and Map Volume Wizard
  - Allocate user volumes to the host server
  - Replicate Logical Units using standard Hitachi replication software
    - Replication wizard
  - Obtain system configuration and status information
  - Automatic Error Alert Monitoring
    - Error Alert email system
    - Error Alert window for failed components, listing all customer replaceable unit (CRU) details

3

The Adaptable Modular Storage 2000 family unit and various other Hitachi storage arrays house the actual disks for storage. Built on a graphical-user-interface, Storage Navigator Modular 2 manages those disks to provide end users access to the disk space to manage their storage environment. Through the GUI, users can centralize their storage management, replicate data, manage performance, and easily diagnose and fix errors.

- Simple
  - Easy to use graphical user interface
  - Installs in minutes
  - Wizard-guided setup, configuration and data replication
  - Intuitive error detection and messaging
  - Non-disruptive firmware updates
  - Online Help

4

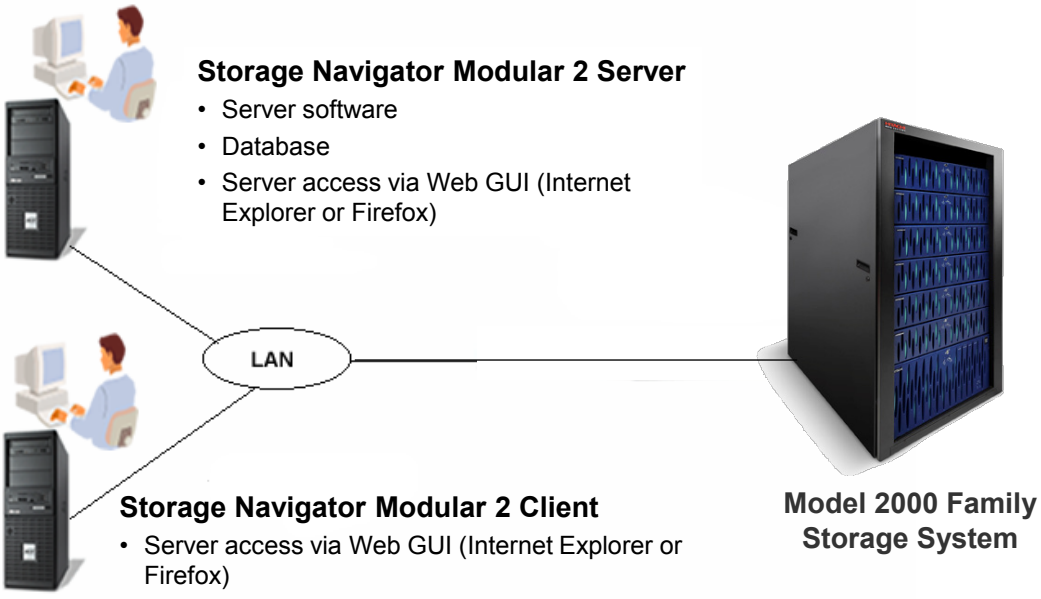
Supported Operations

- Configuration of storage system
  - Create and Map Volume Wizard
- License key enablement of additional supported software
- Installation and updating of firmware
- Data replication
  - Replication Wizard
  - Snapshots (Hitachi Copy-on-Write Snapshot software)
  - Full-volume cloning (Hitachi ShadowImage® Replication software)
  - Disaster Recovery
    - Hitachi TrueCopy® Synchronous Software
    - Hitachi TrueCopy® Extended Distance (Asynchronous) software
- Alert settings
- Storage system health and performance monitoring

5

Architecture

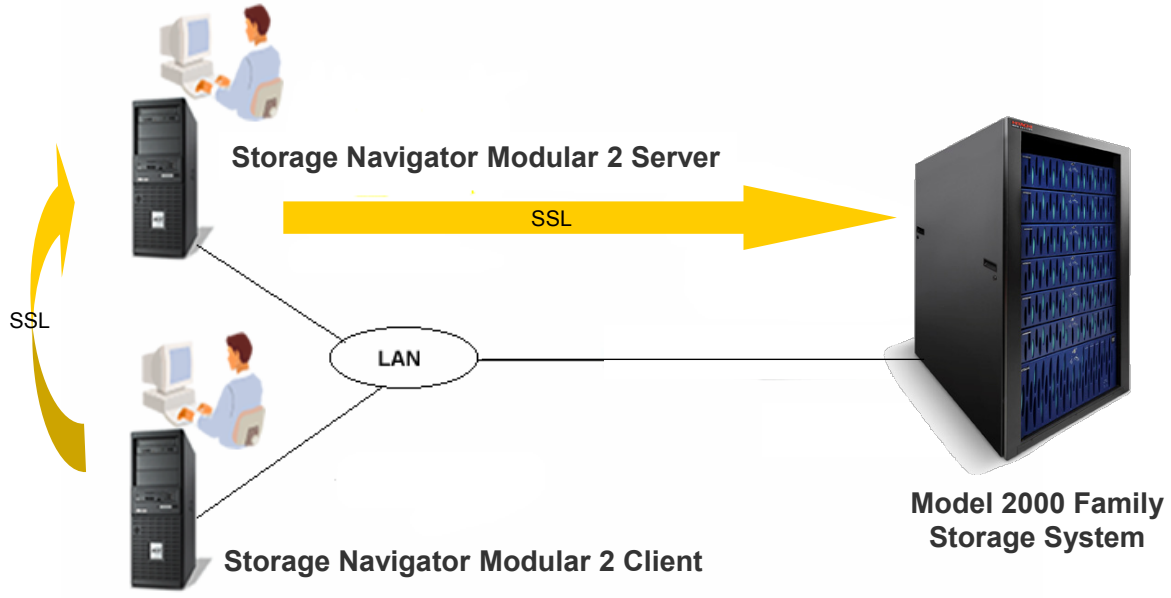
- Web GUI
- Client-Server design



6

Storage Navigator Modular 2 runs from your primary management server or client PC. It is designed on common web-based client-server technology using a standard IP network. In other words, you can attach your model 2100 or 2300 and Storage Navigator Modular 2 primary management server to your existing LAN environment. Storage Navigator Modular 2 communicates with the storage system through a web browser. If client PCs are attached to the network, they can connect to the Storage Navigator Modular 2 primary management server and remotely configure the storage system.

- The communication between the SNM2 server and the storage array can be set up either unsecured or secured with SSL.
- The communication between the SNM2 server and the SNM2 client can be set up either unsecured or secured with SSL.

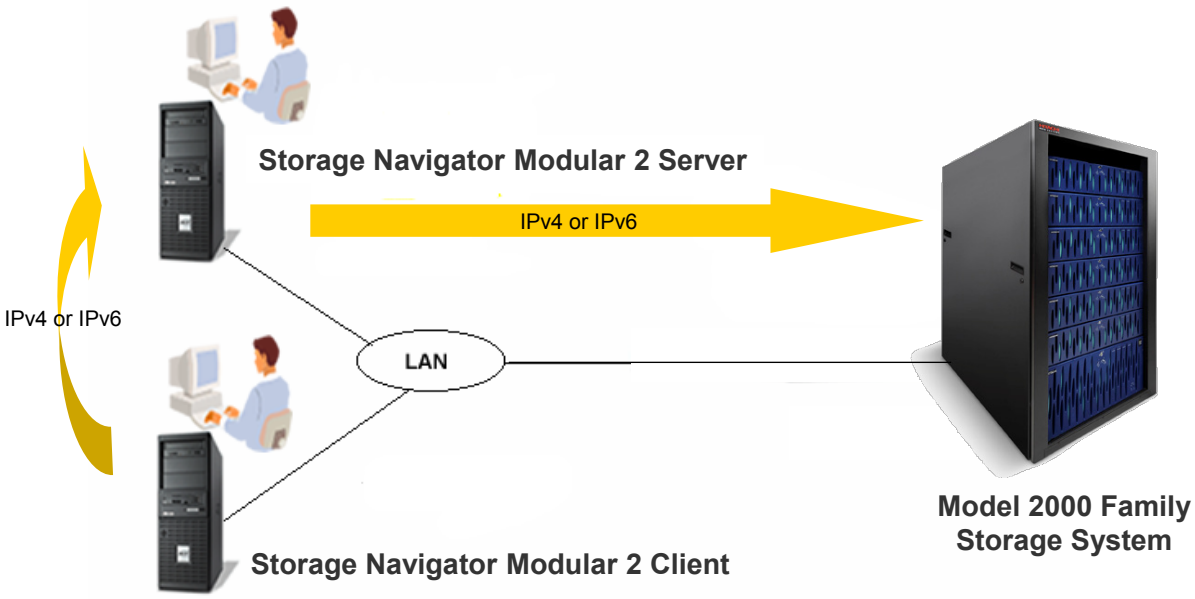


7

To get more details about the setup and configuration please refer to the appropriate user documentation.

The procedures may differ depending on the storage system firmware level and the SNM2 version.

- IPv4 or IPv6 is supported.



8

IPv6 Support

- IPv6 link local address
  - The IPv6 link local address is created automatically from the MAC address regardless of the availability of the IPv6 address. The array creates the interface ID which extends the MAC address (48 bits) to the EUI-64 format (64 bits) and has the address which adds fe80::/10 to the high 64 bits as the link local address.

    (Example) When the MAC address is “00:00:87:12:34:56”

    1. Split the MAC address by 24 bits “000087” and “123456”.
    2. Insert “1111 1111 1111 1110 (0xFFFE)” between the split addresses.
       “0000 87FF FE12 3456”
    3. Reverse the 7th high bits.
       “0200 87FF FE12 3456”
    4. Add “fe80::/10” to high 64 bits to be the link local address.
       “fe80::0200:87FF:FE12:3456”

- Setting IPv6 address
  - We recommend the manual setting for the IPv6 address. When using it by setting to obtain the IPv6 address automatically, since the IPv6 address is created based on the MAC address, the IPv6 address set to the array is changed automatically if the Control Unit is replaced due to a failure, etc. In this case, it is required to perform the search array and registration again.
    For the range of the IPv6 address set manually, use the global unicast address “2001::/16” for the IPv6 Internet.

9

- IPv6 support conditions for each operating systems are shown below.

Vendor	Operating System		IPv6 Support Conditions
	Operating System Name	Service Pack	
Microsoft	Windows 2000	SP3/SP4	Not Support(*1)
	Windows XP	SP2	Not Support (*2)
	Windows Server 2003 (x86)	SP1	Support
	Windows Server 2003 (x86)	SP2	Support
	Windows Server 2003 R2 (x86)	SP1	Support
	Windows Server 2003 R2 (x64)	SP1	Support
	Windows Vista (x86)	SP1	Support
	Windows Server 2008 (x86)	SP1	Support
	Windows Server 2008 (x64)	SP1	Support

*1: IPv6 protocol is not supported.
*2: Although the IPv6 protocol can be used by installing Microsoft TCP/IP version6, **Hitachi Storage Navigator Modular 2** does not support it because the WEB browser cannot use the IPv6 literal address [address in the colon(:)-delimited hexadecimal form].

10

Login Layers

- Connecting to an individual storage array is a **layered** process.
  1. Open a properly configured Java browser and launch SNM2.
     1. The Login window opens.
     2. Log into SNM2 using **system** (USER ID) and **manager** (default password).
     3. The login places you into the **Arrays** window, from which you select a specific array to connect to from a list of registered arrays.
  2. Select a specific array to connect to from a list of registered arrays. Connection to the array is allowed one of two ways:
     - If Account Authentication **is not** installed or disabled, connection is allowed.
     - If Account Authentication **is** installed and enabled, then a second User ID and Password are required to gain access.

       Default strings:

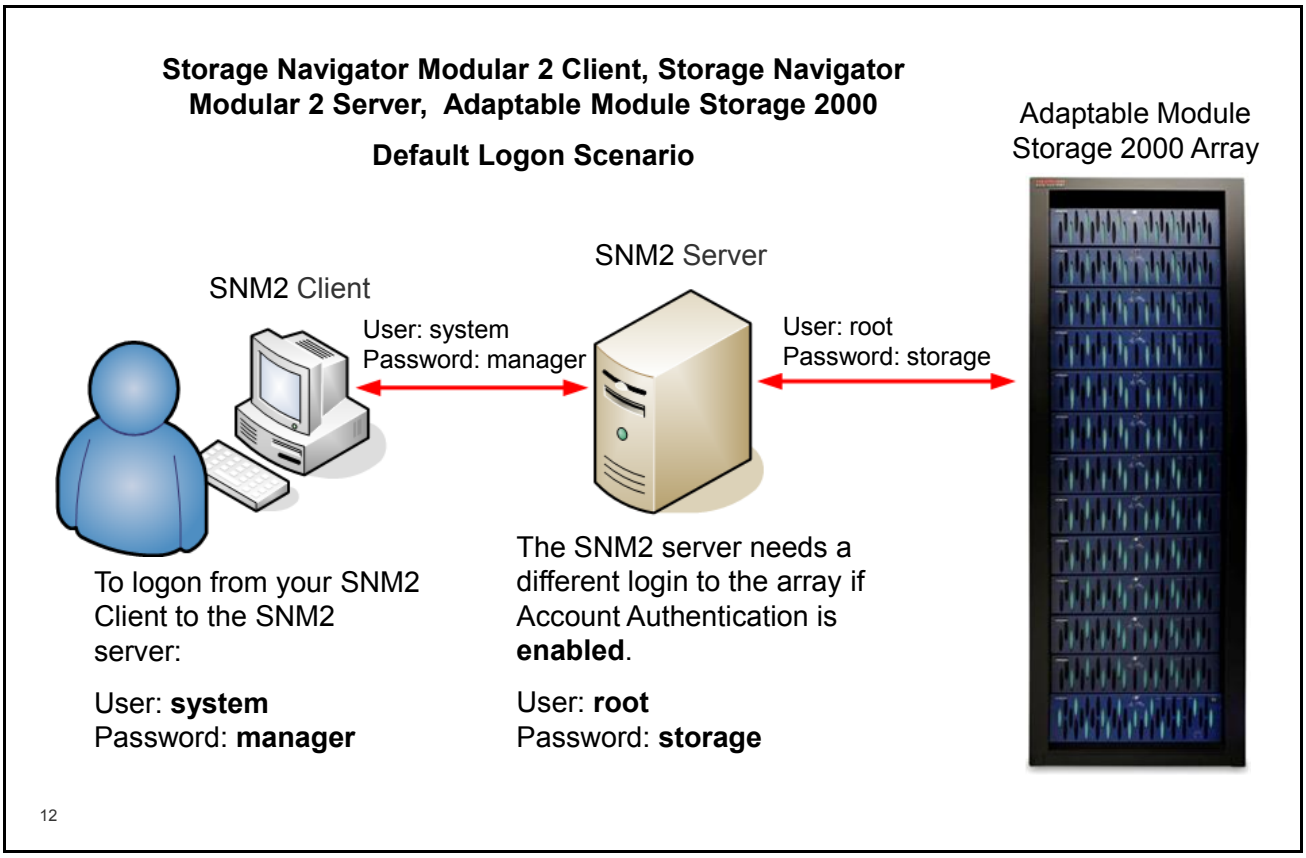
       User ID = **root**

       Password = **storage**

11

When SNM2 is used in a Hitachi Device Manger environment, use the Device Manager credentials to log in to SNM2. This is Single Sign-on mode.

Default Authentication



SNM2: Storage Navigator Modular 2

AMS2000: Adaptable Modular Storage 2000

Installation Requirements

	A computer as Storage Navigator Modular 2 **server**	A computer as Storage Navigator Modular 2 **client**
Network Interface	100BASE or 1000BASE, to communicate with storage system and Storage Navigator Modular 2 client	100BASE or 1000BASE, to communicate with Storage Navigator Modular 2 server
OS	Microsoft Windows 2000 Pro (SP3 and 4), Microsoft Windows Server 2003 (SP1)/XP Pro (SP2)	
RAM	2GB or higher is recommended	512MB or more
Free disk space	1.5GB or more to install	--
CPU	1Ghz Minimum (2.0GHz recommended)	--
Others	Optical drive, to install Storage Navigator Modular 2 from CD-ROM.	JRE* (Java Runtime Environment) 1.6.0 or higher http://java.sun.com/products/archive/
		Video: 1024x768 (recommended) or more
		Web Browser: Microsoft Internet Explorer 6.0
		Mouse (or pointing device) and keyboard

13

Verify that your PC and operating system meet these basic requirements. These are standard for most of the today's applications. In addition, the *Release Notes* and the *User's Guide* have current information.

The JAVA JRE 1.6.0 can be downloaded from the SUN web site at the link.

- Know the IP address of your management PC.
  - Know the IP address prior to starting the installation procedure.
  - You are prompted to enter this IP address during the installation.
  - This IP address can be checked by typing the **`ipconfig`** command into the command prompt window.

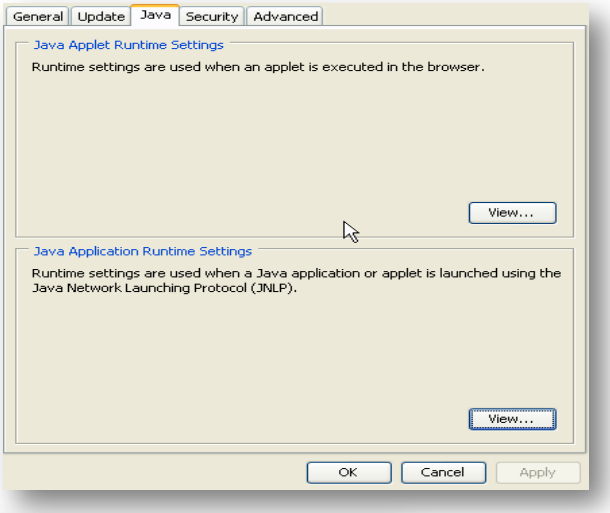
14

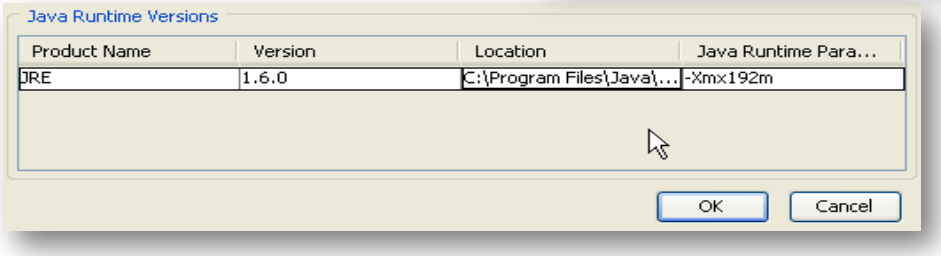
- Advanced Settings
  - Required to configure the following:
    - Configuration Settings
    - Access Mode
    - Performance Monitor
    - Mapping Guard
    - Parity Correction
    - Cache Residency
    - Maintenance
  - Is a **Java applet**
    - Java 6.0 (**1.6.0 or higher**) Runtime environment settings must be configured.
    - Start → Run → Control Panel → Java → (Java Applet Runtime Settings) View - Java Runtime Parameter → **`-Xmx192m`**
  - Disable DHCP on the server operating Storage Navigator Modular 2.
  - Turn off pop-up blockers.

  Note: A time out will occur after **30 minutes** when working with Advanced Settings.

15

- Special Setting to run Java 1.6.0 or higher JRE is required for **Advanced Setting** applet.
- You cannot launch the **Advanced Settings** function of SNM2 (error indicates not enough memory).
- The string placed in the Java Runtime Parameter **(-Xmx192m**) reserves **192MB** of memory for Java to run.





16

This is local user account related Java setting on Microsoft Windows systems.

It has to be set up for each different Windows user who uses the SNM2 Web GUI.

Graphical User Interface

- Main Window
  - System Navigation Area
  - Storage Array Area

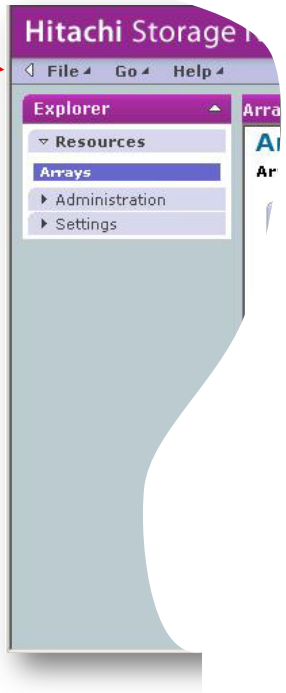
17

The **System Navigation** area is displayed when you first log in.

The **Storage Array** area allows you to perform configuration functions.

Main Window

- System Navigation Area
  - Menu Bar
    - File – Log out
    - Go – ACE Tool (support for other Hitachi Adaptable Modular Storage systems)
    - Help

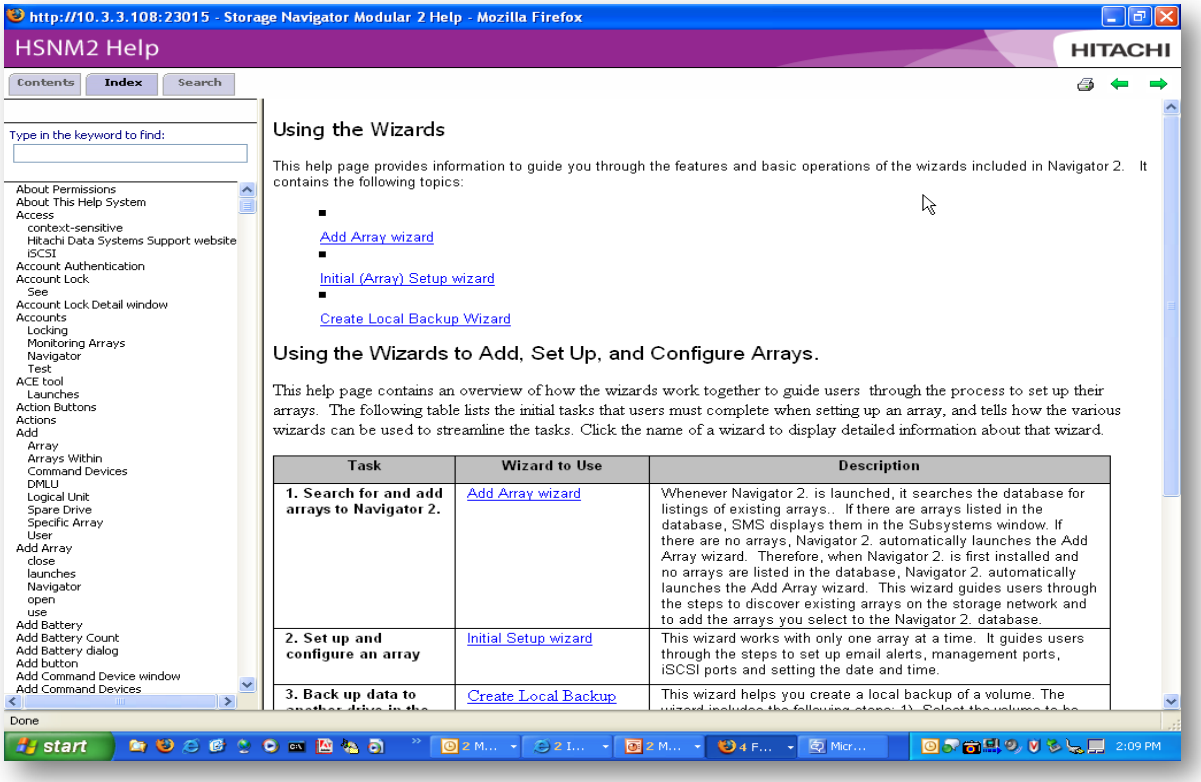


18

On the top menu bar, click **File** to close out of the application or log out.

Click **Help** to open the **Online Help** or select **About** to display the properties of Storage Navigator Modular 2.

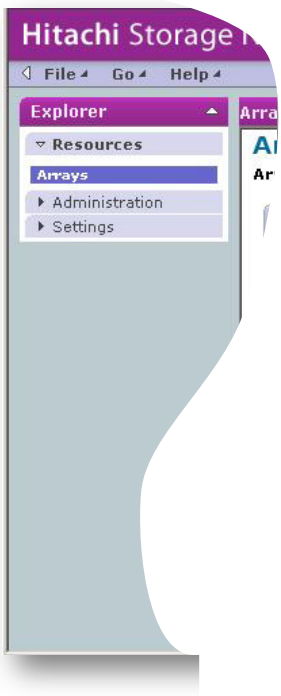
Online Help



19

System Navigation Window

- System Navigation Area
  - Explorer Area
    - Resources
      - List Registered Arrays
    - Administration
      - **Users** and **Permissions**
      - Security
    - Settings
      - Set user profile
      - Set **accounts** and **passwords**



20

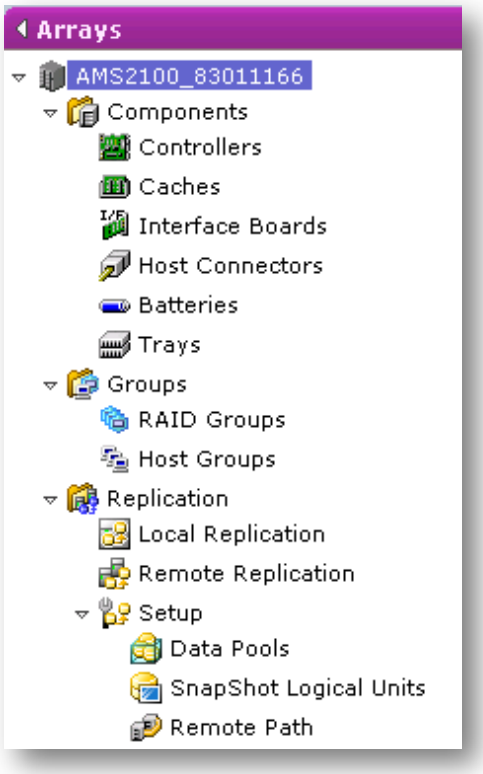
Under **Resources**, click **Arrays**. From the Array Properties area, you can view and configure arrays, add a new array, edit the array properties, remove the array, or toggle the filter. The main window has a lot of information, including serial number, drive types, array capacity, and the IP address of the iSCSI ports.

Under Administration, you can configure User and Permissions and Security.

- Expand Users and Permissions
  - Click **Users**. You can view the users that have been created.
  - You can click the **Permissions** option to view and edit the permissions for each user.
- **Security** settings enable you to edit the password polices, account lock policies, and update the message that appears in the warning banner.
- Under **Settings** you can edit the profiles all of the users created. You can change the password and edit the profile settings.
- Click **Edit Profile** to edit the profile.
- Click **Change Password** to change the password.

Storage Array Navigation Tree

- Components
  - All hardware components status
- Groups
  - RAID Groups
  - Host Groups
- Replication
  - Local Replication
  - Remote Replication
  - Setup
    - Data Pools
    - SnapShot Logical Units
    - Remote Path



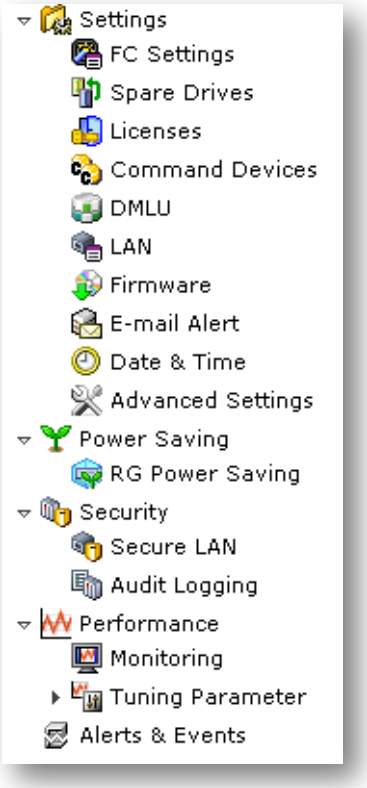
21

This interface allows you to launch and navigate the various components, functions, and array settings.

For example, **Local Replication** allows you to view the status of your replication pairs including pair name, primary volume, secondary volume, group name, and back up time. Beneath the window you can perform additional functions to your backup such as create a new pair, split a pair, resync a pair, restore a pair, and delete a pair.

To view the volumes that you created for snapshots, expand the **Setup** menu and click **Snapshot Logical Units**. From this screen, you can view the snapshot volume that you created and its capacity. Beneath the window, you can perform additional functions such as creating another snapshot volume or deleting the snapshot volume.

- Settings
  - FC Settings
  - Spare Drives
  - Licenses
  - Command Devices
  - DMLU
  - LAN
  - Firmware
  - Email Alert
  - Date & Time
  - Advanced Settings
- Power Savings
  - RAID Group Power Saving
- Security
  - Secure LAN
  - Audit Logging
- Performance
  - Monitoring
  - Tuning Parameter
- Alerts and Events



22

Installation Summary

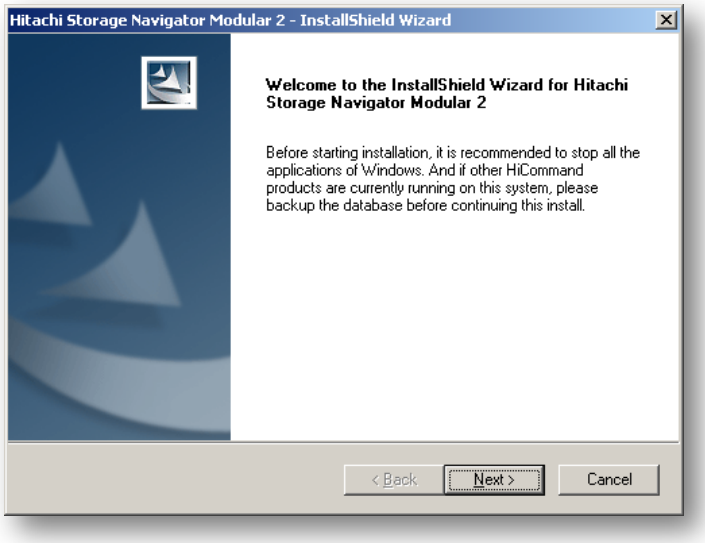
1. Install JAVA JRE 1.6.0 application.
2. Install Storage Navigator Modular 2 from CD-ROM.
3. Start Storage Navigator Modular 2 using Web browser.
4. Use the Add Array Wizard at first time usage to register the storage system.

23

Install Storage Navigator Modular 2

- Insert the installation CD into the host that will serve as the primary management sever.

  The InstallShield Wizard loads to start the installation



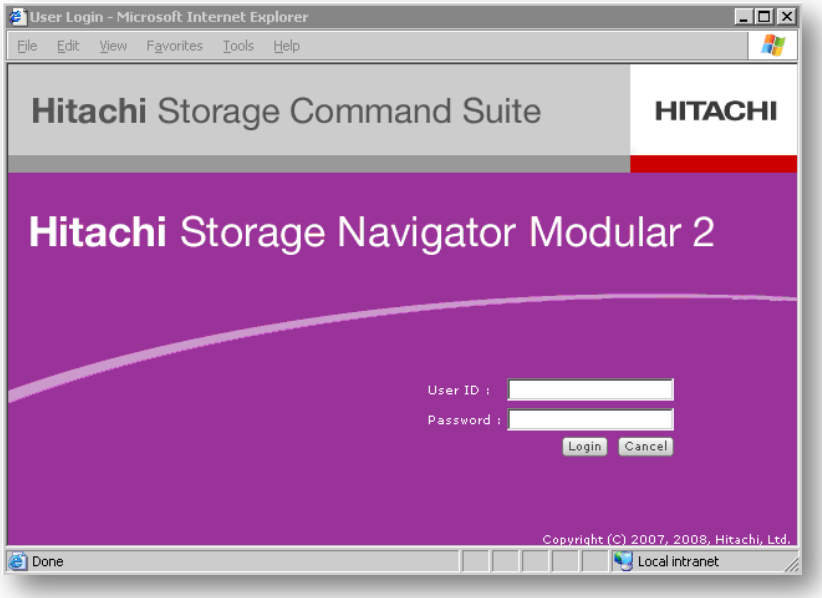
24

The installation process takes approximately 20 minutes to complete.

Click the default file settings. You must enter the IP address of the management server and the port 1099.

Start From Web Brower

1. Open a Web browser.
2. Access the Storage Navigator Modular 2 software from the browser.
   Set URL = http:// <*IP address of host*>:**23015**/StorageNavigatorModular**/**
3. Log in.
   - User Name: **system**
   - Password: **manager**



25

Since this is the first time you are running Storage Navigator Modular 2, the **Add Array** wizard appears and prompts you to add your storage system.

Troubleshooting Installation

- Microsoft Windows Services
  - To access, **Start > Programs > Administrative Tools > Services**
  - HBase Storage Mgmt Common Service
  - HBase Storage Mgmt Web Service
  - HiRDB
  - Storage Navigator Modular 2 Server
- The following command can be run to **start** and **stop** all required services:
  `hcmdssrv.exe /stop` or **`hcmdssrv.exe /start`**
  - The above mentioned command is located at the following folder:
    C:\program files\hicommand\base\bin

Note: If the user is running Hitachi Storage Command Suite, these applications and SNM2 are compatible, but you must stop their services in order to install SNM2. Only one data base will exist, but a second instance will run for SNM2.

26

These services should be running on your PC to successfully run Storage Navigator Modular 2.

Configure

- Adaptable Modular Storage 2000 Family systems default Controller IP settings:
  - Controller 0/1
    - **User** LAN port – **192.168.0.16/17** – factory default
    - **LAN1** port
  - Controller 0/1
    - **Maintenance** LAN port - **10.0.0.16/17** – factory default
    - **LAN0** port

27

1. Perform Initial Setup (The setup wizard is launched automatically.)
   1. Set up email alerts.
   2. Set up management LAN ports.
   3. Set up front end host ports.
   4. Set up spare drives.
   5. Set up date and time.
2. Create and Map Logical Units to Host Servers
   1. Create RAID Groups.
   2. Create LUs.
   3. Create host groups.
   4. Map LUs to hosts and host groups.
3. Enable License Keys

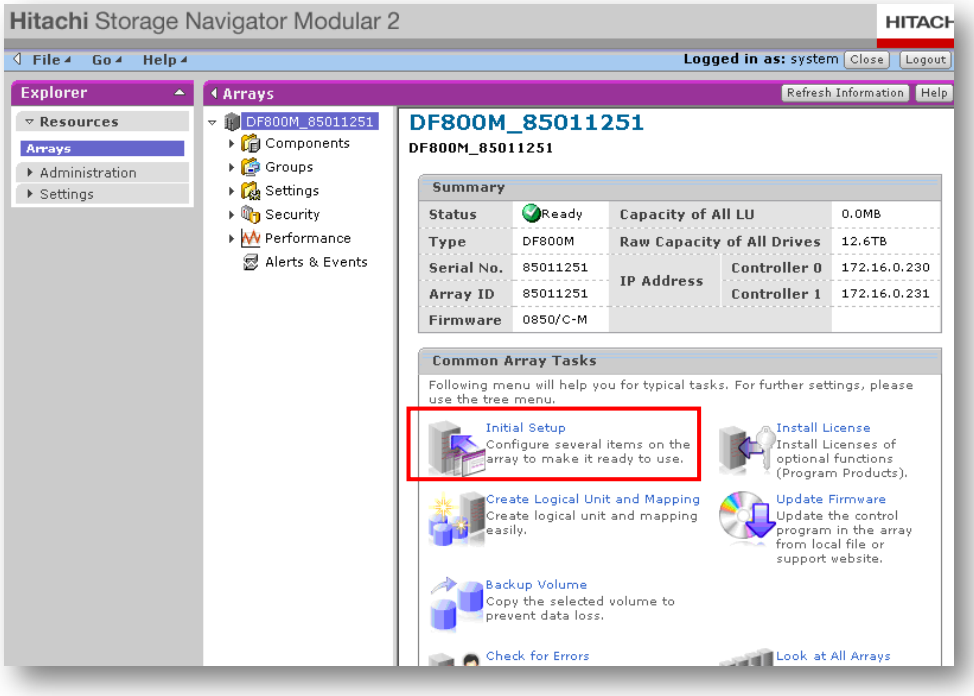
28

Configuring the array is done in easy steps.

1. Initial setup.
2. Install any license keys (in most cases this is done at build center).
3. Create the RG/LU storage volumes.
4. Format the LUs.
5. Create any Host groups and setup.
6. Map the LUs to your hosts.

Initial Setup

- **Initial Setup** wizard guides you through the setup of E-mail alerts, LAN Management ports, Front end Host ports, Spare drives, and Data and Time.

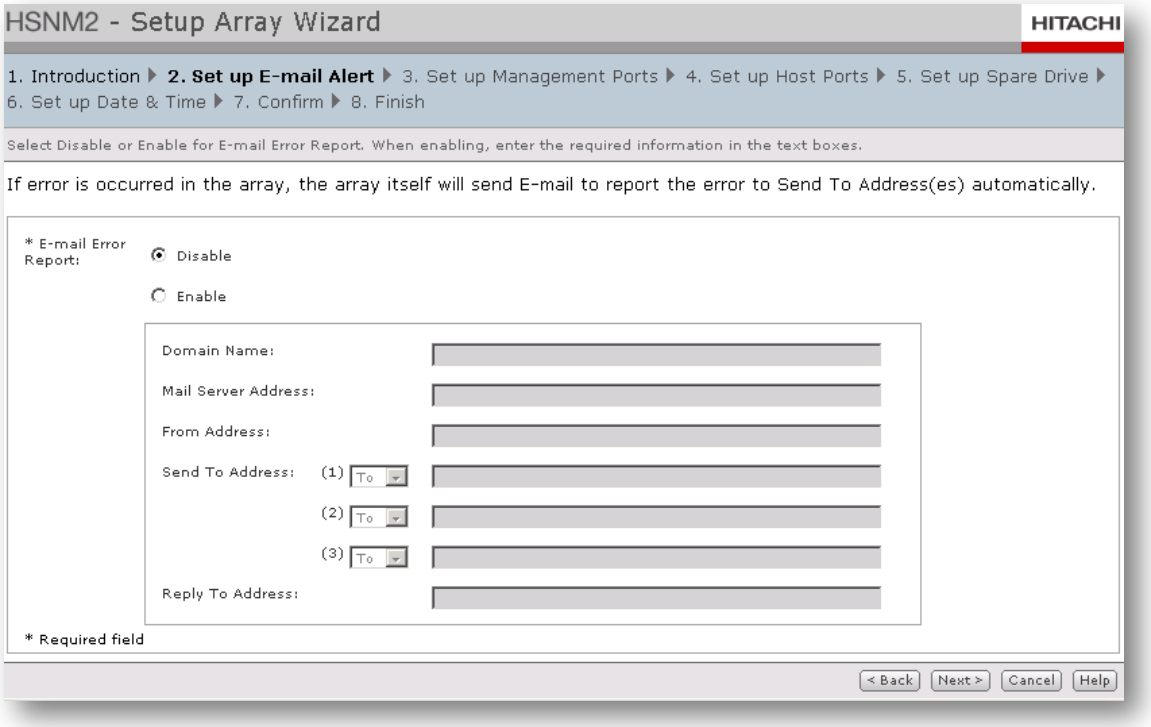


29

The **Initial Setup** is the very first step in configuring your array. The wizard enables you to quickly set up your new storage unit for first-time use. It guides you through setting up the management and the iSCSI ports, and email notification in case the system detects an error.

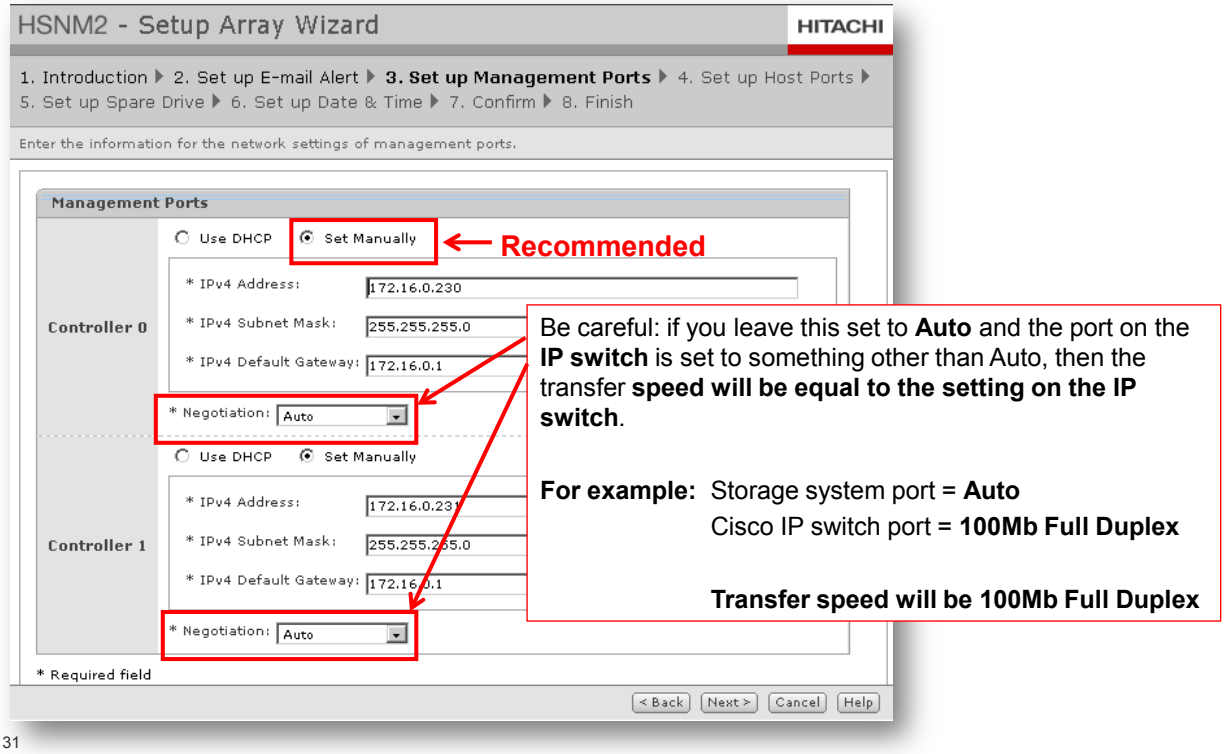
1. From the **Common Array Tasks** window, click **Initial Setup**. The wizard prompts you to set up an email alert, set management ports, set host ports and set up spare drives and date and time.
2. Click **Next** to confirm the modifications you have made to the alerts.
3. Finally, click **Next** to confirm the modifications you have made to the management ports.
4. Click **Confirm.**

- Set up E-mail Alerts



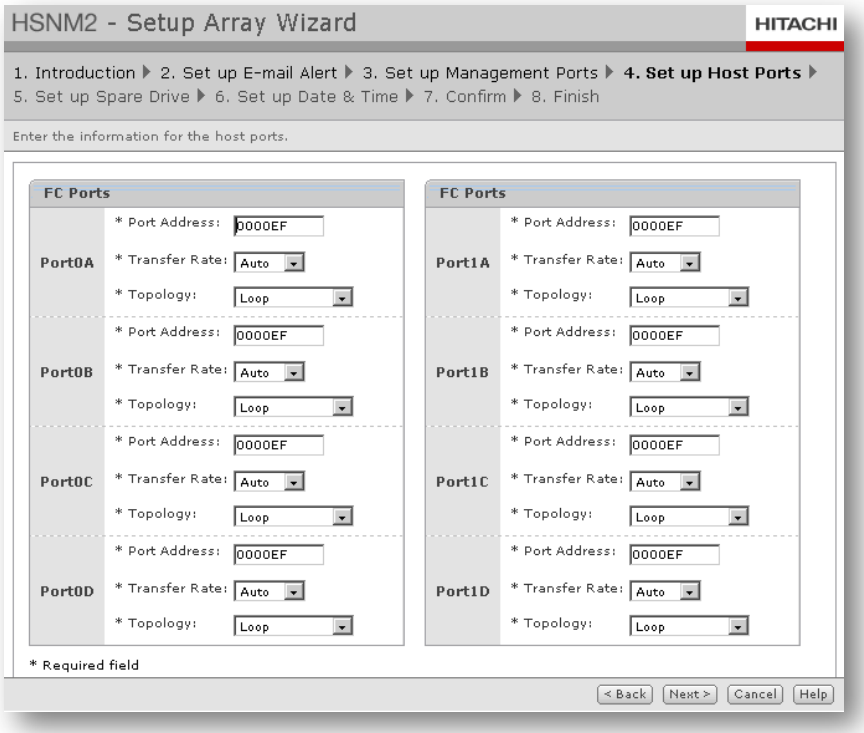
30

- Set up Management Ports



Here you can modify the IP addresses of the controllers. Default for the Adaptable Modular Storage 2000 family is dual controllers.

- Set up Host Ports



32

Fibre Channel Parameters

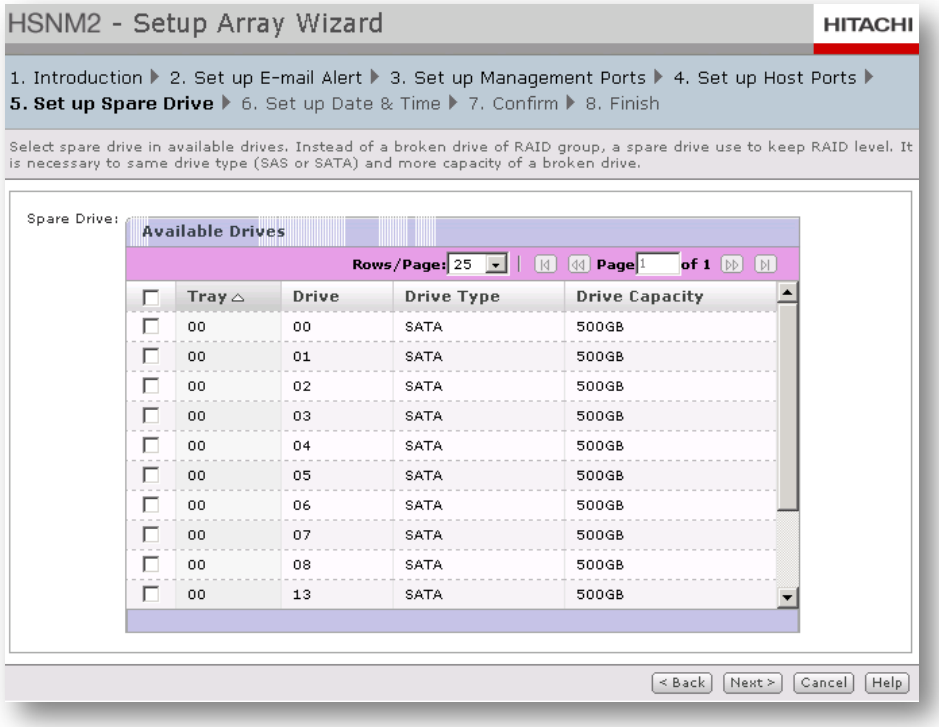
- Fibre Channel Configuration
  - Fibre Channel parameters are set to the **internal port** and not to the physical host connector.
  - The Adaptable Modular Storage **Port Address** parameter is the request for a Fibre Channel Arbitrated Loop Physical Address (**AL_PA**).
  - The **Topology Information** parameter has two settings:
    - **Loop** when **direct-connected**
    - **Point-to-Point** (P-to-P is **fabric mode** and should be used when **connected to a Fibre Channel switch**)
  - The **Transfer Rate** parameter has four settings: 1Gb/s, 2Gb/s and 4Gb/s (only with 4Gb/s hardware), and Auto.

    Recommended setting: Set this parameter to the **known** speed of the HBA or switch port.

33

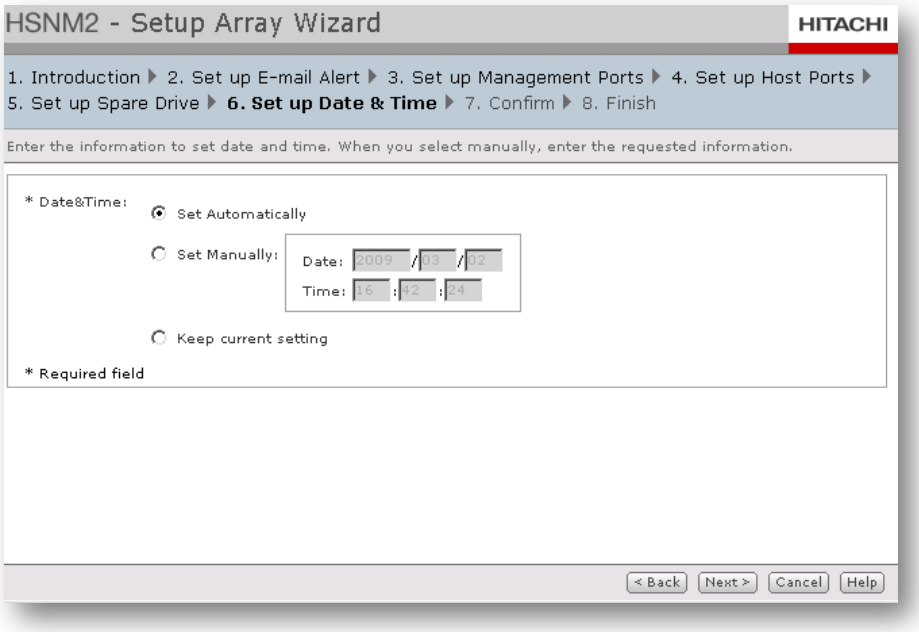
Initial Setup

- Set up Spare Drives



34

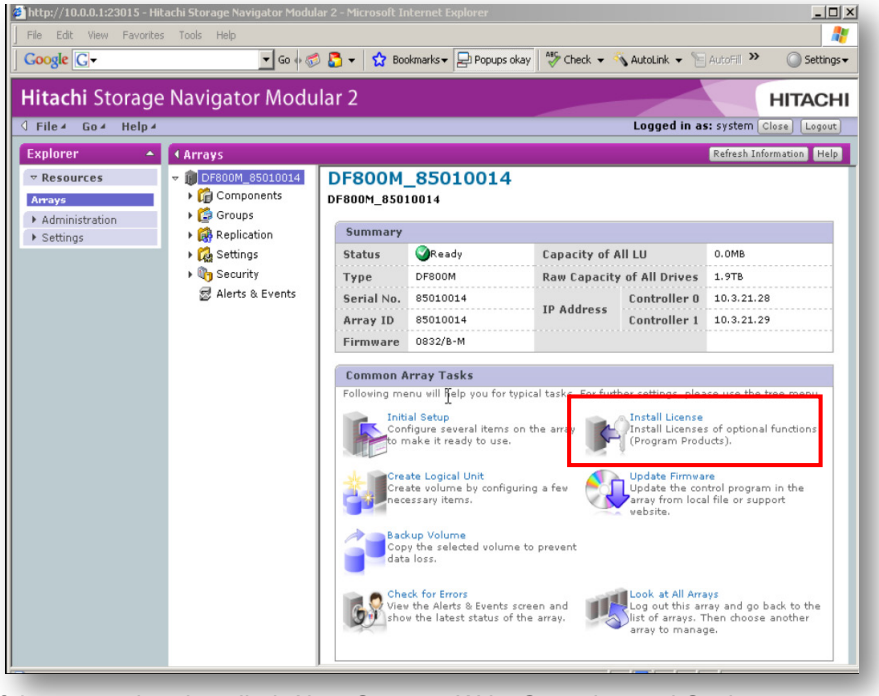
- Set up Date & Time



35

Enable License Keys

- Used to unlock Program Products (PPs)
  - Cache Partition Manager (CPM) feature
  - Cache Residency Manager feature *
  - LUN Manager
  - Modular Volume Migration
  - TrueCopy software
  - TrueCopy Extended software
  - ShadowImage software
  - Copy-on-Write Snapshot (COW) software*
  - Account Authentication*
  - Audit Logging
  - SNMP

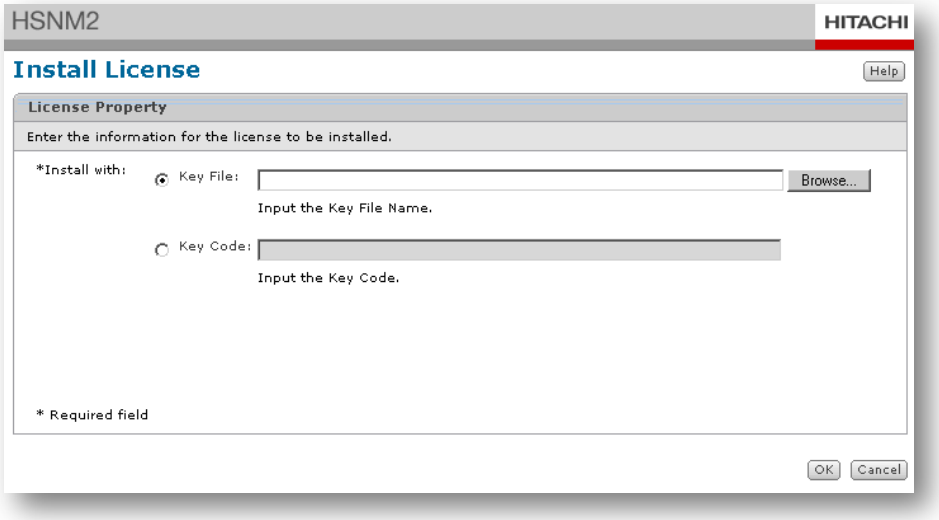


* These PPs require a **reboot** of the array when installed. Also, Copy-on-Write Snapshot and Cache Partition Manager will not load at the same time: COW will load and you will have to manually install **CPM**.

36

In most case these will be installed at the build center, but may or may not be enabled for use.

- Two methods of entering license keys:
  - Enter an individual 48-character key
  - Use the **Product License Key** file (.plk) and install multiple files at once
- Keys can be installed, de-installed, or features can be enabled or disabled.



37

Lab Project 3: SNM2 Installation and Initial Setup

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by their instructor.

Notes:

- Beginning with this lab project and through the remaining lab projects, it is important that **each lab project be followed and completed as written**. The reason for this is to insure that conditions and configurations created by one lab projected are in place at the beginning of a following lab project. **The array configuration is built upon as the course progresses** and in order for all the lab projects to flow smoothly, the expected configuration must exist.
- This does not mean that you cannot experiment, but remember to leave your array in the condition specified at the end of each lab project, and please remember that **specific time limits have been set** to insure all material of the course is effectively covered.

38

Lab Project 3: Objectives

- Upon completion of the lab project, the learner should be able to do the following:
  - Install the correct Java JRE on your management server
  - Configure the Java Runtime Parameter so Storage Navigator Modular 2 (SNM2) clients can utilize the Advanced Settings function of SNM2
  - Install SNM2, creating the SNM2 Management Server on your assigned lab management server
  - Initialize and set up the storage system for first time use
  - Register your assigned storage system with SNM2
  - Install Program Products license keys
  - Create new User accounts and assign role permissions

39

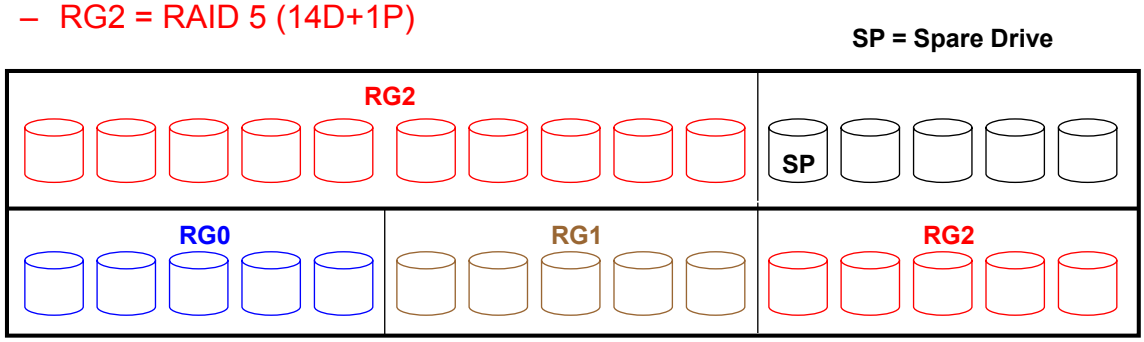
RAID Groups Logical Units Creation

- RAID Groups can be created in two ways:
  - **Automatic Selection** of disk drives
    - Takes drives in numerical order, skipping over unlike drives
  - **Manual Selection** of disk drives (HDD roaming)
    - Drives can be selected at random.
    - You **cannot** select drives of different **densities.**
    - You **can** select drives with different **RPMs.**
- **Logical Units** (**LU**) can be created in two ways:
  - **Create LU** (one at a time)
    - **Automatically**: User specifies the size, SNM2 creates LU from available free space.
    - **Manually**: The user selects one or more segments from a list of available free space segments.
  - Create and Map Volume Wizard (create several LUs at once)

40

RAID Groups versus Parity Groups

- Example of three RAID Groups
  - RG0 = RAID 5 (4D+1P)
  - RG1 = RAID 5 (4D+1P)
  - RG2 = RAID 5 (14D+1P)



When creating an RG, Hitachi Data Systems strongly recommends a **1-to-1** relationship between the RG and Parity Group to avoid any potential performance problems or recovery issues:

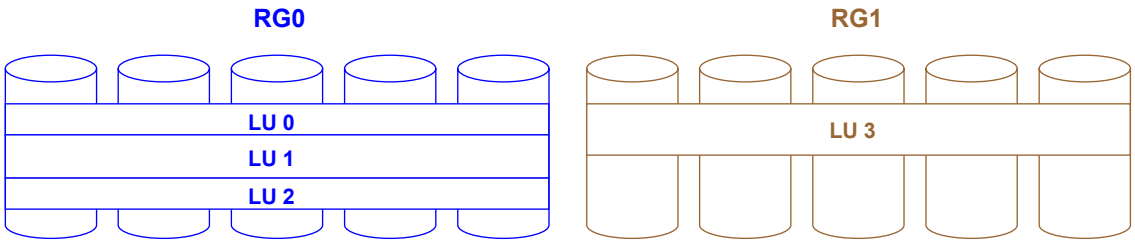
1. During a failure condition, there may be an impact to multiple workloads sharing the RAID Group, even if the LUN resides within the Parity Group that is not sparing out an HDD.
2. The space is concatenated, which means that a LUN may span the two Parity Groups within the RAID Group, thereby increasing the possibility of parity generation overhead.

41

- The building block for a RAID group is a parity group. The building block for parity group is a physical disk.
- 4D+1P refers to the layout of a parity group.
- Keep the ratio of RAID Group and parity Group at 1-to-1.

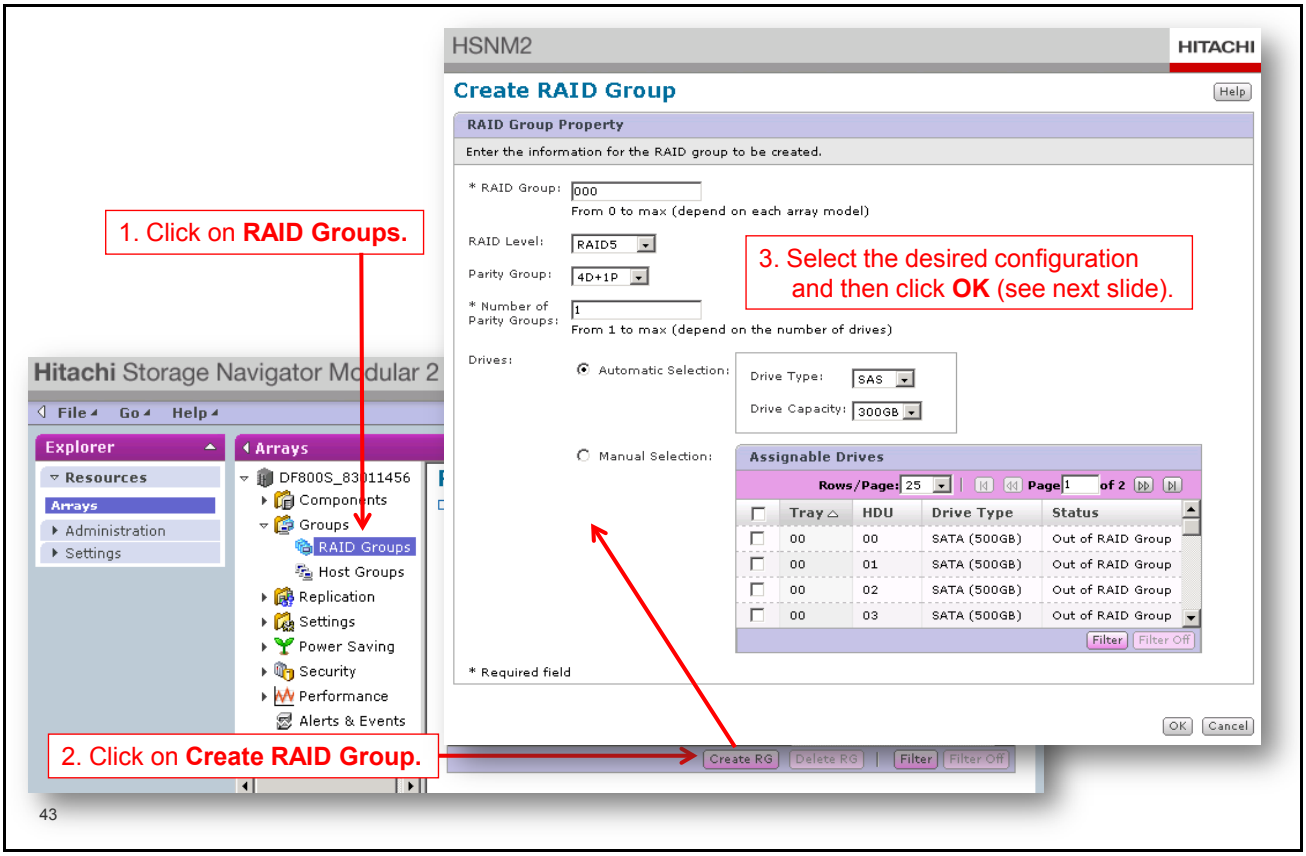
LU Configuration

- LUs are **slices** from the user data area of a RAID Group
  - 3 LUs form RG0
  - 1 LU from RG1
- Maximum LUs
  - Model 2100 = **2,048**
  - Model 2300 = **4,096**
  - Model 2500 = **4,096**

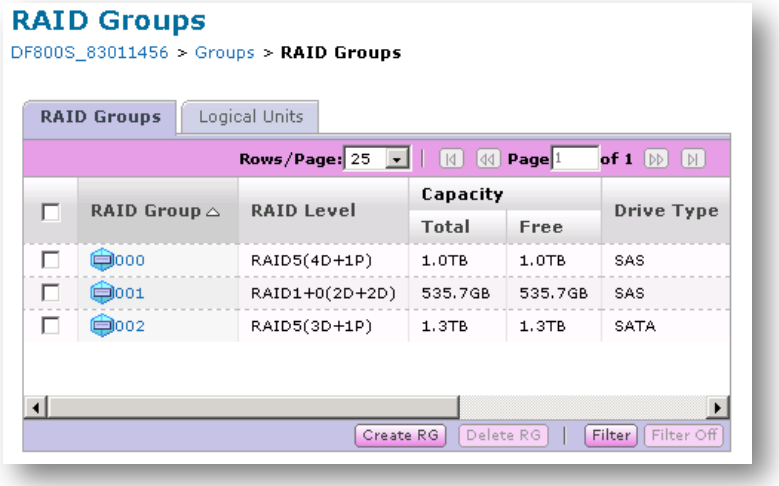


42

Creation of RAID Groups

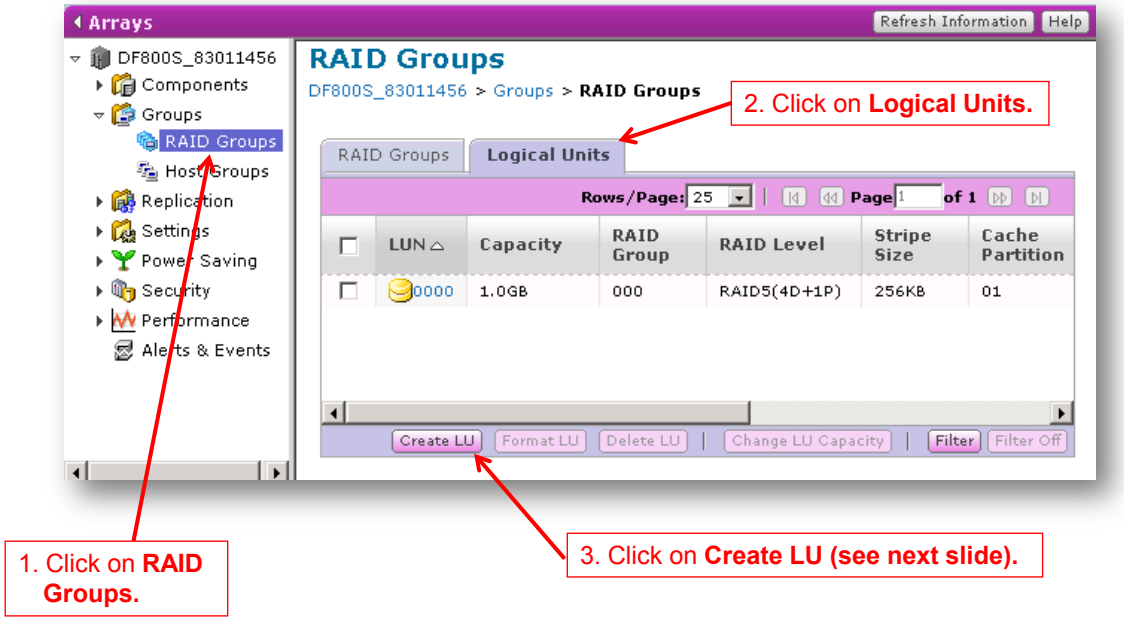


Example of Three RAID Groups

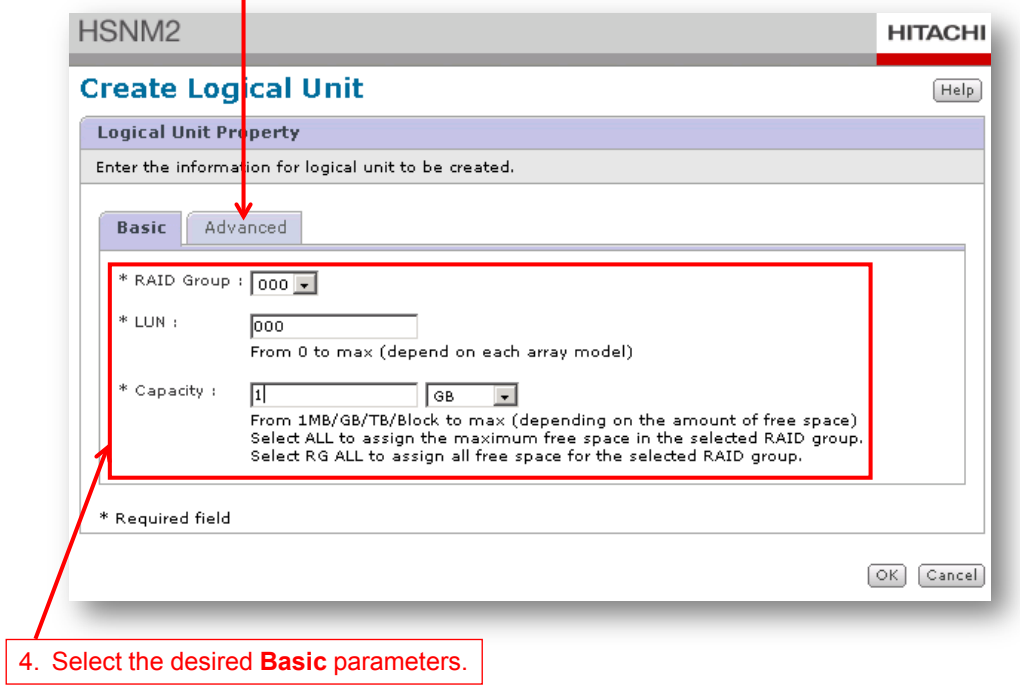


44

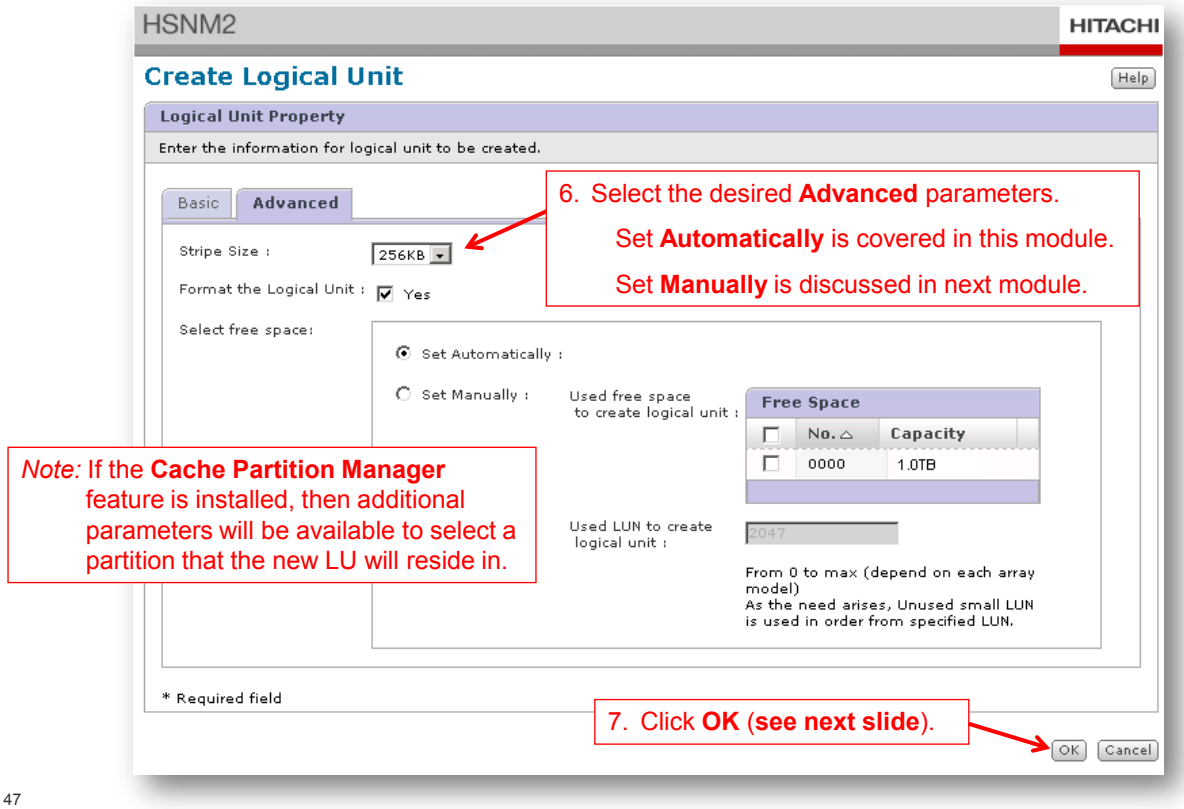
Create Logical Unit Automatically



45

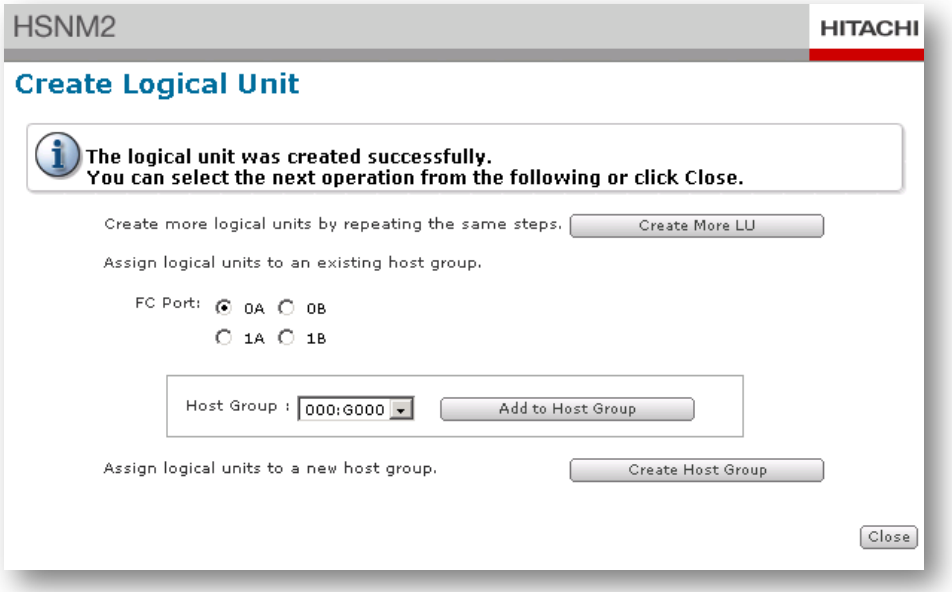

5. Click on **Advanced** to set additional parameters (**see next slide**).
HSNM2
HITACHI
Create Logical Unit
Help
Logical Unit Property
Enter the information for logical unit to be created.
Basic
Advanced
* RAID Group :
000
* LUN :
000
From 0 to max (depend on each array model)
* Capacity :
1
GB
From 1MB/GB/TB/Block to max (depending on the amount of free space)
Select ALL to assign the maximum free space in the selected RAID group.
Select RG ALL to assign all free space for the selected RAID group.
* Required field
OK
Cancel
4. Select the desired **Basic** parameters.

46


HSNM2
HITACHI
Create Logical Unit
Help
Logical Unit Property
Enter the information for logical unit to be created.
Basic
Advanced
6. Select the desired **Advanced** parameters.
Set **Automatically** is covered in this module.
Set **Manually** is discussed in next module.
Stripe Size :
256KB
Format the Logical Unit :
Yes
Select free space:
Set Automatically :
Set Manually :
Used free space to create logical unit :
Free Space
No.
Capacity
0000
1.0TB
Used LUN to create logical unit :
2047
From 0 to max (depend on each array model)
As the need arises, Unused small LUN is used in order from specified LUN.
Note: If the **Cache Partition Manager** feature is installed, then additional parameters will be available to select a partition that the new LU will reside in.
* Required field
7. Click **OK** (**see next slide**).
OK
Cancel

47

Map LU to Host Group

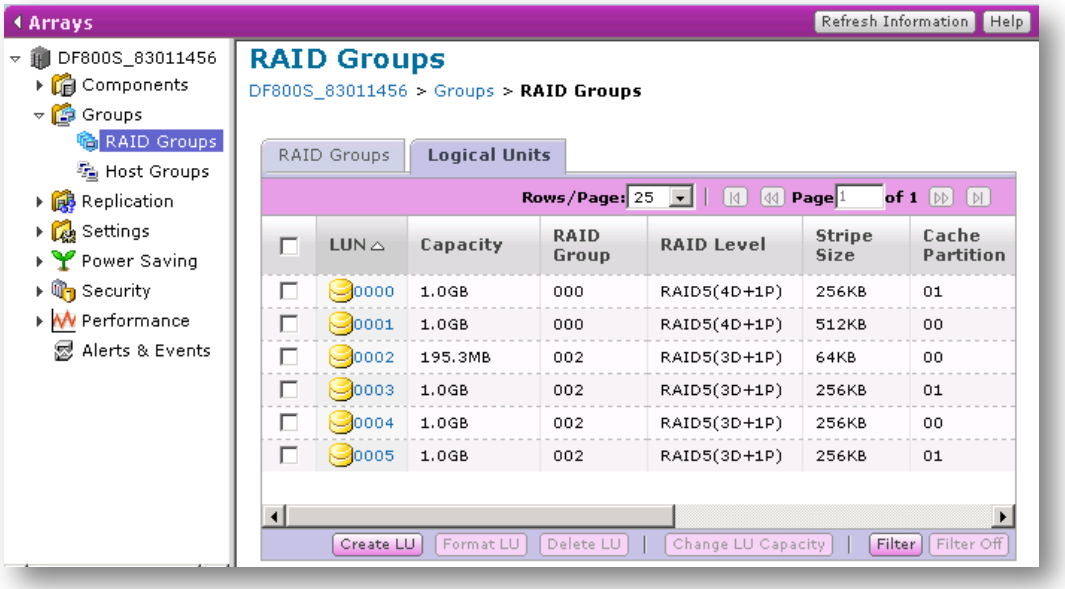


After the LU is created, you have the option to assign it to a **Port** and/or **Host Group**.

Host Groups, Host Group Security, and LU Mapping are discussed later.

48

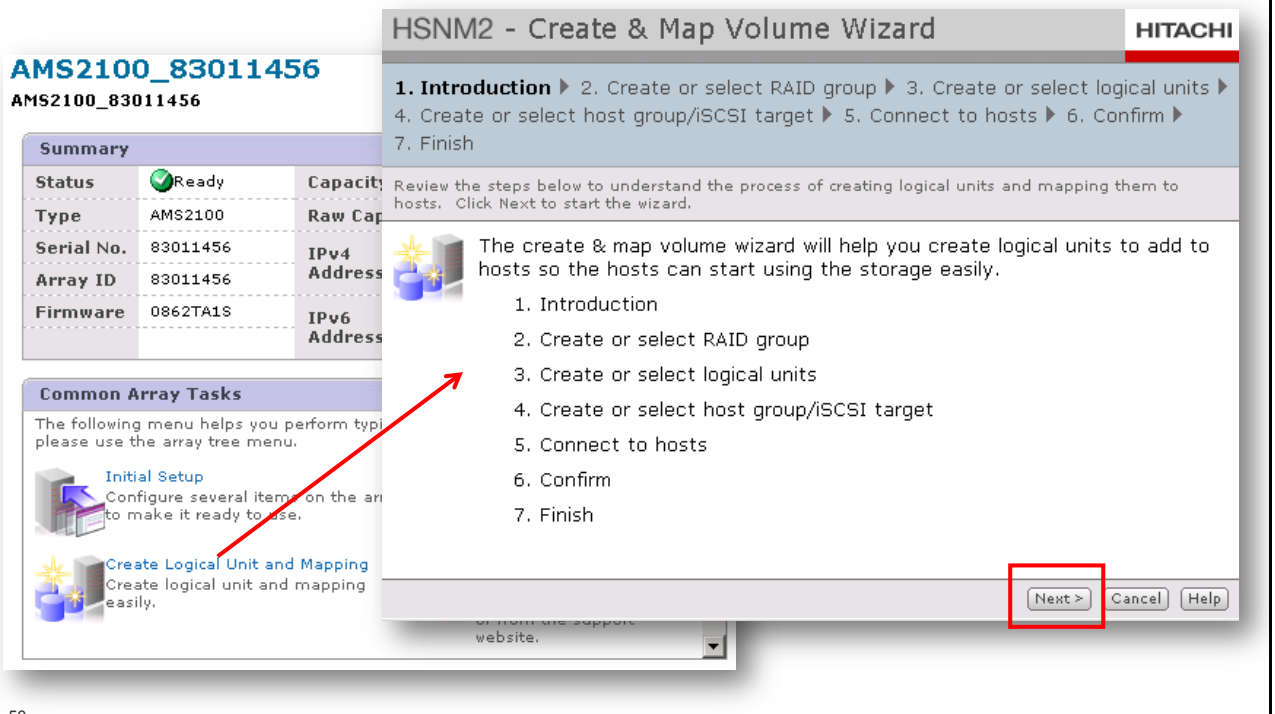
Example of Several LUs



49

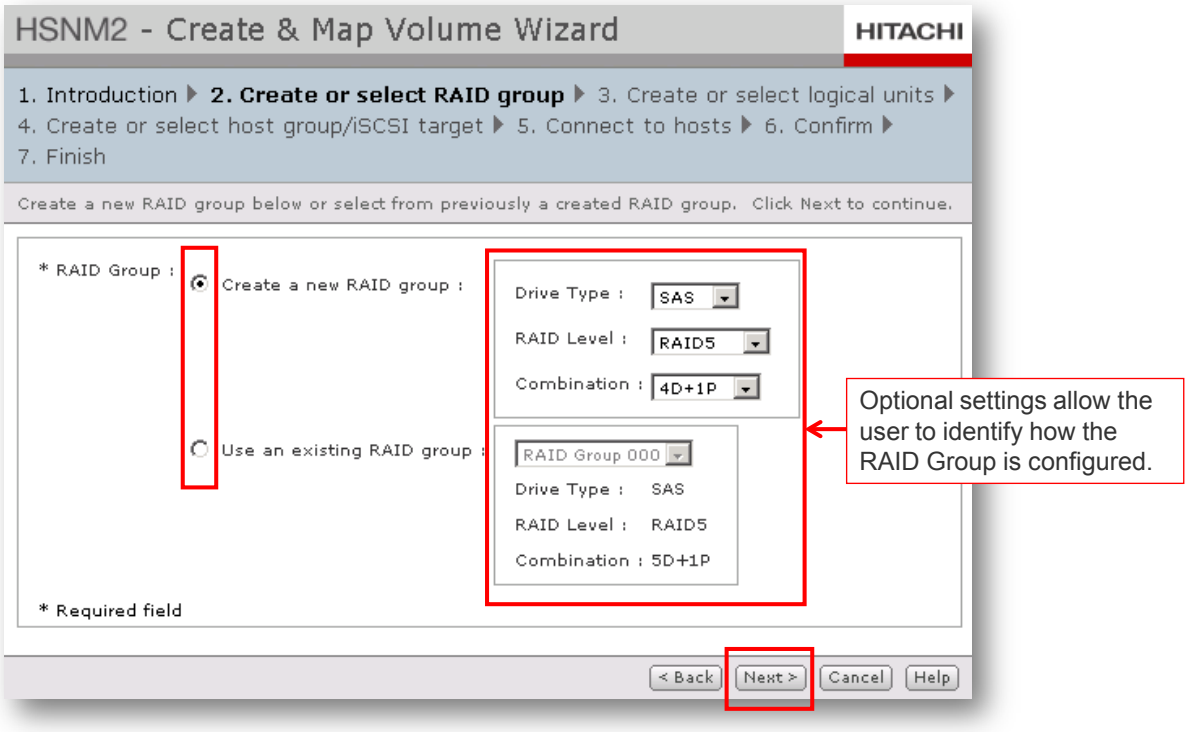
Create & Map Volume Wizard

- Flow of the Wizard

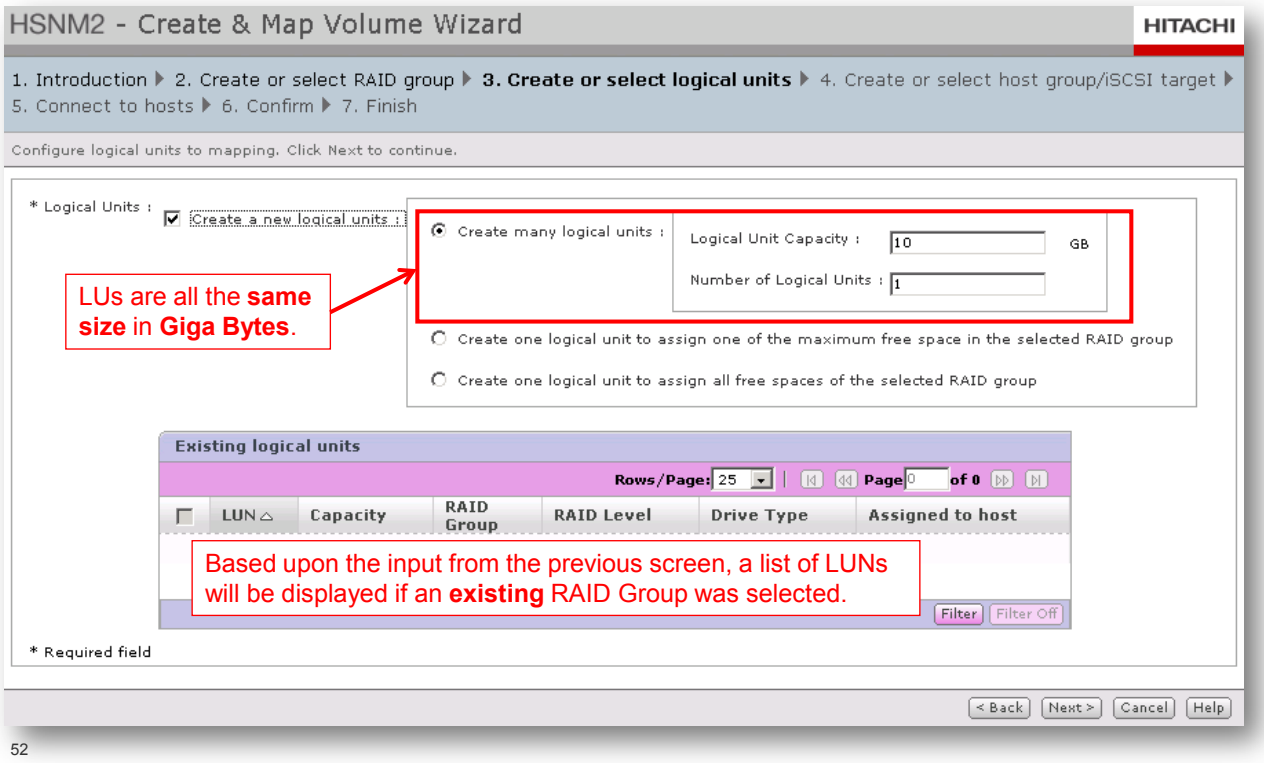


The flow is greatly improved from previous Hitachi modular systems.

- Second screen – Create or Select RAID Group information



- Third screen – Create or Select Logical Units



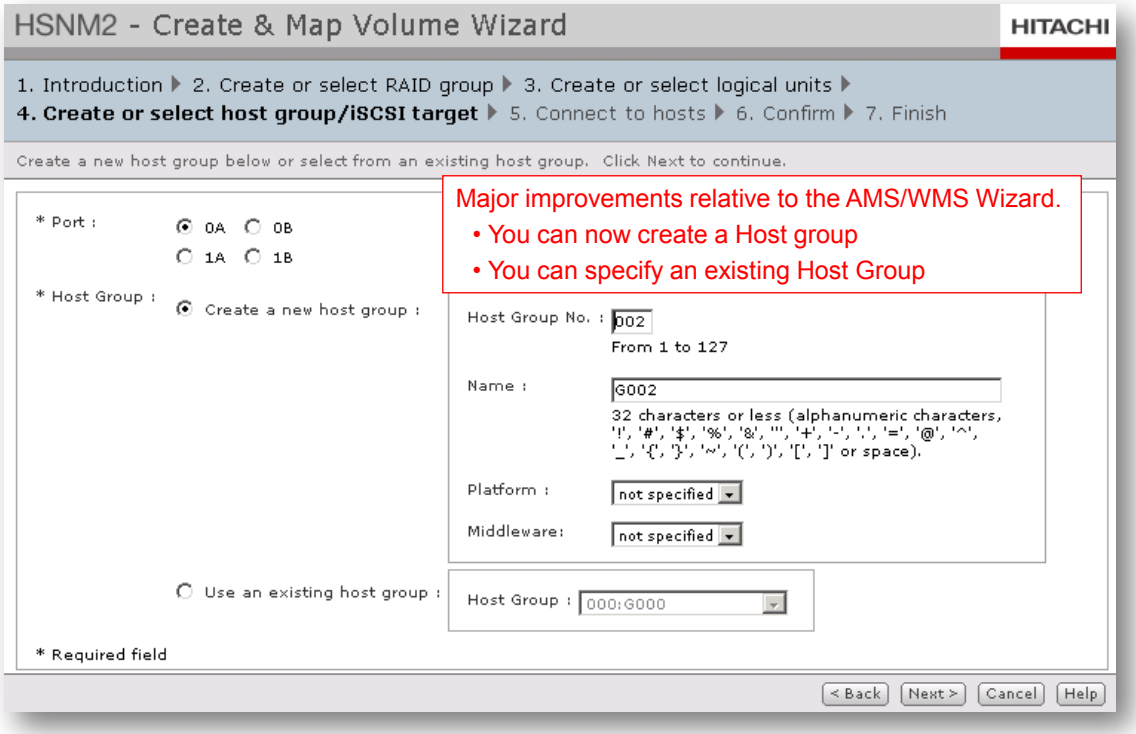
- Internal procedure used for creating LUs:

On what RAID group will the LUs be created?

RAID Configuration	Specification
An existing RAID Group with enough space is available.	LU or LUs will be created on the existing RAID group or you can select from a list of existing LUs.
No usable RAID Group available.	You can create a new RAID Group from which a new LU or LUs will be created.
No usable RAID group, and not enough unused HDDs for a new RAID Group.	The wizard will not allow the operation.

53

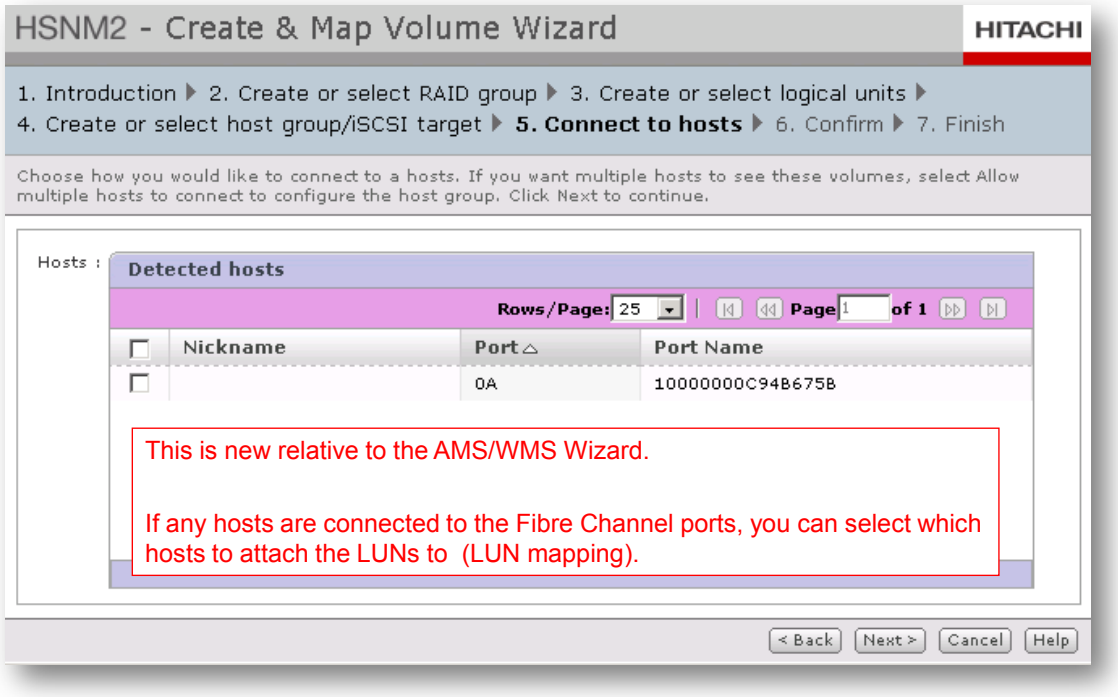
- Fourth screen – Create or Select Host Group



54

Before you can create a Host Group, you must enable Host Group Security for the front end FC ports.

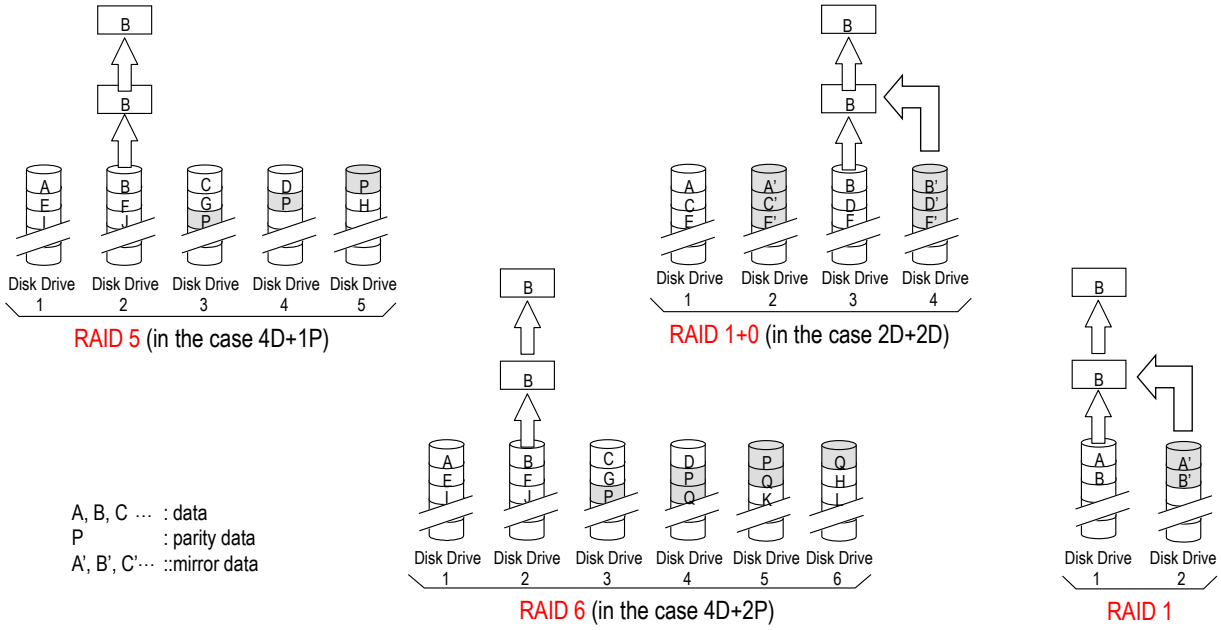
- Fifth Screen – Connect to Host Groups (LUN Mapping)



55

Normal RAID Group I/O Operations

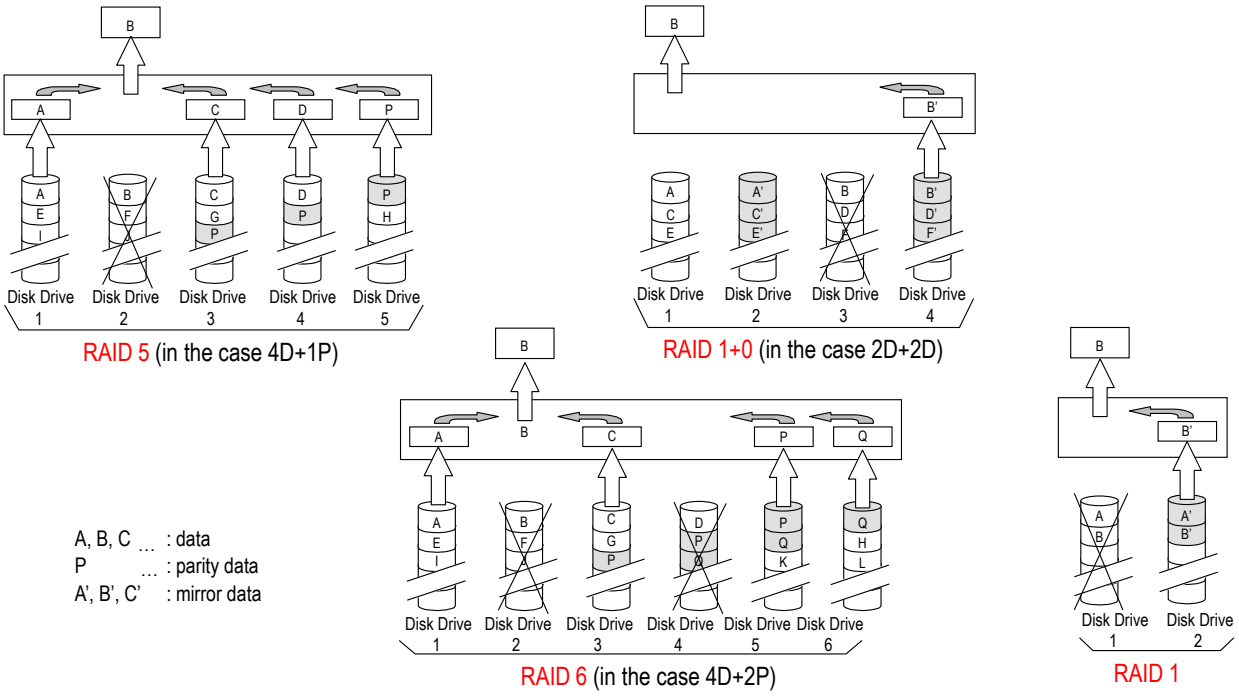
- I/O Operations – **Normal**



56

RAID Group I/O Operation on Drive Failure

- I/O Operation on **Drive Failure**



57

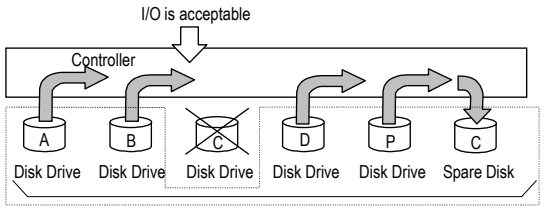
Sparing Out

- Two methods exist that support the *sparing-out* of RAID Group data:
  - **Correction copy**
    - Occurs when a drive in a RAID Group fails and a compatible spare drive exists.
    - **Data is reconstructed** on the spare drive.
  - **Dynamic sparing**
    - Occurs if the **online verify** process (built-in diagnostic) determines that the number of errors has exceeded the specified threshold of a disk in a RAID Group.
    - **Data is moved** to the spare disk (a much faster process than reconstruction).

58

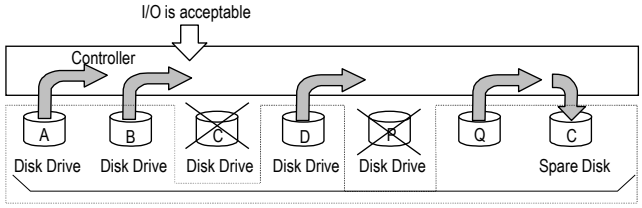
An AMS 2000 system supports up to 30 Spare Drives. Any disk can be configured as a spare drive. However, there are certain rules such as size, FC, and SATA mix.

Correction Copy

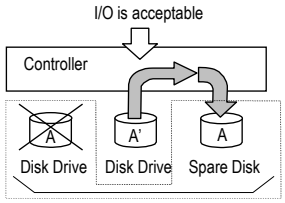


RAID 5 (in the case of 4D+1P)

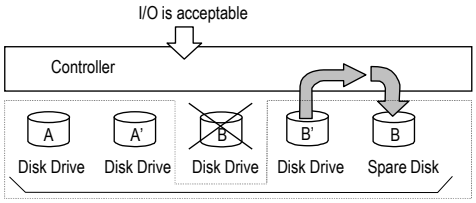
A, B, C ··· : data
P : parity data
A', B', C'··· : mirror data



RAID 6 (in the case of 4D+2P)



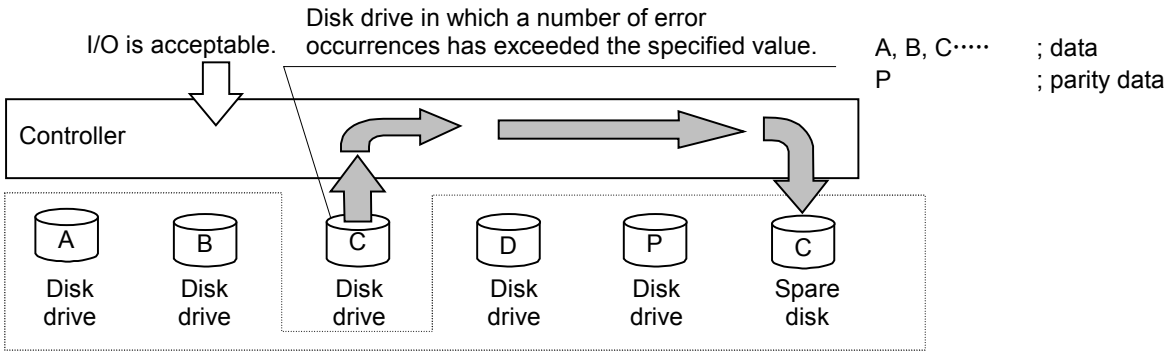
RAID 1



RAID 1+0 (in the case of 2D+2D)

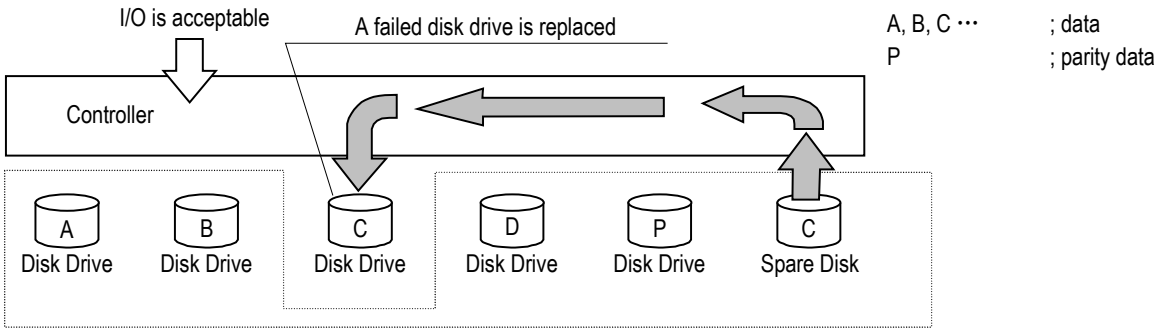
59

Dynamic Sparing



60

Copy Back



Note: The Copy Back operation is controlled by the **Spare Drive Operation Mode** parameter. This parameter has two settings:

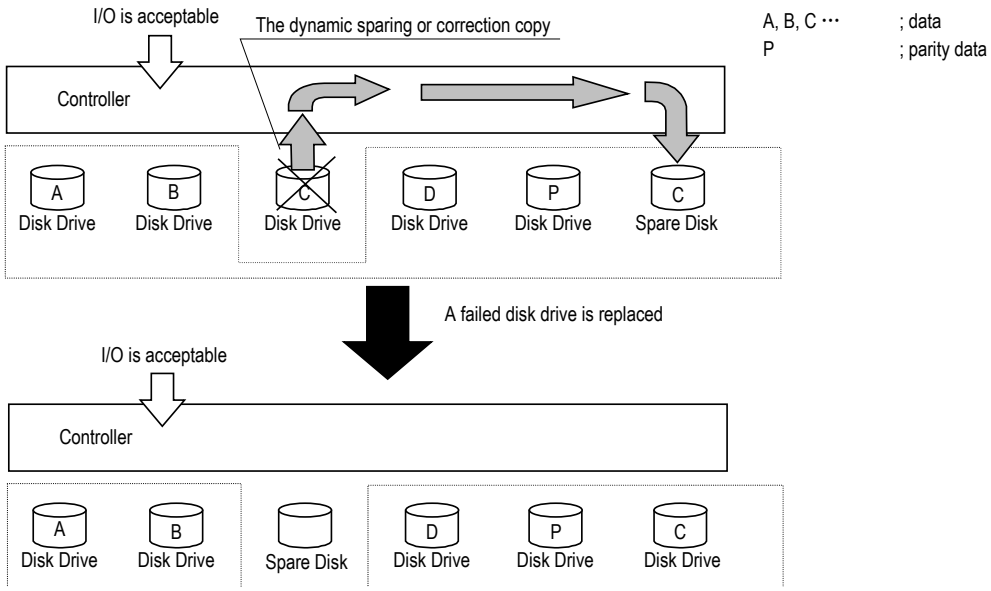
Variable (the default) = **No copy back**

Fixed = **Copy Back**

61

In case a copy is required, the system simply copies the data from the spare disk that was being used to the new replacement disk C in this example.

No Copy Back



Note: The Copy Back operation is controlled by the **Spare Drive Operation Mode** parameter. This parameter has two settings:

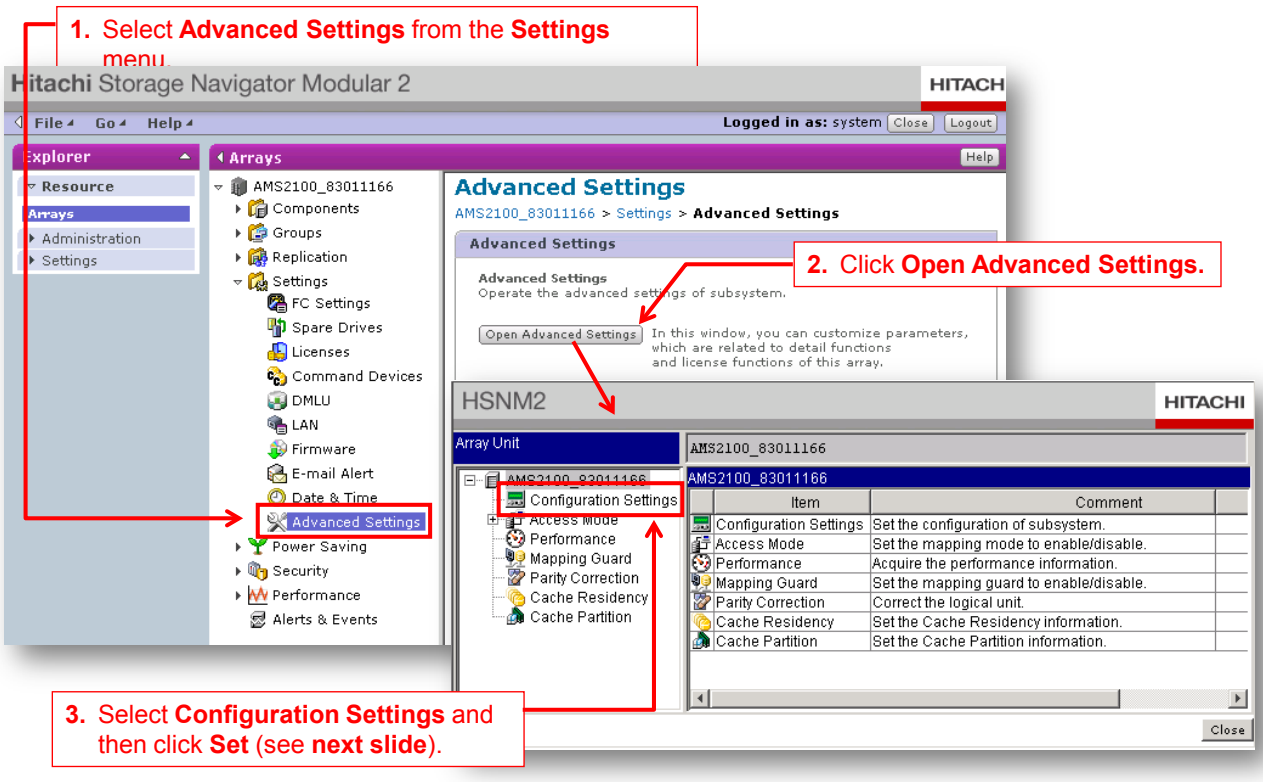
Variable (the default) = **No copy back**

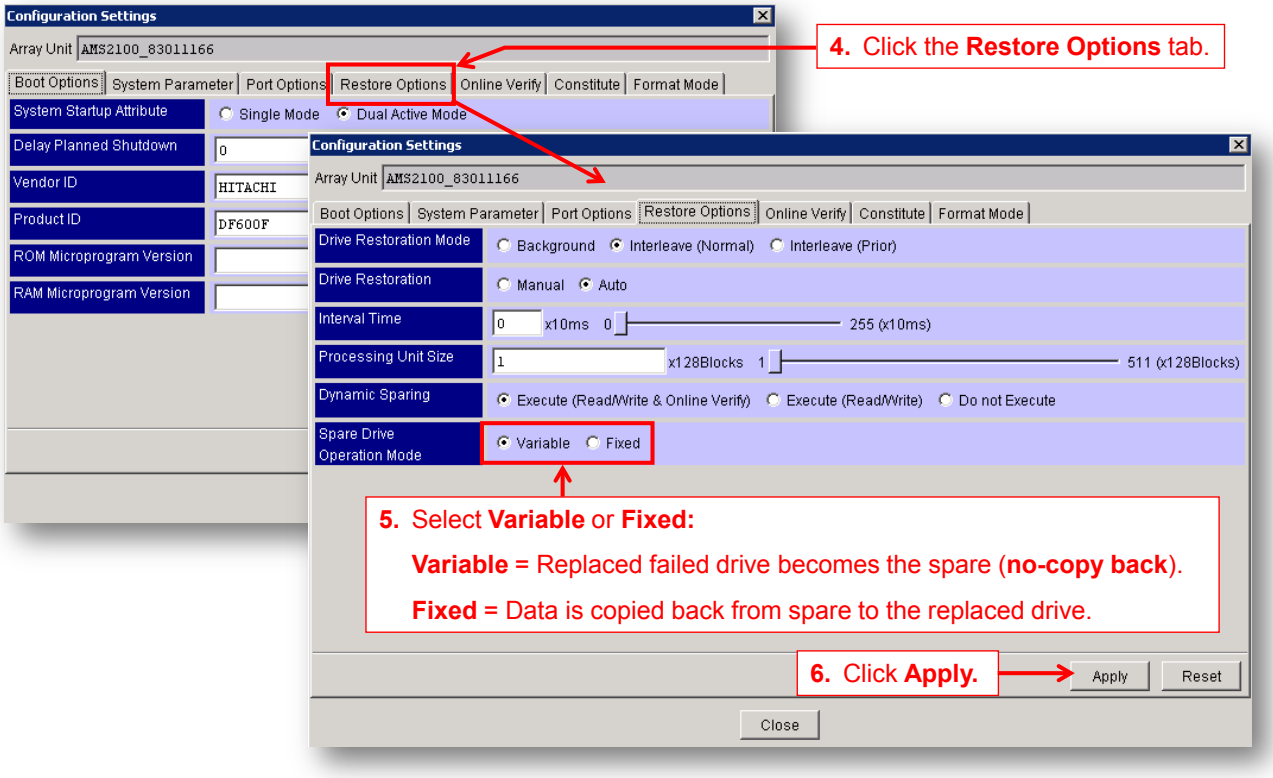
Fixed = **Copy Back**

62

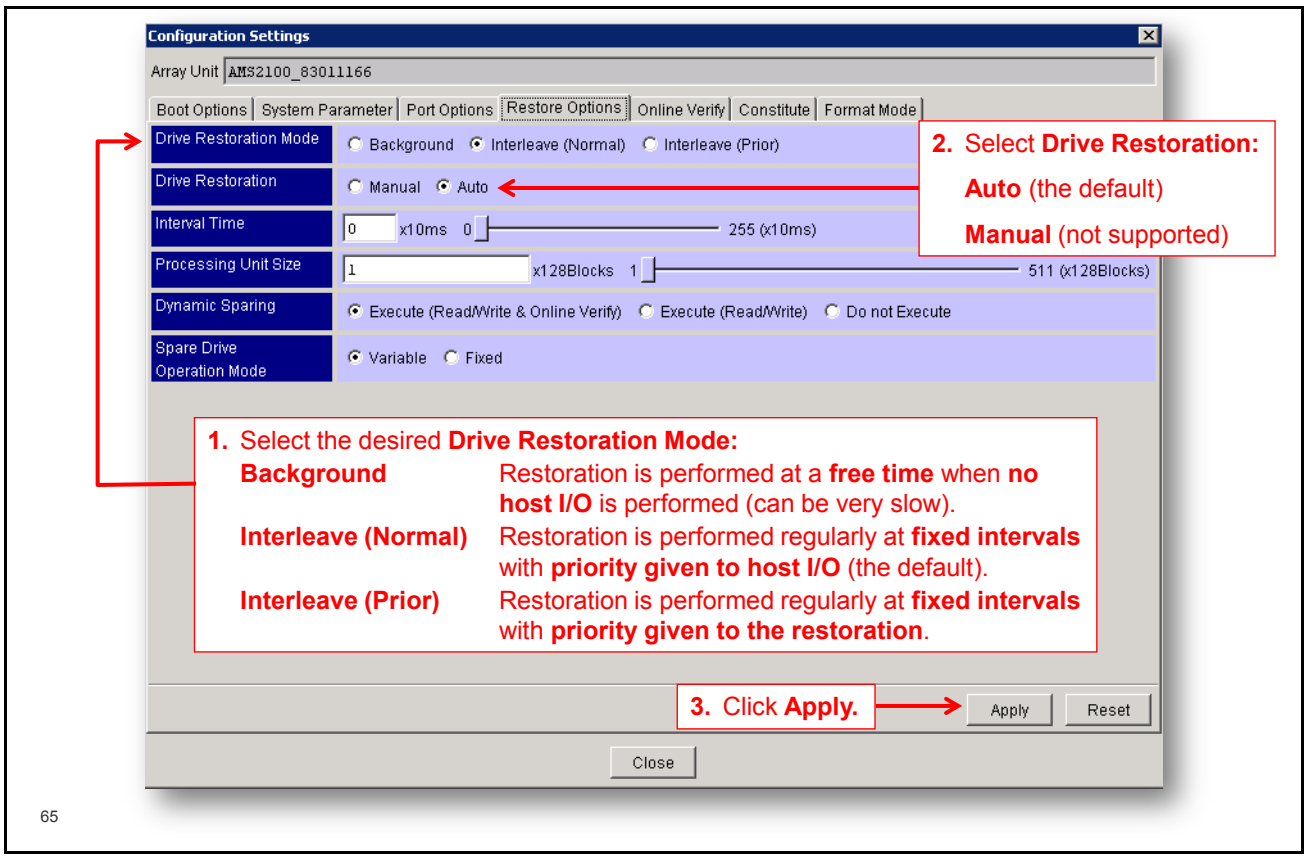
If the HDD Roaming rules allow this process, after a dynamic sparing process or correction copy, the spare disk will become a permanent member of the RAID Group and a copy back will not occur.

Setting Spare Drive Operation Mode




Configuration Settings
Array Unit AMS2100_83011166
Boot Options
System Parameter
Port Options
Restore Options
Online Verify
Constitute
Format Mode
System Startup Attribute
Single Mode
Dual Active Mode
Delay Planned Shutdown
Vendor ID
HITACHI
Product ID
DF600F
ROM Microprogram Version
RAM Microprogram Version
4. Click the Restore Options tab.
Drive Restoration Mode
Background
Interleave (Normal)
Interleave (Prior)
Drive Restoration
Manual
Auto
Interval Time
x10ms
255 (x10ms)
Processing Unit Size
x128Blocks
511 (x128Blocks)
Dynamic Sparing
Execute (Read/Write & Online Verify)
Execute (Read/Write)
Do not Execute
Spare Drive Operation Mode
Variable
Fixed
5. Select Variable or Fixed:
Variable = Replaced failed drive becomes the spare (no-copy back).
Fixed = Data is copied back from spare to the replaced drive.
6. Click Apply.
Apply
Reset
Close
64

Setting Drive Restoration Mode



Lab Project 4: Basic Operations

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by the instructor.

66

Lab Project 4: Objectives

- Upon completion of the lab project, the learner will be able to do the following:
  - Create several RAID Groups specifying different RAID levels and disk combinations using both **Automatic** and **Manual** selection of the disk drives
  - Delete a RAID Group
  - Manually create several Logical Units of different sizes.
  - Delete a Logical Unit
  - Set the Spare Drive Operation Mode to **fixed** (copy-back function)

67

Host Connectivity Basics

- Basic steps for connecting the model 2000 systems to open systems hosts:
  1. Verify that the host has a compatible OS and HBAs
     - Required patches and software are installed.
     - HBAs are running with the correct version of firmware.
     - You can refer to **HiFire** for this information.
  2. Connect ports to HBAs (direct connect - loop) or Switch (point-to-point)
  3. Set correct Topology and Transfer Rate for each HBA and AMS 2000 port
  4. Verify Fibre Channel Link and Login
  5. Enable Host Group Security on desired storage system ports
  6. Create RAID Groups and LUs
  7. Create Host Groups and associate the correct HBA WWNs to each Host Group
  8. Map Internal storage system LUs to Host Group LUs
  9. Verify the Host detection of LUs and prepare LUs for use

68

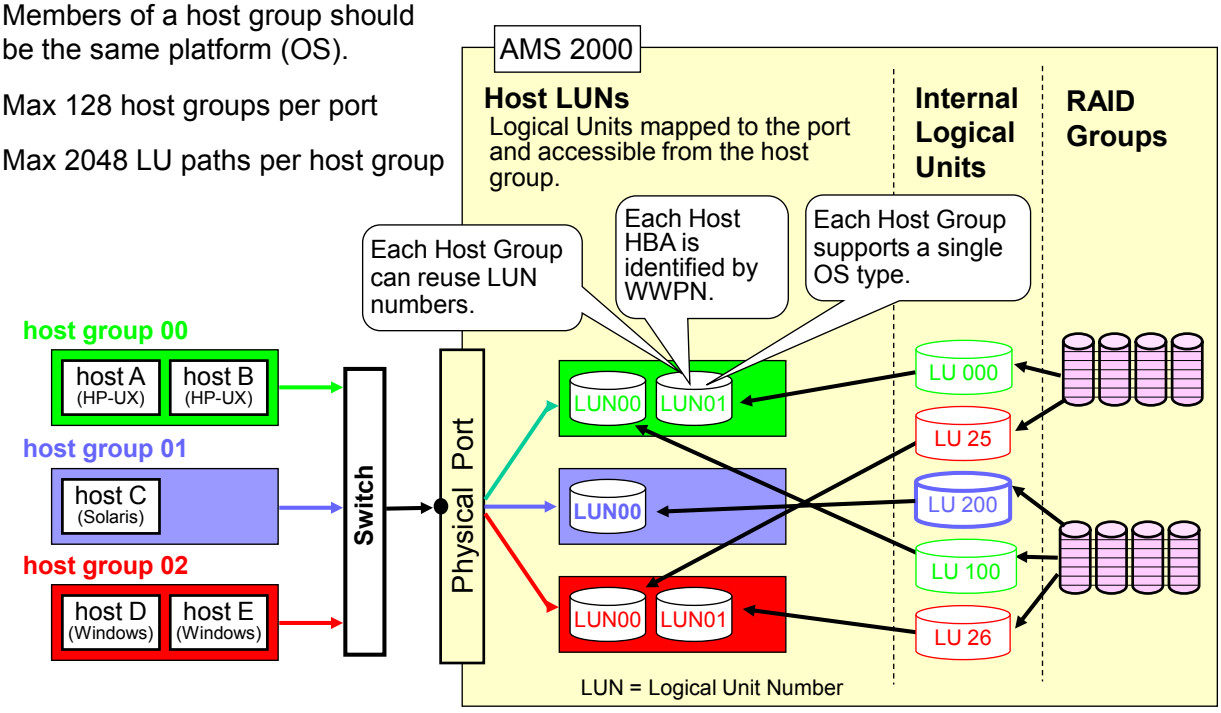
Host Groups and LUN Mapping

- Host Groups allow for the Heterogeneous Multi-Host Connections.
- **LUN Manager** is the Program Product that manages access paths between hosts and logical units for each port.
- Illegal access to LUNs from any host system can be prevented using the **LUN Security** feature.
- Host Group is a **virtual port** created on the physical port.
  - Host Group can be tuned to the connected host OS.
  - Each physical port has **one** default Host Group (Host Group **000**).
- **Internal** LUs are mapped to a Host Group as **Host LUNs.**
  - Two of more hosts that require a LUN 0 can be connected to the same port.

69

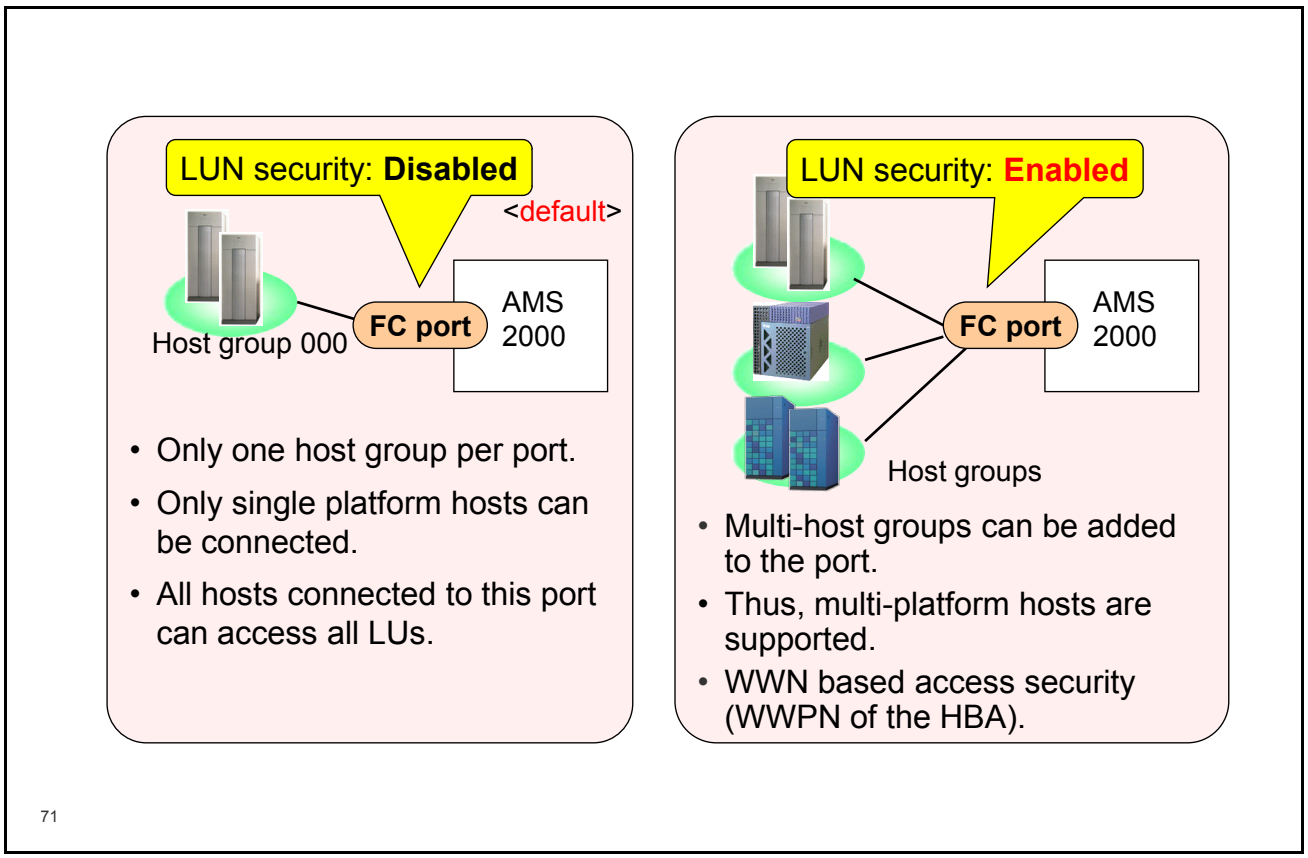
Host Groups

- Members of a host group should be the same platform (OS).
- Max 128 host groups per port
- Max 2048 LU paths per host group



70

Host Group Security (LUN Security)



To protect mission-critical data in your disk storage system from unauthorized access, you should implement LUN security. LUN security allows you to prevent unauthorized hosts from either seeing or accessing the data on the secured LU. If LUN security is applied to a particular port, that port can only be accessed from within its own host group (also known as a host storage domain). The hosts cannot access LUs associated with the other host groups.

Host Group — Options Settings

- Options Settings
  - **Platform**:
    - HP-UX, Solaris, AIX, Linux, Windows, and VMware
    - ***not specified*** is the default
  - **Middleware**:
    - VCS and TruCluster
    - ***not specified*** is the default

Note: Refer to the System Parameter section of the latest *Maintenance Manual* or the *Adaptable Modular Storage 2000 Family Host Installation Guides* for a complete list of all options, settings, and combinations.

72

VCS = Veritas™ Cluster Server

TruCluster = HP high availability cluster server

Host Group — Common Settings

- The following describes the I/F specification and purpose of the Connection Settings:

No	Mode	I/F Specifications	Purpose
1	Standard Mode	(standard)	---
2	Open VMS Mode	Exclusive format on Inquiry(83H) byte0 data for Open VMS	Necessary to connect Open VMS
3	TRESPASS Mode	Add LU ownership information to Inquiry byte0 data	Necessary to connect Sequent, egenera, VVM V3.0SP1/V3.1
4	Wolfpack Mode	Adjust management of SCSI command to MSCS	Necessary to connect MSCS

73

Host Group — Additional Settings

- Additional Settings

  When the Platform or Middleware settings are selected, corresponding **Additional Setting** parameters are set automatically.

No.	Mode	Purpose
1	HP-UX Mode	This mode makes LUs, whose LU numbers are 8 up to 63, recognized when the subsystem is connected to the HP server.
2	PSUE Read Reject Mode	Set it when the fence level of TrueCopy remote replication is used with Data and the pair status suppresses the read access to P-VOL at the time of PSUE transition.
3	Mode Parameters Changed Notification Mode	Unit attention (06/2A00) is reported.
4	NACA Mode	Supports NACA (Normal Auto Contingent Allegiance) that is a standard on SCSI-3.
5	Task Management Isolation Mode	Set it when the own port also does not reset the command while another port received the command reset instruction.
6	Unique Reserve Mode 1	Supports Persistent Reserve command.
7	Port-ID Conversion Mode	This mode enables Port-ID that reported by Inquiry command is converted. Do not set it usually.

74

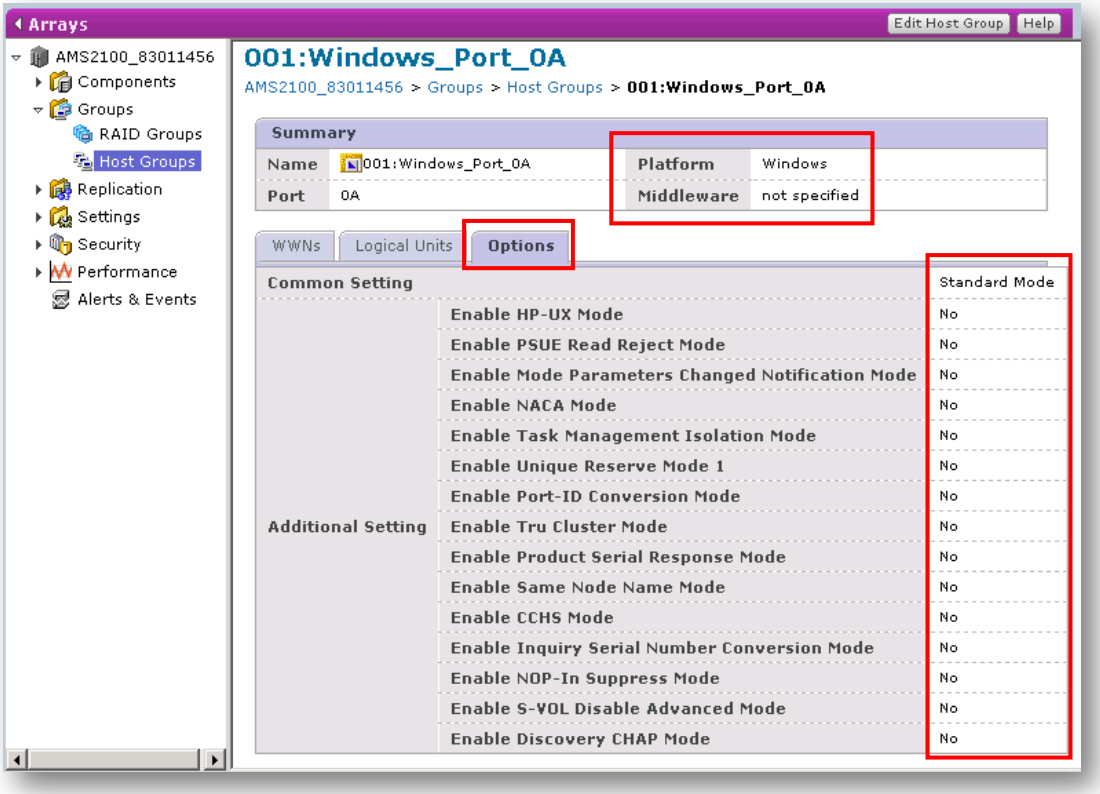
Connecting to the Host

- Additional Settings

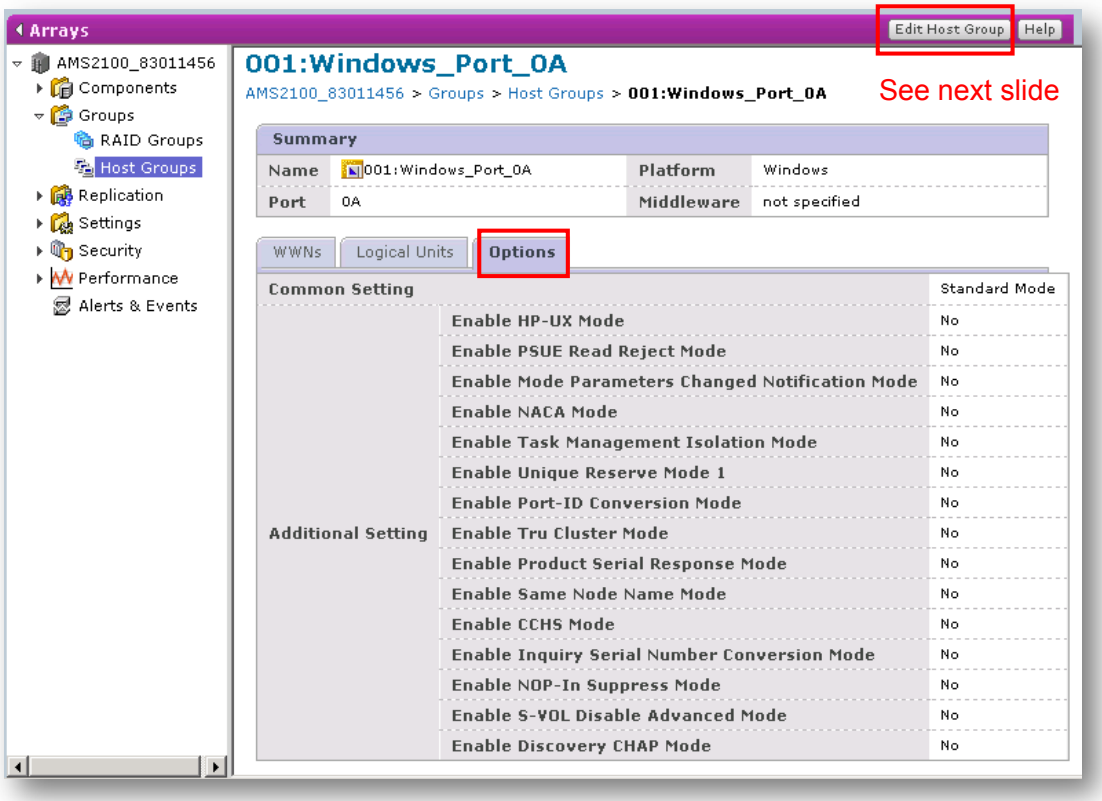
No.	Mode	Purpose
8	Tru Cluster Mode	When using Tru Cluster, set this mode.
9	Product Serial Response Mode	This mode enables each LU to be assigned a unique DID in the SUN Cluster 3.0 system.
10	Same Node Name Mode	This mode allows each port of same array to respond as the same World Wide Node Name.
11	CCHS Mode	CCHS convert Mode
12	Inquiry Serial Number Conversion Mode	This mode enables the serial number that is reported by the Inquiry command to be converted. Usually, do not set it.
13	NOP-In Suppress Mode	This mode suppresses that NOP-In transmission.
14	S-VOL Disable Advanced Mode	When using C2NAS, set this mode.

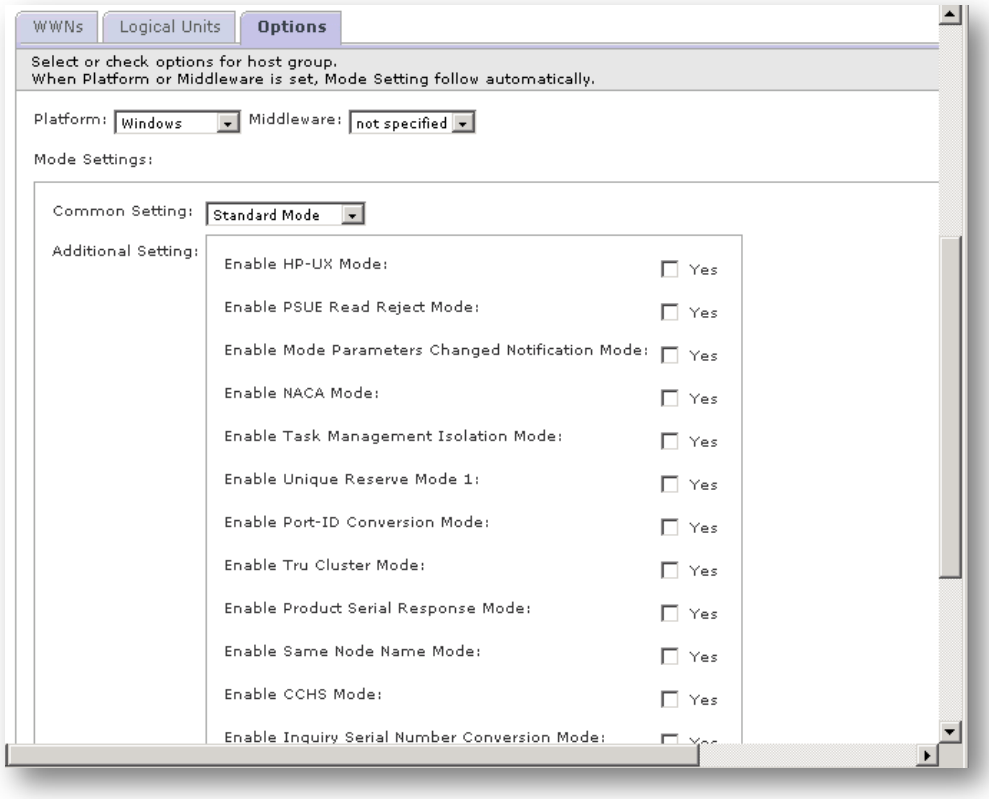
75

View Host Group Parameters



Edit the Host Group Parameters




WWNs
Logical Units
Options
Select or check options for host group.
When Platform or Middleware is set, Mode Setting follow automatically.
Platform: Windows
Middleware: not specified
Mode Settings:
Common Setting: Standard Mode
Additional Setting:
Enable HP-UX Mode: Yes
Enable PSUE Read Reject Mode: Yes
Enable Mode Parameters Changed Notification Mode: Yes
Enable NACA Mode: Yes
Enable Task Management Isolation Mode: Yes
Enable Unique Reserve Mode 1: Yes
Enable Port-ID Conversion Mode: Yes
Enable Tru Cluster Mode: Yes
Enable Product Serial Response Mode: Yes
Enable Same Node Name Mode: Yes
Enable CCHS Mode: Yes
Enable Inquiry Serial Number Conversion Mode:

78

World Wide Names

- Adaptable Modular Storage World Wide Names (WWNs)
  - Each Hitachi storage system sets its own WWN for each port.
  - Each WWN is the result of the following:
    - Specific bits are determined by the storage family and model.
    - The system serial number is part of the WWN.
    - The last digit of the WWN identifies the port.

79

The first **three** digits identify the **model**, the last **five** digits the **Serial Number**:

830XXXXX = model 2100
850XXXXX = model 2300
870XXXXX = model 2500

For Example: 85011251$_{10}$ (a decimal value)

11251
+ 10000 (add this offset)
21251$_{10}$

WWN

5 0 0 6 0 E 8 0 1 0 4 5 3 0 3 0$_{16}$

Fixed

Model descriptor
2 = 2300
4 = 2100
0 = 2500

Serial Number
In Hexadecimal

Refers to the physical
FC Host Connector Port
See next slide

80

2100	2300	2500
CTL0 Port A = 0 CTL0 Port B = 1 CTL1 Port A = 2 CTL1 Port B = 3	CTL0 Port A = 0 CTL0 Port B = 1 CTL0 Port C = 2 CTL0 Port D = 3 CTL1 Port A = 4 CTL1 Port B = 5 CTL1 Port C = 6 CTL1 Port D = 7	CTL0 Port A = 0 CTL0 Port B = 1 CTL0 Port C = 2 CTL0 Port D = 3 CTL0 Port E = 4 CTL0 Port F = 5 CTL0 Port G = 6 CTL0 Port H = 7 CTL1 Port A = 8 CTL1 Port B = 9 CTL1 Port C = A CTL1 Port D = B CTL1 Port E = C CTL1 Port F = D CTL1 Port G = E CTL1 Port H = F

81

Fibre Channel Parameters

- Fibre Channel Configuration
  - Fibre Channel parameters are set to the **internal port** and not to the physical host connector.
  - The Adaptable Modular Storage **Port Address** parameter is the request for a Fibre Channel Arbitrated Loop Physical Address (**AL_PA**).
  - The **Topology Information** parameter has two settings:
    - **Loop** when **direct-connected**
    - **Point-to-Point** (P-to-P is **fabric mode** and should be used when **connected to a Fibre Channel switch**)
  - The **Transfer Rate** parameter has four settings: 1Gb/s, 2Gb/s and 4Gb/s (only with 4Gb/s hardware), and Auto.

    Recommended setting: Set this parameter to the **known** speed of the HBA or switch port.

82

Host HBA Persistent Binding

- If your host systems are connected to a Fibre Channel switch, HDS strongly recommends that host HBA Persistent Binding be configured.
  - User associates WWPN of the connected storage array port to a specified Target ID (TID).
  - LUNs are identified and associated to the TID.
  - Binding prevents the TID from changing when devices join or leave the fabric.
  - If the TID changes, the host will lose access to the LUNs on that path.

83

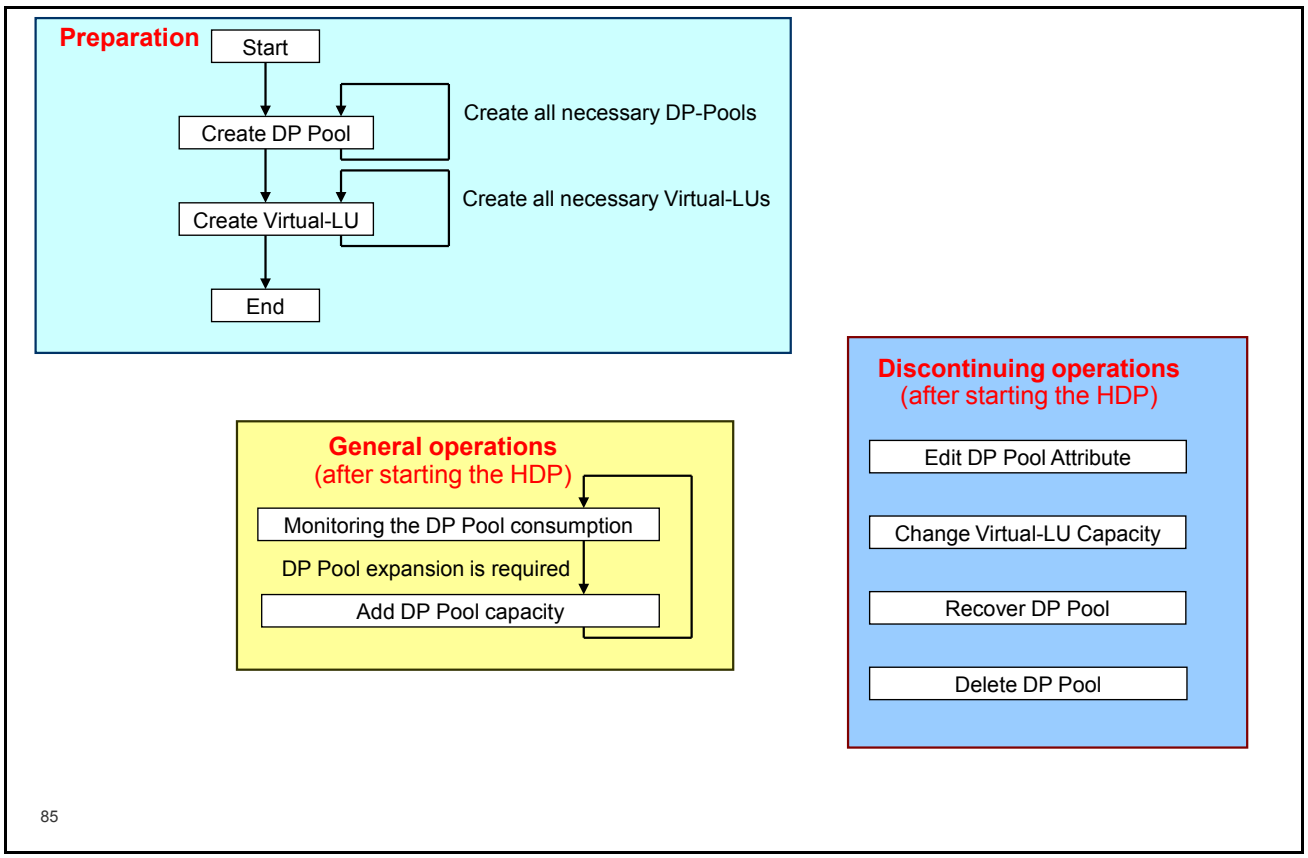
Persistent Binding is also known as LUN mapping or mapping.

HSNM2 Procedures

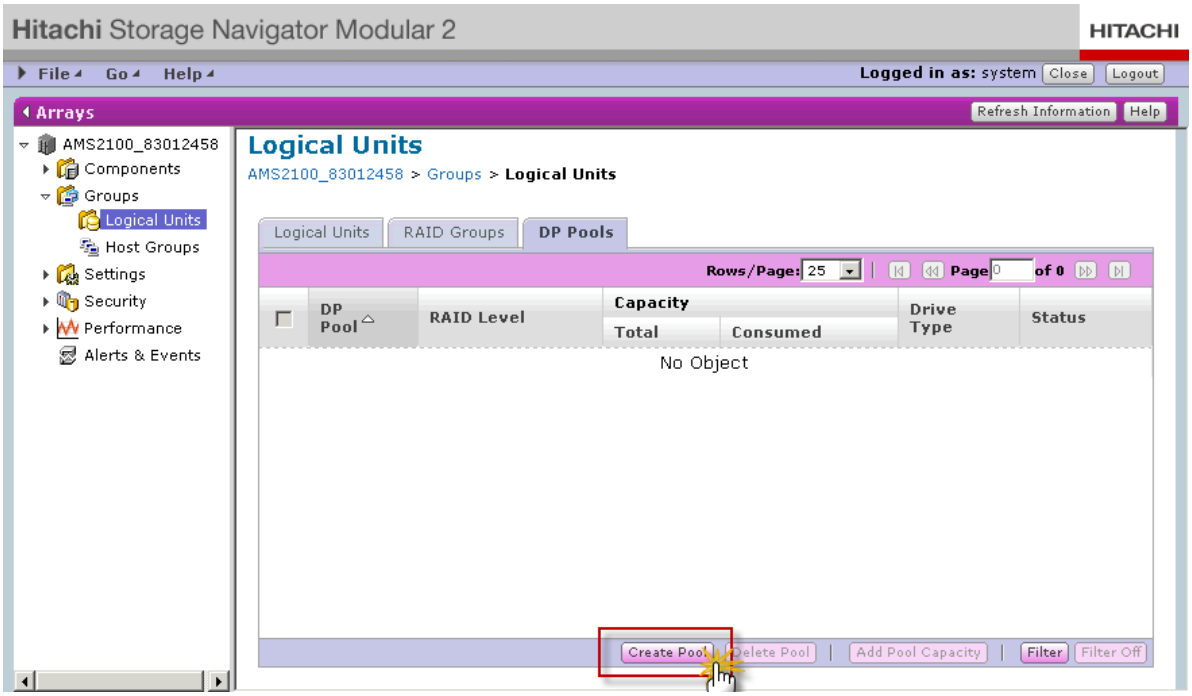
- General operation flow
- Create DP Pool
- Create Logical Unit (Virtual-LU)
- Monitoring the DP Pool consumption (get DP Pool Trend information)
- Add DP Pool Capacity
- Edit DP Pool Attribute
- Change Logical Unit (Virtual-LU) Capacity
- Recover DP Pool
- Delete DP Pool

84

General Operation Flow

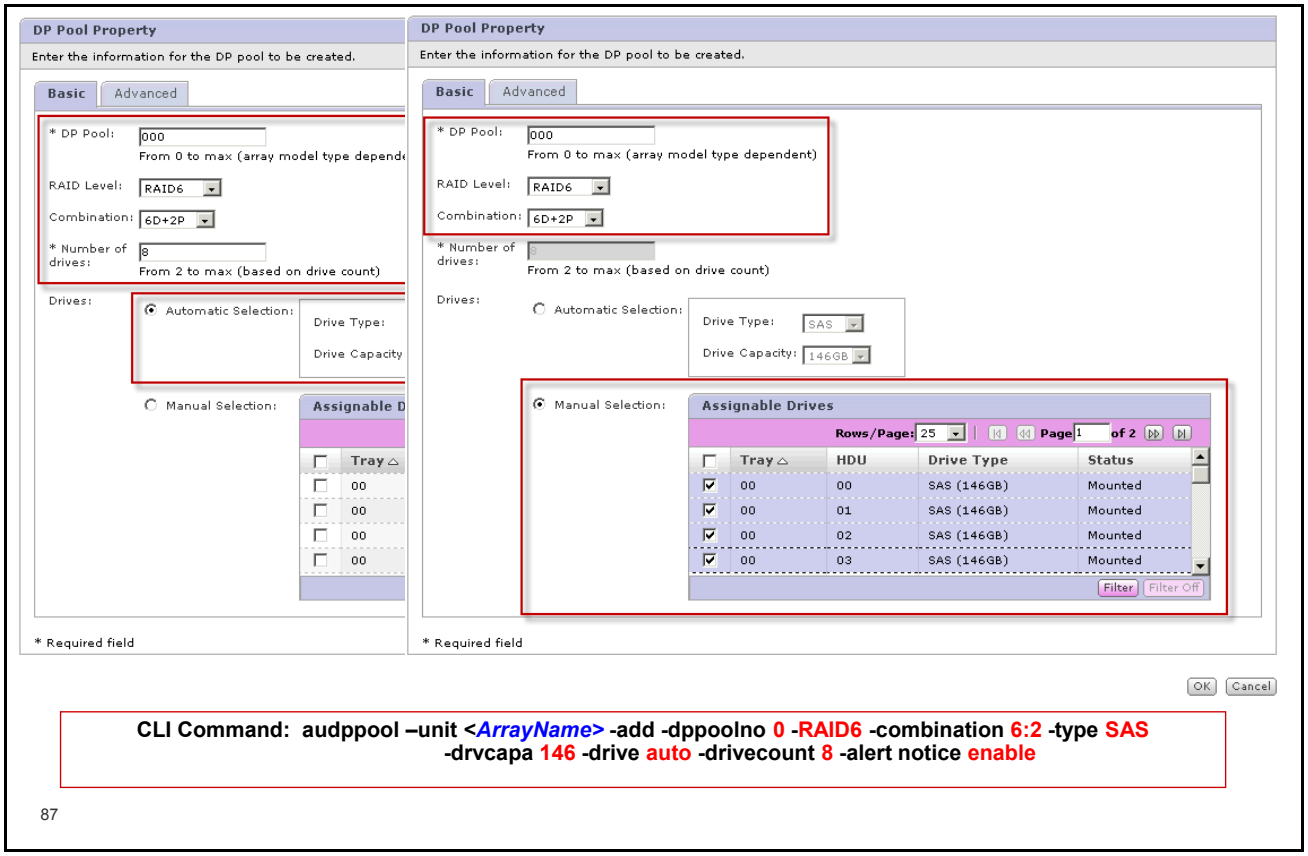


Create a HDP Pool



86

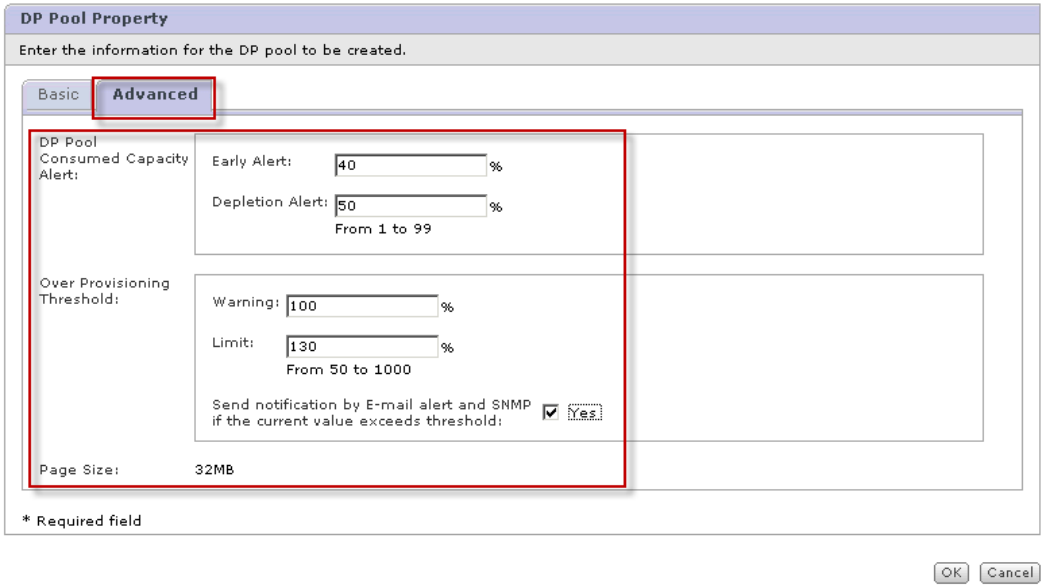
Create HDP Pool – Pool Properties



CLI Command: audppool –unit <*ArrayName*> -add -dppoolno 0 -RAID6 -combination 6:2 -type SAS -drvcapa 146 -drive auto -drivecount 8 -alert notice enable

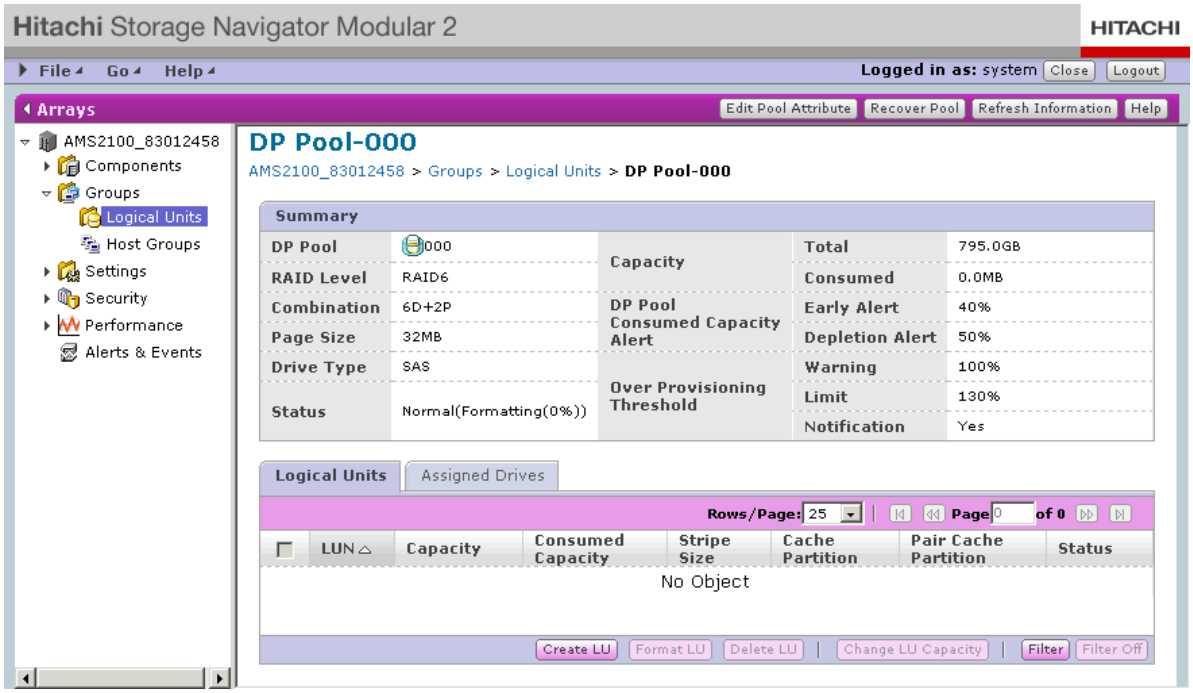
87

Create DP Pool – Pool Advanced Settings



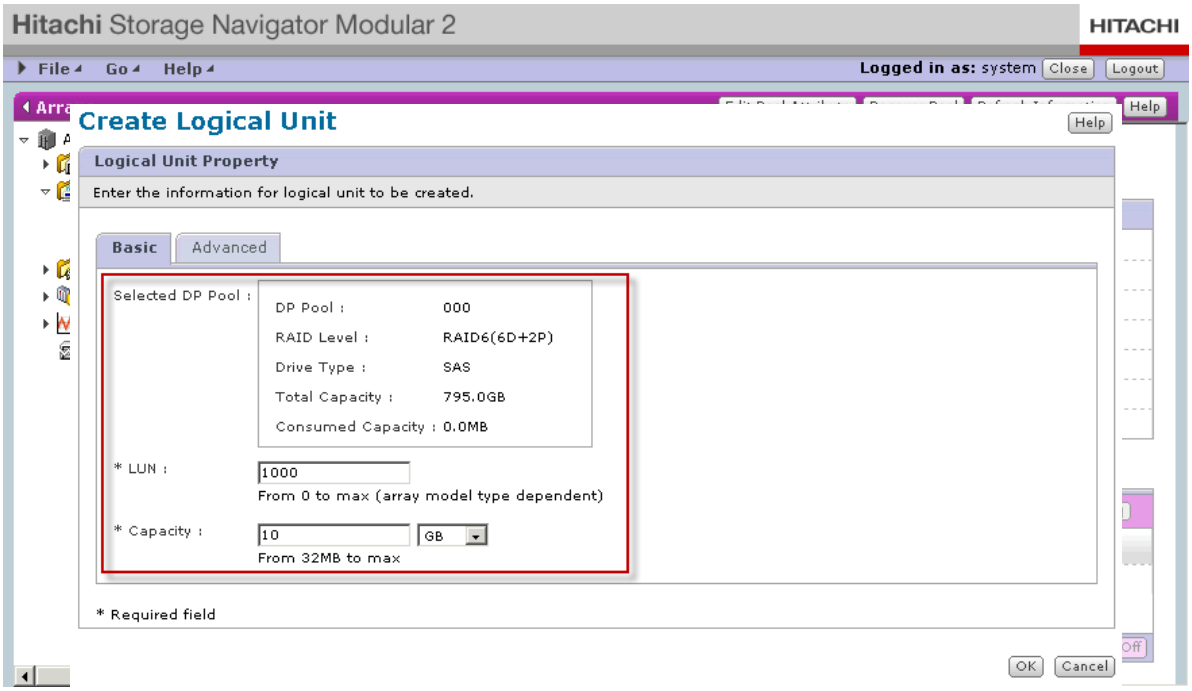
88

Create a HDP Pool – View the Pool Properties



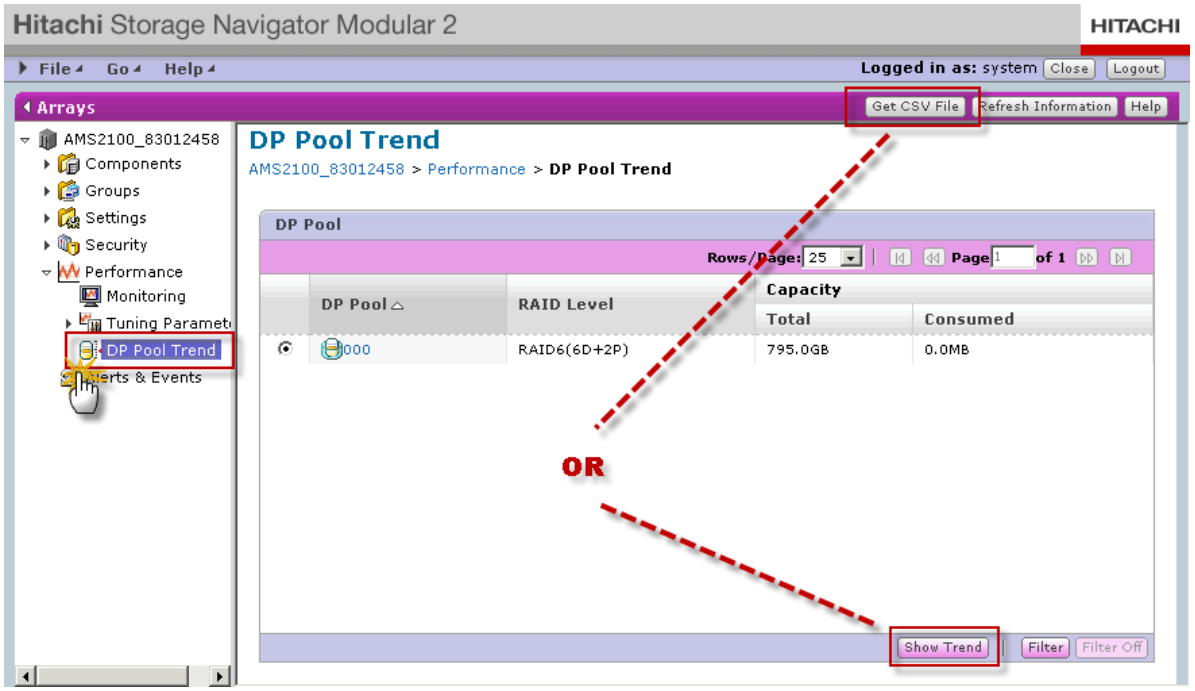
89

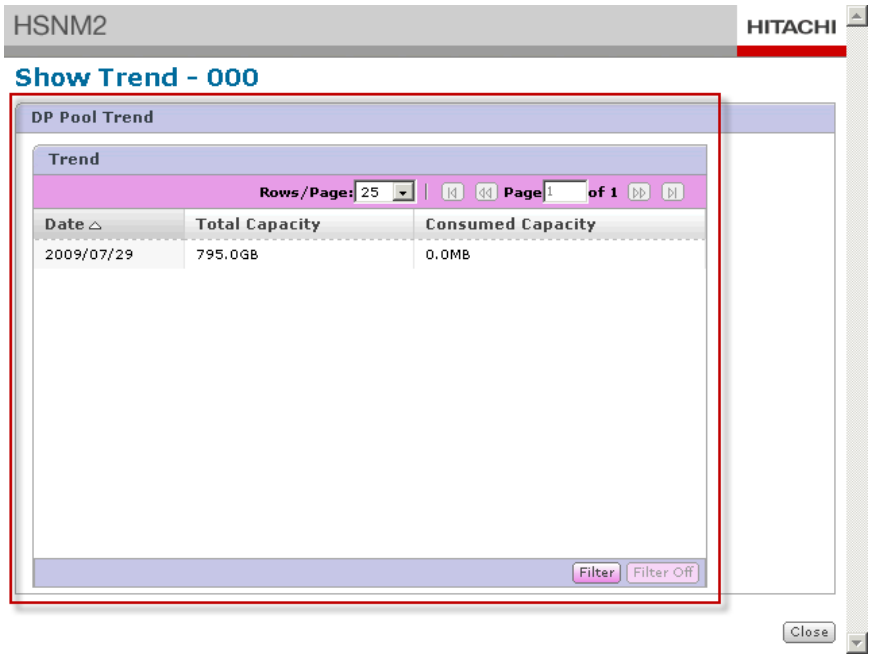
Create an HDP Logical Unit (Virtual-LU)



90

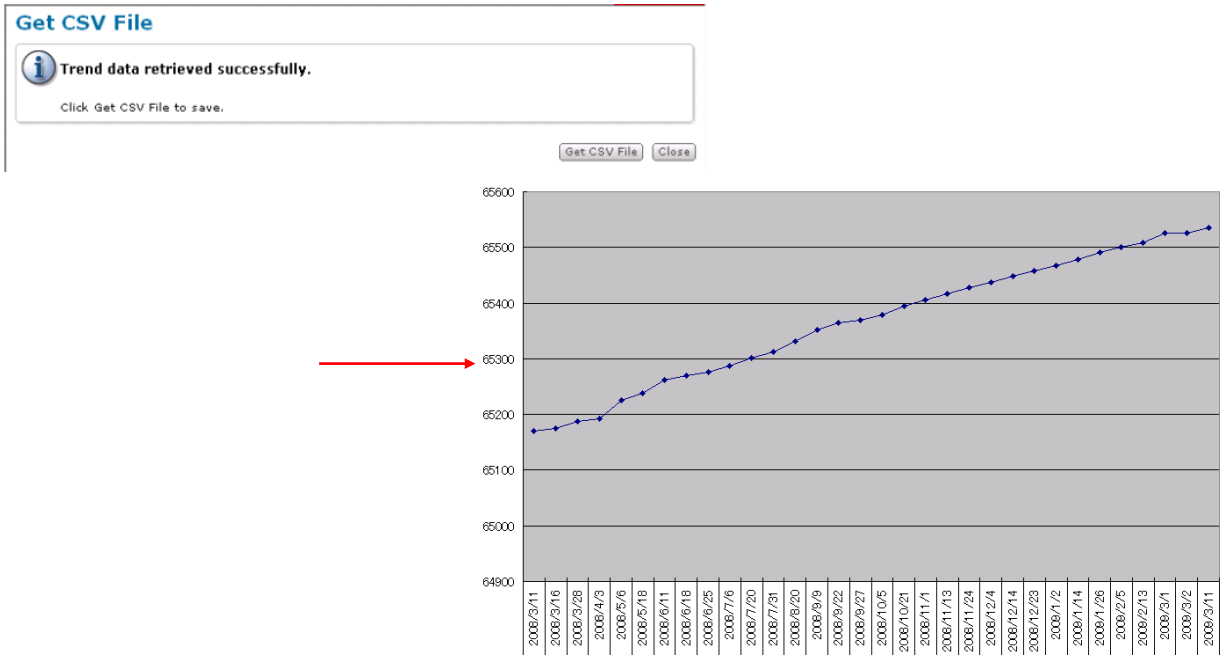
Monitoring the DP Pool Consumption (Get DP Pool Trend Information)





CLI Command: audptrend -unit <*ArrayName*> -refer -dppoolno 0

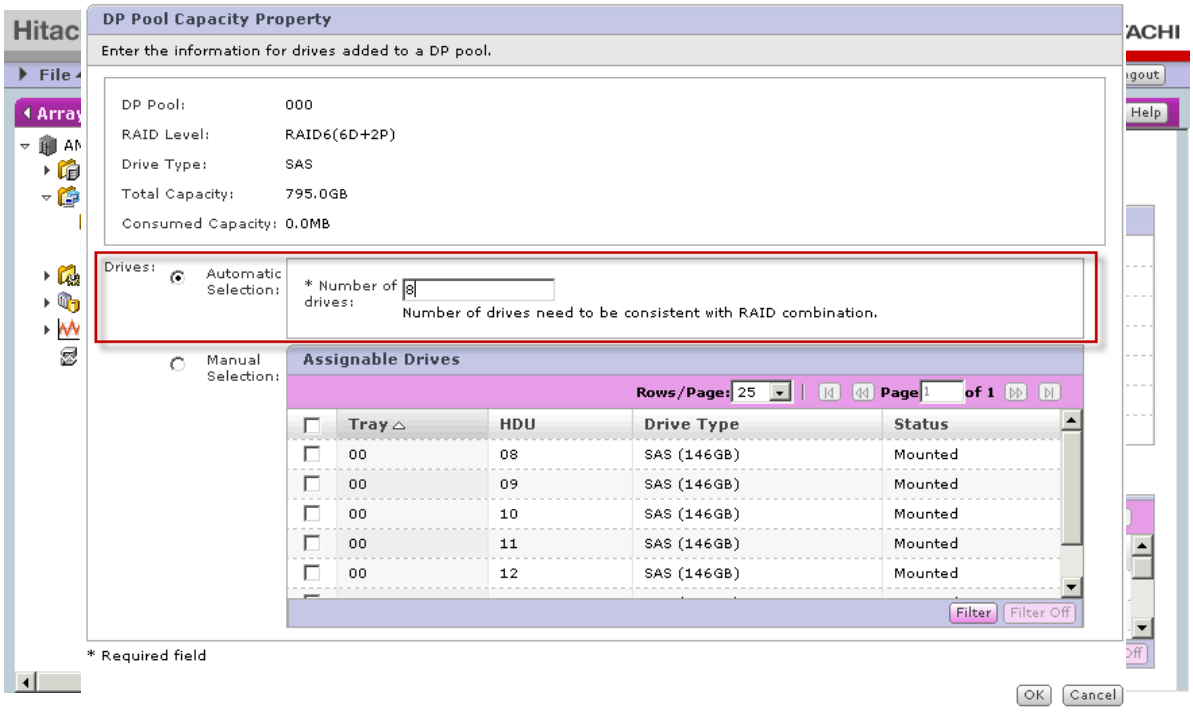
92



CLI Command: audptrend -unit <*ArrayName*> -export -path C:\tmp

93

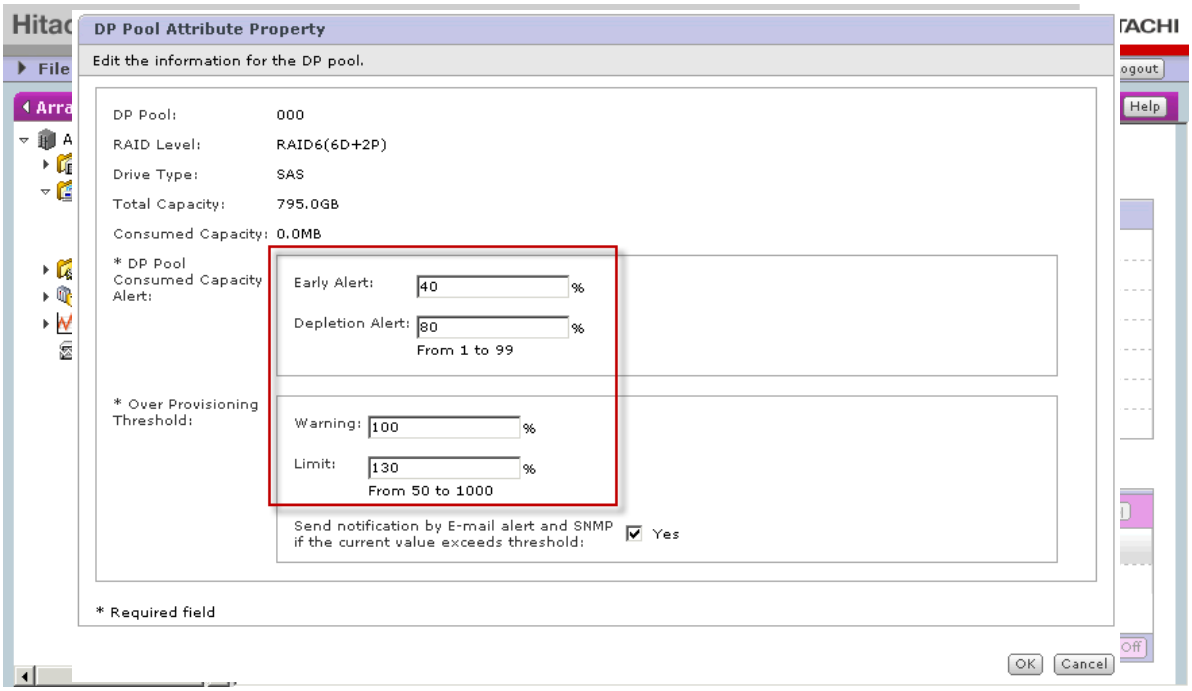
Add DP Pool Capacity



CLI Command: audppool -unit <*ArrayName*> -chgsize -dppoolno 0 -drivecount 8

94

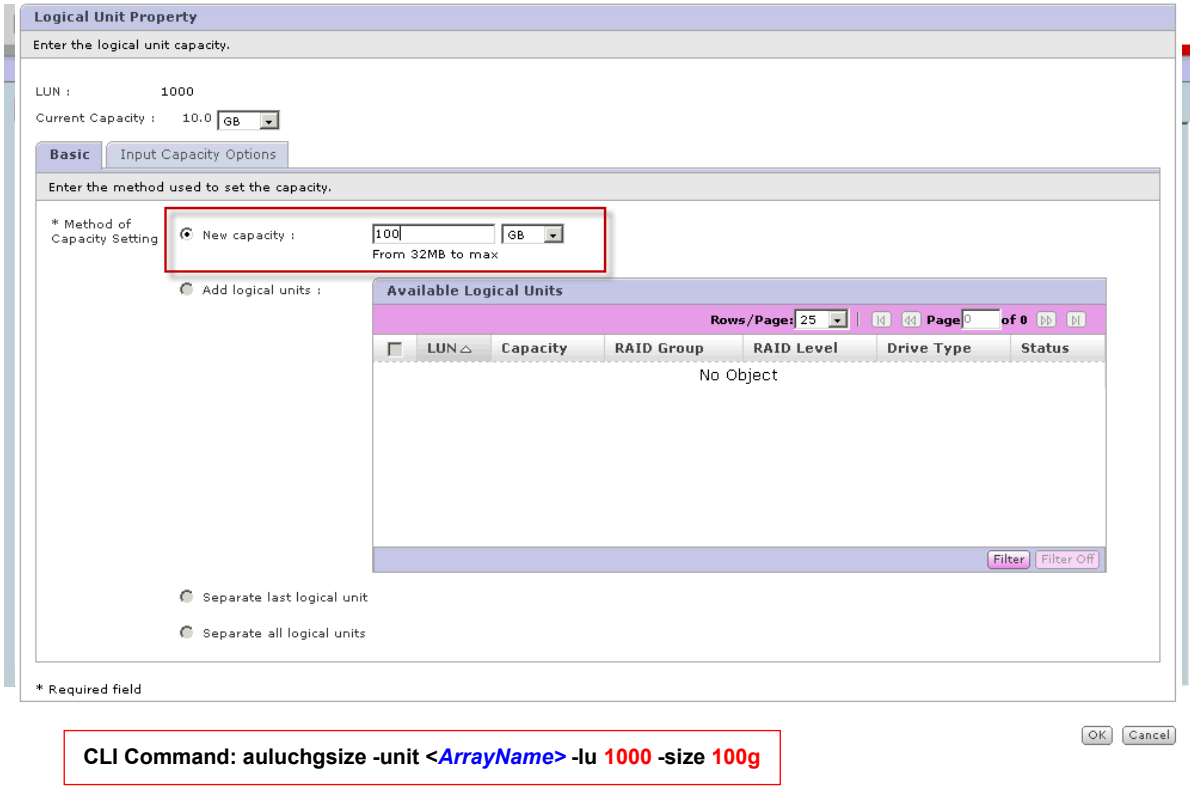
Edit the DP Pool Attributes



CLI Command: audppool -unit <*ArrayName*> -chg -dppoolno 0 -depletion_alert 80

95

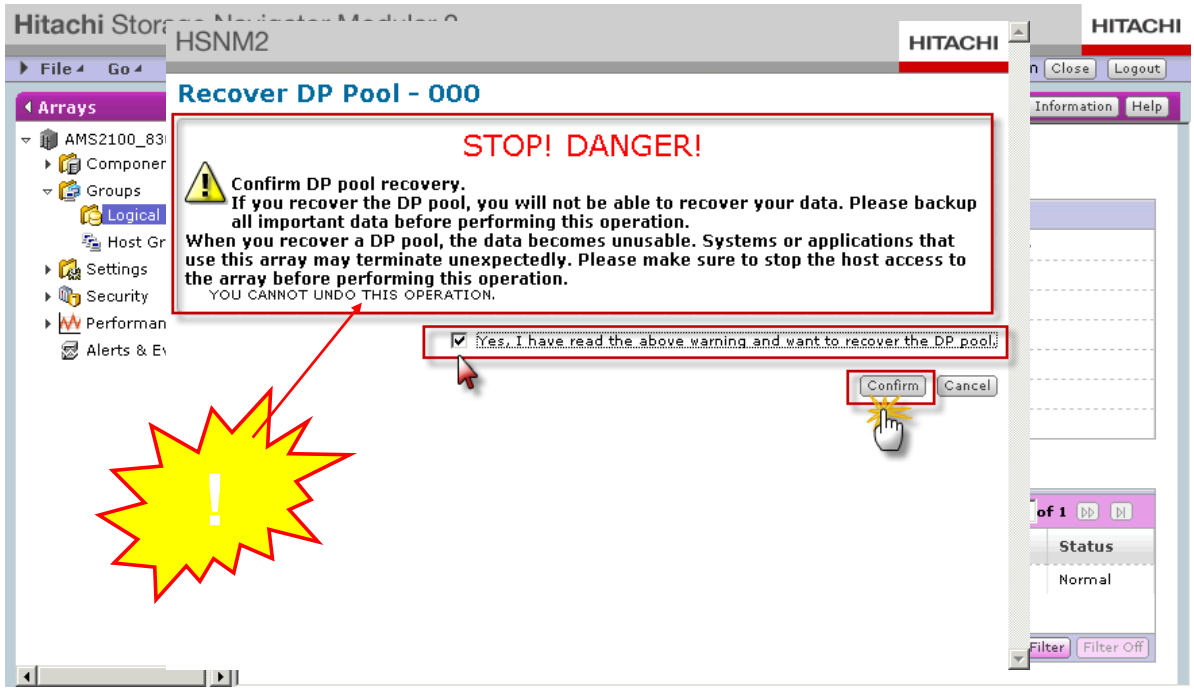
Change HDP Logical Unit (Virtual-LU) Capacity



CLI Command: auluchgsize -unit <*ArrayName*> -lu 1000 -size 100g

96

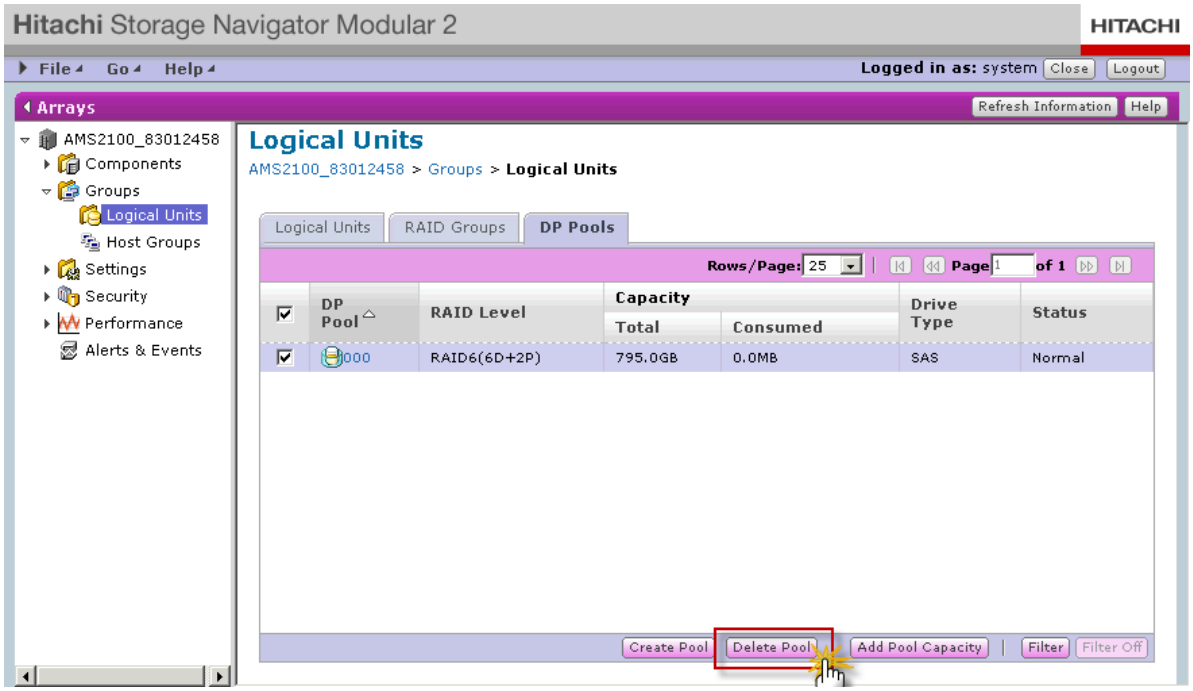
Recover DP Pool



CLI Command: audppool -unit <*ArrayName*> -recover -dppoolno 0

97

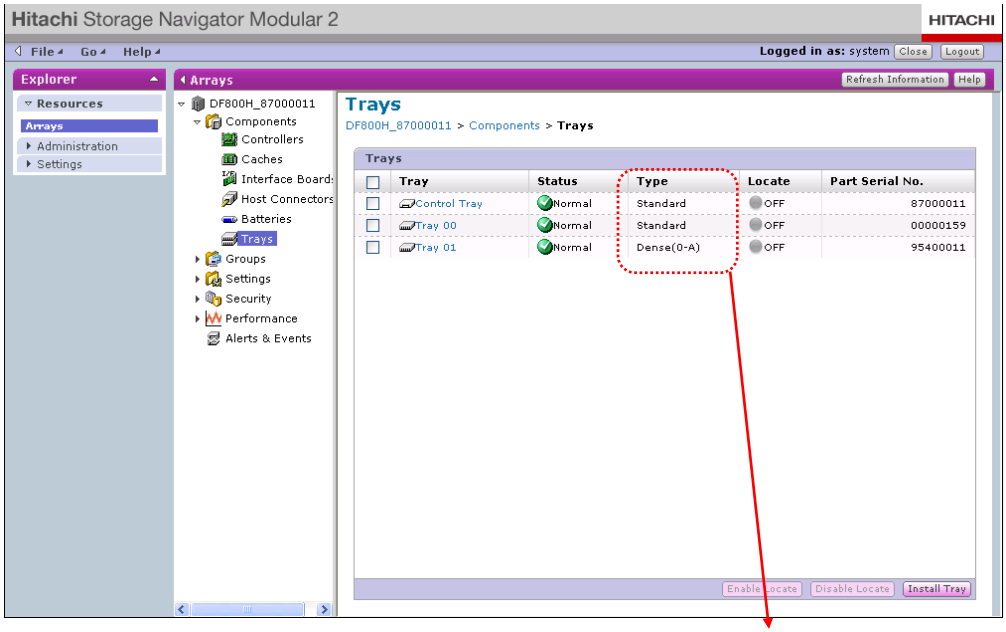
Delete DP Pool



CLI Command: audppool -unit <*ArrayName*> -rm -dppoolno 0

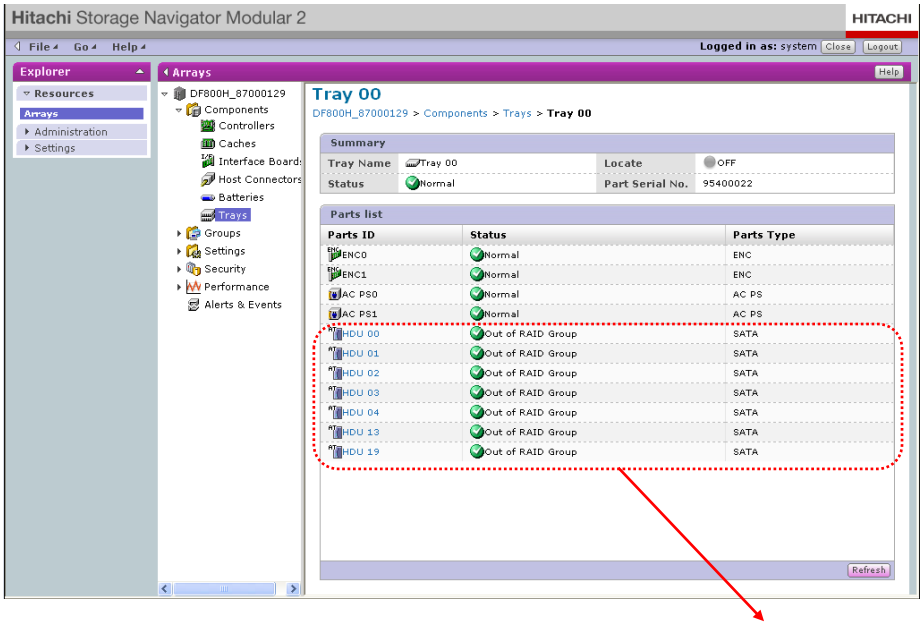
98

Addition on New Dense Tray



"Type" row is added newly.
"Standard": Conventional RKA,
"Dense(x-y): Dense RKA, (x: Dense number, y: UnitA or UnitB)

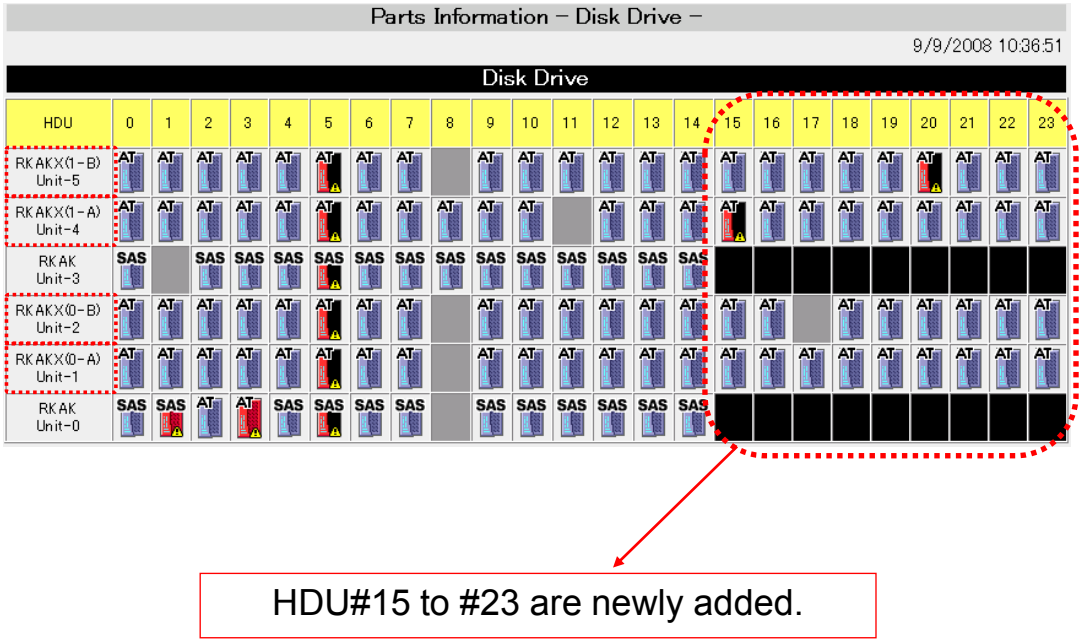
99



You can see a maximum of 24 HDUs here.

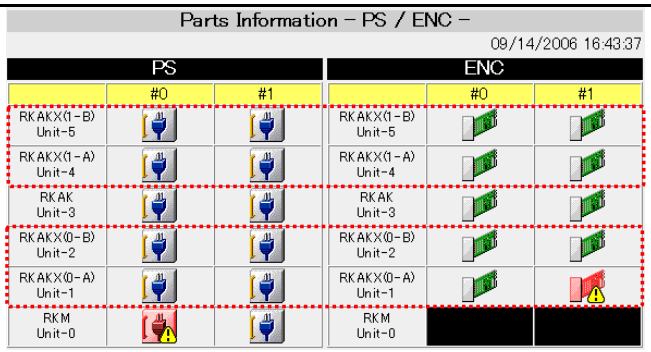
100

RKAKX Dense Tray Drive Configuration



101

RKAKX Dense Tray Drive Configuration



SNM2 helps you locate failed components.

102

Lab Project 5: Host Groups and LUN Mapping

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by their instructor

103

Lab Project 5: Objectives

- Upon completion of the lab project, the learner should be able to:
  - Enable Host Group Security for ports 0A and 1A (also called LUN Security).
  - Create a Host Group for the Windows host server on ports 0A and 1A
  - Set the port options parameter to support a Windows host connection
  - Associate the WWPN of the Windows HBA port to the Windows Host Group
  - Map two internal logical units (LUs) to the newly created Windows Host Groups
  - Verify that the Windows host server discovers the LUNs
  - Create and manage Hitachi Dynamic Provisioning Pools

104

7. LU Grow and Shrink

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Use the Change LU Capacity function to **expand** the capacity of a LUN by adding additional LUNs to it
  - Use the Change LU Capacity function to **grow** the capacity of a LUN by adding additional space to it from existing free space
  - Describe how the Change LU Capacity function can **shrink** (reduce) the capacity of a LU
  - Describe how a new LU can be created manually

2

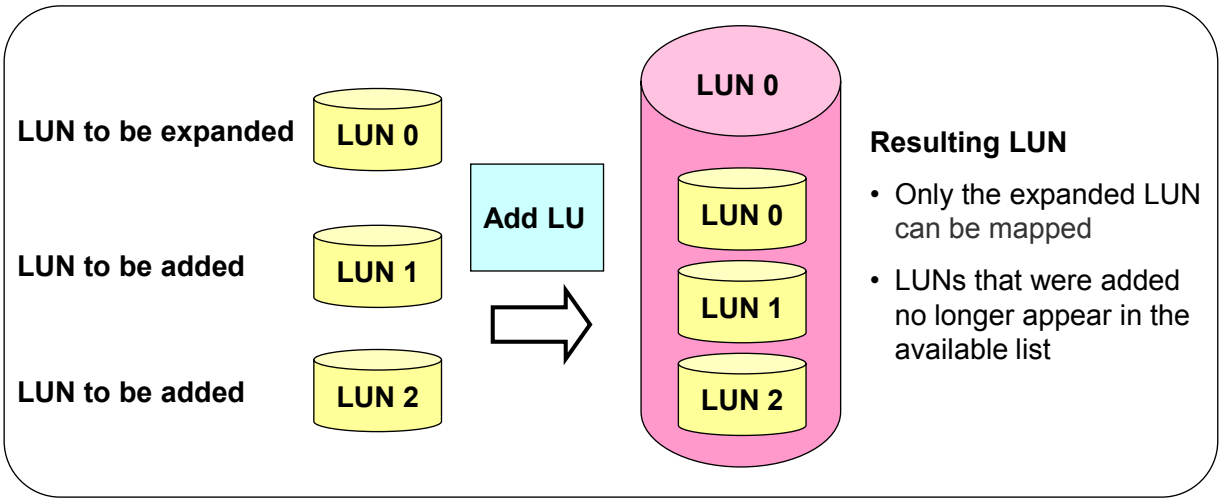
Change LU Capacity — LU Expansion

- Relative to LU expansion by unifying LUs, Change LU Capacity is comprised of the following functions:
  - **Add LUs** – add additional LUNs to an existing unified LUN
  - **Separate Last LU** – separate the last LUN from the unified LUN
  - **Separate All LUs** – separate all the LUNs from the unified LUN
- Change LU Capacity is part of the LUN Manager function
- Change LU Capacity operations can be performed using Storage Navigator Modular 2 GUI or CLI
- This function used to be called Logical Unit Size Expansion (LUSE)

3

Overview of Adding LUs together

- Two or more LUNs are unified (concatenated) into one larger LU
- LUNs can come from different RAID Groups
- 128 LUNs maximum
- RAID 5/RAID 6/RAID 1/RAID 1+0 (RAID 0 is not supported)
- LUN concatenation up to 60TB



4

The LUSE function refers to the LUNs in the process as:

- The top LUN is the **Main LUN**.
- The other LUNs are called **Sub-LUNs**.

General Conditions and Restrictions

1. LUNs must be in normal status.
2. You cannot expand LUs that are being formatted.
3. You cannot expand a LU if drive restoration is in progress on the affected LU.
4. You cannot expand the following LU types:
   - ShadowImage replication and Copy-on-write SnapShot pairs
   - TrueCopy remote replication or TrueCopy Extended Distance pairs
   - LUs or reserved LUs for Modular Volume Migration
   - LUs in which Cache Residency Manager is set
   - LUs that are set for a command device
   - Differential Management Logical Units (DMLUs)
   - LUs that are registered in the data pool
   - LUs that are in the RAID Group during a RAID Group expansion

5

Backup First

- Data assurance of the LUNs to be unified
  - Follow all the steps of the on-screen instructions (data could be lost).
  - Back up the logical units before modifying them.
  - Format the unified logical units to delete the volume label which the operating system adds to logical units.
  - Map the expanded LUN to the host and restore the data.
    - Depending on the Host OS and software installed, a reboot may or may not be necessary.

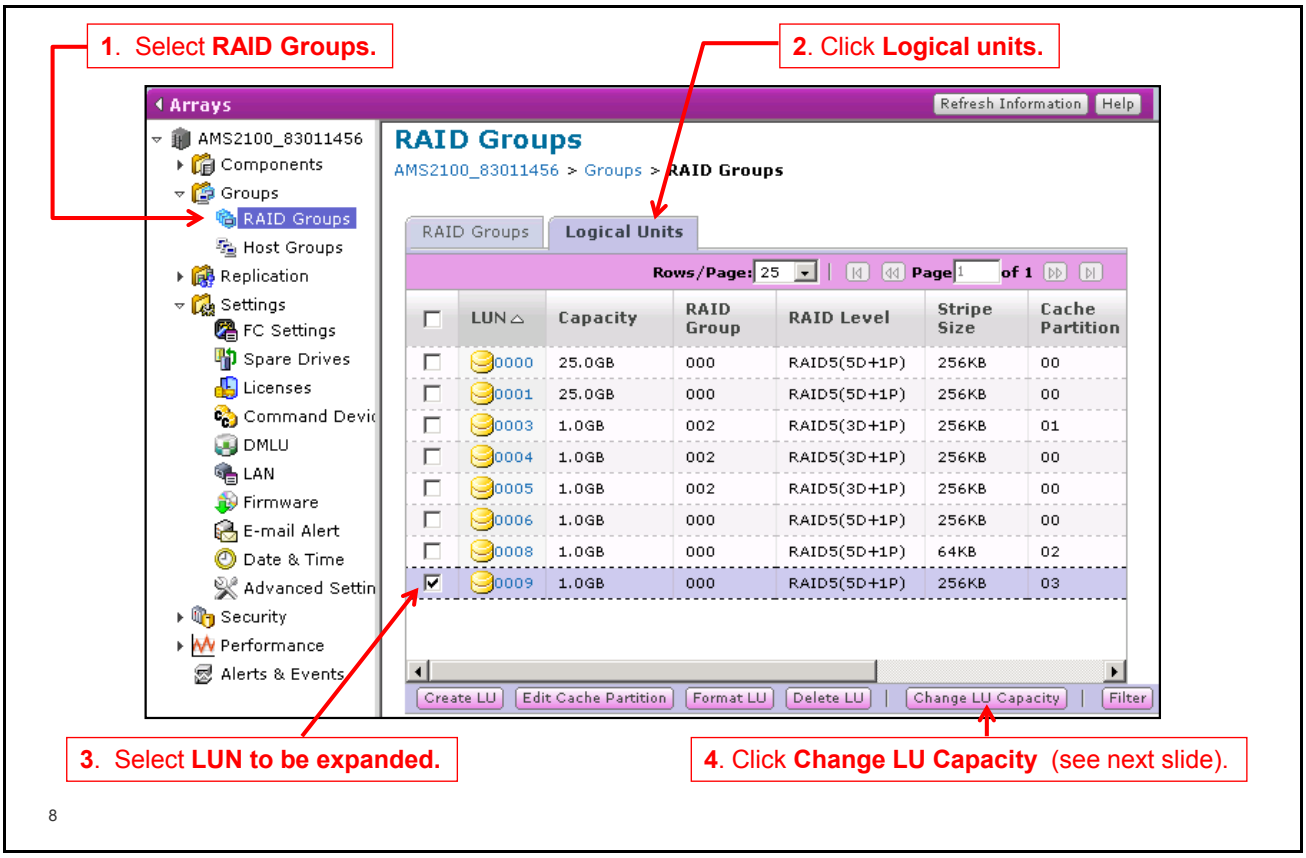
6

Formatting Issues

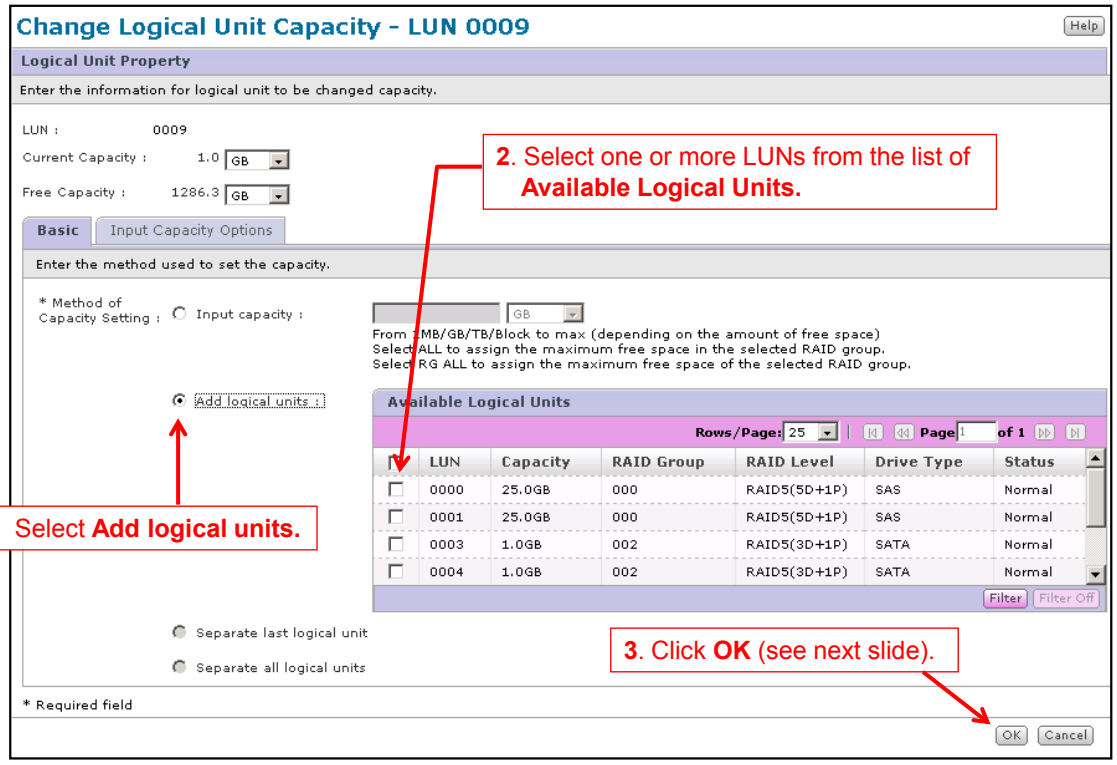
- Formatting the Unified LUN
  - A format on the unified LUN is also performed on all the internal LUNs in sequence.
  - When an internal LUN blockage or degeneration (Alarm or Regression) occurs while formatting, the status of the unified LUN becomes blocked or degenerated at the time when formatting finishes.

7

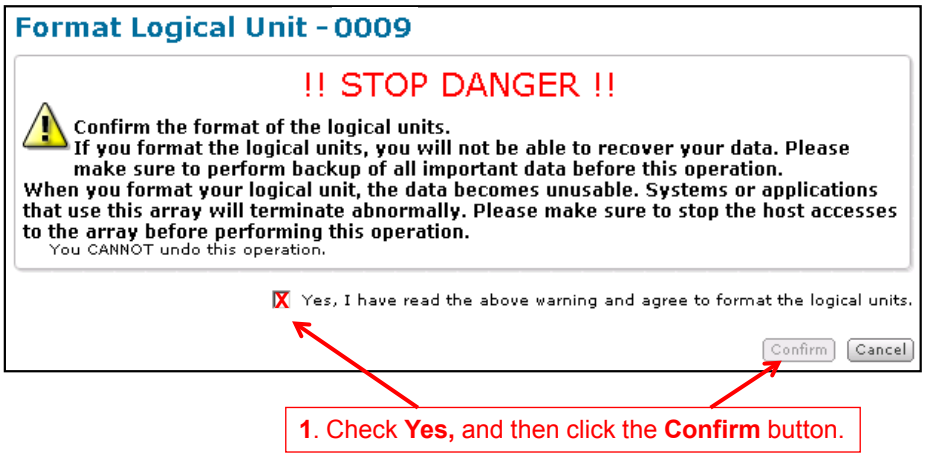
Add LUs to Increase Size



Unifying a Logical Unit



9

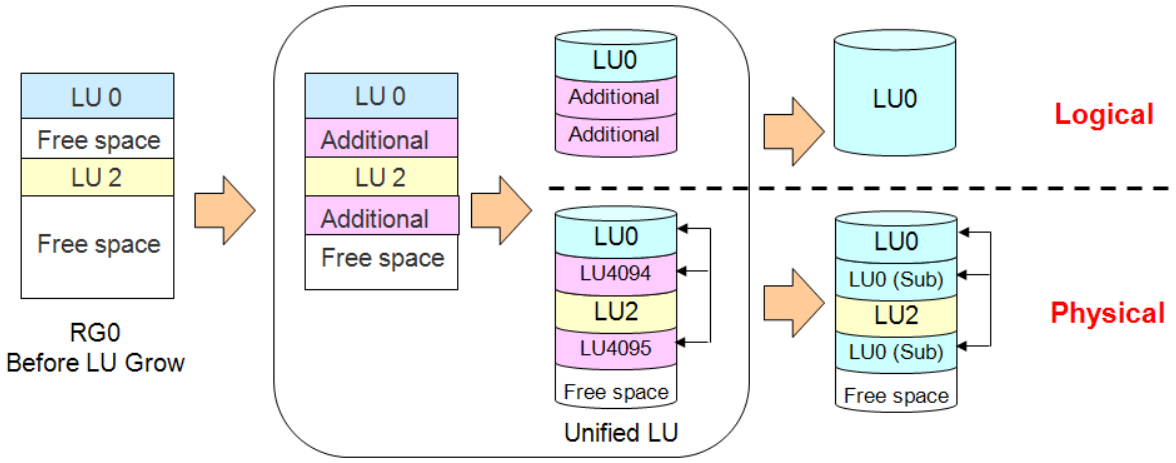


1. Check **Yes,** and then click the **Confirm** button.

10

Change LU Capacity — Grow LU Capacity from Free Space

- Grow (add) a specific capacity to an existing LU from disk free space.
- Free space has to be in the same RAID Group.

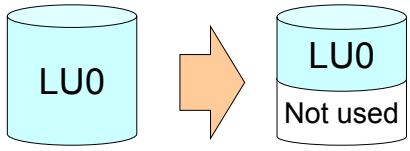


Grow **LU 0** by specifying a growth capacity and SNM2 automatically selects the space.

11

Change LU Capacity: LU Shrink

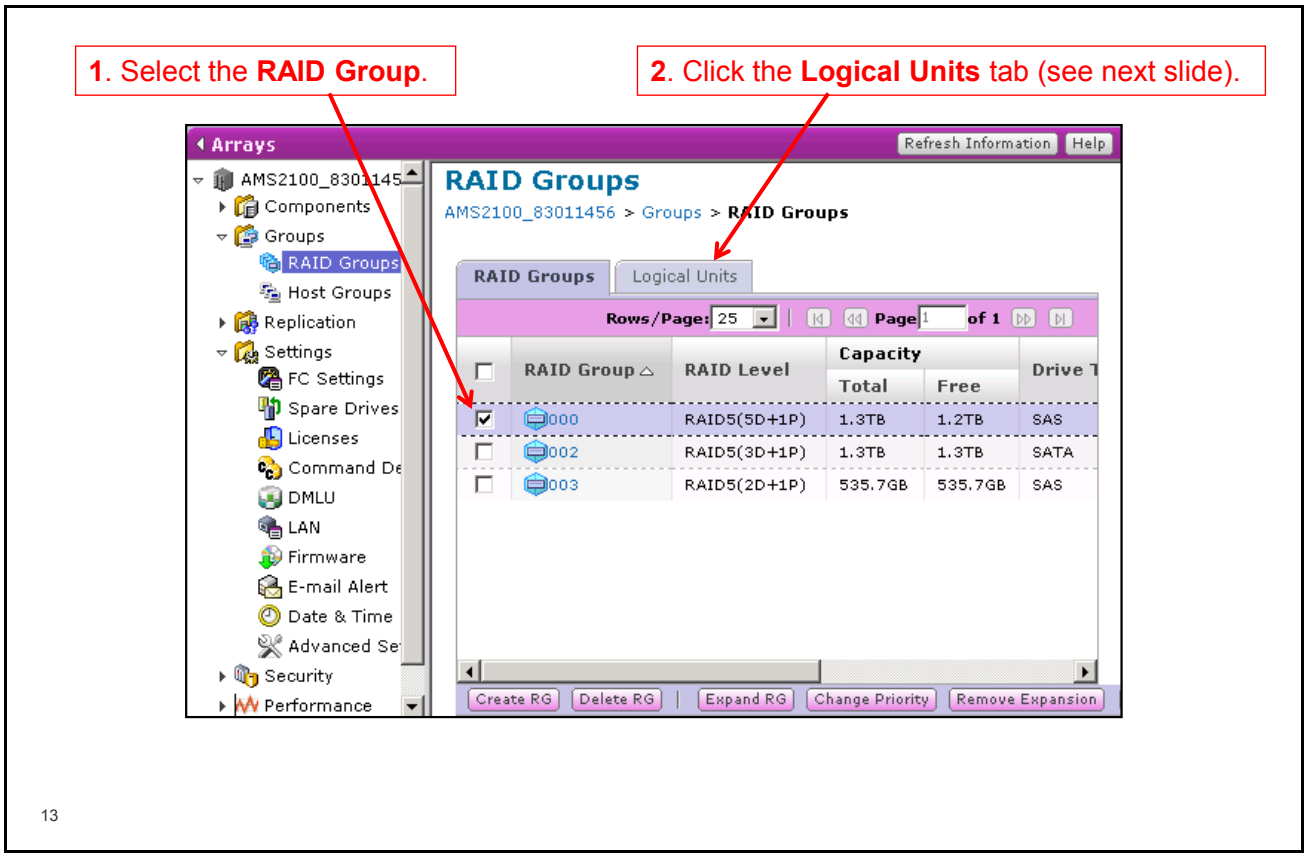
- This function reduces the capacity from an LU.

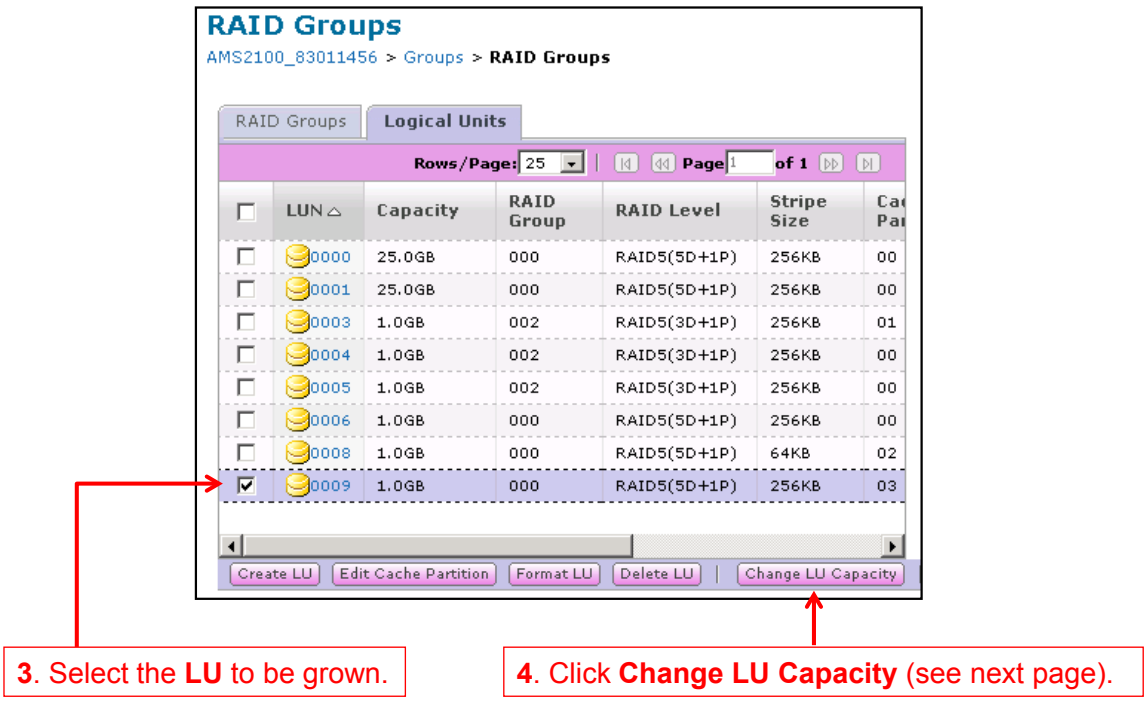


Note: The Host OS must support volume shrinking if you use LU Shrink, and you must execute the Host OS side volume shrink first, then execute the storage array side LU Shrink.

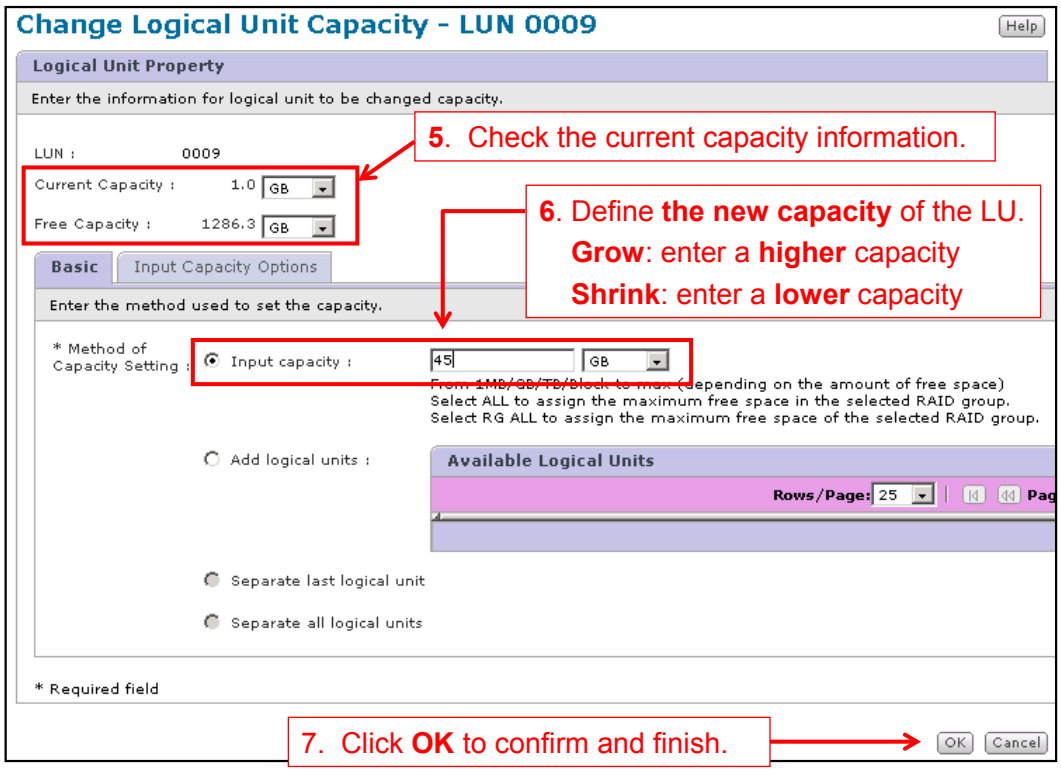
12

LU Grow or Shrink




RAID Groups
AMS2100_83011456 > Groups > RAID Groups
RAID Groups
Logical Units
Rows/Page: 25
Page 1 of 1
LUN
Capacity
RAID Group
RAID Level
Stripe Size
0000 25.0GB 000 RAID5(5D+1P) 256KB 00
0001 25.0GB 000 RAID5(5D+1P) 256KB 00
0003 1.0GB 002 RAID5(3D+1P) 256KB 01
0004 1.0GB 002 RAID5(3D+1P) 256KB 00
0005 1.0GB 002 RAID5(3D+1P) 256KB 00
0006 1.0GB 000 RAID5(5D+1P) 256KB 00
0008 1.0GB 000 RAID5(5D+1P) 64KB 02
0009 1.0GB 000 RAID5(5D+1P) 256KB 03
Create LU
Edit Cache Partition
Format LU
Delete LU
Change LU Capacity
3. Select the LU to be grown.
4. Click Change LU Capacity (see next page).

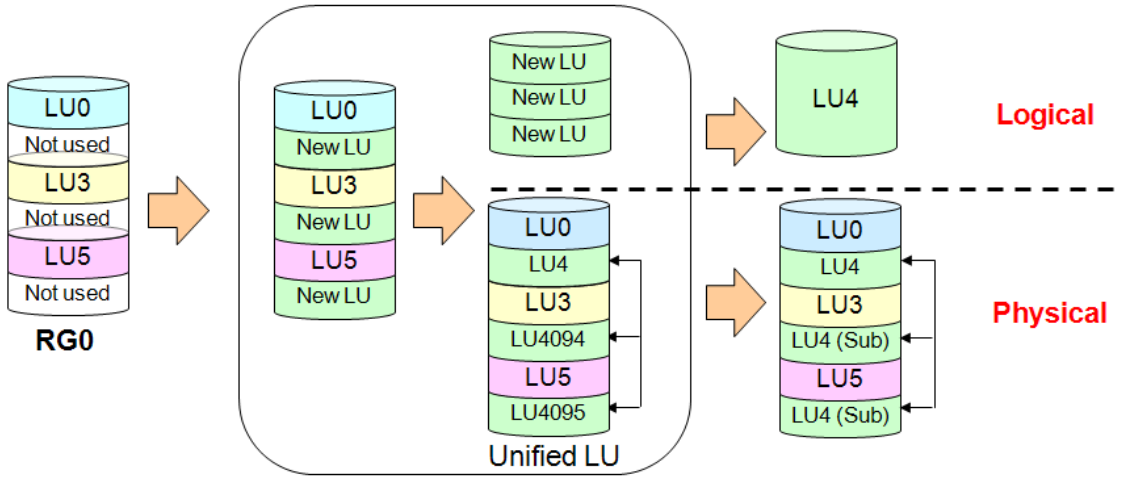
14


Change Logical Unit Capacity - LUN 0009
Help
Logical Unit Property
Enter the information for logical unit to be changed capacity.
5. Check the current capacity information.
LUN : 0009
Current Capacity : 1.0 GB
Free Capacity : 1286.3 GB
6. Define the new capacity of the LU.
Grow: enter a higher capacity
Shrink: enter a lower capacity
Basic
Input Capacity Options
Enter the method used to set the capacity.
* Method of Capacity Setting :
Input capacity : 45 GB
Select ALL to assign the maximum free space in the selected RAID group.
Select RG ALL to assign the maximum free space of the selected RAID group.
Add logical units :
Available Logical Units
Rows/Page: 25
Separate last logical unit
Separate all logical units
* Required field
7. Click OK to confirm and finish.
OK
Cancel

15

Manual LU Creation from Free Space

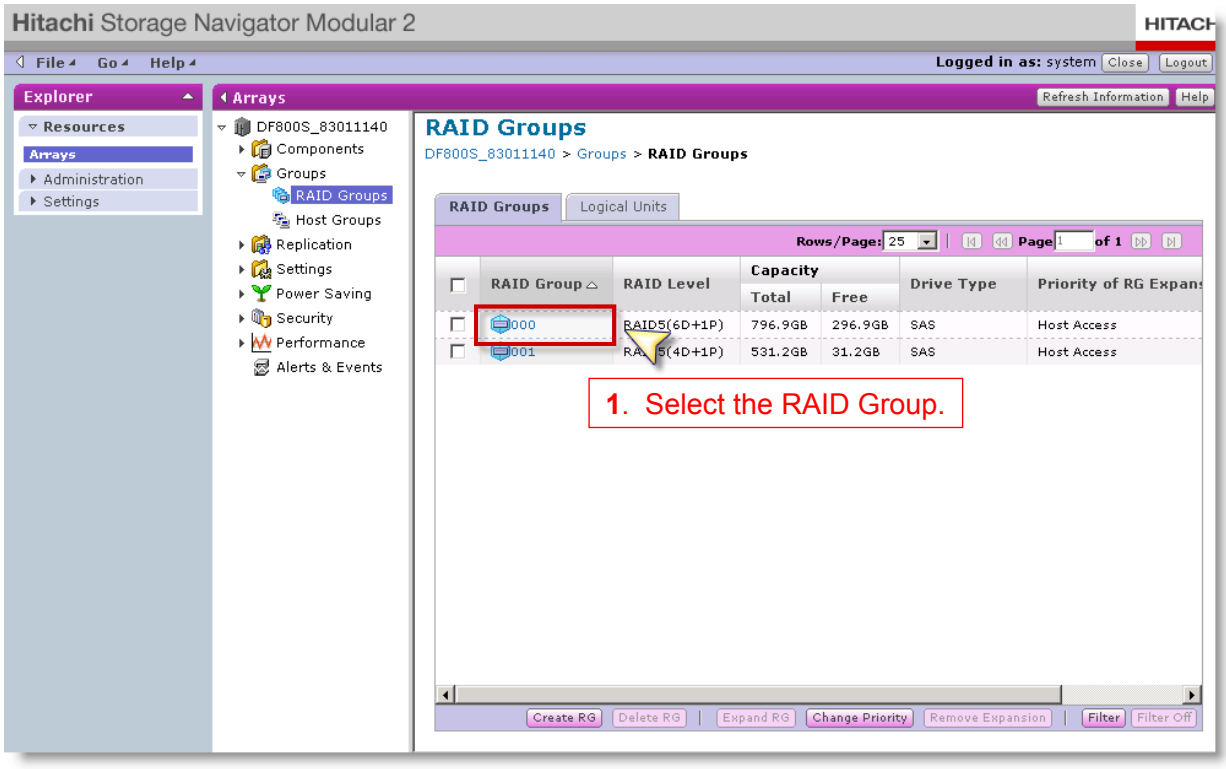
- Create a new LU by manually selecting free space segments that exist in the same RG.



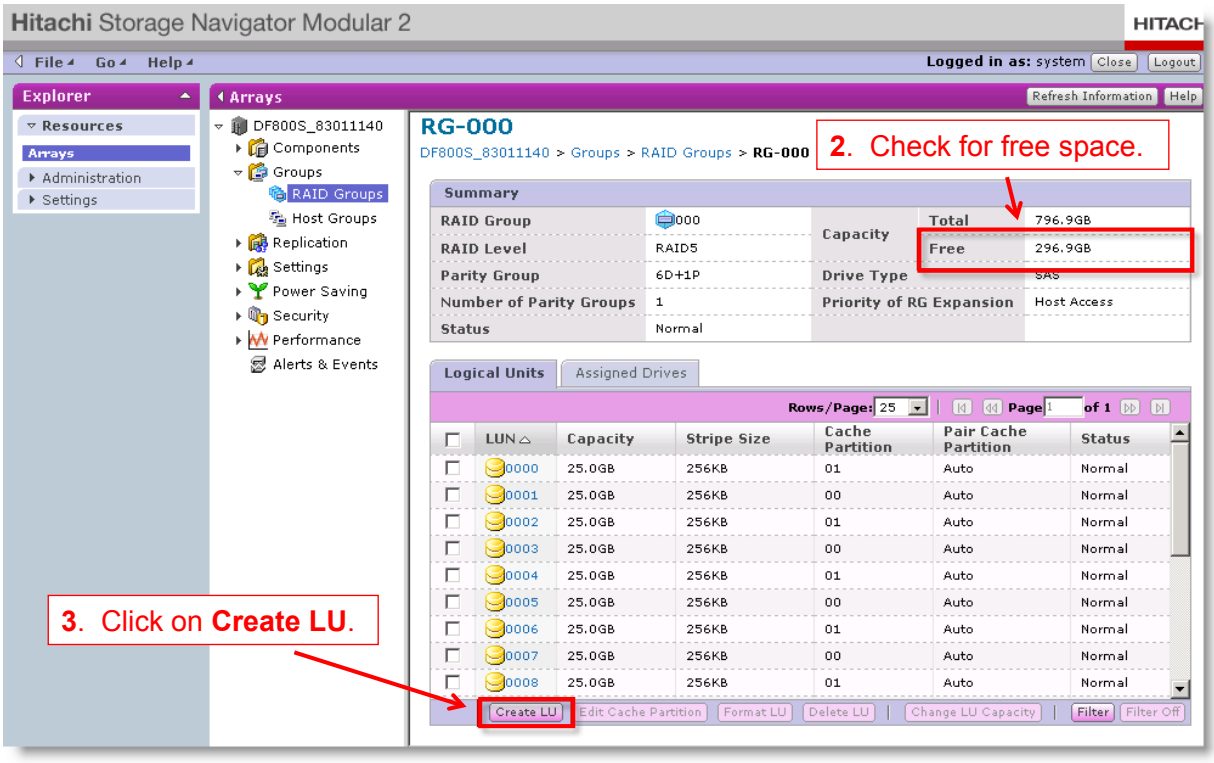
Create a new **LU 4** from existing free space segments.

16

Create LU from Non-contiguous Free Space

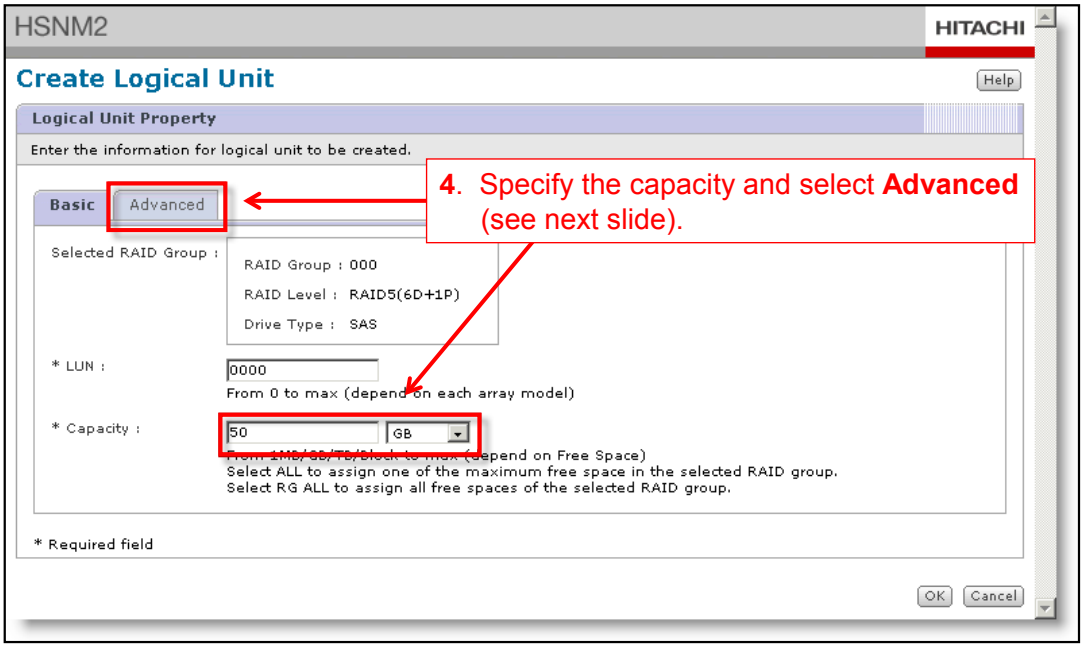


17


Hitachi Storage Navigator Modular 2
HITACHI
File
Go
Help
Logged in as: system
Close
Logout
Explorer
Resources
Arrays
Administration
Settings
Arrays
Refresh Information
Help
DF800S_83011140
Components
Groups
RAID Groups
Host Groups
Replication
Settings
Power Saving
Security
Performance
Alerts & Events
RG-000
DF800S_83011140 > Groups > RAID Groups > RG-000
2. Check for free space.
Summary
RAID Group
000
RAID Level
RAID5
Parity Group
6D+1P
Number of Parity Groups
1
Status
Normal
Capacity
Total
796.9GB
Free
296.9GB
Drive Type
SAS
Priority of RG Expansion
Host Access
Logical Units
Assigned Drives
Rows/Page: 25
Page 1 of 1
LUN
Capacity
Stripe Size
Cache Partition
Pair Cache Partition
Status
0000 25.0GB 256KB 01 Auto Normal
0001 25.0GB 256KB 00 Auto Normal
0002 25.0GB 256KB 01 Auto Normal
0003 25.0GB 256KB 00 Auto Normal
0004 25.0GB 256KB 01 Auto Normal
0005 25.0GB 256KB 00 Auto Normal
0006 25.0GB 256KB 01 Auto Normal
0007 25.0GB 256KB 00 Auto Normal
0008 25.0GB 256KB 01 Auto Normal
3. Click on Create LU.
Create LU
Edit Cache Partition
Format LU
Delete LU
Change LU Capacity
Filter
Filter Off

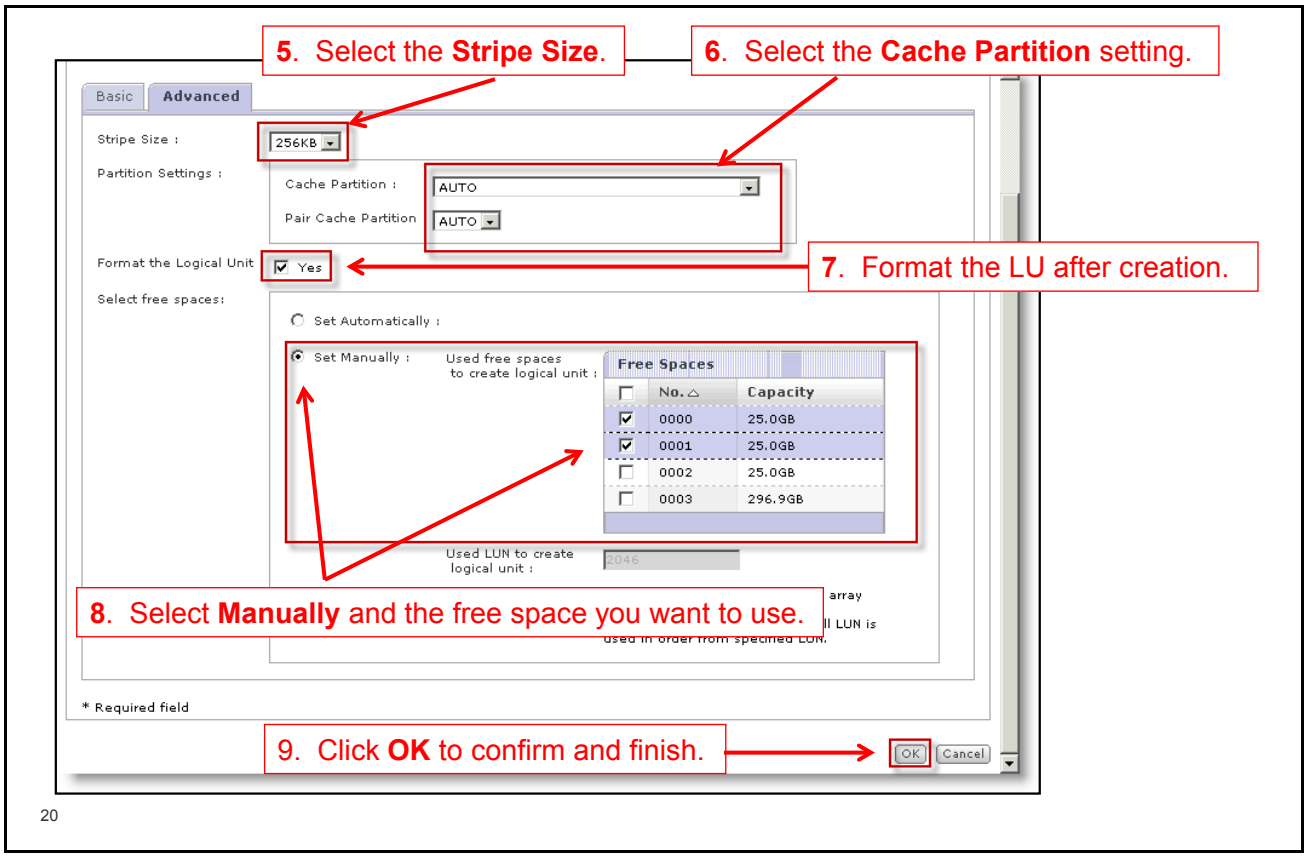
18

Create LUs from Non-contiguous Free Space



19

Create LU from Non-contiguous Free Space



General Specifications

No	Functions	Specifications
1	Supporting Model	2100, 2300, 2500
2	LU Grow	Available
3	LU Shrink	Available
4	Easy LU creating	Available
5	Supported RAID Level	RAID-5/RAID-6/RAID-1/RAID-1+0 (RAID-0 is not supported)
6	Allocation of LUN for Add LU	Allocating of the last LUN which is not used automatically
7	Max. Number of Internal Unified LU	128 LUN
8	RG that the LU Grow can be executed.	LU expansion is done only by using unused space in the same RG.
9	Maximum capacity for shrinking the LU	Less than the original LU capacity (not deleting the LU)

21

LU Grow Detailed Specification

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
1	LU formatting	Available	N/A
2	LU Expansion (LUSE)	Available	N/A within multiple RG Available within the same RG
3	Parity recovery	Available	N/A
4	HDD recovery	Available	Available
5	RG no redundancy	Available	N/A (LUSE is available)
6	Online verify	Available	Available
7	Firmware upgrade	Available	N/A
8	ENC Microprogram download	Available	Available
9	Online HDD Firmware upgrade	Available	N/A

22

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
10	DM-LU setting	Available	N/A
11	Command Device setting	Available	N/A
12	POOL LU setting	Available	N/A
13	LU deletion	Available (If the LU includes unified LUs from multiple RAID groups, it **cannot** be deleted.)	N/A
14	RG deletion	Available (If the RG includes unified LUs from multiple RAID groups, it **cannot** be deleted.)	N/A
15	LU Shrink	Available	N/A

23

LU Grow Detailed Specification

No	Program Product	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes a PP task
1	Shadowimage	Available	Available just in SMPL status
2	Snapshot	Available	Available just in SMPL status
3	TrueCopy/TCE	Available	Available just in SMPL status
4	Modular Volume Migration	Available	N/A
5	Cache Residency Manager	N/A	N/A
6	Power Saving	Available	N/A for the spined down RG
7	Cache Partition Manager	Available	N/A for a LU where the CPM setting reserved.
8	Data Retention Utility	Available	N/A
9	LUN Manager	Available	Available
10	Password Protection	Available	Available
11	SNMP Agent	Available	Available
12	Account Authentication	Available	Available
13	Audit Logging	Available	Available

24

LU Shrink Detailed Specification

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
1	LU formatting	Available	N/A
2	LU Expansion (LUSE)	Available	N/A within multiple RG Available within the same RG
3	Parity recovery	Available	N/A
4	HDD recovery	Available	N/A
5	RG no redundancy	Available	Available
6	Online verify	Available	Available
7	Firmware upgrade	Available	N/A
8	ENC Microprogram download	Available	Available
9	Online HDD Firmware upgrade	Available	N/A

25

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
10	DM-LU setting	Available	N/A
11	Command Device setting	Available	N/A
12	POOL LU setting	Available	N/A
13	LU deletion	Available (If the LU includes unified LUs from multiple RGs, it **cannot** be deleted.)	N/A
14	RG deletion	Available (If the RG includes unified LUs from multiple RGs, it **cannot** be deleted.)	N/A
15	LU Grow	Available	N/A

26

No	Program Product	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes a PP task
1	Shadowimage	Available	Available just in SMPL status
2	Snapshot	Available	Available just in SMPL status
3	TrueCopy/TCE	Available	Available just in SMPL status
4	Modular Volume Migration	Available	N/A
5	Cache Residency Manager	N/A	N/A
6	Power Saving	Available	Available
7	Cache Partition Manager	Available	Available
8	Data Retention Utility	Available	N/A
9	LUN Manager	Available	Available
10	Password Protection	Available	Available
11	SNMP Agent	Available	Available
12	Account Authentication	Available	Available
13	Audit Logging	Available	Available

27

Easy LU Creation Detailed Specification

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
1	LU formatting	Available	N/A
2	LU Expansion (LUSE)	Available	N/A
3	Parity recovery	Available	N/A
4	HDD recovery	Available	Available
5	RG no redundancy	Available	Available
6	Online verify	Available	Available
7	Firmware upgrade	Available	N/A
8	ENC Microprogram download	Available	Available
9	Online HDD Firmware upgrade	Available	N/A

28

No	Array Tasks	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes task
10	DM-LU setting	Available	N/A
11	Command Device setting	Available	N/A
12	POOL LU setting	Available	N/A
13	LU deletion	Available (If the LU includes unified LUs from multiple RGs, it cannot be deleted.)	N/A
14	RG deletion	Available (If the RG includes unified LUs from multiple RGs, it cannot be deleted.)	N/A
15	LU Grow / Shrink	Available	N/A
16	RG Expansion	Available	N/A

29

No	Program Product	Specifications	
		LU Grow operation in general	LU Grow operation while the array executes a PP task
1	Shadowimage	Available	Available
2	Snapshot	Available	Available
3	TrueCopy/TCE	Available	Available
4	Modular Volume Migration	Available	Available
5	Cache Residency Manager	N/A	Available
6	Power Saving	Available	N/A within spun down RGs
7	Cache Partition Manager	Available	Available
8	Data Retention Utility	Available	Available
9	LUN Manager	Available	Available
10	Password Protection	Available	Available
11	SNMP Agent	Available	Available
12	Account Authentication	Available	Available
13	Audit Logging	Available	Available

30

Lab Project 6: LU Expansion and LU Grow/Shrink

- Timing and Organization
  - Time allotted to complete the project: **30 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups
  - The class will be split into lab groups and will perform the lab project on the lab equipment assigned to them by their instructor.

31

Lab Project 6: Objectives

- Upon completion of the lab project, the learner should be able to:
  - Create an expanded LUN from two normal internal LUNs
  - Separate an expanded LUN into its original internal LUNs
  - Expand an existing LU
  - Shrink an existing LU

32

8. Online RAID Group Expansion

Module Objectives

- Upon completion of this module, the learner should be able to:
  - Describe the online RAID group expansion feature
  - Use Hitachi Storage Navigator Modular 2 to perform online RAID Group expansion operations

2

Overview

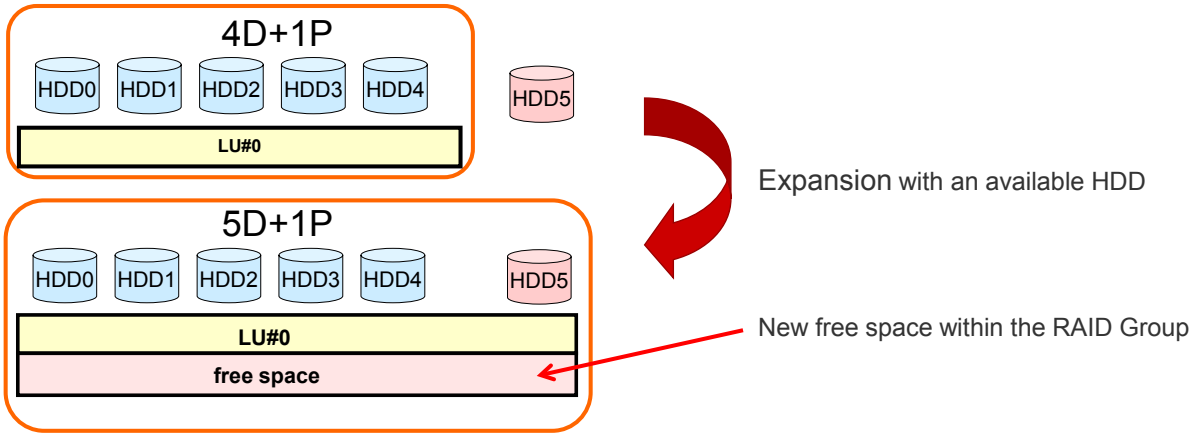
- The online RAID group expansion feature allows you to expand an existing RAID group in an Hitachi Adaptable Modular Storage 2000 Family storage system.
- To expand an RAID group you can use existing unused hard disk drives or a newly installed one.
- All RAID levels are supported for expansion, but you cannot change the RAID level (for example, from RAID 5 to RAID 6 or from RAID 5 to RAID 1+0).
- You **cannot** shrink a RAID group.
- You can remove the expansion on a **Waiting expansion** RAID group.
- You can remove the expansion on an **Expanding** RAID group[1].

[1] This is a disruptive procedure and requires Storage Navigator Modular 2 in **Maintenance Mode** and HDS Technical Resource Center assistance.

3

Example

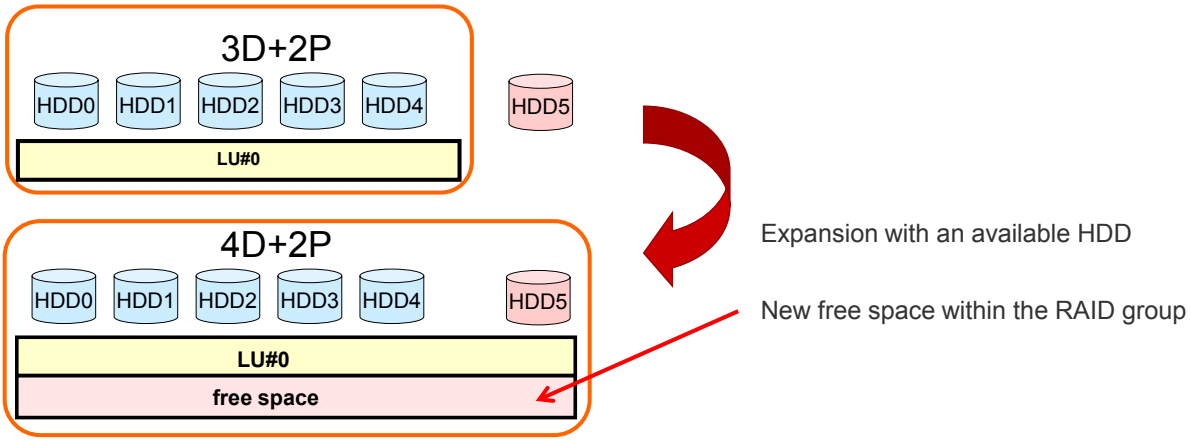
- Example of a RAID 5 4+1 RAID group expansion



- After the expansion, you can either expand LU #0 by using the LU Grow feature or you can create a new LU.

4

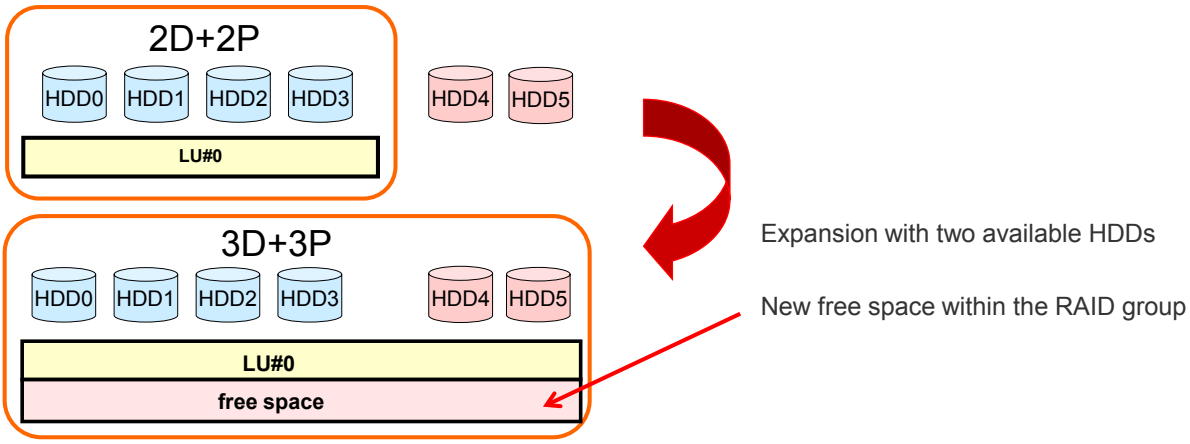
- Example of an RAID 6 3+2 RAID group expansion



- After the expansion, you can either expand LU #0 by using the LU Grow feature or you can create a new LU.

5

- Example of an RAID 1+0 2+2 RAID group expansion



- After the expansion, you can either expand LU #0 by using the LU Grow feature or you can create a new LU.

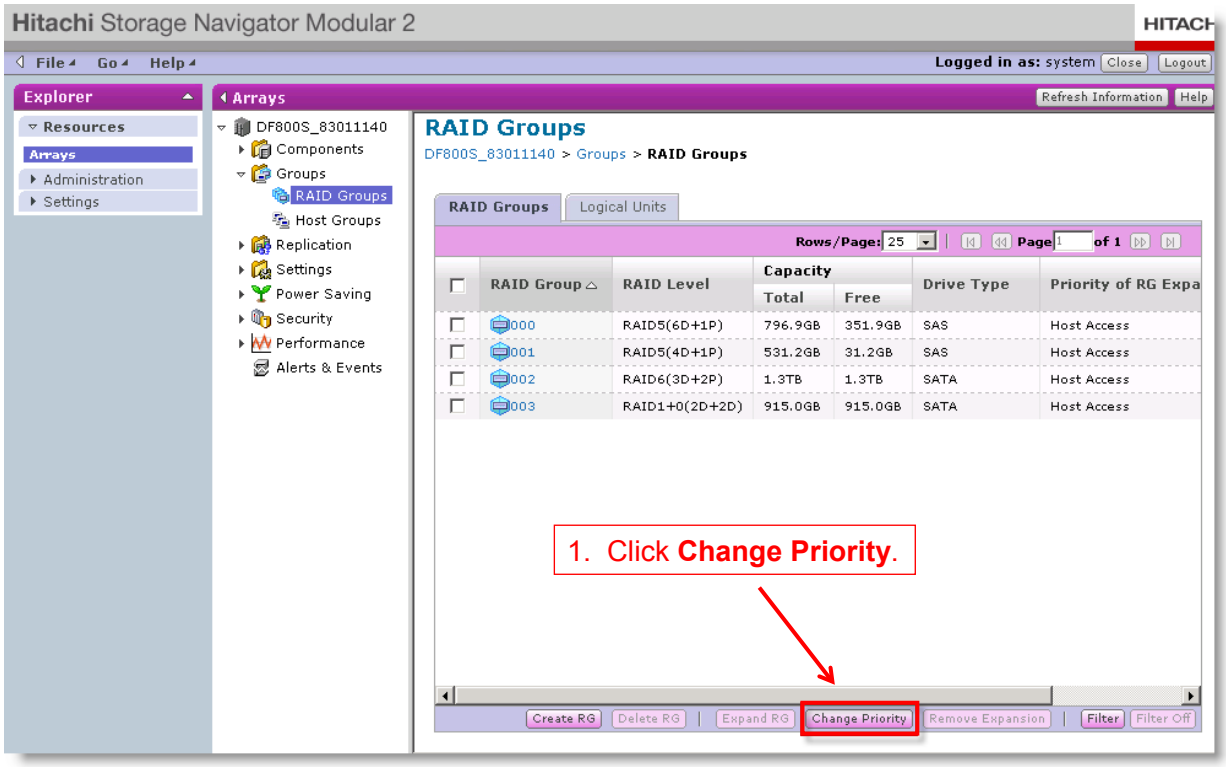
Note: When expanding RAID 1 or RAID 1+0 RAID groups, you must expand these RAID groups with a multiple of at least two HDDs.

6

Priority Mode

- RAID Group expansion **affects front-end performance.**
- The user needs to select one of following two priority modes, which can be changed at any time:
  - **Host Access**
    - If the Host I/O **exceeds** a specific threshold, the RAID group expansion transaction will be aborted and the Host I/O transaction will be prioritized.
    - If the Host I/O rate is **low**, the RAID group expansion transaction will be executed normally.
  - **RAID Group Expansion**
    - The Host I/O gets a lower priority than the RAID group expansion transaction.

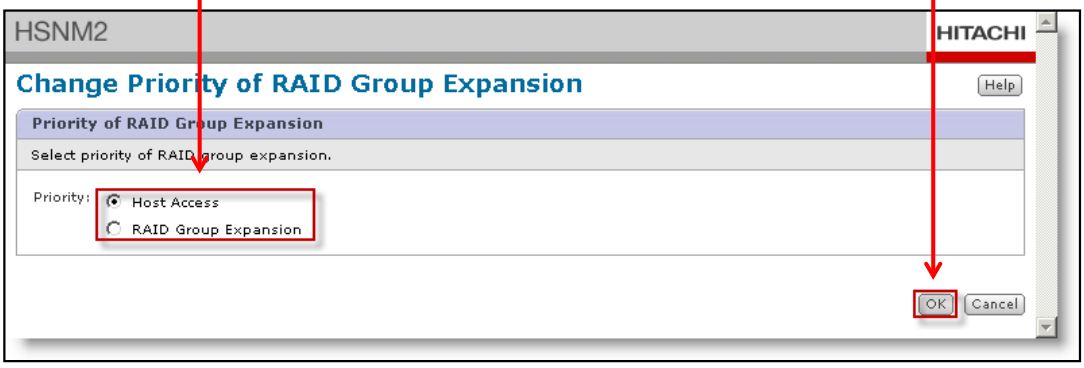
7



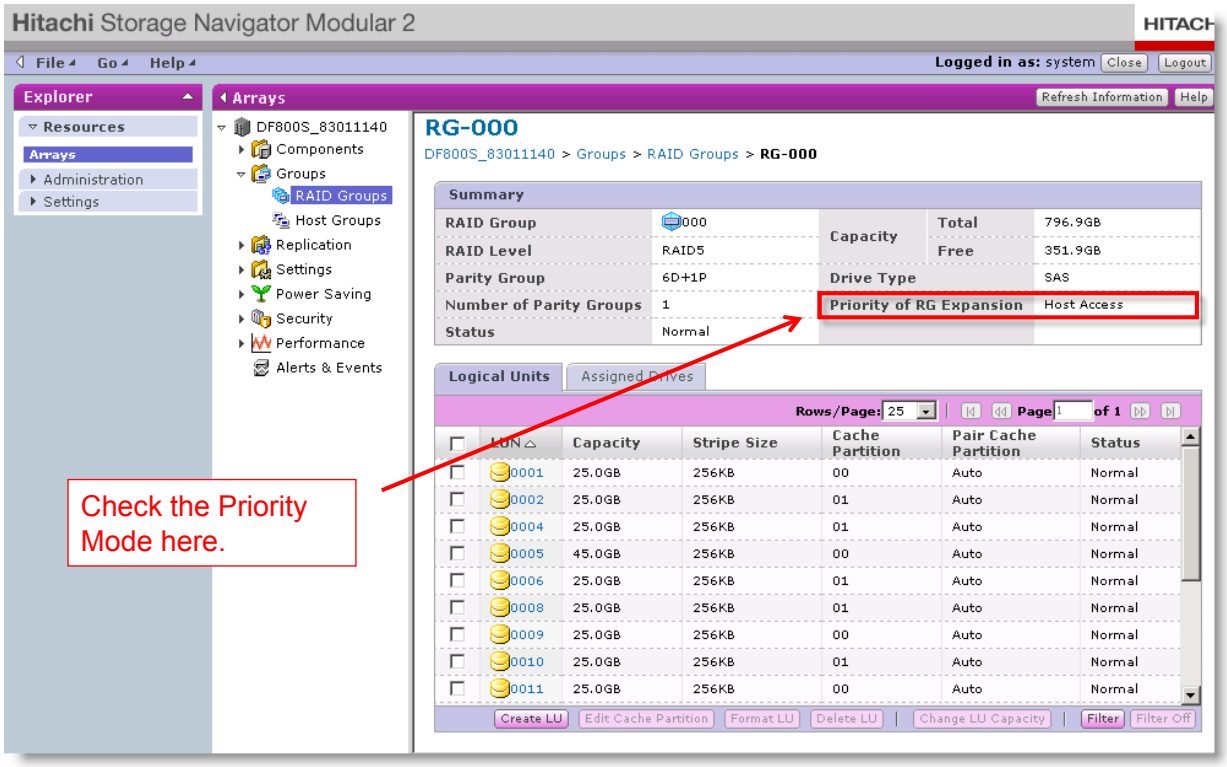
8

2. Select the **Priority** Mode.

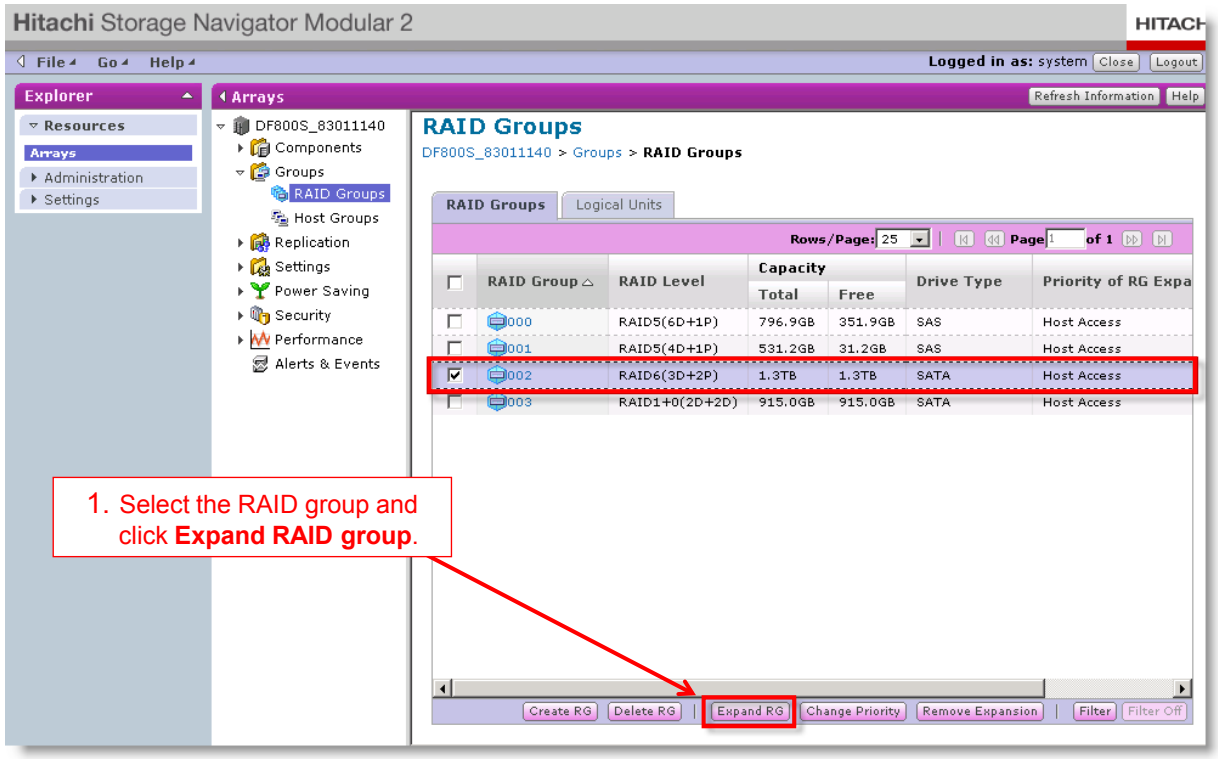
3. Click **OK** to confirm.

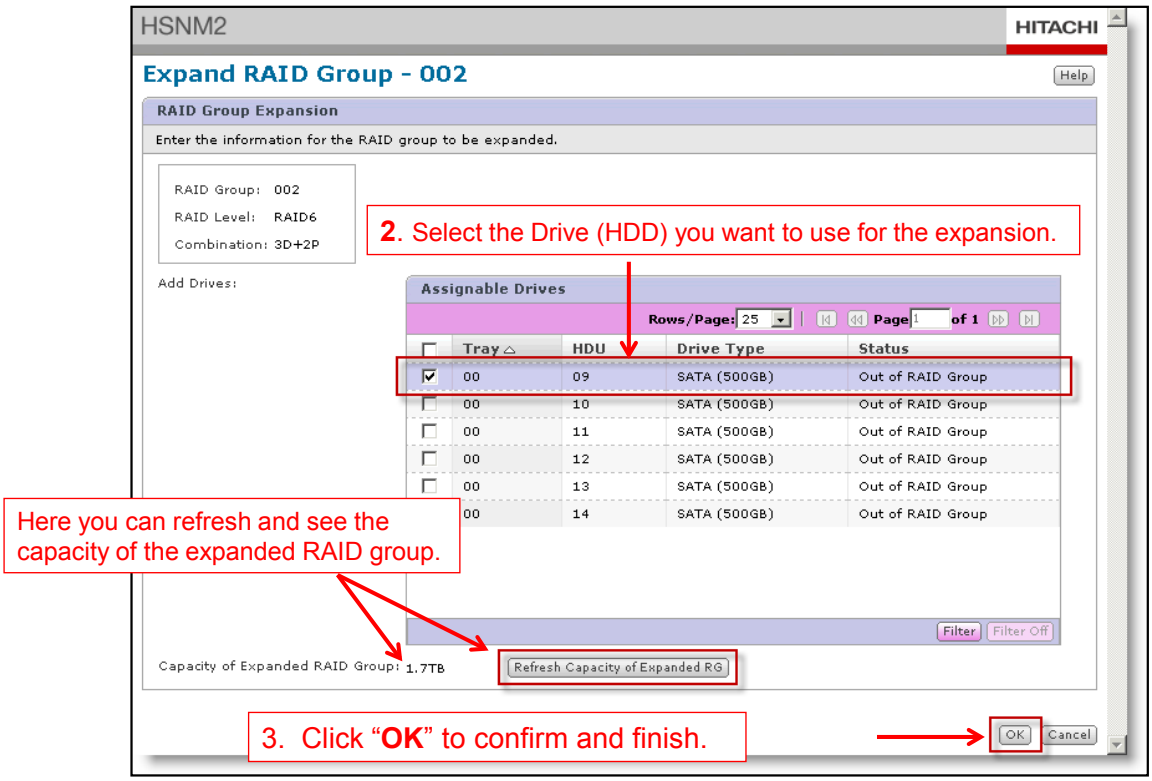


9


Hitachi Storage Navigator Modular 2
HITACHI
File
Go
Help
Logged in as: system
Close
Logout
Explorer
Resources
Arrays
Administration
Settings
Arrays
Refresh Information
Help
DF800S_83011140
Components
Groups
RAID Groups
Host Groups
Replication
Settings
Power Saving
Security
Performance
Alerts & Events
RG-000
DF800S_83011140 > Groups > RAID Groups > RG-000
Summary
RAID Group
000
RAID Level
RAID5
Parity Group
6D+1P
Number of Parity Groups
1
Status
Normal
Capacity
Total
796.9GB
Free
351.9GB
Drive Type
SAS
Priority of RG Expansion
Host Access
Logical Units
Assigned Drives
Rows/Page: 25
Page 1 of 1
LUN
Capacity
Stripe Size
Cache Partition
Pair Cache Partition
Status
0001 25.0GB 256KB 00 Auto Normal
0002 25.0GB 256KB 01 Auto Normal
0004 25.0GB 256KB 01 Auto Normal
0005 45.0GB 256KB 00 Auto Normal
0006 25.0GB 256KB 01 Auto Normal
0008 25.0GB 256KB 01 Auto Normal
0009 25.0GB 256KB 00 Auto Normal
0010 25.0GB 256KB 01 Auto Normal
0011 25.0GB 256KB 00 Auto Normal
Create LU
Edit Cache Partition
Format LU
Delete LU
Change LU Capacity
Filter
Filter Off
Check the Priority Mode here.
10

Perform Expansion




HSNM2
HITACHI
Expand RAID Group - 002
Help
RAID Group Expansion
Enter the information for the RAID group to be expanded.
RAID Group: 002
RAID Level: RAID6
Combination: 3D+2P
Add Drives:
2. Select the Drive (HDD) you want to use for the expansion.
Assignable Drives
Rows/Page: 25
Page 1 of 1
Tray
HDU
Drive Type
Status
00 09 SATA (500GB) Out of RAID Group
00 10 SATA (500GB) Out of RAID Group
00 11 SATA (500GB) Out of RAID Group
00 12 SATA (500GB) Out of RAID Group
00 13 SATA (500GB) Out of RAID Group
00 14 SATA (500GB) Out of RAID Group
Filter
Filter Off
Here you can refresh and see the capacity of the expanded RAID group.
Capacity of Expanded RAID Group: 1.7TB
Refresh Capacity of Expanded RG
3. Click "OK" to confirm and finish.
OK
Cancel
12

Remove Expansion

- The Remove Expansion feature can only be used for RAID groups, where the status is **Waiting expansion.**
- If the status is **Expanding**, you must use the **Forcible suspending function.**
  - This function can only be executed when Storage Navigator Modular 2 is in **Maintenance Mode.**
  - Internally, the LUs of the expanding RAID group are in half finished status, so the operator needs to select one of the following two options:
    1. Change the status of the LUs in the expanded area to **unformat**

       OR

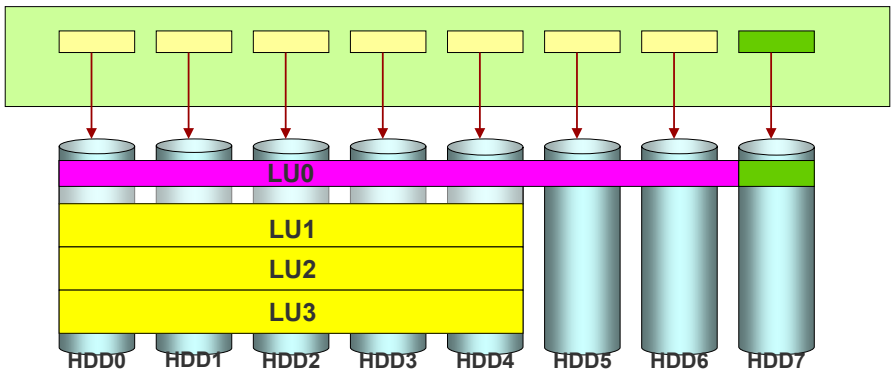
    2. Change the status of the LUs in the unexpanded area to **unformat**

Note: The **Forcible Suspending Function** causes data loss on the affected LUs and HDS Technical Resource Center must be asked for permission.

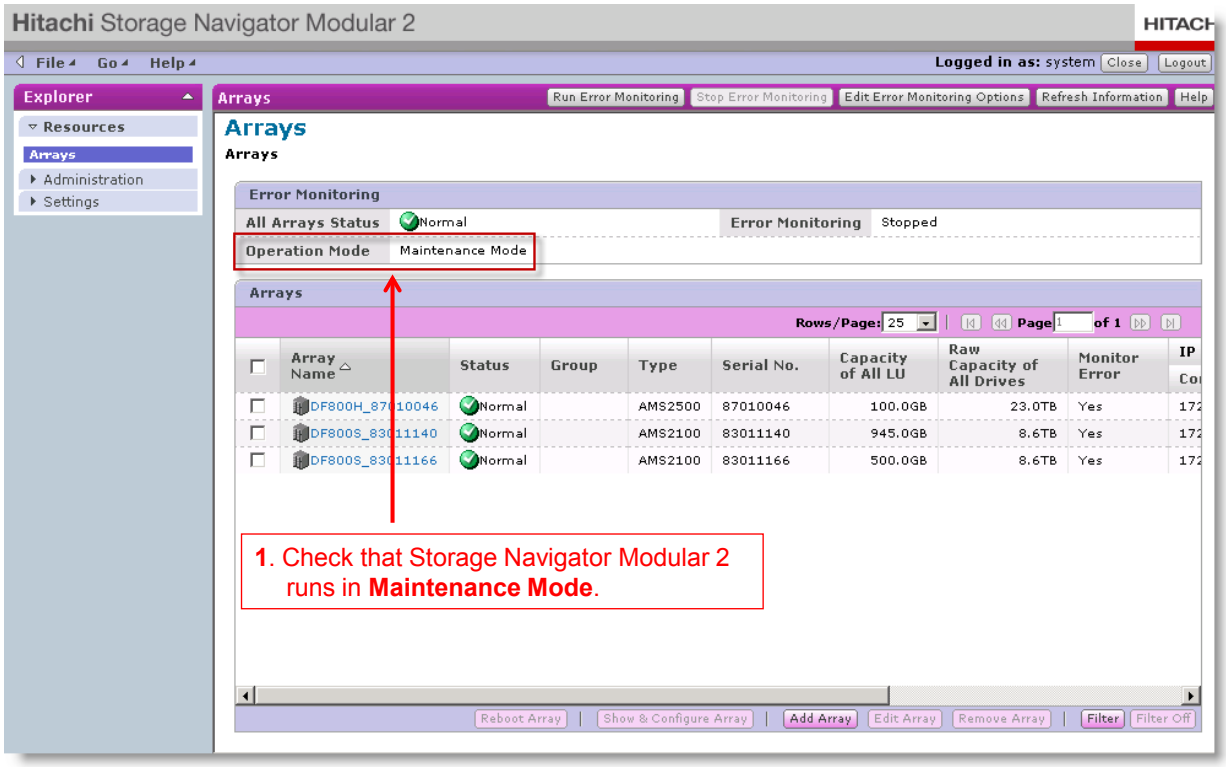
13

Remove (Cancel) Expansion

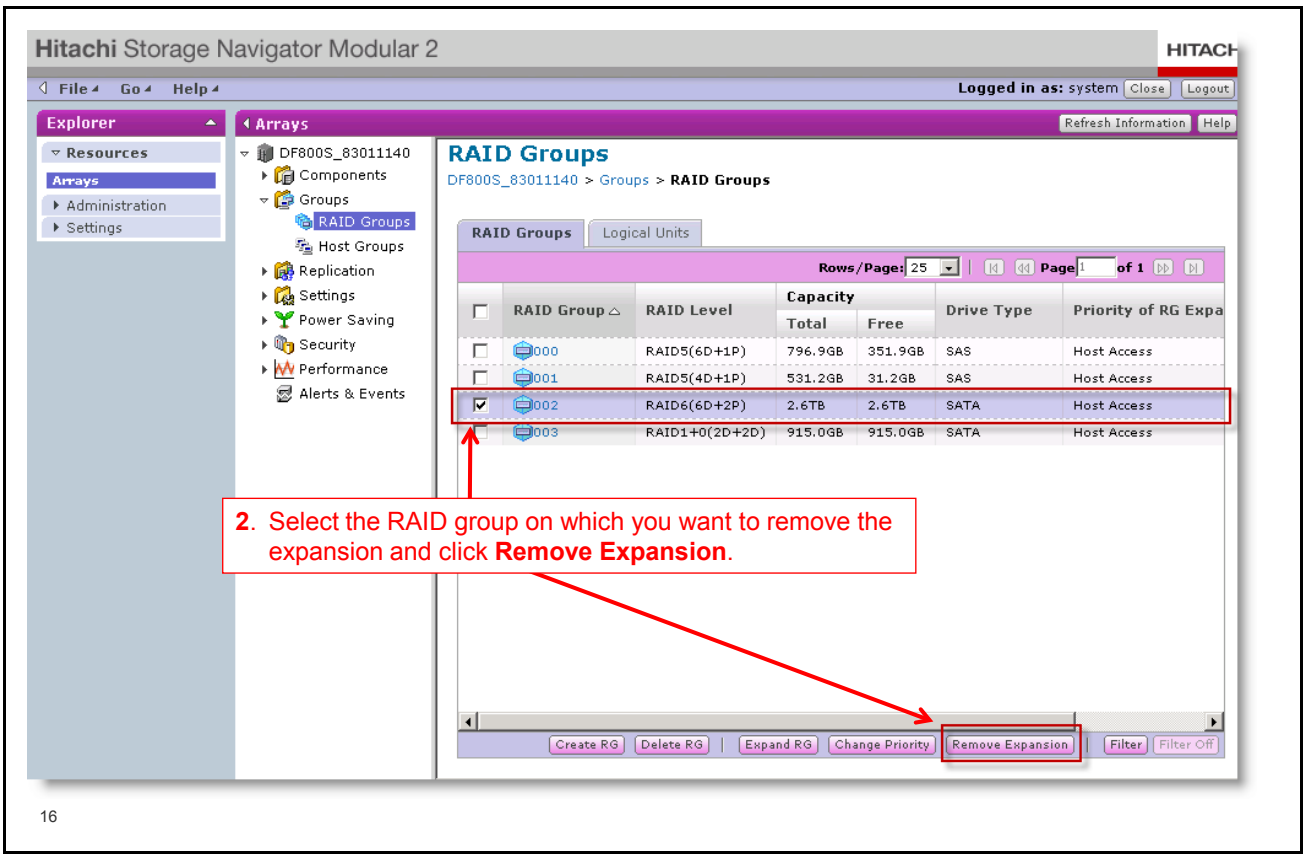
- Change the status of the LUs in the expanded area to ---------- **unformat**
- Change the status of the LUs in the unexpanded area to --------- **unformat**



14

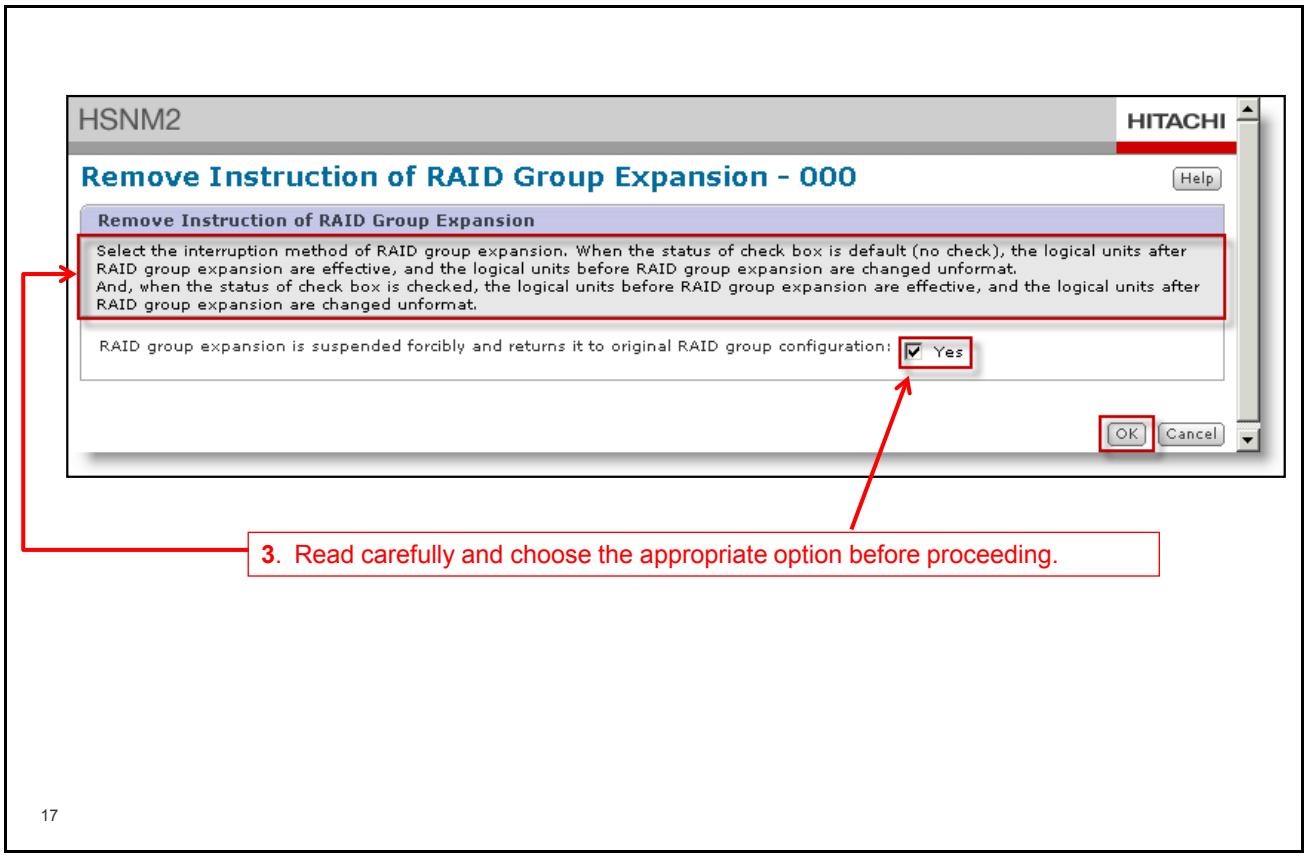

Hitachi Storage Navigator Modular 2
HITACHI
File
Go
Help
Logged in as: system
Close
Logout
Explorer
Resources
Arrays
Administration
Settings
Arrays
Run Error Monitoring
Stop Error Monitoring
Edit Error Monitoring Options
Refresh Information
Help
Arrays
Arrays
Error Monitoring
All Arrays Status
Normal
Error Monitoring
Stopped
Operation Mode
Maintenance Mode
Arrays
Rows/Page: 25
Page 1 of 1
Array Name
Status
Group
Type
Serial No.
Capacity of All LU
Raw Capacity of All Drives
Monitor Error
IP
DF800H_87010046
Normal
AMS2500
87010046
100.0GB
23.0TB
Yes
DF800S_83011140
Normal
AMS2100
83011140
945.0GB
8.6TB
Yes
DF800S_83011166
Normal
AMS2100
83011166
500.0GB
8.6TB
Yes
1. Check that Storage Navigator Modular 2 runs in Maintenance Mode.
Reboot Array
Show & Configure Array
Add Array
Edit Array
Remove Array
Filter
Filter Off

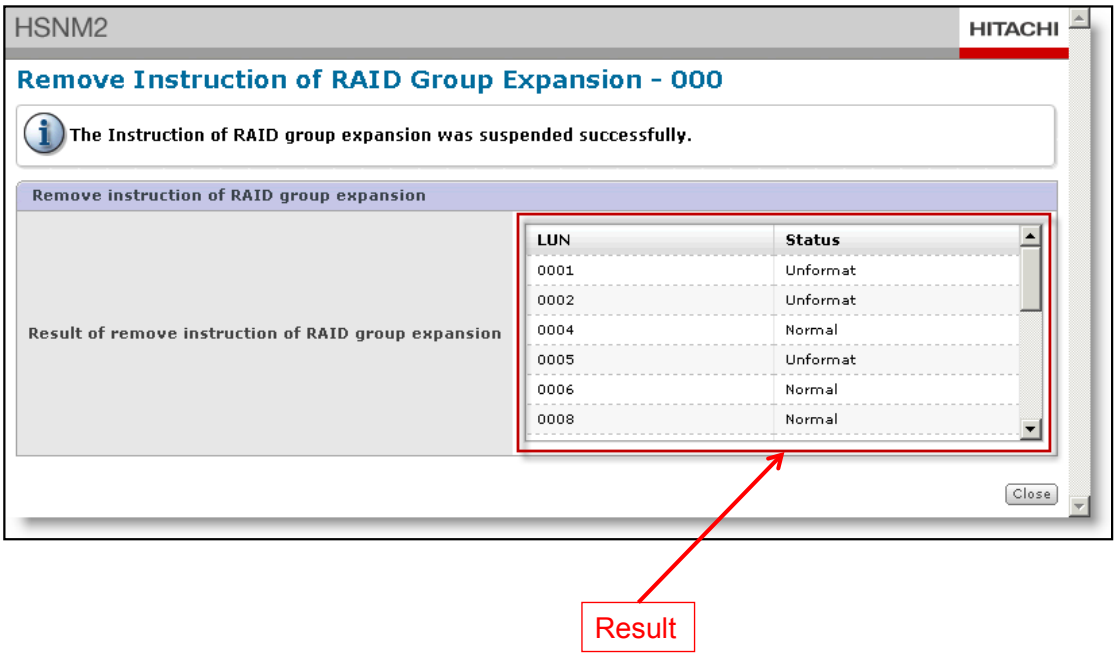
15



Note: You only can remove expansion from RAID Groups where an expansion task is running.

Forcible Suspending Function




HSNM2
HITACHI
Remove Instruction of RAID Group Expansion - 000
The Instruction of RAID group expansion was suspended successfully.
Remove instruction of RAID group expansion
Result of remove instruction of RAID group expansion
LUN
Status
0001
Unformat
0002
Unformat
0004
Normal
0005
Unformat
0006
Normal
0008
Normal
Close
Result

18

General Specification

No	Functions	Specifications
1	Supported Model	2100, 2300, and 2500
2	Operation Interface	Storage Navigator Modular 2 (GUI/CLI)
3	Online RAID group expansion[1]	Available
4	RAID group shrink	N/A
5	RAID level Change	N/A
6	Supported RAID Level	RAID 5, RAID 6, RAID 1, RAID 1+0
7	Maximum number of RAID Groups they can be expanded simultaneously in the same system.	2 RAID Groups per System（1 RAID Group per CTL）at the same time
8	Supported Parity Group Depth	1 only
9	Maximum number of HDDs they can be added to the original RAID group in one operation.	Maximum 8 HDDs per RAID Group
10	Criteria for an available HDD for expansion	Same HDD type (SAS/SATA) Capacity is same or larger than the current HDDs in the RAID Group.
11	The time when the expanded capacity will be available	After the expansion completed successfully (reboot of the storage system is not necessary.)
12	The Maximum number of queued RAID group expansion tasks	No restriction (the 1st one will be executed and other will be pending/waiting)
13	RAID group expansion if the DM-LU, a Command Device or a POOL LU resides in this RAID group	Available
14	Priority Mode	Prioritizing the Host I/O [Default] Prioritizing the RAID Group expansion (re-striping)

19

[1] The Hosts can utilize the LUs in the RAID Group being expanded. This function is non-disruptive to the Hosts.

Detailed Specification

No	Functions	Specifications	
		System operations during RG Expansion	RG Expansion during system operations
1	LU formatting	Available	N/A for RAID group containing a LU being formatted.
2	LU Expansion (LUSE)	N/A for LU in RAID group being expanded.	Available
3	HDD recovery	Available	N/A for RAID group containing a LU being recovered.
4	Parity recovery	Available	N/A for RAID group containing a LU being recovered.
5	RAID group no redundancy	Available	N/A
6	Online verify	Available	Available
7	Online Firmware Upgrade	N/A	N/A
8	Offline Firmware Upgrade	Available	N/A
9	ENC Microprogram downloading	Available	Available
10	Online HDD Firmware upgrading	Available	N/A
11	DM-LU setting	Available	Available
12	Command Device setting	Available	Available
13	POOL LU setting	Available	Available
14	LU creation/deletion	N/A	N/A
15	RAID group creation/deletion	N/A	N/A
16	Load balancing	Back end load balancing is N/A for the RAID group which is being expanded	

20

- If the LU is in a RAID Group which is being expanded, the LU formatting process is prioritized. After format completion, the RAID Group expansion process will be restarted.
- If the HDD is in a RAID Group which is being expanded, the HDD recovery process is prioritized. After recovery completion, the RAID Group expansion process will be restarted.
- If the LU is in a RAID Group which is being expanded, the LU recovery is prioritized. After recovery completion, the RAID Group expansion process will be restarted.
- The HDD firmware upgrade process will be started after completion of the RAID Group expansion process.

Detailed Specification

No	Functions	Specifications	
		System operations during RG Expansion	RG Expansion during system operations
1	ShadowImage	Cannot execute pair operations	Must be in “SMPL/PSUS” beforehand
2	Snapshot	Cannot execute pair operations	Must be in “SMPL/PAIR” beforehand
3	TrueCopy/TCE	Cannot execute pair operations	Must be in “SMPL/PSUS” beforehand
4	Modular Volume Migration	N/A	N/A
5	Cache Residency Manager	N/A	N/A
6	Power Saving	N/A	N/A
7	Cache Partition Manager	N/A	N/A
8	Data Retention Utility	Available	Available
9	LUN Manager	Available	Available
10	Password Protection	Available	Available
11	SNMP Agent	Available	Available
12	Account Authentication	Available	Available
13	Audit Logging	Available	Available

21

Failure Management

No	Failures during RG Expansion	Failure management policy
1	HDD failure (with redundancy)	The system continues the RAID group expansion process.
2	HDD failure (no redundancy)	The system stops the RAID group expansion process. After fixing the failed HDD, the process continues.
3	HDD recovery process	The system stops the RAID group expansion process until the HDD failure is recovered.
4	Controller failure	The system continues the RAID group expansion process.
5	Array shutdown / reboot	The system memorizes the progression before the power off and continues the RAID group expansion process after the power on.
6	P/S stop without volatile	The system continues the RAID group expansion process after the Reboot.
7	P/S stop with volatile	The system reduces the effect of data lost as much as possible and continues the RAID group expansion process after the Reboot.[1]
8	Other critical abnormal status	The system prepares for the forcible suspending function.

[1] With the reboot after a P/S stop with volatile, the forcible parity recovery process will be performed. During this process, if a HDD fails, the status of all LUs in the affected RAID group will be changed to unformatted.

22

Lab Project 7: Online RAID Group Expansion

- Timing and Organization
  - Time allotted to complete the project: **30 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups.
  - The lab groups will perform the lab project on the lab equipment assigned to them by their instructor.

23

Lab Project 7: Objectives

- Upon completion of the lab project, the learner will be able to do the following:
  - Create an expanded RAID Group from an existing RAID Group

24

9. Setup and Configuration of Hitachi Storage Navigator Modular 2 CLI

Module Objectives

- Upon completion of this module, the learner should be able to:
  - State the purpose of Hitachi Storage Navigator Modular 2 Command Line Interface (CLI)
  - Identify the two modes of operation
  - Install the CLI on a Dynamic Link Manager Microsoft Windows host system
  - Register an Adaptable Modular Storage 2000 family system
  - Create or delete a RAID Group
  - Create or delete a LUN
  - Format a LUN

2

GUI Functions –> CLI Functions

- Host Group setting
- LAN configuration
- Spare disk setup
- Drive restoration control option
- Host Group port options
- Create RAID Groups and LUNs
- Map LUNs to Host Groups
- Microcode replacement
- Drive restoration mode
- SNMP configuration
- Collect performance statistics
- Configuration information import and export from or to a file
- Fibre Channel information
  - Topology setup
  - Setting port address (not really used)
  - Connection speed
- Enable features and optional software
- Configure online verify mode
- Configure optional software components
  - ShadowImage Replication software
  - Copy-on-Write Snapshot software
  - TrueCopy Remote Replication software
  - TrueCopy Extended Distance software

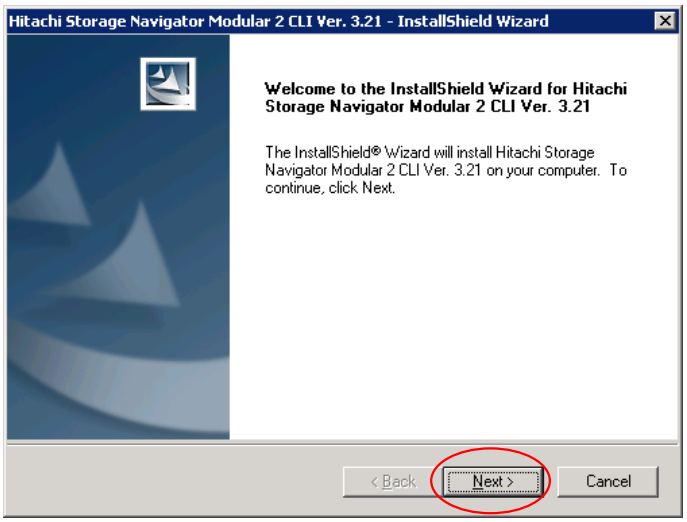
CLI commands can be put into a **script** file, giving the CLI a major advantage over the GUI. Specific functions can be automated.

3

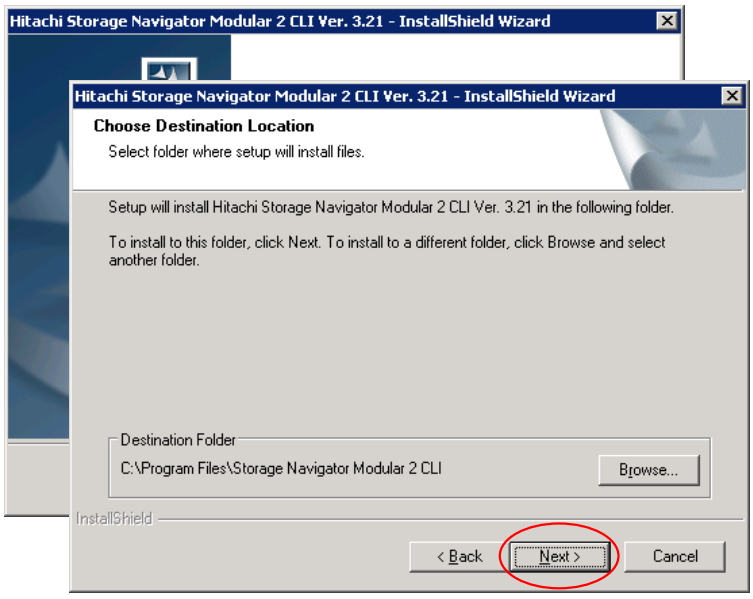
Install

- Insert the Storage Navigator Modular 2 - CLI CD-ROM or browse to the folder that contains the installation program.
- If installation does not start automatically, run **setup.exe.**
- Follow the instructions, leaving the defaults when possible.

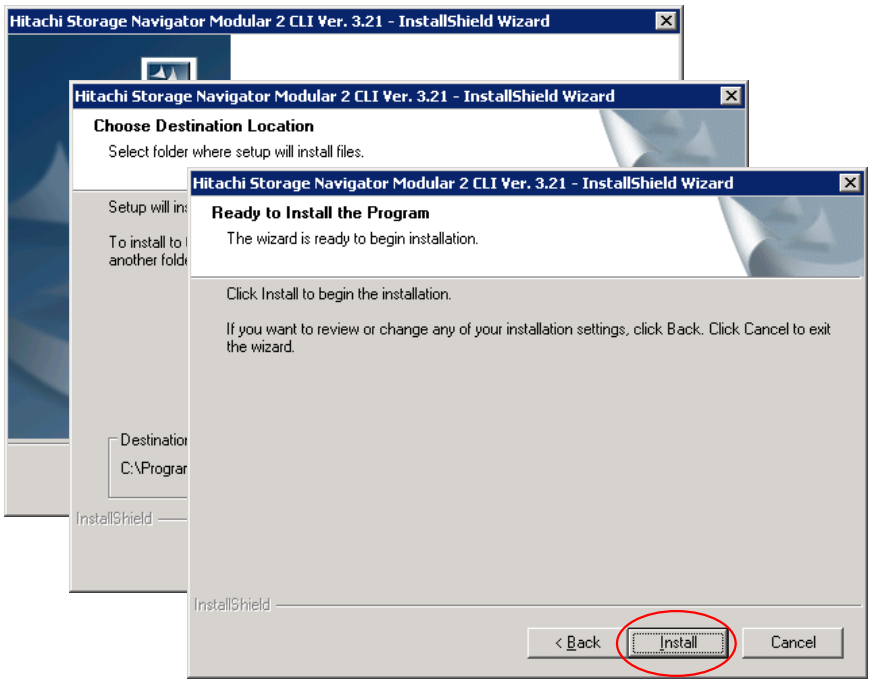
4


Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Welcome to the InstallShield Wizard for Hitachi Storage Navigator Modular 2 CLI Ver. 3.21
The InstallShield® Wizard will install Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 on your computer. To continue, click Next.
< Back
Next >
Cancel

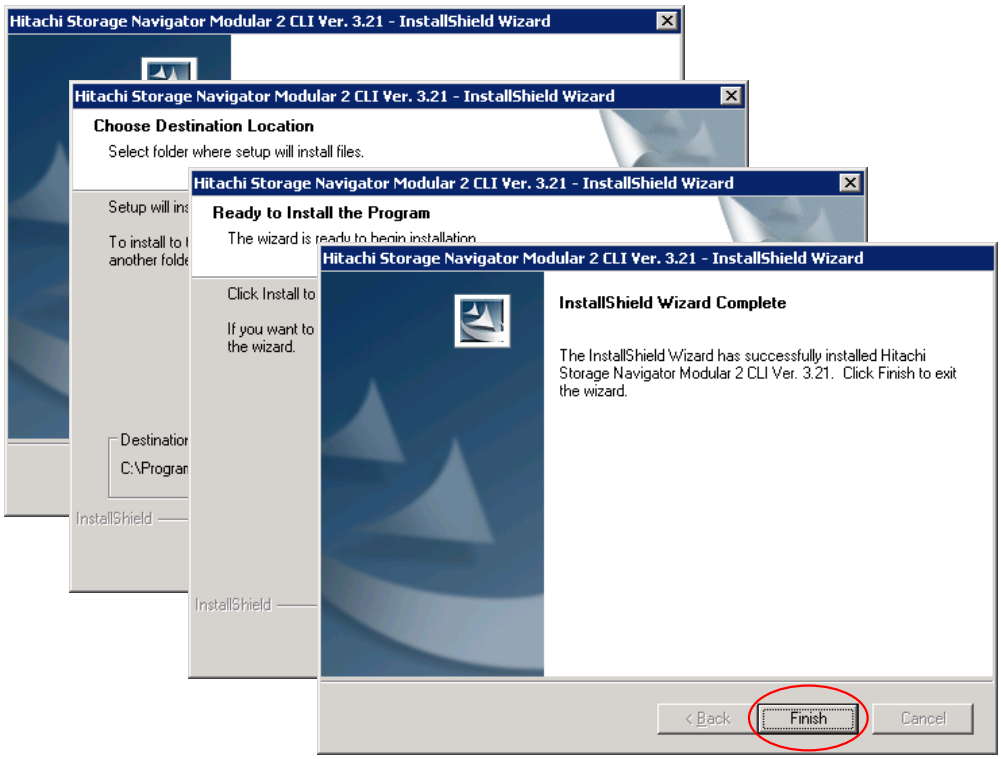
5


Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Choose Destination Location
Select folder where setup will install files.
Setup will install Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 in the following folder.
To install to this folder, click Next. To install to a different folder, click Browse and select another folder.
Destination Folder
C:\Program Files\Storage Navigator Modular 2 CLI
Browse...
InstallShield
< Back
Next >
Cancel

6


Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Choose Destination Location
Select folder where setup will install files.
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Ready to Install the Program
The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield
< Back
Install
Cancel

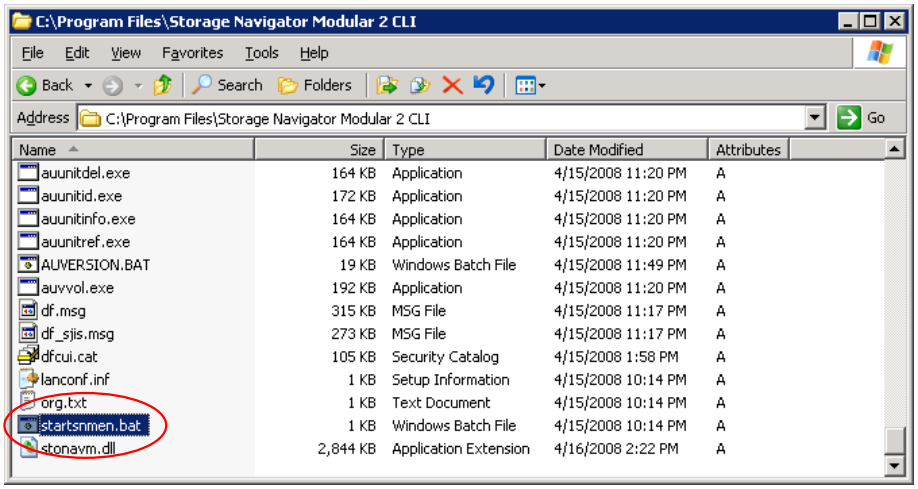
7


Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Choose Destination Location
Select folder where setup will install files.
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
Ready to Install the Program
Hitachi Storage Navigator Modular 2 CLI Ver. 3.21 - InstallShield Wizard
InstallShield Wizard Complete
The InstallShield Wizard has successfully installed Hitachi Storage Navigator Modular 2 CLI Ver. 3.21. Click Finish to exit the wizard.
< Back
Finish
Cancel

8

Start CLI

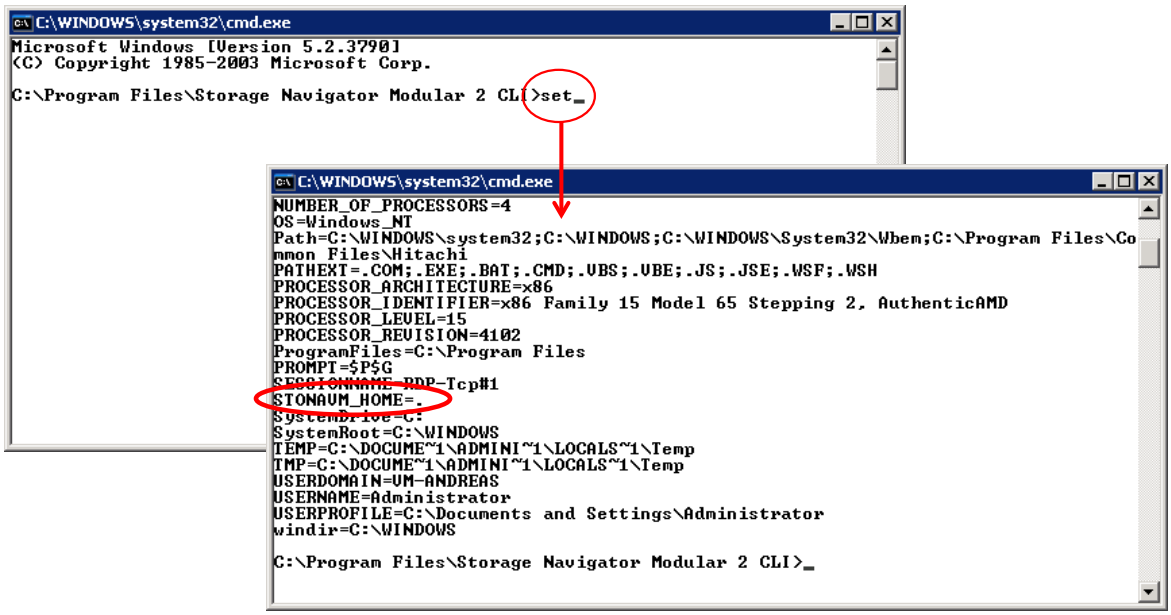
- To start the CLI, browse to the Installation folder and double click **startsnmen.bat.**



9

Check the Environment Variables

- Before using the CLI, check the environment variables.
- Type **`set`** on the command line prompt and look for **STONAVM_HOME** setting.



When starting CLI as described here, the environment variables are set automatically.

But in any case, it is recommended to double check the settings.

Modes of Operation

- Before DF800
  - Normal Mode
    - No password is required to switch to Management Mode.
    - This is a view-only mode.
  - Management Mode
    - A password is required.
    - You can change various settings in this mode.
- DF800
  - Management Mode is the default.
  - No password is required.

11

Register a Storage System

- To manage a storage system you must register it in Storage Navigator Modular 2.

  Array Unit Registration

  – Format

  auunitadd [-unit unit_name] [-group group_name]
  [-RS232C | -LAN] -ctl0 device | address
  [-ctl1 device | address] [-ignore]

  – Description

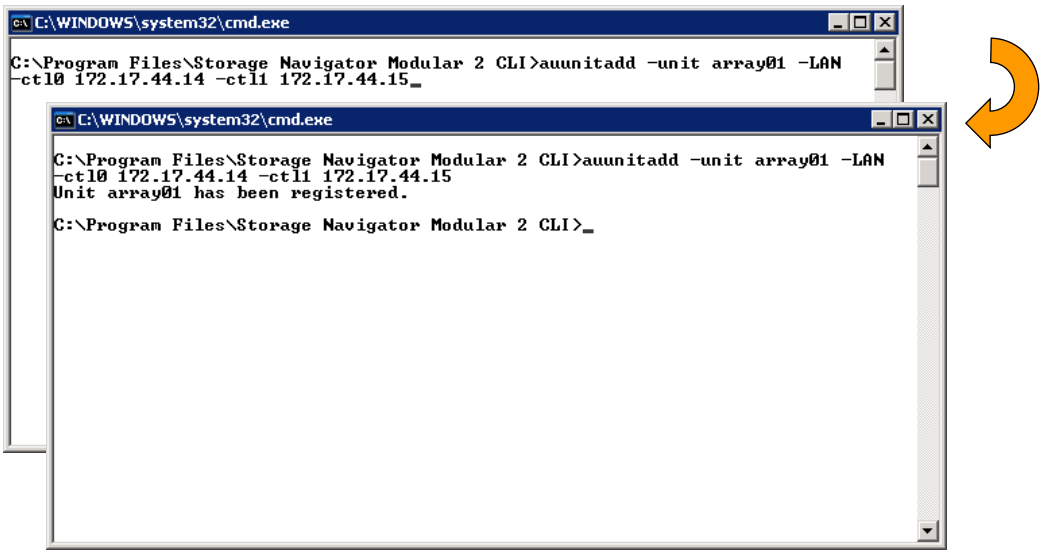
  This command registers an array unit with the Resource Manager. The registration information consists of the array unit name, group name, connection interface, and device.

  – Example:

  auunitadd –unit array01 –LAN –ctl0 172.17.44.14 -ctl1 172.17.44.15

12

- To manage a storage system you must register it in Storage Navigator Modular 2.



13

Creating a RAID Group

- Create a RAID Group
  - Format

    aurgadd -unit unit_name -rg rg_no
    -RAID0 | -RAID1 | -RAID5 | -RAID10 | -RAID6
    -drive unit_no. hdu_no ...
    -pnum pty_num

  - Description

    This command creates a RAID Group in a specified array unit.

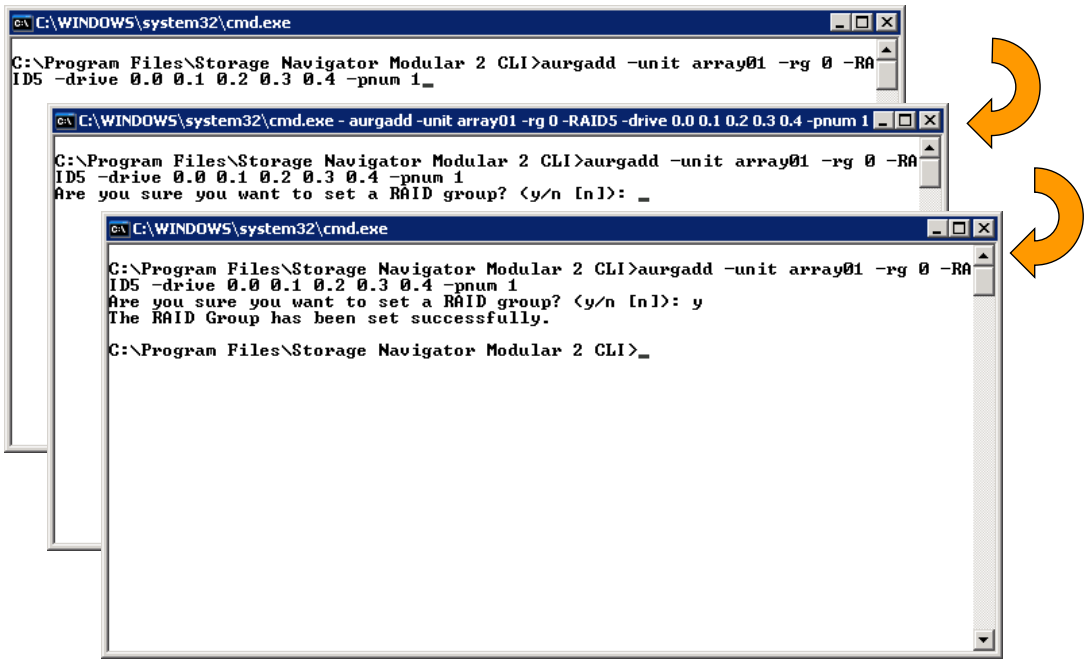
  - Example:

aurgadd –unit array01 -rg 0 -RAID5 –drive 0.0 0.1 0.2 0.3 0.4 -pnum 1

This will create RAID Group 0 in RAID5 4+1 from the first five disks in Unit 0.

Disk Number = **X.Y**, where **X** = the Tray Number, **Y** = Disk Number

14


C:\WINDOWS\system32\cmd.exe
C:\Program Files\Storage Navigator Modular 2 CLI>aurgadd -unit array01 -rg 0 -RAID5 -drive 0.0 0.1 0.2 0.3 0.4 -pnum 1
C:\WINDOWS\system32\cmd.exe - aurgadd -unit array01 -rg 0 -RAID5 -drive 0.0 0.1 0.2 0.3 0.4 -pnum 1
C:\Program Files\Storage Navigator Modular 2 CLI>aurgadd -unit array01 -rg 0 -RAID5 -drive 0.0 0.1 0.2 0.3 0.4 -pnum 1
Are you sure you want to set a RAID group? (y/n [n]):
C:\WINDOWS\system32\cmd.exe
C:\Program Files\Storage Navigator Modular 2 CLI>aurgadd -unit array01 -rg 0 -RAID5 -drive 0.0 0.1 0.2 0.3 0.4 -pnum 1
Are you sure you want to set a RAID group? (y/n [n]): y
The RAID Group has been set successfully.
C:\Program Files\Storage Navigator Modular 2 CLI>

15

Referencing the RAID Groups

- Review the RAID Group configuration of a storage system
  - Format

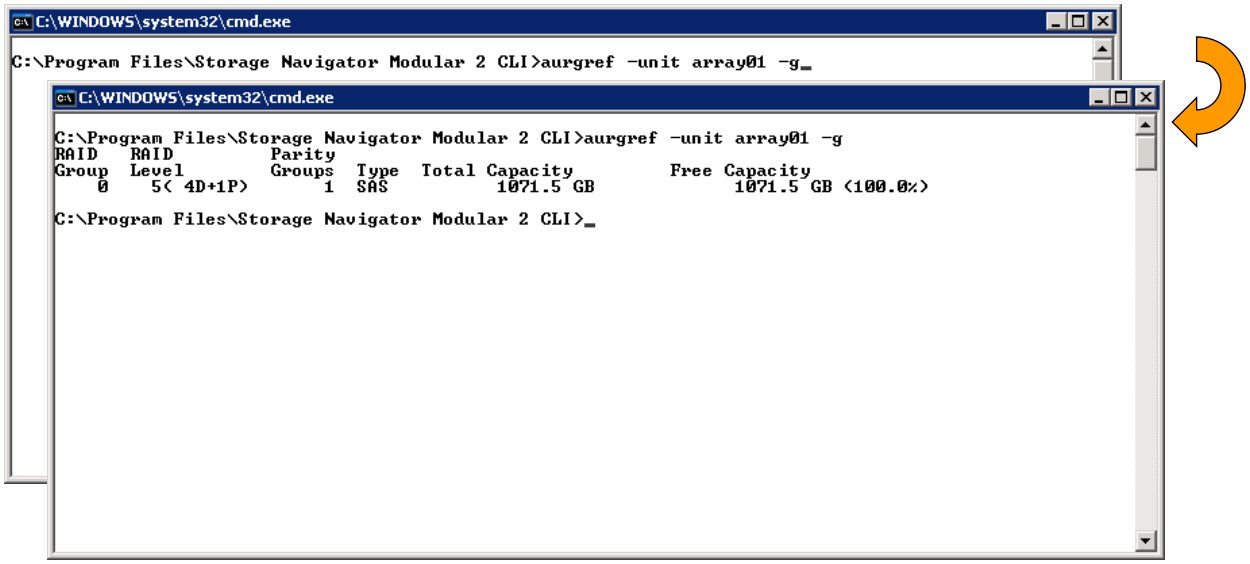
    aurgref -unit unit_name [-m | -g] [-detail rg_no]
  - Description

    This command displays a list of existing RAID Groups. The displayed contents include the RAID group number, RAID level, and size in blocks (default) MB or GB.
  - Example:

    aurgref –unit array01 -g

16

- Review the RAID Group configuration of a storage system.



17

Deleting RAID Groups

- Delete RAID Groups
  - Format

    aurgdel -unit unit_name -rg rg_no [-f]

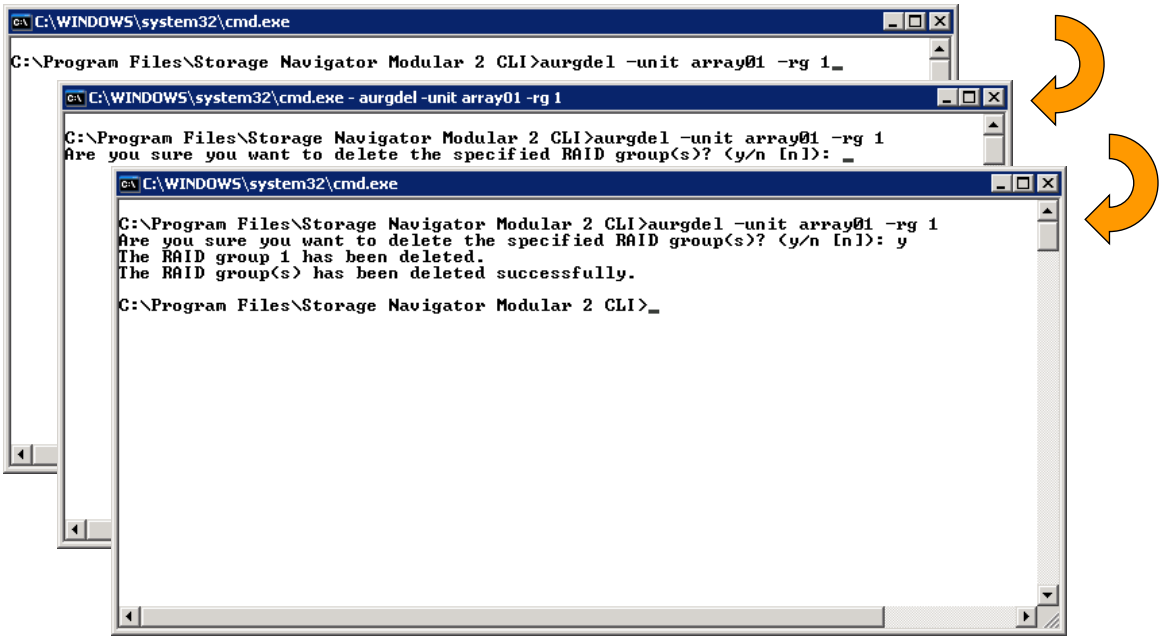
    aurgdel -unit unit_name -ALL [-f]
  - Description

    This command deletes the specified RAID Group or deletes all RAID groups in an array unit
  - Example:

    aurgdel –unit array01 –rg 1

18

- Delete RAID Group



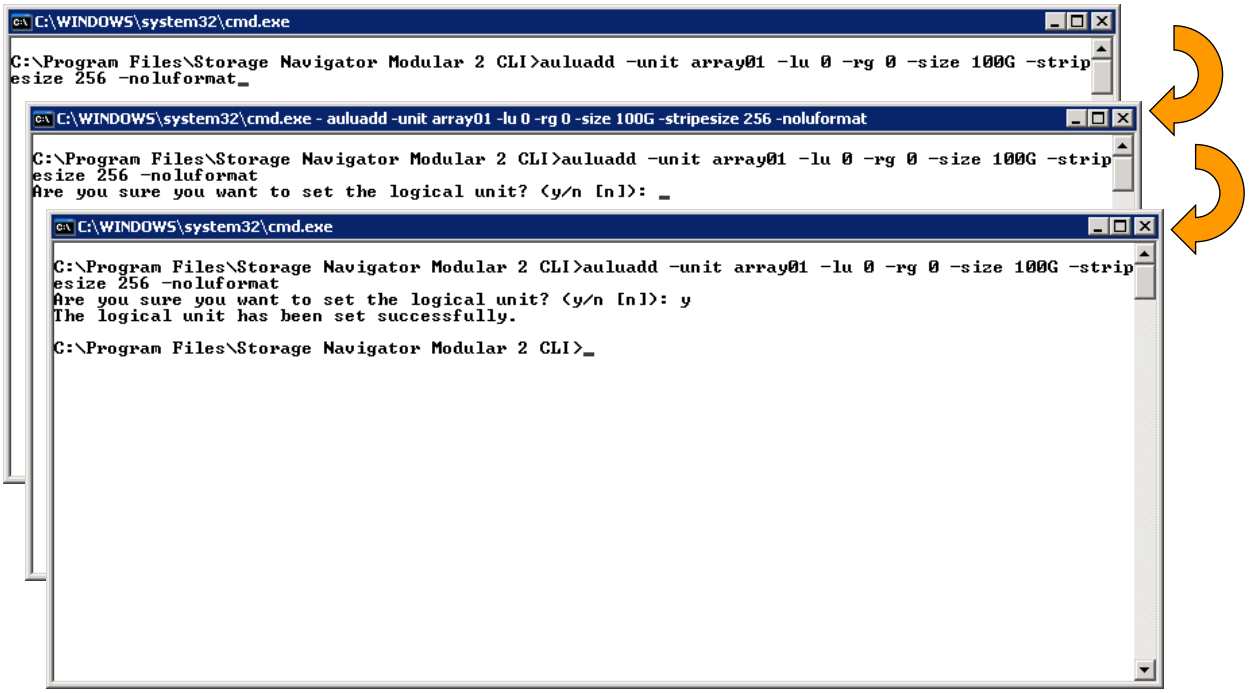
19

Creating LUs

- Create an LU
  - Format
    auluadd -unit unit_name [-lu lun] -rg rg_no -size num [m | g | t] | rest
    [-stripesize 64 | 256 | 512]
    [-cachept pt_no]
    [-paircachept pt_no | auto]
    [-createarea area_no]
    [-noluformat]
  - Description
    This command is used to create LUs.
  - Example:
    auluadd –unit array01 –lu 0 –rg 0 –size 100g –stripesize 256 -noluformat

20

- Create an LU



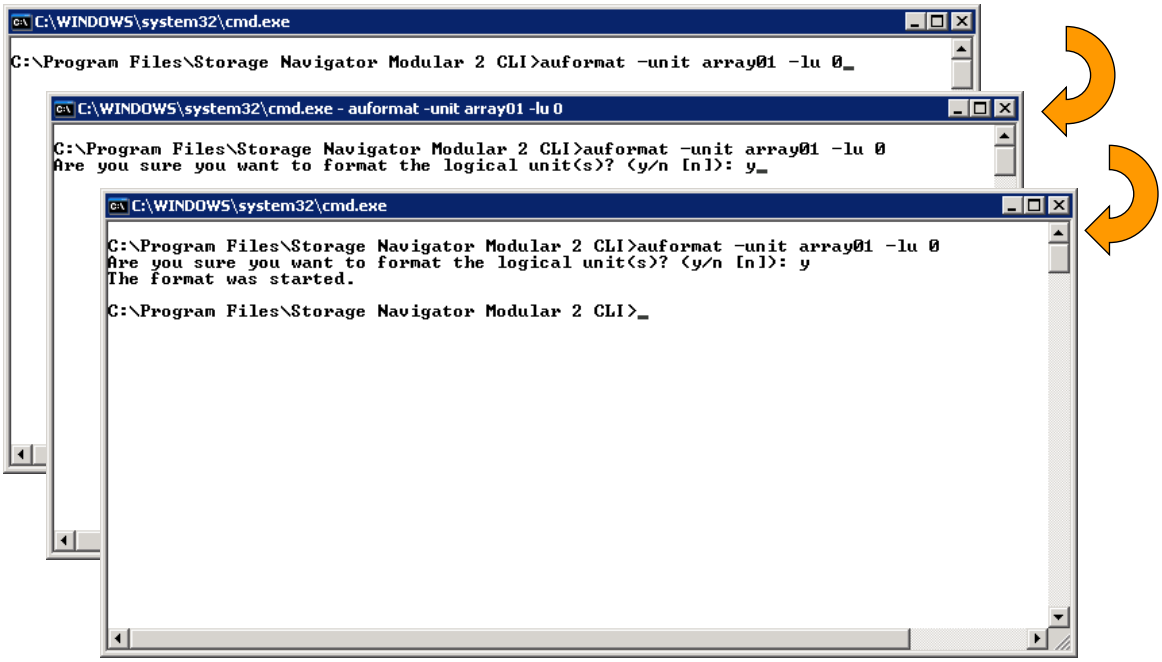
21

Format LUs

- Format an LU
  - Format
    auformat -unit unit_name -lu lun...
  - Description
    This command formats a specified LUN or a group of LUNs
  - Example:
    auformat –unit array01 –lu 0

22

- Format an LU



23

Referencing LUs

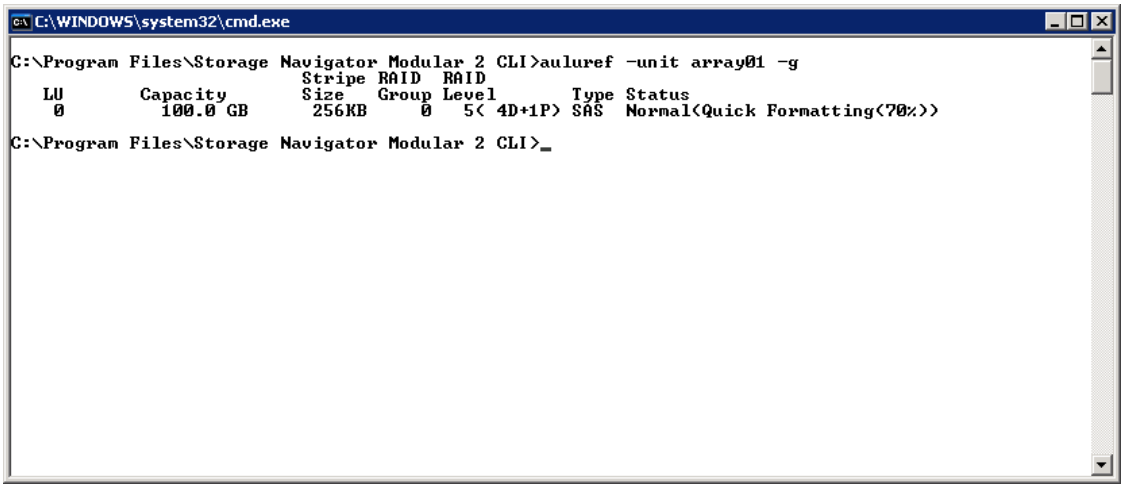
- Referencing the LUs
  - Format

    auluref -unit unit_name [-m | -g] [-lu lun ...]
  - Description

    This command displays information of existing LUs (capacity, status, current controller number, default controller number, RAID group number of a RAID group and its RAID level).
  - Example:
    auluref –unit array01 -g

24

- Referencing the LUs



25

Deleting LUs

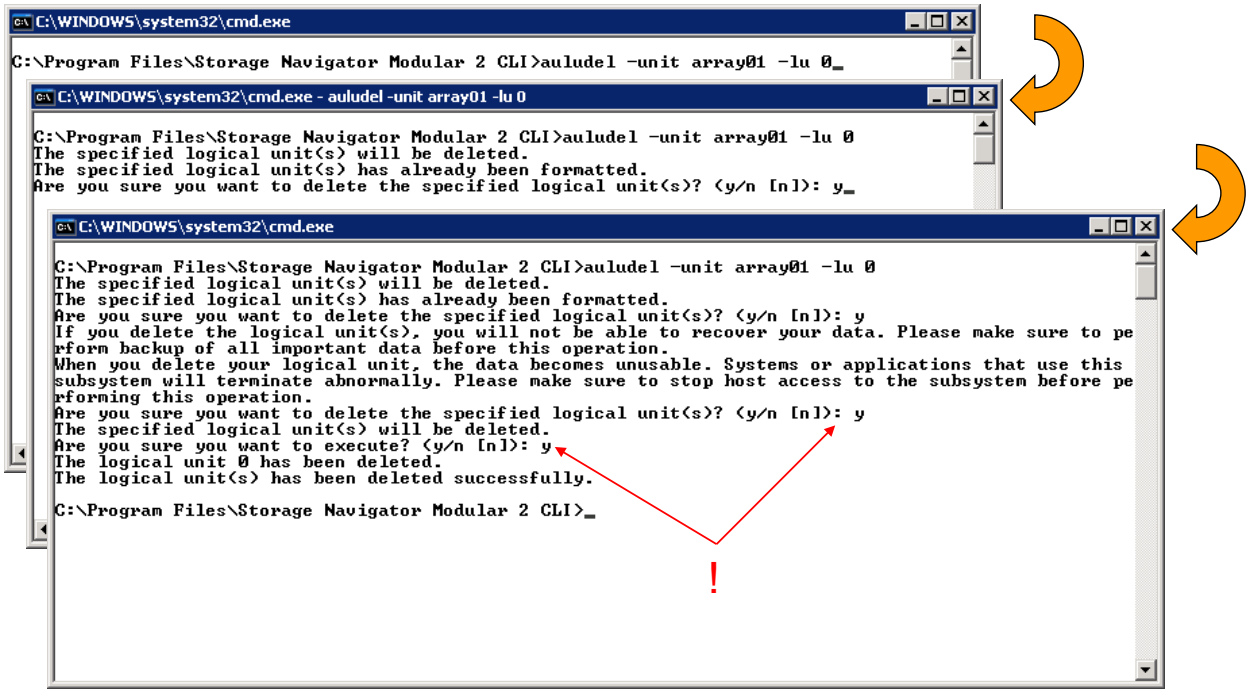
- Delete an LU
  - Format

    auludel -unit unit_name -lu lun . . . .
  - Description

    This command deletes a single LU or a group of LUs
  - Example:
    auludel –unit array01 –lu 0

26

- Delete an LU



27

Display Help

- Display Help
  - Format

    auman [-en | -jp] command_name
  - Description

    This command displays the help information in English (-en) or Japanese (-jp) for a command.

28

Lab Project 8: SNM2 CLI

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups.
  - The lab groups will perform the lab project on the lab equipment assigned to them by their instructor.

29

Lab Project 8: Objectives

- Upon completion of the lab project, the learner should be able to:
  - Install the Storage Navigator Command Line Interface on a host system
  - Verify CLI system variables
  - Register an Adaptable Modular Storage 2000 system with the CLI
  - Create a Management Mode password
  - Collect status of existing RAID Groups and LUNs
  - Create and delete a RAID Group
  - Create a LUN
  - Format a LUN

30

10. Software Feature Overview

Module Objectives

- Upon completion of this module, the learner should be able to:
  - List the software features that are included with the Adaptable Modular Storage 2000 Family
  - Describe what Program products can be accessed only with Storage Navigator Modular 2 Advanced Setting applet
  - Describe, enable, and configure Cache Partition Manager feature
  - Load a specific internal LUN into cache as a cache-resident LUN using Cache Residency Manager feature
  - State the purpose of the Performance Monitor feature and identify the types of performance data that can be collected
  - Load, configure, and launch HDLM
  - Use Iometer to generate I/O activity to specific DF800 LUNs
  - Launch Performance Monitor and collect and display specific performance metrics

2

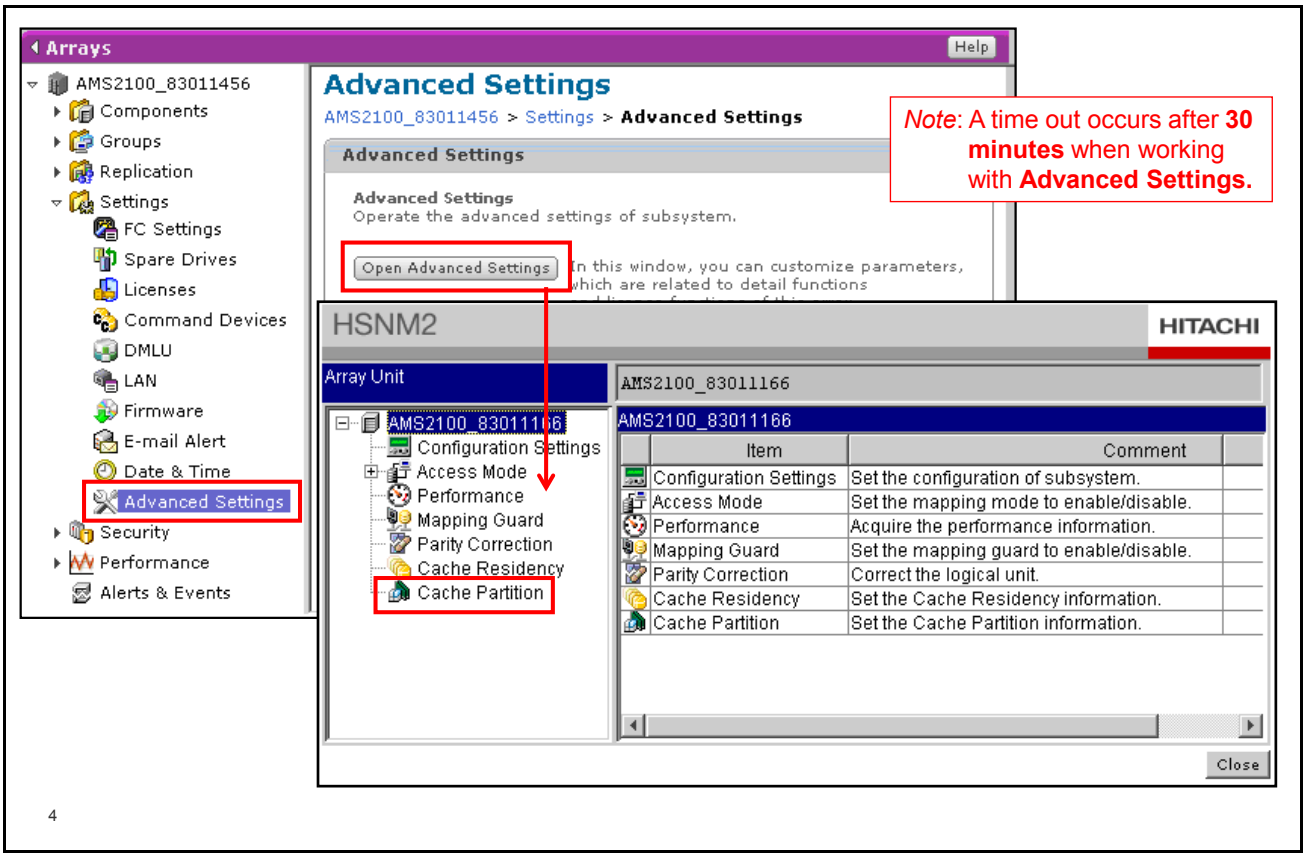
Features and Usage

Product or Feature	Usage	Model
LUN Manager/LUN Expansion	Host Groups	All
Cache Residency Manager	Increase LUN access performance	All
Cache Partition Manager	Increase host access performance	All
SNMP Agent Support Function	Report events and status	All
Account Authorization	Robust security for restricting access	All
Audit Logging	Audit logging of all changes performed in AA	All
Performance Monitor	Monitor and collect utilization statistics	All
LUN Grow/Shrink	Expand or reduce the capacity of an LU	All
Online Raid Group Expansion	Expand the capacity on an Raid Group	All
Data Retention Utility	Protect LUNs	All
Data Shredding – (future)	**Parity group /LU data erase**	**All**
Power Saving	**Power down of RAID groups that are not used**	**All**
Hitachi ShadowImage Replication software	**Create local copies of production LUNs**	**All**
Hitachi TrueCopy Synchronous software	**Create remote copies of production LUNs**	**All**
Hitachi TrueCopy Extended Distance Software	**Create remote copies of production LUNs**	**All**
Hitachi Copy-on-Write Snapshot software	**Create point-in-time copies of production LUNs**	**All**

3

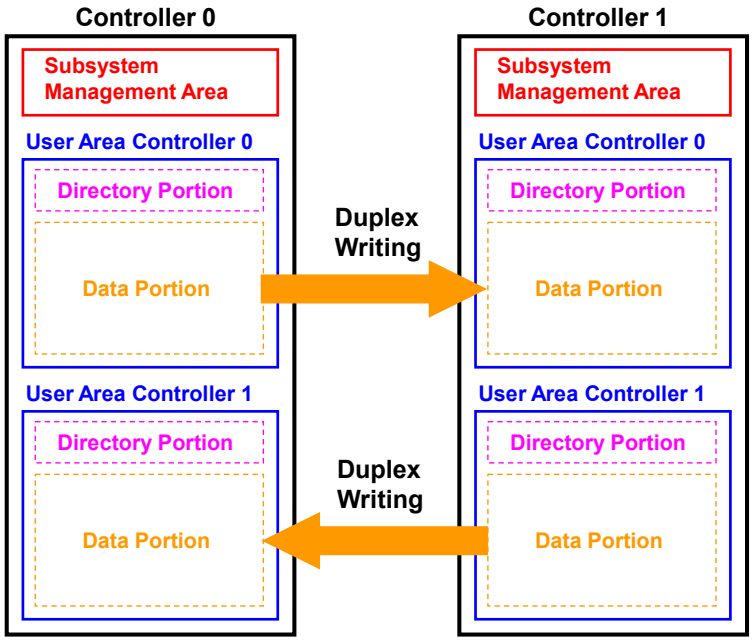
Note: Highlighted features on this slide are optional software features, not included in BOS-M, and there is additional cost and the features require a key.

Launch Advanced Settings



Cache Memory Configuration

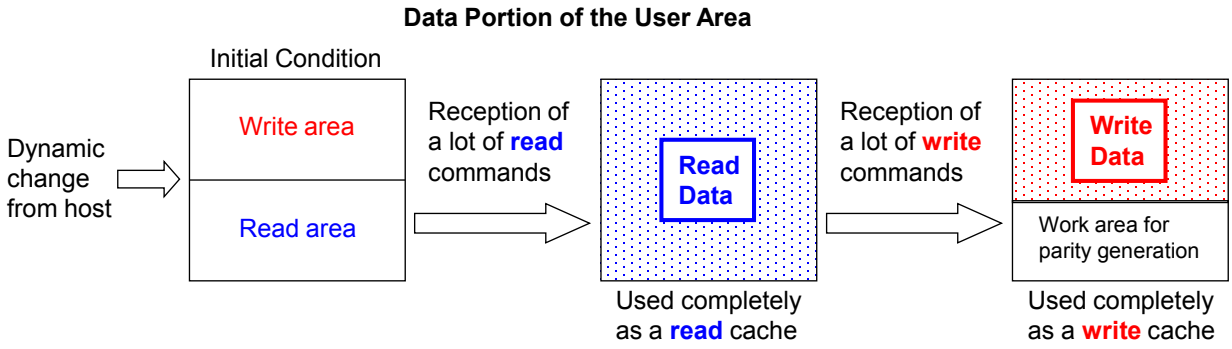
- Cache Memory Configuration



5

Basic Operation of Cache Control

- Dynamic Optimizing is performed on the cache per the following
  - Read / Write cache area assignment:
    The read and write cache areas are not fixed but are dynamically assigned according to the type of I/O from the host.
  - Destaging algorithm:
    This is selected automatically according to the write pattern occurring from the host.
  - Staging algorithm:
    This is selected automatically through a study of the read commands from the host.



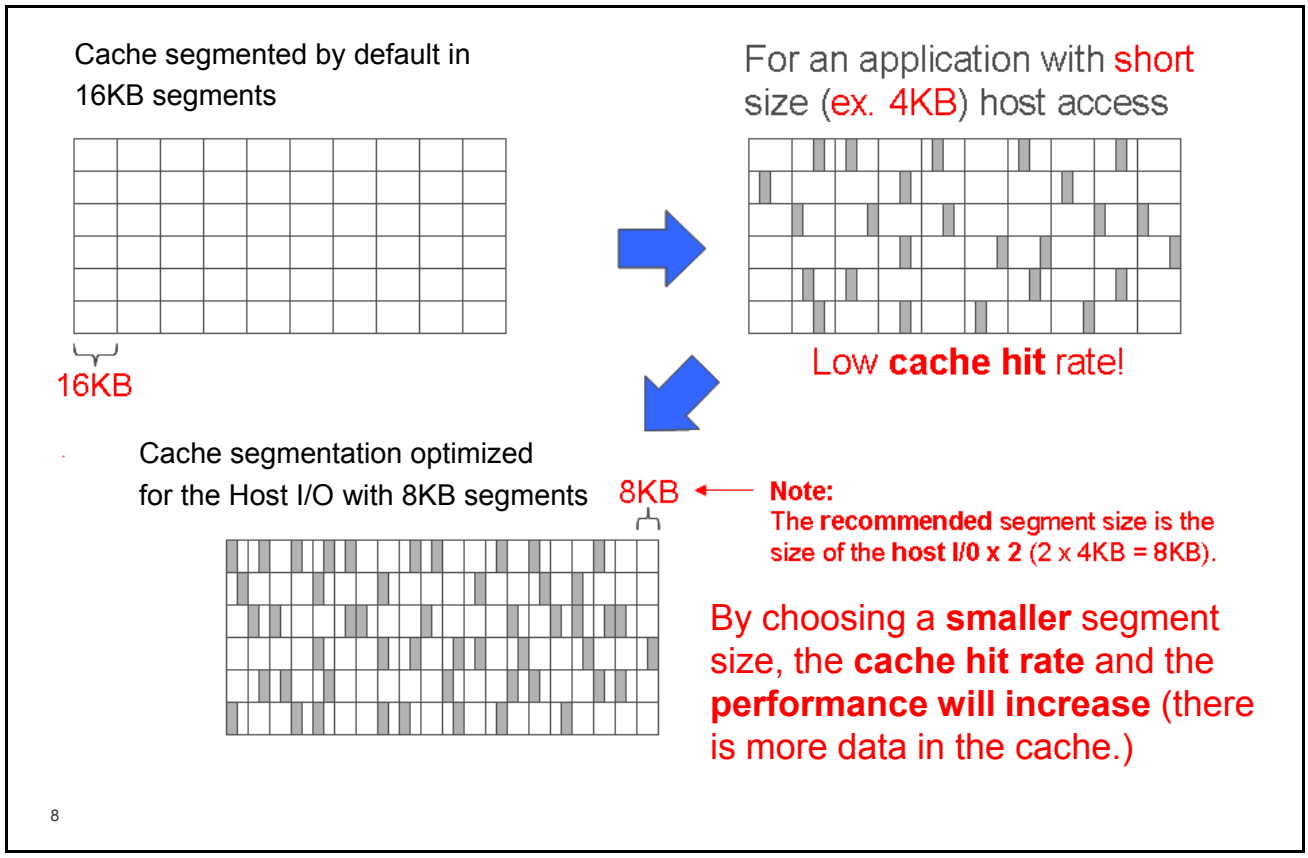
6

Cache Partition Manager Feature

- Cache Partition Manager (CPM) allows for the **segregation of workloads** within the system.
- It includes the following:
  - **Selectable segment size**
    Customize the cache segment size for a user application
  - **Partitioning of cache memory**
    Separate workloads by dividing cache into individually managed, multiple partitions
    - A partition can then be customized to best match the I/O characteristics of its assigned Lus.
  - **Selectable stripe size**
    To increase performance by customizing the disk access size

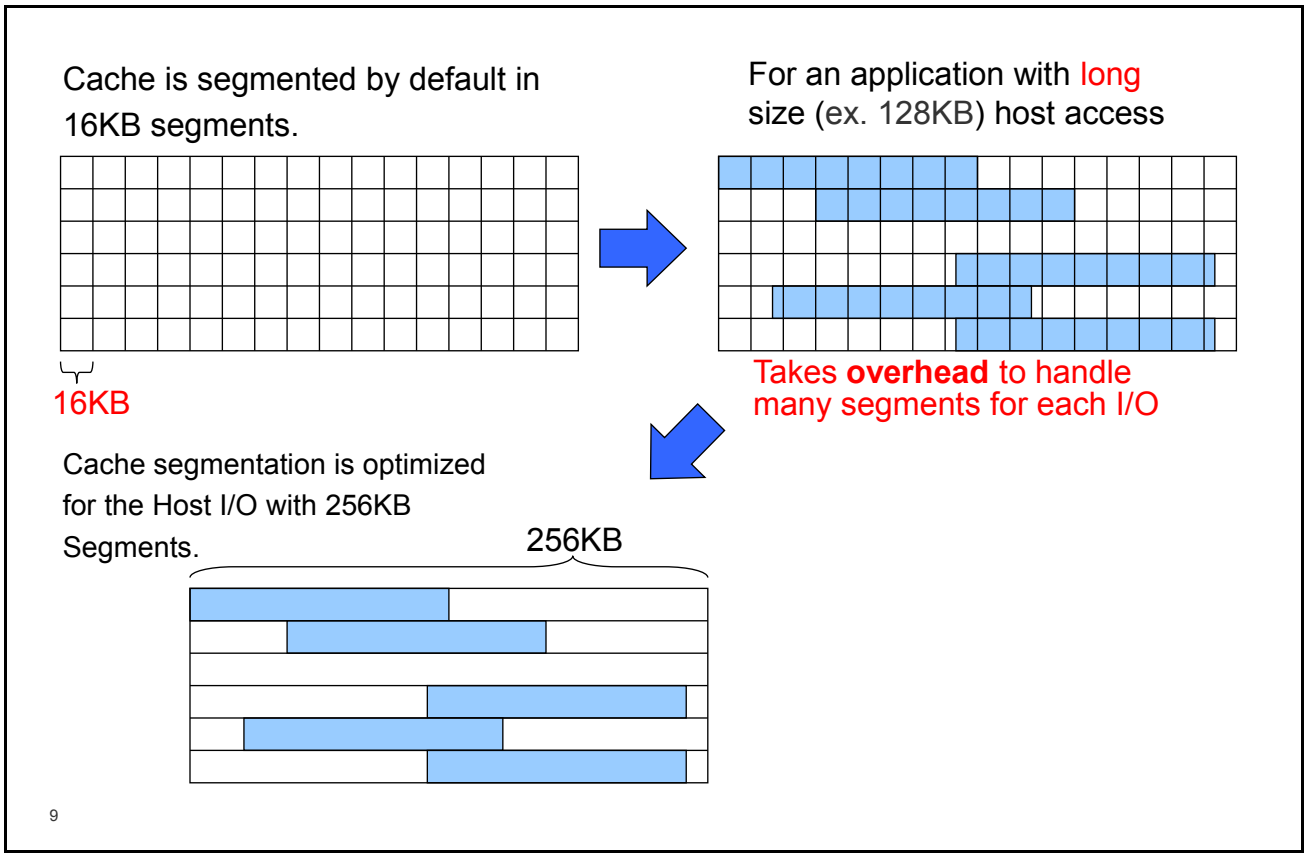
7

Advantage of Selectable Segment Size – Small I/O



- Recommended segment size is the host I/O size times two.
- Setting the segment size in this example to 4KB indicates that up to two segments will be used for cache processing overhead.

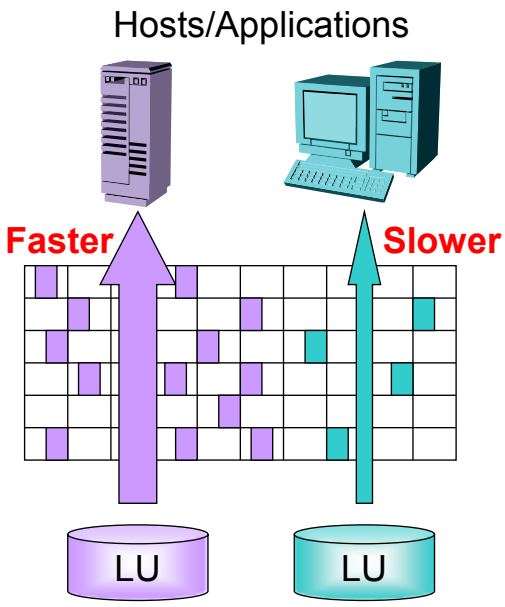
Advantage of Selectable Segment Size – Large I/O



Advantage of Global Cache

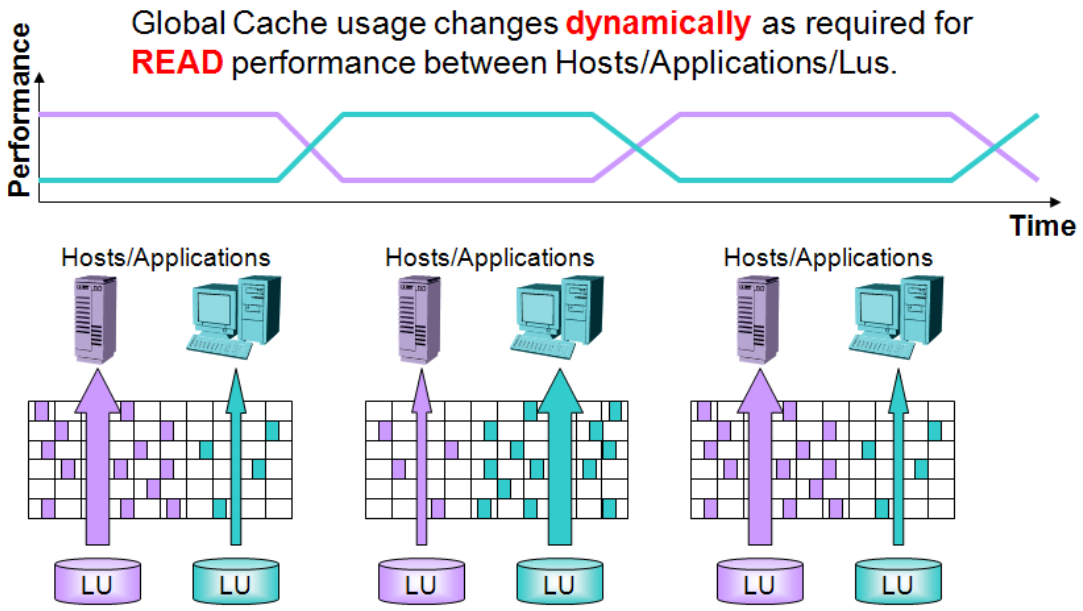
- For **READ** access:
  - Cache memory is used on demand by multiple applications.
  - Therefore:
    - **Faster hosts** (applications) do not have a negative effect on **slower hosts** (applications).
    - A **faster LU** does not have a negative effect on a **slower LU.**

Model 2000 system ***without*** **Cache Partition Manager** or different cache partitions



10

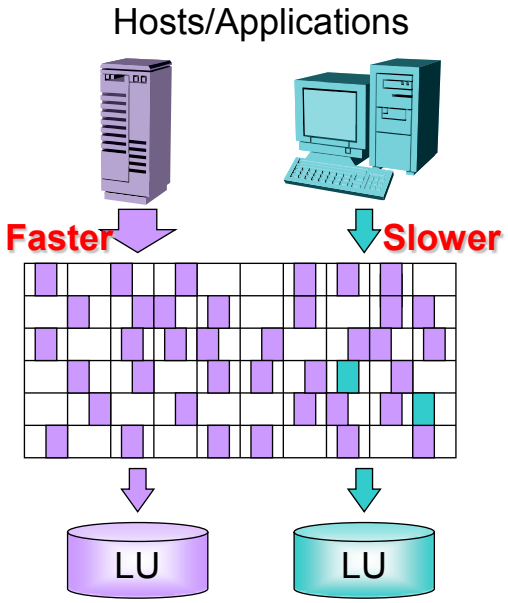
- Storage system without Cache Partition Manager or different cache partitions



11

Disadvantage of Global Cache

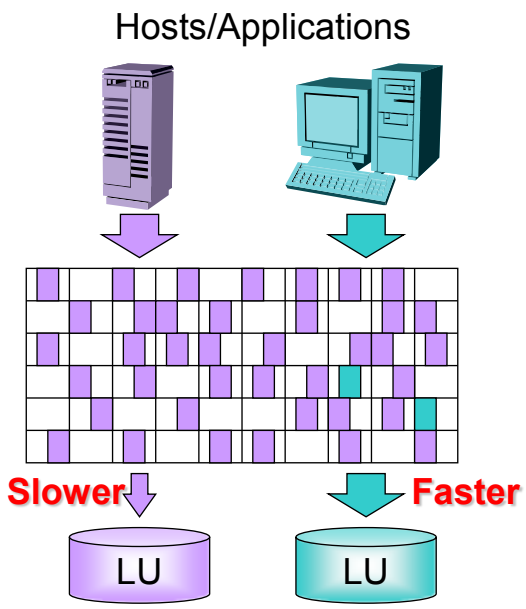
- Storage system without Cache Partition Manager or different cache partitions



- High-intensity **WRITE** access from faster/slower hosts (applications):
  - Faster hosts (applications) use **much more** cache than slower hosts (applications), and fill almost all the cache memory.
  - Faster hosts (applications) have a **negative** effect on slower hosts (applications).

12

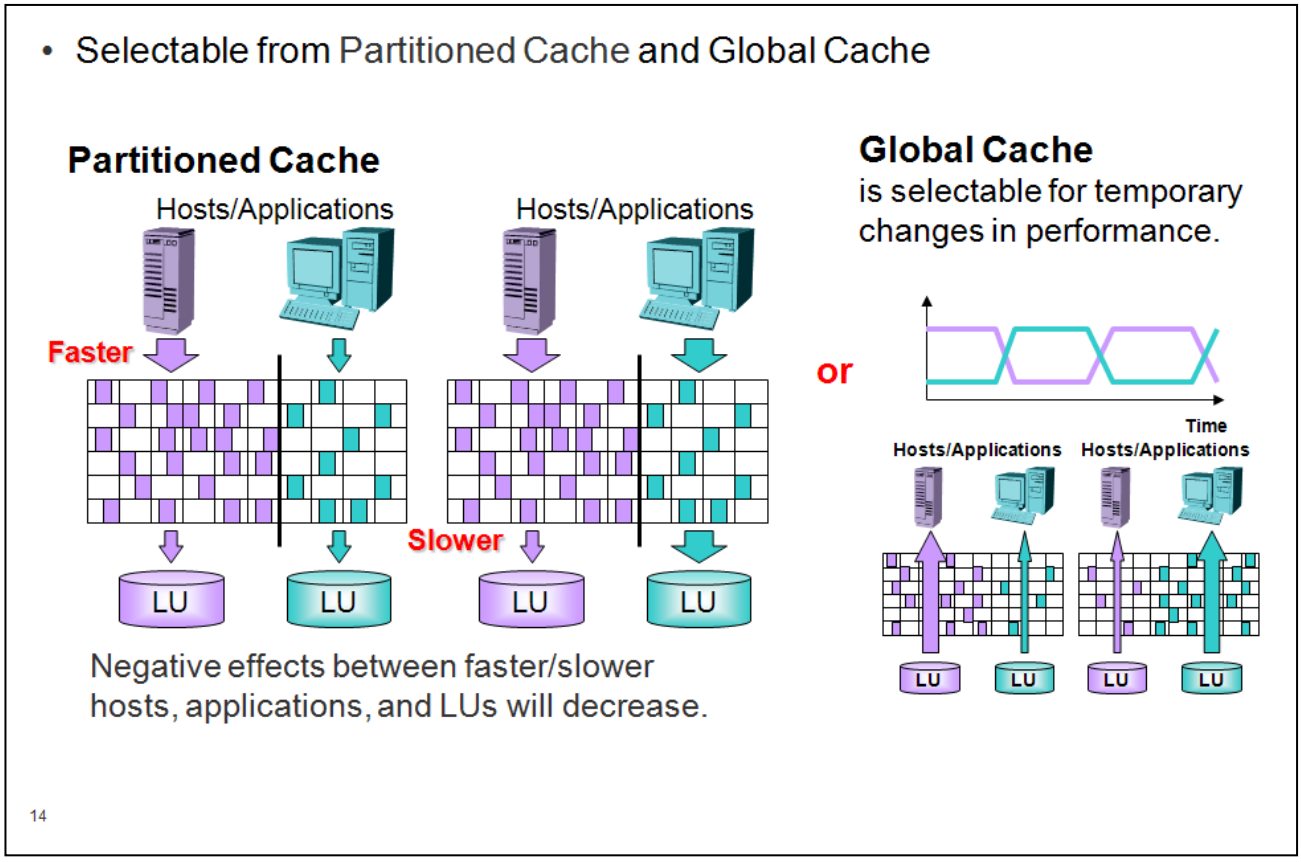
- Storage system without Cache Partition Manager or different Cache Partitions



- High-intensity **WRITE** access to faster/slower **LUs**:
  - Hosts (applications) use same amount of cache memory, but data for **slower LUs** remains **longer** in cache memory.
  - Slower LUs have **negative** effects on faster LUs.
  - Faster/slower LUs can be caused by:
    - SAS/SATA HDD
    - RAID level
    - The Parity Group

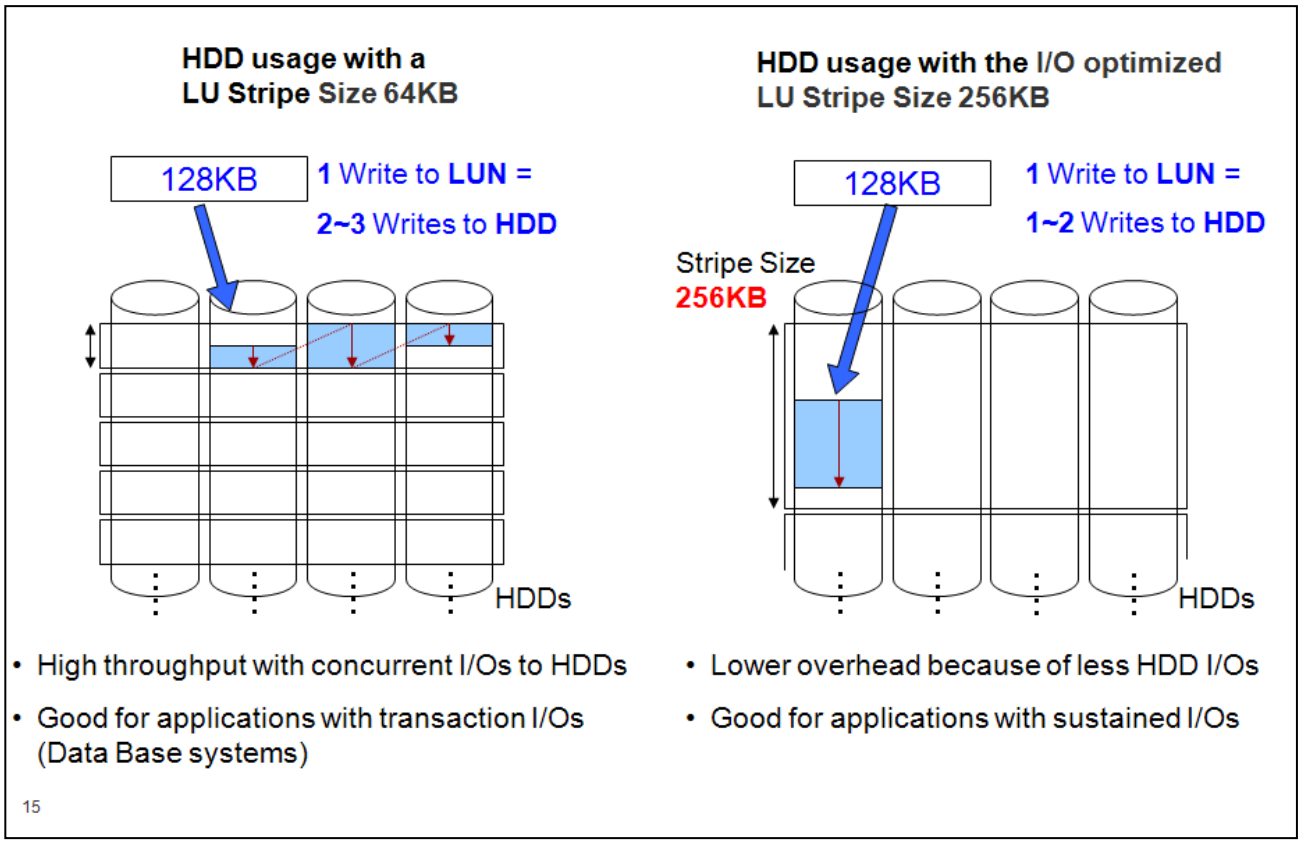
13

Advantage of Partitioned Cache



Configuring the cache for partitions is a **static adjustment** that will not dynamically change afterwards.

Advantage of Selectable Stripe Size



By selecting the most appropriate Stripe Size, the number of HDD I/Os can be brought back to the minimum which will improve the performance.

Partitioning Cache

- Cache can be divided into partitions that can be exclusively used by assigned LUNs.
  - Maximum number of partitions:
    - Model 2100: 16
    - Model 2300: 16
    - Model 2500: 32
  - Partition 0/1 are the master partitions (fixed at16KB only).
  - Partition 2 to n have selectable-size segments of: 4, 8, 16, 64, 256 and 512K.
  - Partition sizes are flexible (each partition has a certain minimum).

16

- Although proper use of the Cache Partition Manager can contribute to improving an application's performance, an incorrect configuration can easily achieve the opposite effect.
- One partition can be used by **one or more** LUNs.

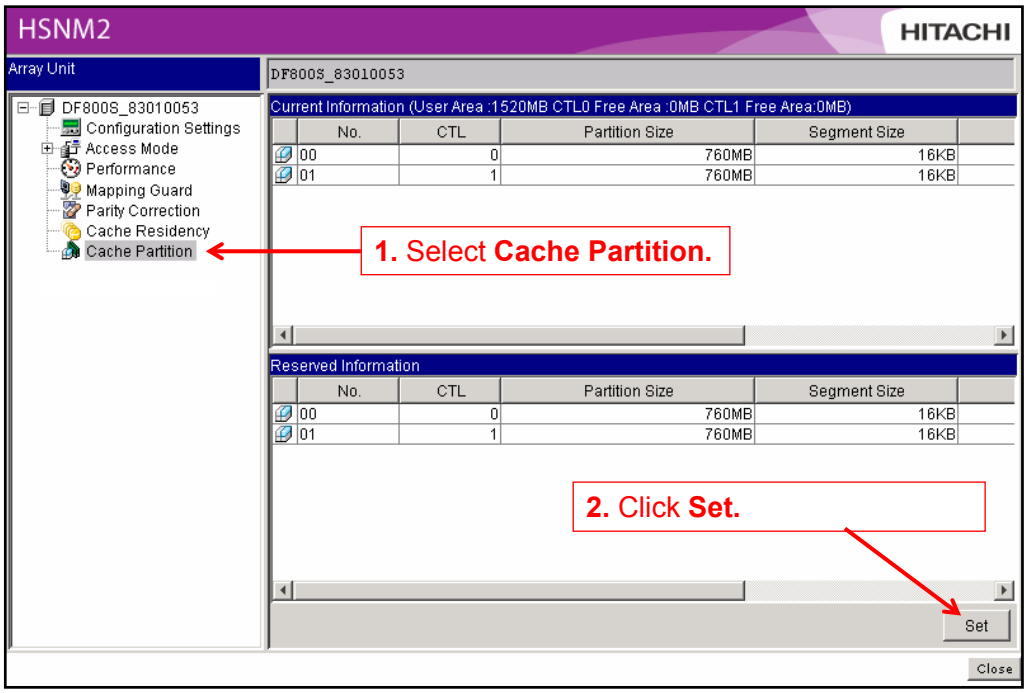
- Relationship between segment size and stripe size

Segment Size	Stripe Size			
	16KB	64KB	256KB (default)	512KB
4KB	Available	Available	N/A	N/A
8KB	Available	Available	Available	N/A
16KB (Default)	Available	Available	Available	Available
64KB	N/A	Available	Available	Available
256KB	N/A	N/A	Available	Available
512KB	N/A	N/A	N/A	Available

17

Partitioning Cache Feature

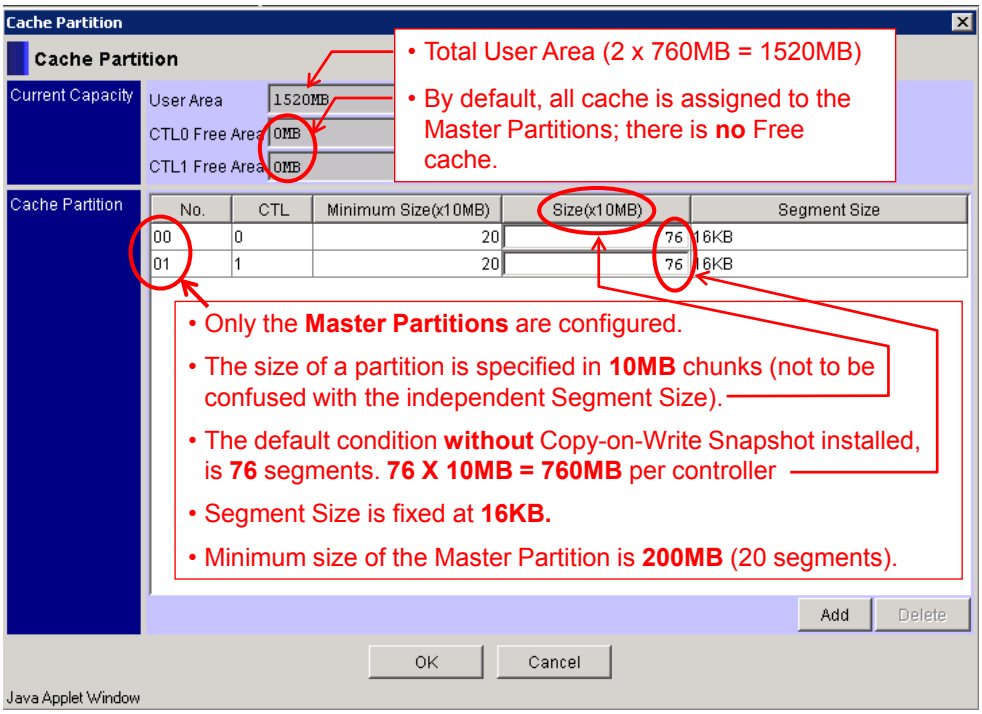
- Cache Partition Manager is launched from the **Advanced Settings** window.



18

User Area

- Initial configuration of cache when Copy-on-Write is not installed

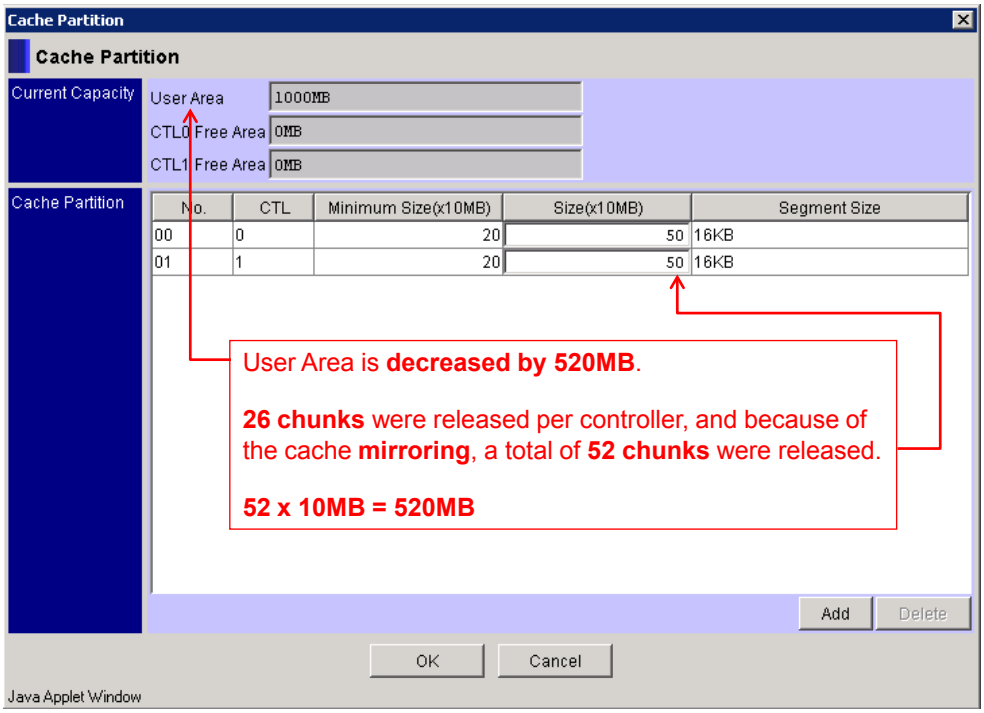


19

The DF800 used to create this screen shot the following screen shots had **2GB** of cache per controller.

User Area with Copy-on-Write SnapShot Installed

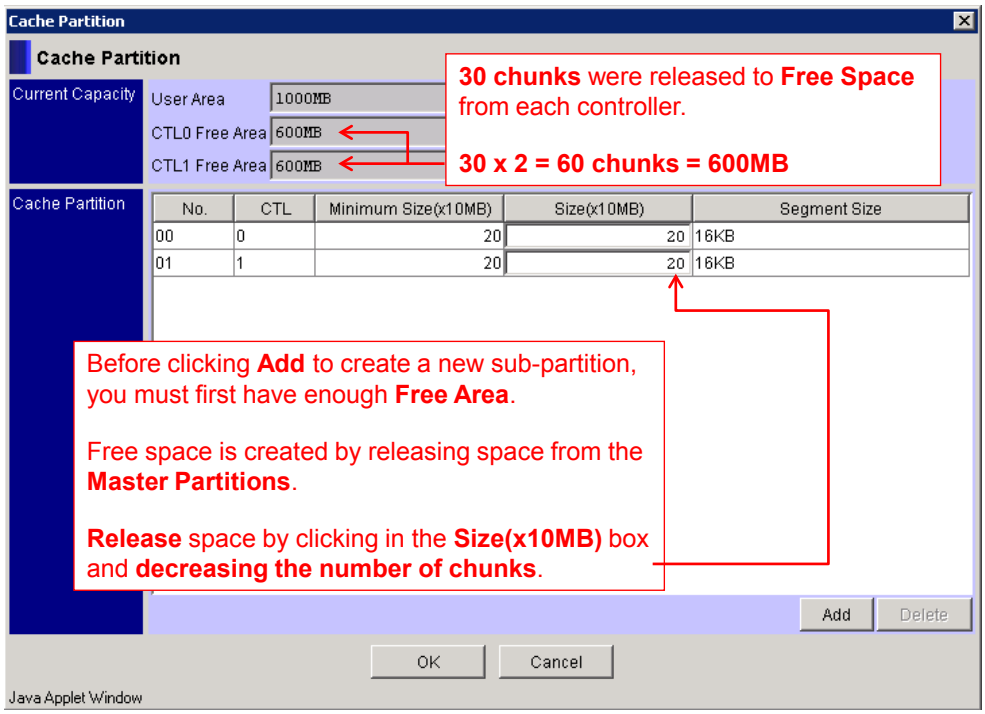
- Configuration of cache when Copy-on-Write is installed



20

Create Cache Free Space

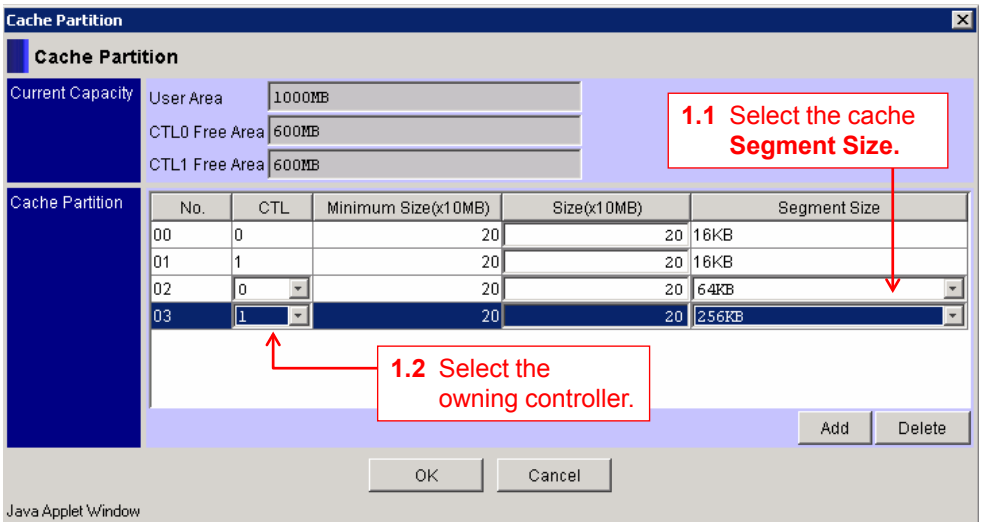
- Example shows the release of **30 chunks** from the **Master Partitions**.



21

Create Sub-partitions Example

- This is an example of the creation (Add) of two new sub-partitions.



2. Click **OK** to apply the additions. This causes a **reboot** of the array.

1. Click **Add** to create and then configure a new sub-partition.

22

Lab Project 9: Cache Partition Manager

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups.
  - The lab groups will perform the lab project on the lab equipment assigned to them by their instructor.

23

Lab Project 9: Objectives

- Upon completion of the lab project, the learner will be able to do the following:
  - Release cache space from the two Master Partitions (0 and 1), releasing it to Free Space for each controller
  - Create two new partitions, one in each controller
  - Assign a different cache segment size to each of the new partitions
  - Create two new LUNs, assigning each to one of the new partitions

24

Cache Residency Manager Overview

- User-specified LUN resident in the Cache Memory
  - 100% hit ratio for the resident LUN
  - Improve system throughput
    - Apply to a LUN that contains data being accessed frequently

Required conditions for Cache Residency Manager Feature

Item	Specification
Controller Configuration	Dual Controller
RAID level	RAID 1+0, 5, 6
Max number of LUNs	1 per Controller

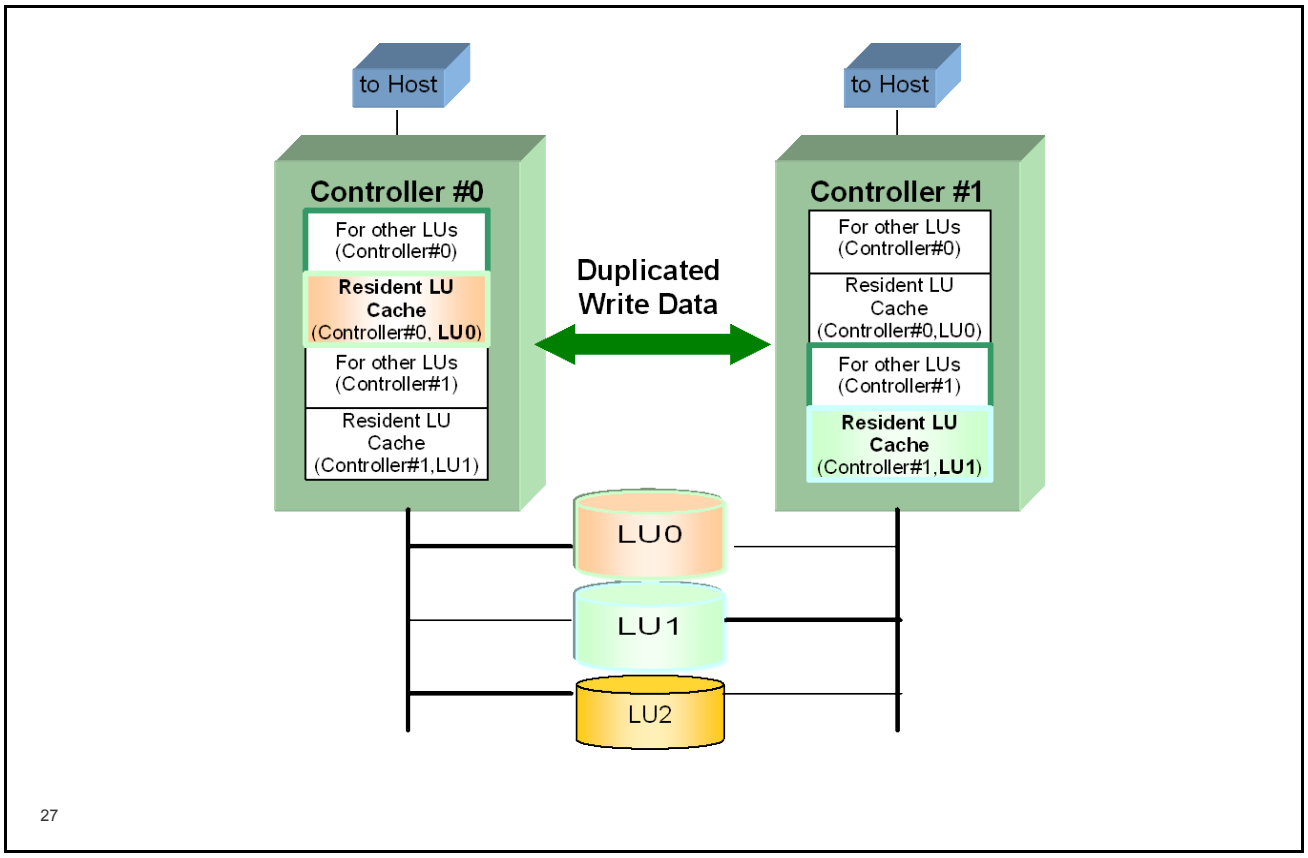
25

Installing Cache Residency Manager Feature

- Cache Residency Manager feature must be installed or uninstalled using a software license key.
- The storage system must be rebooted in order for the Cache Residency Manager changes to take effect, including installing, uninstalling, enabling, or disabling.

26

Functionality



Conditions that Terminate Cache Residency Manager

No	Conditions	Remarks
1	When the setting of Cache Residency Manager is cleared.	All of these conditions are caused by the operator.
2	When Cache Residency Manager is disabled or uninstalled	
3	When the LUN used for Cache Residency Manager is deleted or the RAID group in which the LUN is created is deleted	

28

Maximum LUN Size for Cache Residency Manager

- The maximum size of a LUN that is used for the Cache Residency Manager feature depends on the capacity of the installed cache memory.
- Cache Residency Manager feature uses part of the cache memory.

29

Performance Monitor Feature Overview

- The Performance Monitor feature enables the user to collect and analyze performance information from the following functional areas:
  - Port information
  - RAID group / Logical Unit information
  - Cache information
  - Processor information
  - Drive information
  - Drive operating information
  - Back end information
- Performance Monitor presents the information in **chart** or **table format** (.txt file).
  - Chart gives a real-time 2-dimensional view of the system in graph format.
  - Table format gives snapshots over a specified period of time.
    - Set an interval from 1 minute to 23 hours 59 minutes
    - Set number of repetitions from 1 to 20,000
    - Snapshots can be concatenated into a single, compressed into a ZIP file
- Requires a license.

30

Monitored Statistics

Functional Area	Measurement Item
Port Information **Logical Unit Information**	Command Count
	Command Hit Count
	Hit Rate
	I/O Rate
	Transfer Rate
	Initiator Command Count
	Initiator Command Transfer Size
	Initiator Command Time
	Initiator Command I/O Rate
	Initiator Command Transfer Rate
RAID Group Information	Command Count
	Command Hit Count
	Hit Rate
	I/O Rate
	Transfer Rate

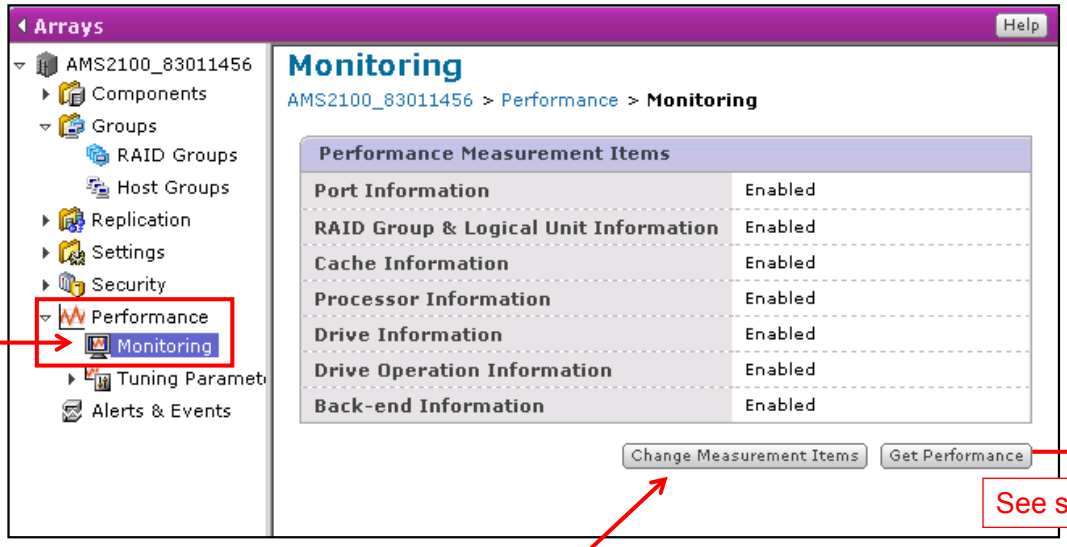
31

Functional Area	Measurement Item
Cache Information	Cache Write Pending Rate
	Cache Usage Rate
Processor Information	Processor Operating Rate
Drive Information **Back end Information**	Command Count
	I/O Rate
	Transfer Rate
	Online Verify Command Count
Drive Operation Information	Drive Operating Rate
	Drive Loading Information

32

Enabling Performance Data Collection

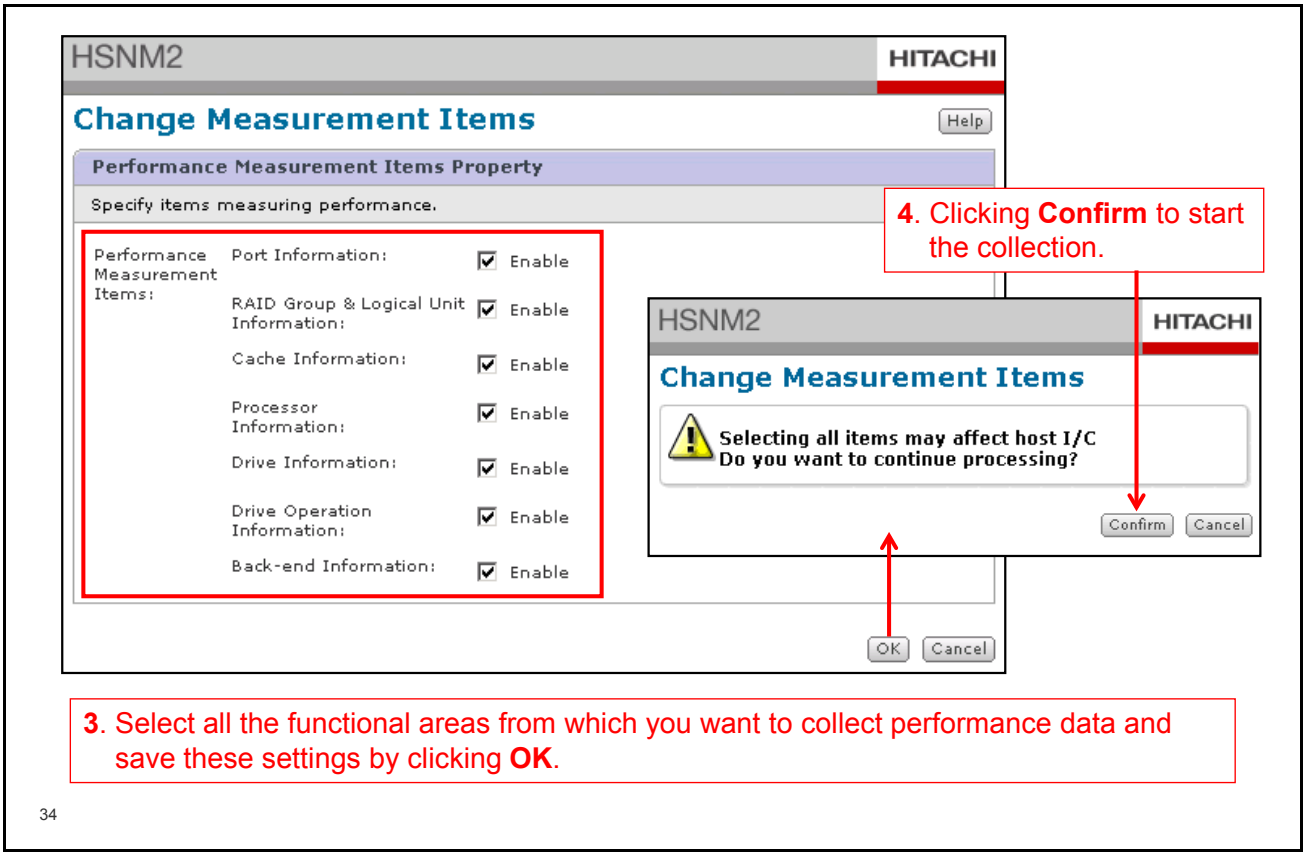
1. From the **Arrays panel,** expand **Performance** and click on **Monitoring**.



See slide 35

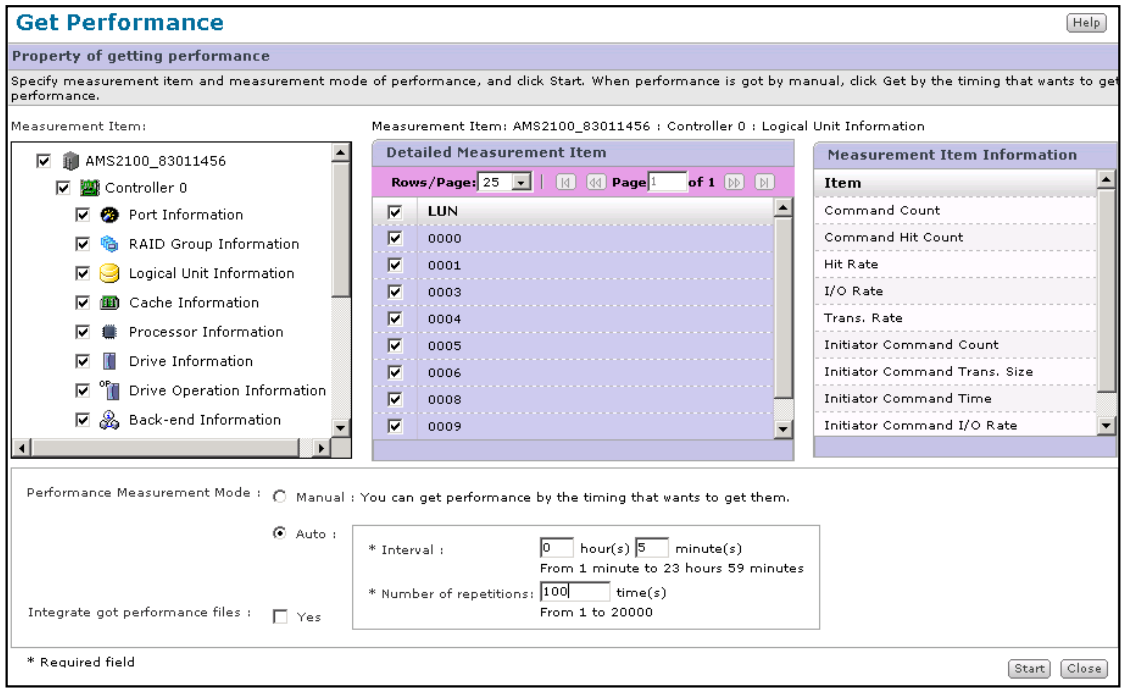
2. Click on the **Change Measurement Items** button (see next slide).

33



By default, performance data will be collected from all seven functional areas.

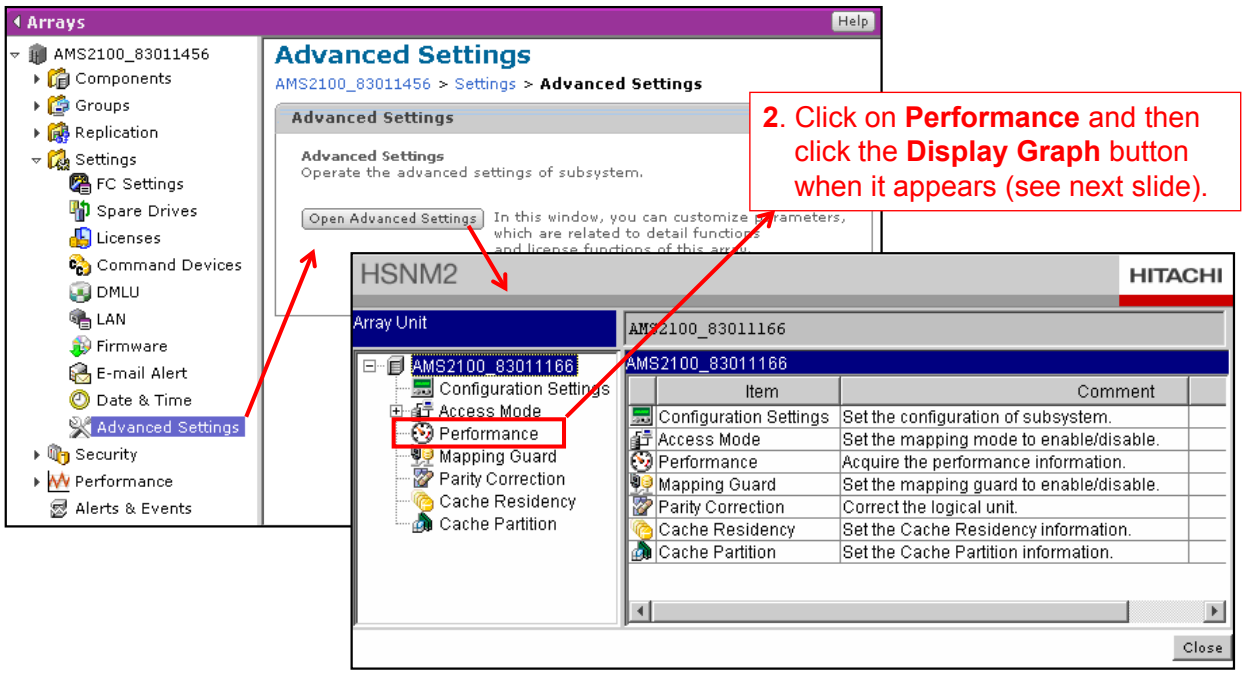
Get Performance Function



Note: The **Get Performance** function would allow you to configure a plan that would collect the data a specified number of times over a defined period of time. In class you will skip this function.

Reviewing Performance Data

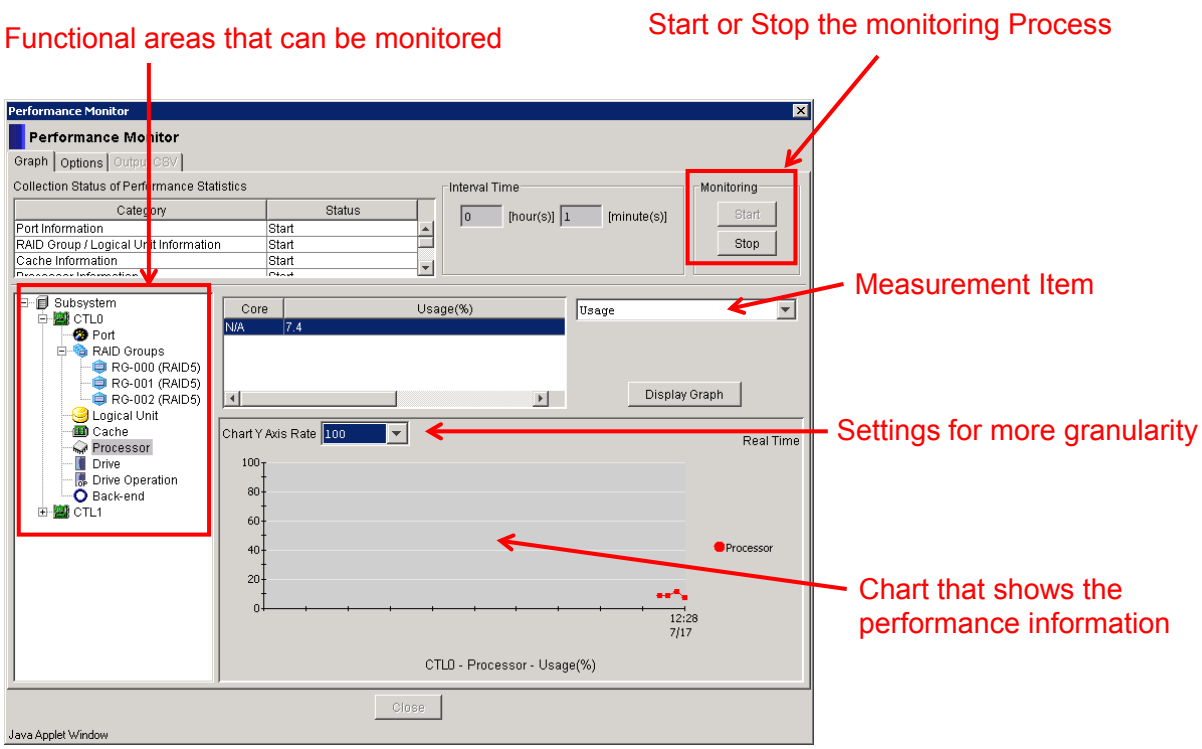
1. From the **Arrays** panel, expand **Settings**, click on **Advanced Settings** and then click the **Open Advanced Settings** button.



2. Click on **Performance** and then click the **Display Graph** button when it appears (see next slide).

36

Performance Monitor Window



37

Lab Project 10: Performance Monitor

- Timing and Organization
  - Time allotted to complete the project: **60 minutes**
  - The lab project contains **two** sections:
    - **Section 1** is the lab activity
    - **Section 2** contains the review questions
  - Time allotted to go over the review questions: **15 minutes**
  - The class will be split into lab groups.
  - The lab groups will perform the lab project on the lab equipment assigned to them by their instructor.

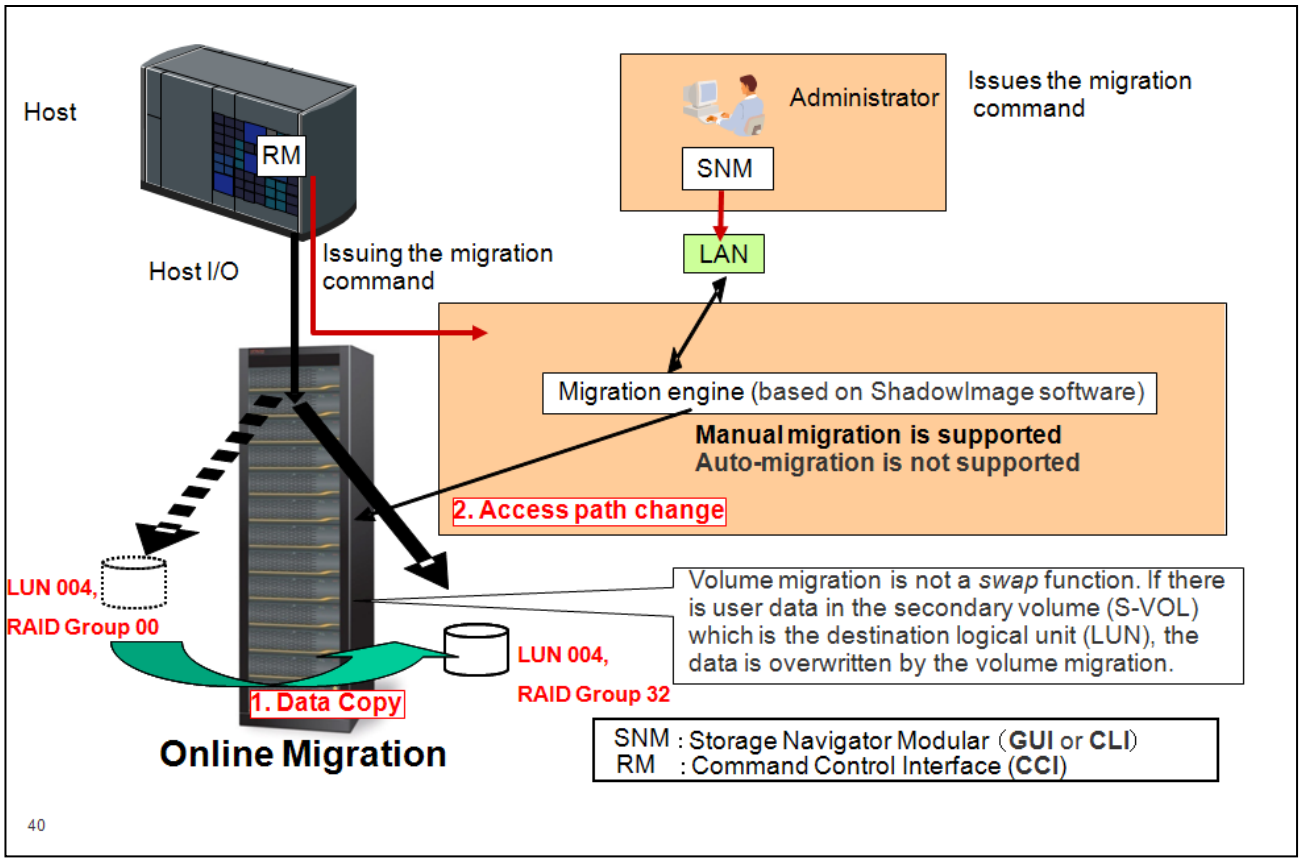
38

Lab Project 10: Objectives

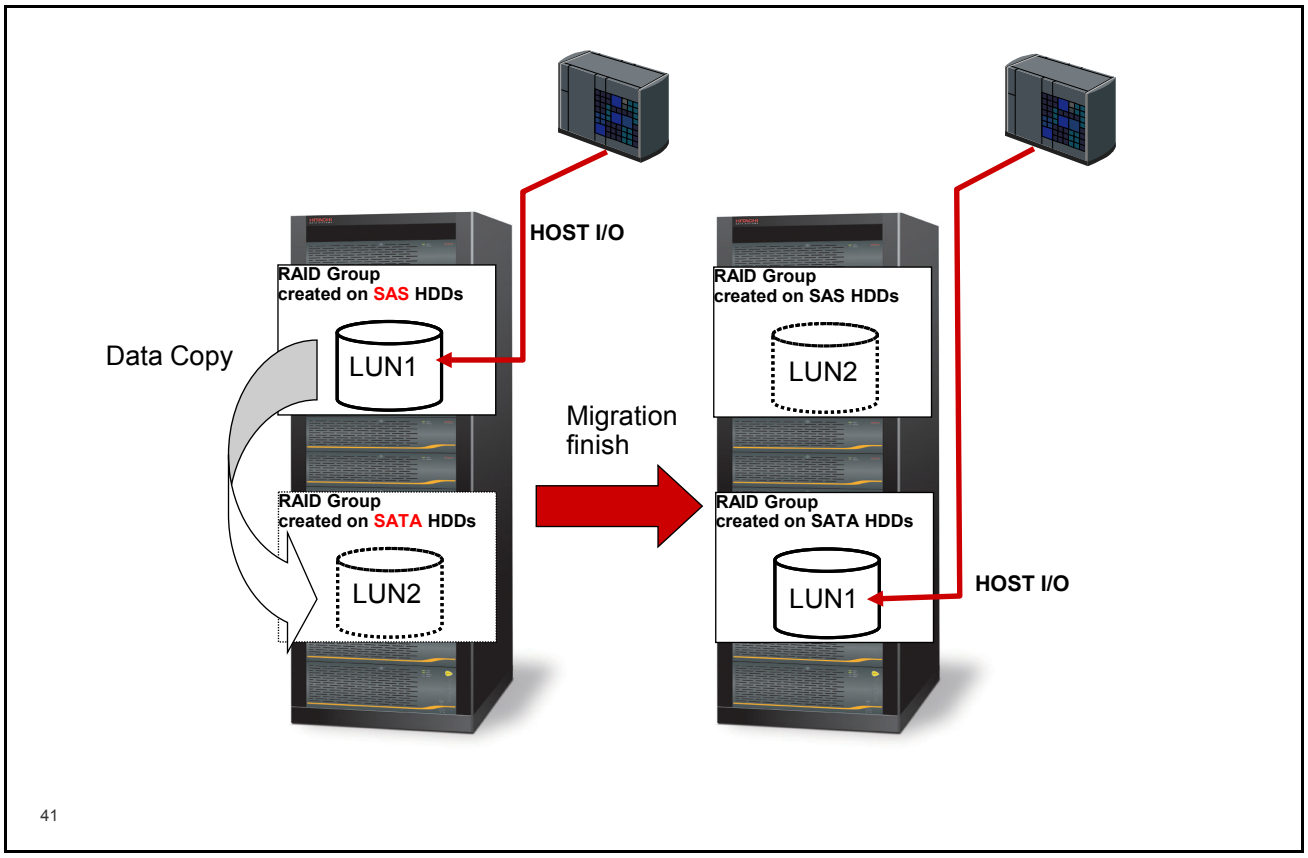
- Upon completion of the lab project, the learner will be able to do the following:
  - Install, launch, and configure the Hitachi Dynamic Link Manager (HDLM) GUI on the Windows host system
  - Using HDLM, display I/O activity and status of the managed paths
  - Launch and configure **Iometer** to generate Write and Read I/O for four hypothetical workers (users) to specific DF800 LUNs
  - Launch and configure the SNM2 Performance Monitor to collect all categories of performance metrics
  - Launch the SNM2 Performance Monitor Graph and display individual metrics as I/O flows into the array

39

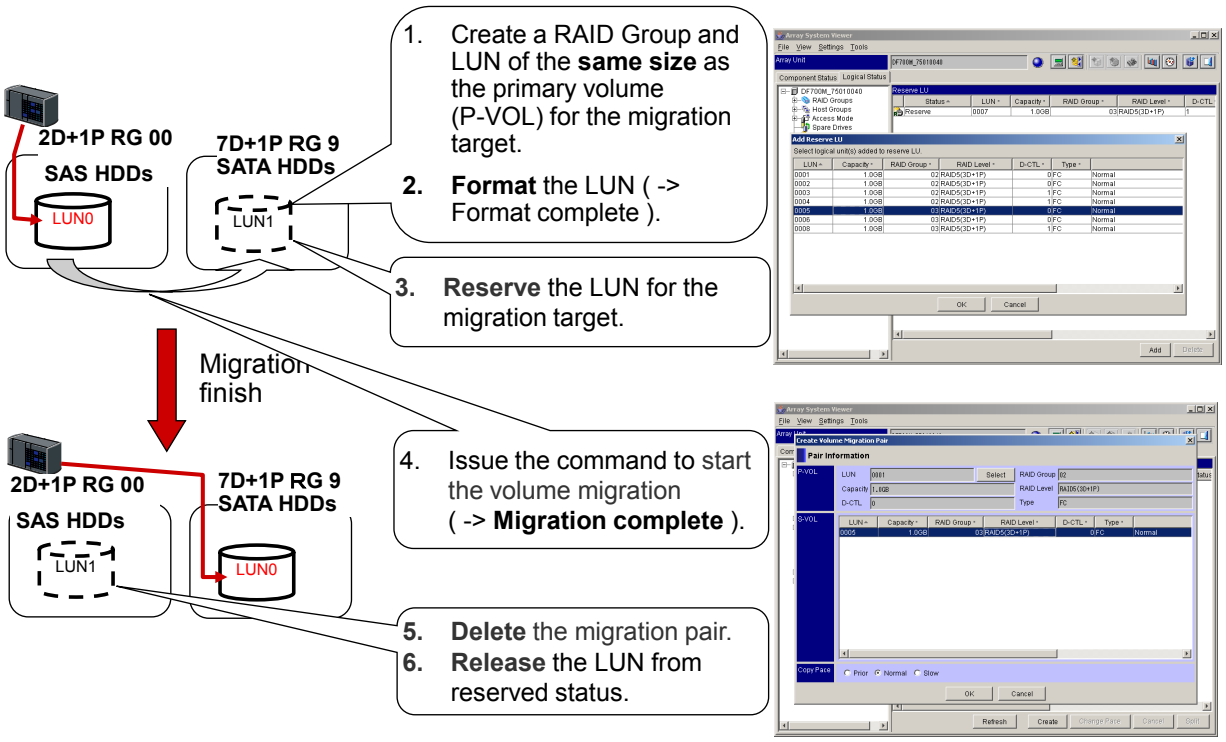
Overview of Modular Volume Migration



Migration From SAS Drives to SATA Drives

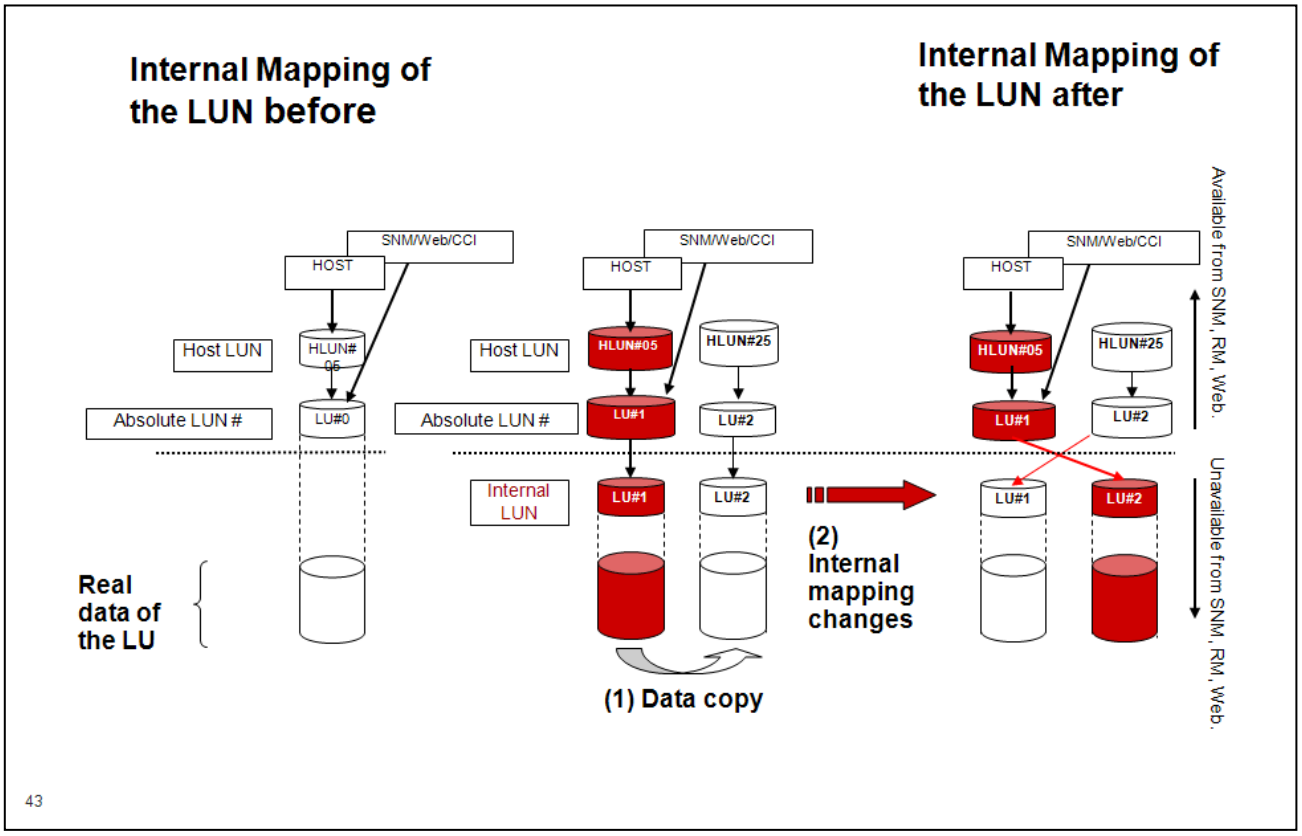


Migrating Volumes for Performance



42

Internal Mapping and I-LUNs



Volume Migration can move LUNs online by changing the internal mapping.

- Internal LUN = I-LUN

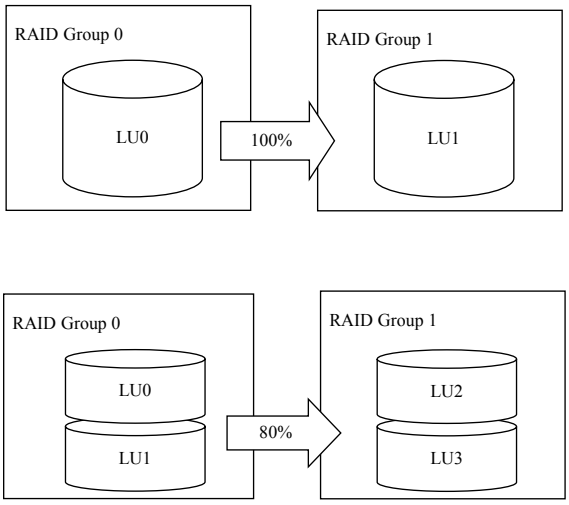
The LUN# available from Storage Navigator Modular (SNM), Web or command control interface (CCI) does not change before or after a volume migration.

Performance Considerations

- The recommended Copy Pace is **Normal**, but when the host I/O load is heavy, performance may deteriorate considerably. In that case, select **Slow** to maintain performance levels.
  - For example, the LUN is migrated from a SAS disk drive to a SAS disk drive:
    1. Random Read I/O declines from 65% to 45% when the Copy Pace is **Normal**.
    2. Random read I/O declines from 80% to 60% when the Copy Pace is **Slow**.
- Not only does the RAID structure of the P-VOL affect the performance of the host I/O, but it also affects the performance of the S-VOL.
  - For example, when a LUN is migrated from a SAS disk drive to a SATA disk drive, the random write I/O declines from 60% to 40% when the Copy Pace is **Normal**.

44

- Do not execute a volume migration to multiple LUNs in the same RAID Group at the **same** time.
  - For example, when the LUN is migrated from SAS disk drives to SAS disk drives, copy performance declines to 80%.



45

- Do not execute a volume migration when the LUNs upon which the migration will be executed are in a COPY status from ShadowImage software and are included in the same RAID Group. Either:
  - Schedule a volume migration operation to be executed when the ShadowImage pairs are in a PSUS status.
  - Stop the ShadowImage software data copy operation before the volume migration is executed.

46

Volume Migration Setup

- To use Modular Volume Migration software, some preparations are needed. (These are similar to ShadowImage software.)
  - Install the Modular Volume Migration key
  - Set the differential management LUNs
- To operate with the command control interface (CCI Raid Manager), additional preparations are needed.
  - Set the command devices
  - Set the Target ID (LUN mapping)

    Note: Target ID for migration cannot be set through Storage Navigator Modular 2. Use Storage Navigator Modular original version.
  - Set the environment variables

47