



力麗科技股份有限公司  
資訊服務事業部

HDS Training for TKU



# Hitachi Adaptable Modular Storage 2000 Family

2011/10



# Agenda

- Hitachi Data Systems Portfolio
- Hitachi Adaptable Modular Storage 2000 family Product Overview
- Key Features
  - Symmetric active/active controller with dynamic load balancing
  - SAS architecture
  - Online RAID group expansion
  - LUN grow/shrink
  - Mega-Lun
  - High Density Expansion Trays
  - RAID-6
  - Multiprotocol: FC SAN/iSCSI
  - Volume Migration Modular software
  - Hitachi TrueCopy<sup>®</sup> Extended Distance software



# Hitachi Adaptable Modular Storage 2000 Family

## *In the Spotlight...*



The Hitachi Adaptable Modular Storage (AMS) Series 2000 was selected by the editors of TechTarget's SearchStorage.com as a Bronze Award Winner its annual "Storage Products of the Year" ...in the disk, disk subsystems category.



WINNER - Green IT Innovation  
The Hitachi Adaptable Modular System 2500 has won the Eco-Responsibility Award in this year's Information Age Innovation Awards, beating out stiff competition.



Gartner positioned Hitachi & the Hitachi AMS2000 family in its Magic Quadrant... "this quadrant reflects highest scores for their ability to execute and completeness of vision...they are innovators...with a clear understanding of market needs" – Nov 17, 2008



Hitachi achieves overall best-in-class Storage Performance Council (SPC-1™) benchmark results for its midrange storage system (Hitachi AMS2000). March 24, 2009

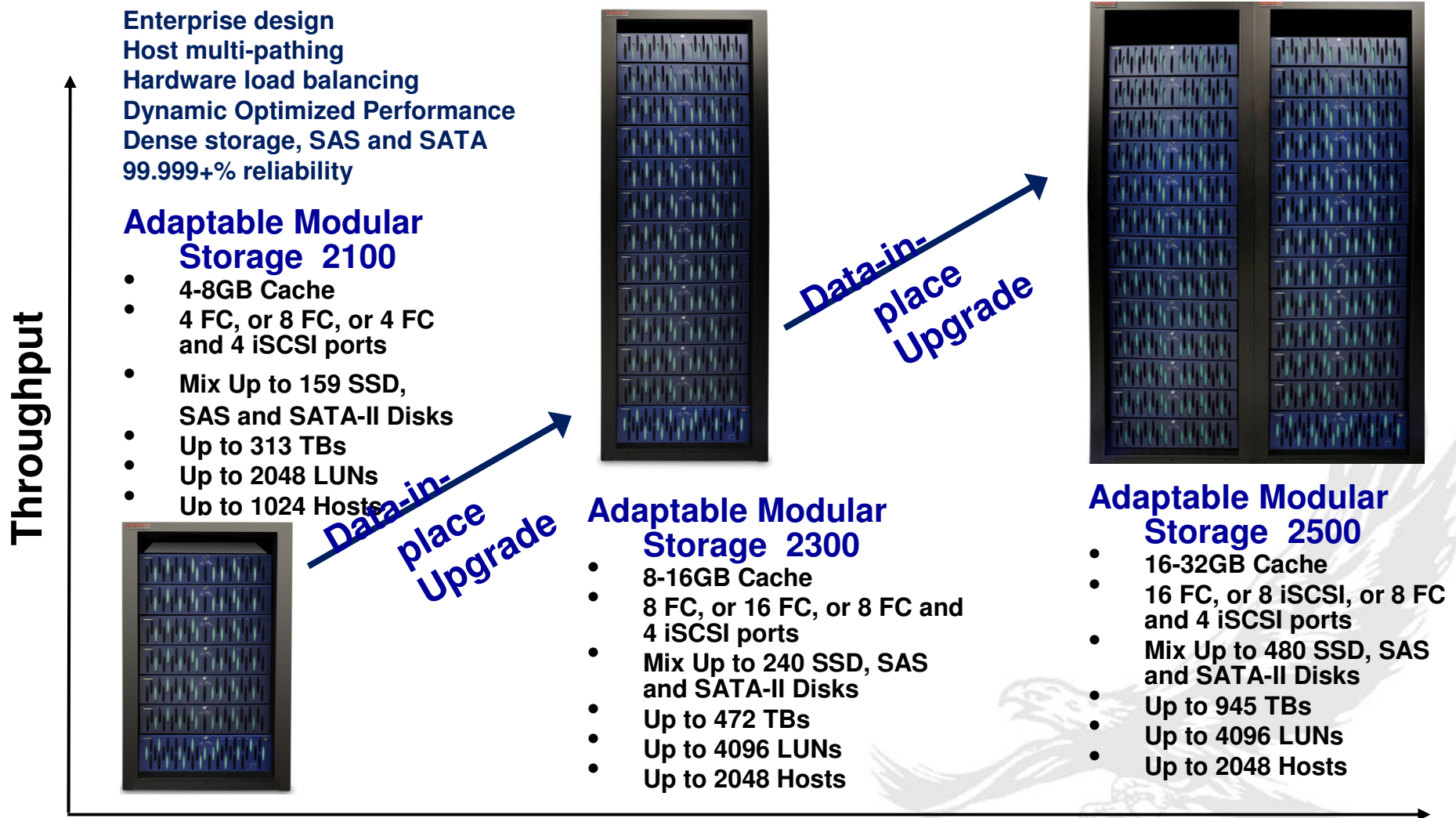
"With the AMS, I actually think a layperson could use it. I think that's how easy it is; it's really a point and click deal." – Matthew Colona, IT Manager at Pite Duncan LLP (Storage Magazine, March 2009)



"The AMS2000 series combination of enterprise class features with easy to manage midrange usability and reduced operational costs is powerful and worthy of serious consideration by an IT organization. "

Hitachi Data Systems has consolidated its claim as the top-rated high-end array vendor by *repeating its win...*"- Rich Castagna, Editor

# Adaptable Modular Storage 2000 Family



**Scalability**

# Hitachi Adaptable Modular Storage 2100

- Hitachi Dynamic Load Balancing controller
  - Symmetrical active/active design
  - Host port options:
    - 4 x 8Gb/sec FC
    - 8 x 8Gb/sec FC
    - 4 x 8Gb/sec FC and 4 x 1Gb/sec iSCSI
  - Cache size: 4GB or 8GB
  - LUNs maximum number: 2048
  - Maximum attached hosts through virtual ports: 1024
  - **3Gb/sec SAS links: 16**
  
- SATA-II and SAS intermix
  - Max drives supported: **120**
  - Drive options:
 

<u>SAS:</u>	<u>SATA:</u>	<u>SSD:</u>	
300GB 15K RPM		1TB 7200 RPM	200GB
450GB 15K RPM		2TB 7200 RPM	
600GB 15K RPM			
2TB 7200 RPM			
  
- Protection
  - RAID Groups/System: 50
  - RAID levels: -6, -5, -1+0, -1, -0\*

## Hitachi Adaptable Modular Storage 2100



**3U trays (max of 7)  
2 to 15 disk drives/tray**

**4U trays (max of 3)  
4 to 48 disk drives/tray**

**4U controller  
4 to 15 disk drives**

\* RAID-0 available on SAS drives only

# Hitachi Adaptable Modular Storage 2300

- Hitachi Dynamic Load Balancing Controller
  - Symmetrical active/active design
  - Host port options:
    - 8 x 8Gb/sec FC
    - 16 x 8Gb/sec FC
    - 8 x 8Gb/sec FC and 4 x 1Gb/sec iSCSI
  - Cache size: 8GB or 16GB
  - LUNs maximum number:4096
  - Maximum attached hosts through virtual ports: 2048
  - **3Gb/sec SAS links: 16**
- SATA-II and SAS intermix
  - Min/Max drives supported: **240**
  - Drive options:

<u>SAS:</u>	<u>SATA:</u>	<u>SSD:</u>	
300GB 15K RPM		1TB 7200 RPM	200GB
450GB 15K RPM		2TB 7200 RPM	
600GB 15K RPM			
2TB 7200 RPM			
- Protection
  - RAID Groups/System: 75
  - RAID levels: -6, -5, -1+0, -1, -0\*

## Hitachi Adaptable Modular Storage



**3U trays (max of 15)**  
**2 to 15 disk drives/tray**

**4U trays (max of 4)**  
**4 to 48 disk drives/tray**

**4U controller**  
**4 to 15 disk drives**

\* RAID-0 available on SAS drives only



# Hitachi Adaptable Modular Storage 2500

- Hitachi Dynamic Load Balancing Controller
  - Symmetrical active/active design
  - Host port options:
    - 16 x 8Gb/sec FC
    - 8 x 1Gb/sec iSCSI
    - 8 x 8Gb/sec FC and 4 x 1Gb/sec iSCSI
  - Cache size: 16GB or 32GB
  - LUNs maximum number:4096
  - Maximum attached hosts through virtual ports: 2048
  - **3Gb/sec SAS links: 32**
- SATA-II and SAS intermix
  - Min/Max Drives Supported: **480**
  - Drive options:

<u>SAS:</u>	<u>SATA:</u>	<u>SSD:</u>	
300GB 15K RPM		1TB 7200 RPM	200GB
450GB 15K RPM		2TB 7200 RPM	
600GB 15K RPM			
2TB 7200 RPM			
- Protection
  - RAID Groups/System: 100
  - RAID levels: -6, -5, -1+0, -1, -0\*

## Hitachi Adaptable Modular Storage



**3U trays (max of 32)**  
**4 to 15 drives/first tray**  
**2 to 15 drives/ additional trays**

**4U trays (max of 10)**  
**4 to 48 disk drives/tray**

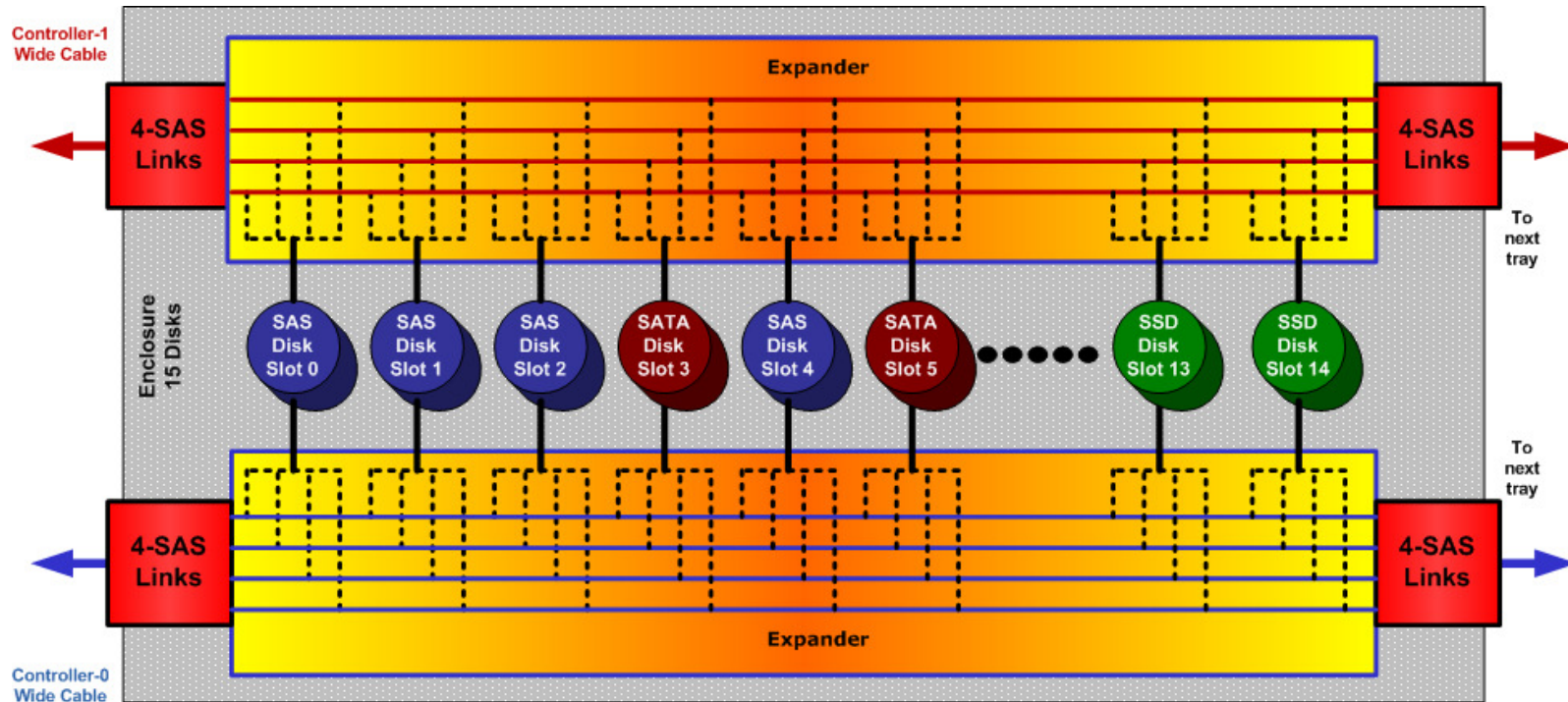
**4U controller**  
**0 disk drives**

\* RAID-0 available on SAS drives only





# External Disk Enclosure – 15 Disk

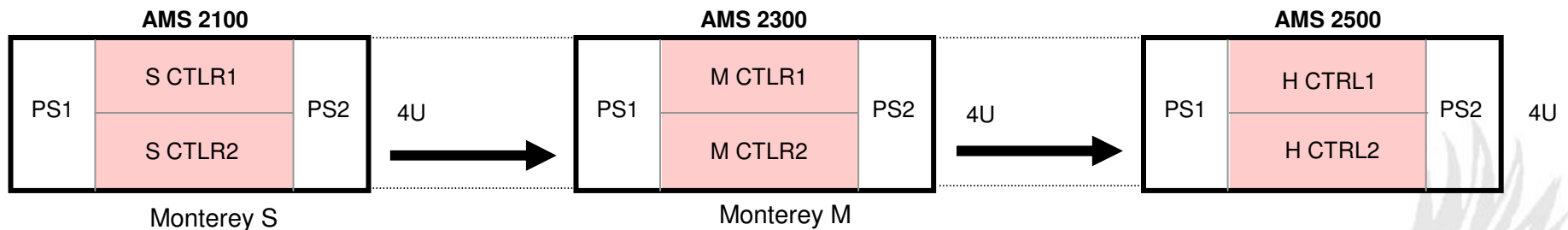


- This is the 15-disk shelf which may be freely populated with SSD, SAS and SATA-II disks. The two SAS Expanders in each enclosure attach each disk port to any of the four SAS links in that Expander. The SATA-II canisters provide the dual-port logic. Additional enclosures are daisy-chained from the outbound SAS links port.

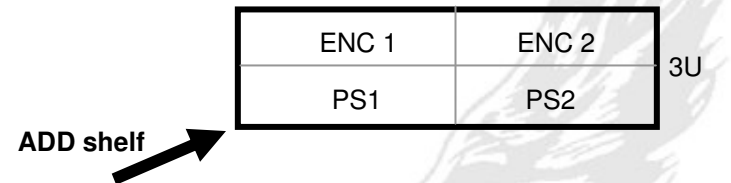
# Hitachi Adaptable Modular Storage 2000 family - Field Controller Upgrade Process – Easy Upgrades



Upgrade by changing two controller cards only. Data undisturbed



Note : BATTERY is at the front side in each model of 2100



**HDD Chassis**

- Usable w/S/M/H
- 3 GB/sec capable
- ENC different from upgrade ENC

15 x 3.5 inch SAS/ISATA-II HDD's

ENC 1	ENC 2
PS1	PS2

# Hitachi Adaptable Modular Storage 2000 Family Battery Backup Times

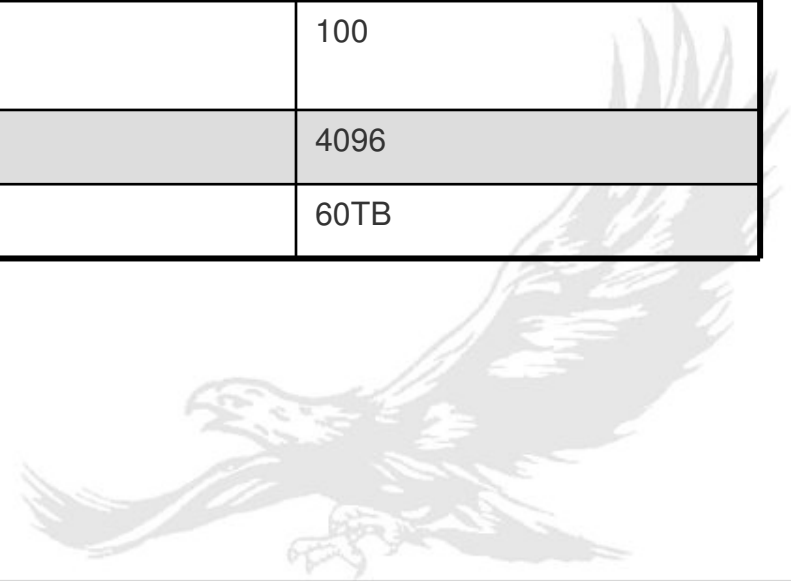
Model	Batteries	Small Cache - 2GB DIMMS	Large Cache - 4GB DIMMS
<b>Standard Configurations</b>			
AMS2100	2 Internal	72 hours	48 hours
AMS2300	2 Internal	36 hours	24 hours
AMS2500	4 Internal	48 hours	24 hours
<b>Optional Configurations</b>			
AMS2500	1 External + 4 Internal	96 hours	48 hours
AMS2500	2 External + 4 Internal	168 hours	96 hours

# Hardware Details

	<b>Adaptable Modular Storage 2100</b>	<b>Adaptable Modular Storage 2300</b>	<b>Adaptable Modular Storage 2500</b>
<b>Models</b> (3 models)	<ul style="list-style-type: none"> <li>• Symmetric active/active controllers</li> <li>• 4 or 8 GB cache</li> <li>• 1.67GHz Celeron, single core processor</li> <li>• PCIe internal bus</li> <li>• 15 internal disk slots</li> <li>• Dual redundant power supplies</li> <li>• Dual batteries</li> </ul>	<ul style="list-style-type: none"> <li>• Symmetric active/active controllers</li> <li>• 8 or 16 GB cache</li> <li>• 1.67GHz Xeon, single core processor</li> <li>• PCIe internal bus</li> <li>• 15 internal disk slots</li> <li>• Dual redundant power supplies</li> <li>• Dual batteries</li> </ul>	<ul style="list-style-type: none"> <li>• Symmetric active/active controllers</li> <li>• 16 or 32 GB cache</li> <li>• 2GHz Xeon, dual core processor</li> <li>• PCIe internal bus</li> <li>• 0 internal disk slots</li> <li>• Dual redundant power supplies</li> <li>• Dual batteries</li> </ul>
<b>Host Interface Options</b> (Dedicated FC or iSCSI)	<ul style="list-style-type: none"> <li>• 4 x 8Gbps Fibre Channel (FC)</li> <li>• 8 x 8Gbps FC</li> <li>• 4 x 8Gbps FC + 4 x 1Gbps iSCSI</li> </ul>	<ul style="list-style-type: none"> <li>• 8 x 8Gbps Fibre Channel (FC)</li> <li>• 16 x 8Gbps FC</li> <li>• 8 x 8Gbps FC + 4 x 1Gbps iSCSI</li> </ul>	<ul style="list-style-type: none"> <li>• 16 x 8Gbps Fibre Channel (FC)</li> <li>• 8 x 1Gbps iSCSI</li> <li>• 8 x 8Gbps FC + 4 x 1Gbps iSCSI</li> </ul>
<b>Max attached host ports through virtual ports</b>	1024	2048	2048
<b>Data in place upgrades</b>	To Adaptable Modular Storage 2300 or 2500	To Adaptable Modular Storage 2500	N/A

# Hardware Details

	Adaptable Modular Storage 2100	Adaptable Modular Storage 2300	Adaptable Modular Storage 2500
<b>Maximum cache partitions</b>	16	32	32
<b>Drive Interface</b>	16 Serial Attached SCSI (SAS) wide links	16 Serial Attached SCSI (SAS) wide links	32 Serial Attached SCSI (SAS) wide links
<b>RAID Levels</b>	RAID-1, RAID-1+0, RAID-5, RAID-6 and RAID-0 (SAS drives only)		
<b>Max # of RAID Groups</b>	50	75	100
<b>Max # of LUs</b>	2048	4096	4096
<b>Max LU size</b>	60TB	60TB	60TB





# Hardware Details

	Adaptable Modular Storage 2100	Adaptable Modular Storage 2300	Adaptable Modular Storage 2500
<b>Supported Drives</b>	SAS: 300GB/15k, 450GB/15k, 600GB/15k, 2TB/7200 SATA-II: 1TB/7200, 2TB/7200 SSD: 200GB (SAS interface)		
<b>Trays</b>	<ul style="list-style-type: none"> <li>• Controller tray: 4 (min) to 15 (max) HDDs</li> <li>• Expansion tray ( up to 7 ): 2 (min) to 15 (max) HDDs</li> <li>• Dense tray ( up to 3 ): 4 (min) to 48 (max) HDDs</li> <li>• Max of 159 total HDDs</li> </ul>	<ul style="list-style-type: none"> <li>• Controller tray: 4 (min) to 15 (max) HDDs</li> <li>• Expansion trays ( up to 15 ): 2 (min) to 15 (max) HDDs</li> <li>• Dense tray ( up to 4 ): 4 (min) to 48 (max) HDDs</li> <li>• Max of 240 total HDDs</li> </ul>	<ul style="list-style-type: none"> <li>• Controller tray: 0 HDD</li> <li>• First expansion tray: 4 (min) to 15 (max) HDDs</li> <li>• Up to 31 additional expansion trays, each with 2 (min) to 15 (max) HDDs</li> <li>• Dense tray ( up to 10 ): 4 (min) to 48 (max) HDDs</li> <li>• Max of 480 total HDDs</li> </ul>
<b>Maximum Capacity</b>	313TB	472TB	944TB
<b>Supported Operating Systems</b>	Microsoft Windows 2000, Windows Server 2003, Windows 2008 ( including Hyper V ) Sun Solaris ( Sparc and x64 ) RedHat Enterprise Linux RedFlag Linux Asianux HP-UX MAC OSX HP Tru64 UNIX	VMware SuSE Linux Oracle Enterprise Linux MiracleLinux IBM® AIX® Novell NetWare HP OpenVMS	

# Full Software and Firmware Offering

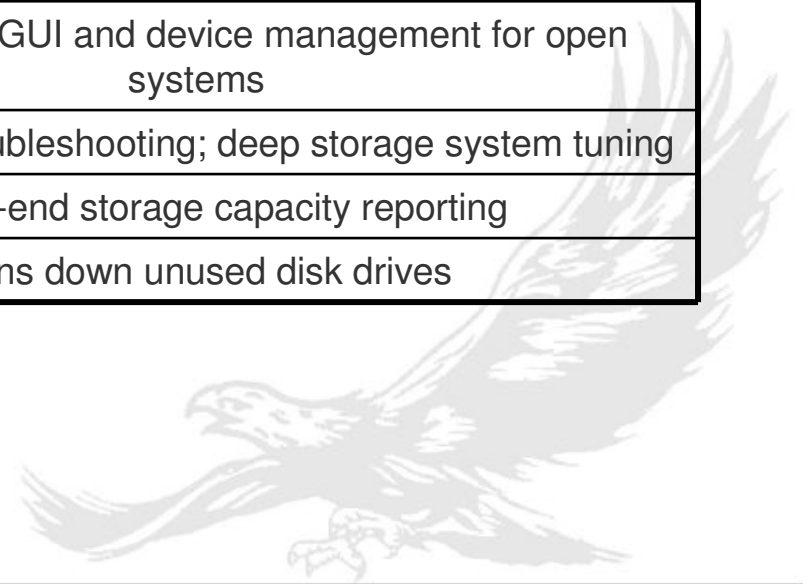
## Standard Firmware Features

Storage Management Software	Capabilities
Storage Navigator Modular 2	System management via GUI and CLI
Bundled Storage Functions	Capabilities
Account Authentication	Provides access control to management functions
Audit Logging	Records all system changes
Dynamic Provisioning	Enables creation of logical, virtual volumes
LUN Manager	Manages LUN configuration operations
LUN Grow/LUN Shrink	Dynamically adds or reduces LUN capacity
Online RAID Group Expansion	Dynamically adds HDDs to a RAID group
Cache Residency Manager	Loads data for selected LUN into cache
Cache Partition Manager	Customizes cache utilization for applications
Modular Volume Migration	Moves data between RAID groups
SNMP Agent Support Function	Reports failures and status to a SNMP server
Performance Monitor	Monitors and reports performance data

# Full Software and Firmware Offering

## Optional Firmware Features

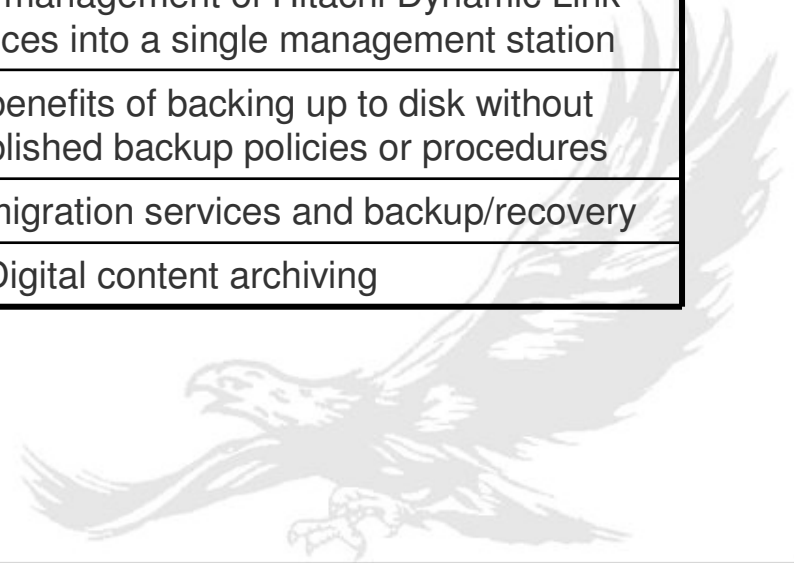
Optional Storage Features	Capabilities
ShadowImage® (Clone)	1 Primary:8 Secondary, 2047 Max , GUI and CLI mgmt
Copy-on-Write (Snapshot)	1 Primary:32 Snaps, 2047 Max , GUI and CLI mgmt
TrueCopy® (Sync Remote Mirroring)	1 Primary:1 Secondary, GUI and CLI mgmt
TrueCopy Extended Distance (Asynchronous Remote Mirroring)	1 Primary:1 Secondary, GUI and CLI mgmt
Data Retention Utility (DRU)	Protects LUNs from I/O activity
Device Manager	Configuration GUI and device management for open systems
Tuning Manager	Performance troubleshooting; deep storage system tuning
Storage Capacity Reporter	End-to-end storage capacity reporting
Power Savings Service (Spin Down)	Spins down unused disk drives



# Full Software and Firmware Offering

## Optional Firmware Features

Optional Storage Features	Capabilities
Replication Manager	Simplifies configuration and management of replication services
Protection Manager	Performs rapid backup and recovery management
Storage Services Manager	Standards-based platform for heterogeneous storage resource management and active SAN management
Dynamic Link Manger	Path failover and load balancing capabilities
Global Link Manager	Aggregates the management of Hitachi Dynamic Link Manager instances into a single management station
Virtual Tape Library	Provides the benefits of backing up to disk without changing established backup policies or procedures
Data Protection Suite	Archiving, data migration services and backup/recovery
Content Archive Platform	Digital content archiving



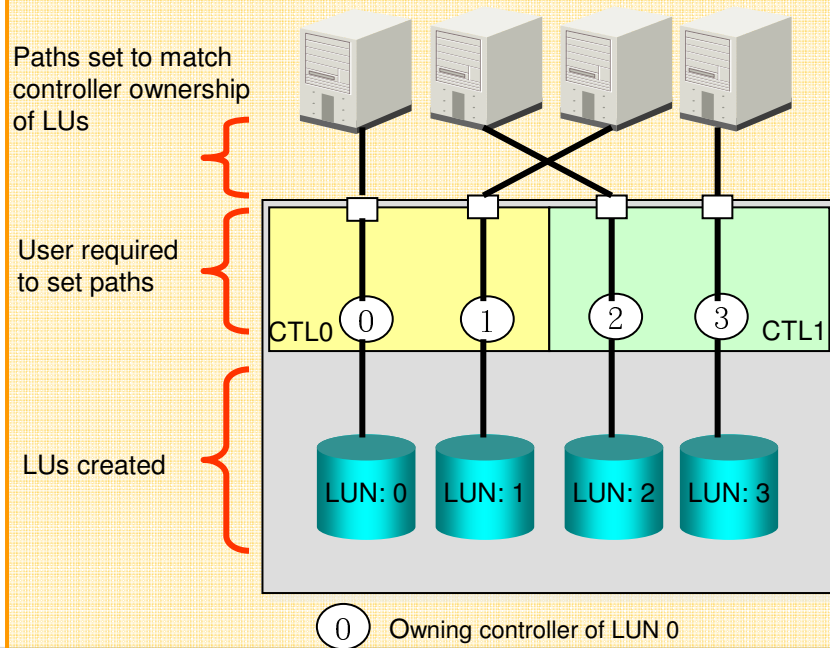
# Hitachi Dynamic Load Balancing Controller Architecture - Simplified Installation

## Benefits

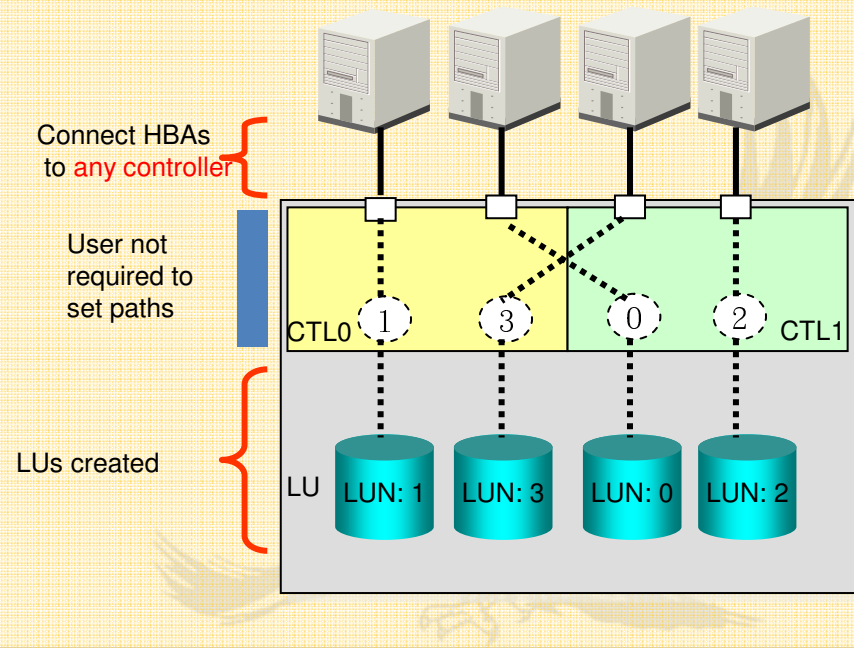
Quick and Easy setting at installation:

1. No need to set controller ownership for each LU
2. Set host connection port without regards to controller ownership.

### Traditional



### Adaptable Modular Storage 2000 family





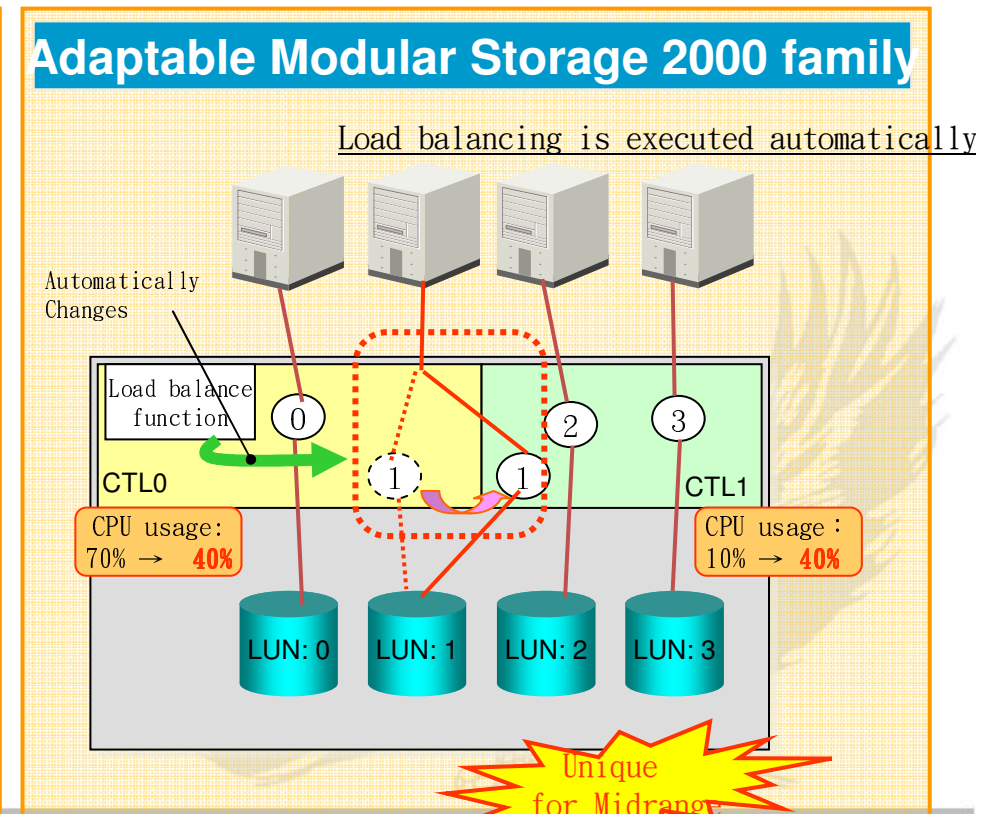
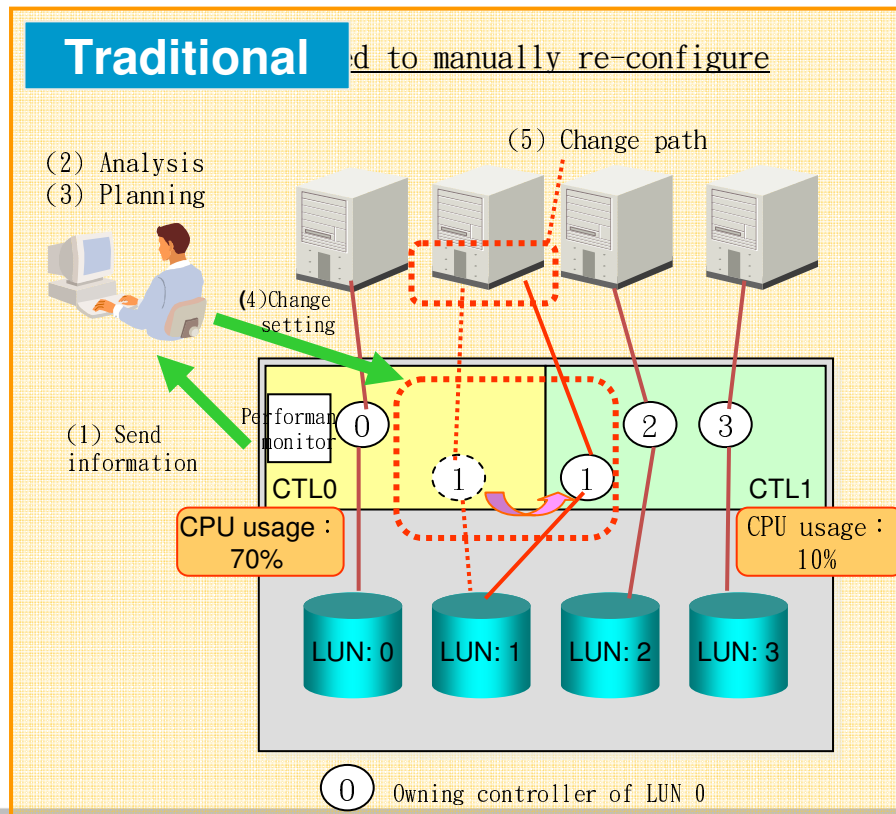
# Back End Load Balancing

## Automatic Internal Load Balancing

### Benefits

Optimal performance is achieved with minimal input from storage administrator.

Load balancing occurs automatically and evens out the utilization rates of both controllers.



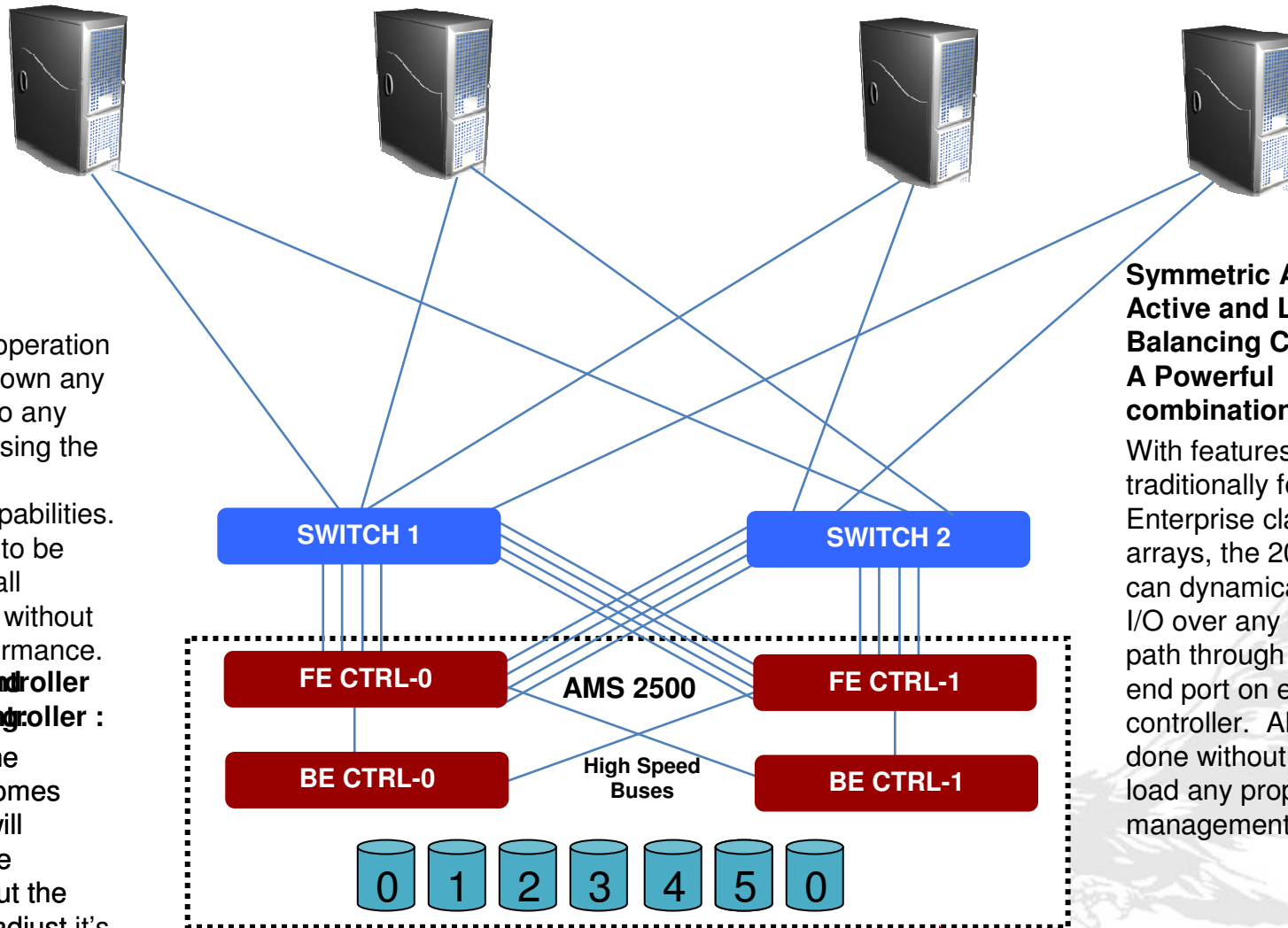
# Hitachi Dynamic Load Balancing Controller

## Symmetric Active-Active Controllers:

During normal operation I/O can travel down any available path to any front end port using the native host OS multipathing capabilities. This allows I/O to be balanced over all available paths without impacting performance.

## Automatic Controller Balancing Controller:

If the load on the controllers becomes unbalanced it will automatically be balanced without the host having to adjust it's primary path.



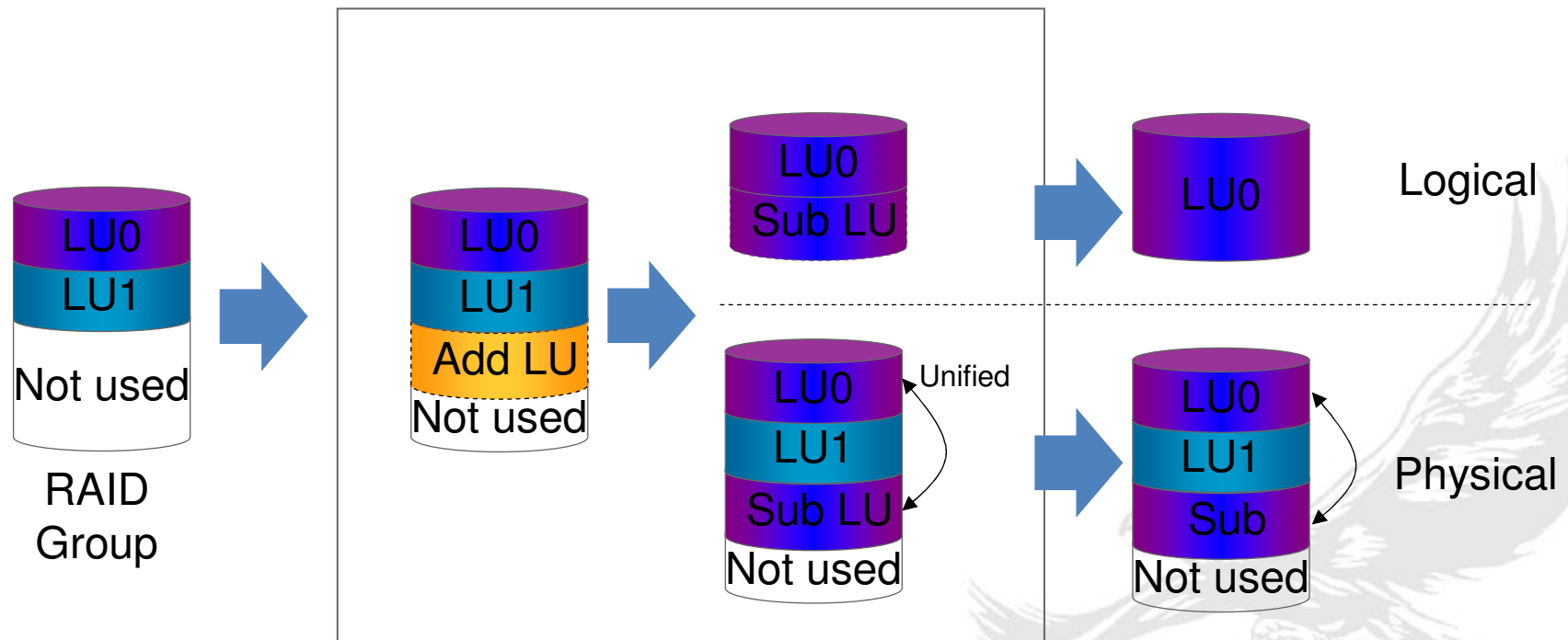
## Symmetric Active-Active and Load Balancing Controllers: A Powerful combination!

With features traditionally found only in Enterprise class storage arrays, the 2000 Family can dynamically balance I/O over any available path through any front end port on either controller. All this is done without having to load any propriety path management software.

I/O is redirected to less busy controller

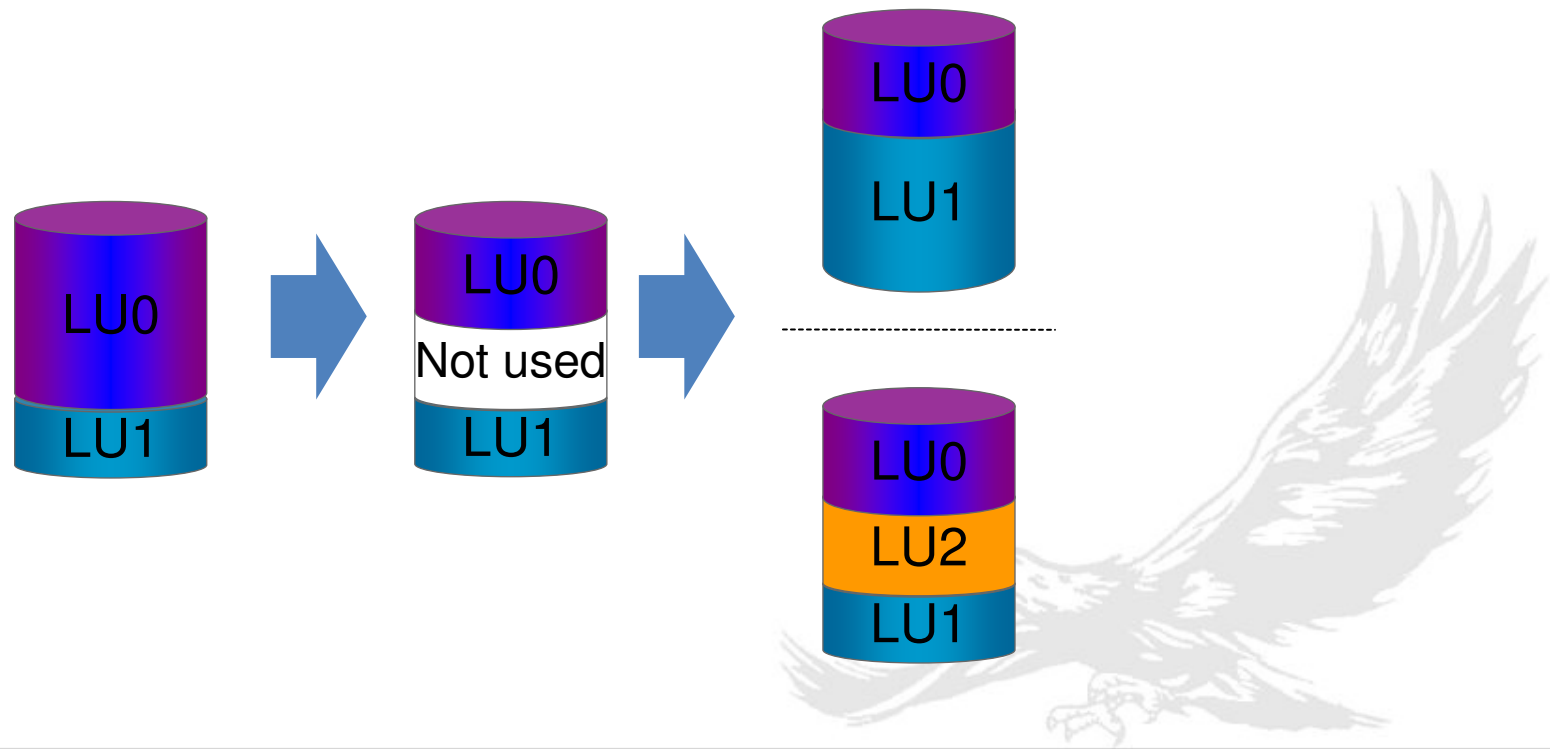
# LUN grow

- User adds a new Sub LUN from the unused capacity in an existing RAID group
- Any of the existing LUNs and the sub LUN are unified
- LUN grow is an online process



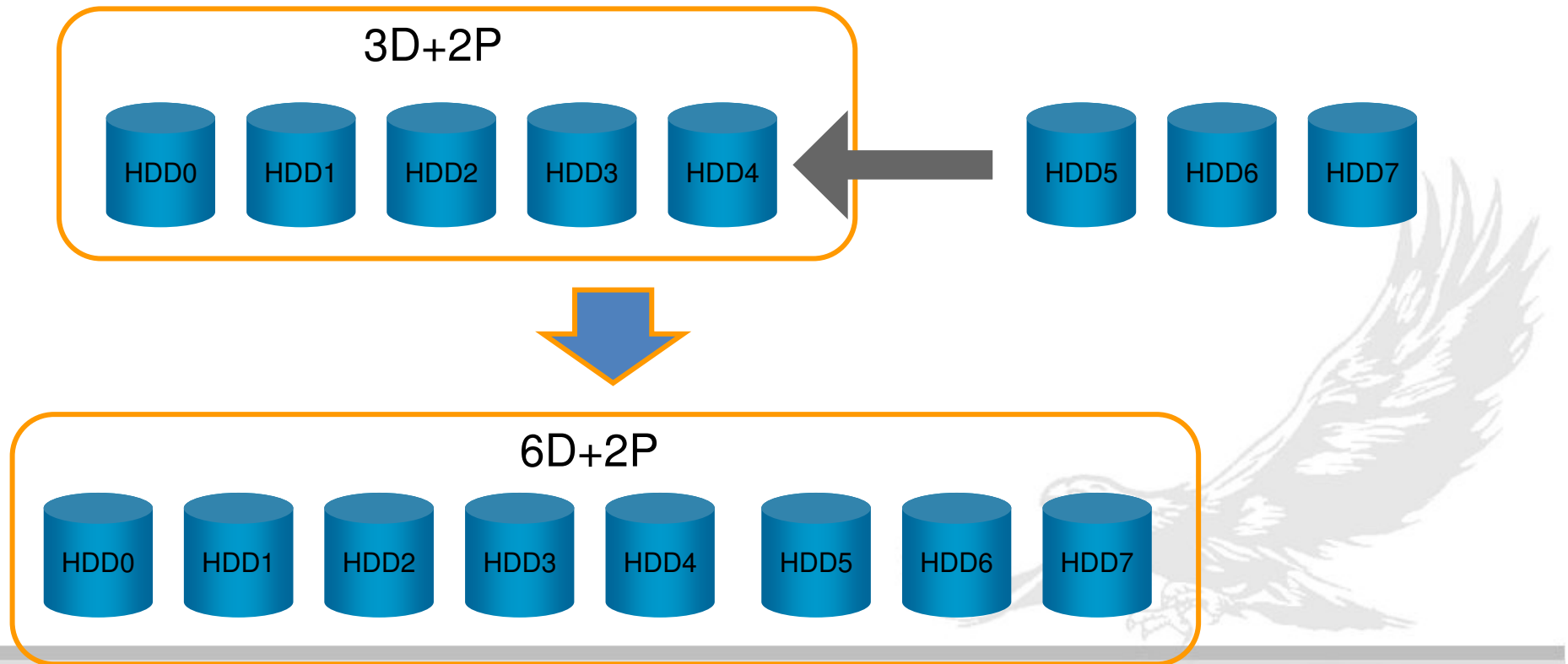
# LUN shrink

- Users can release space from an existing LUN
- The released space is no longer provisioned
- Released space can be used for new LUNs or to expand an existing LUN



# Online RAID Group Expansion

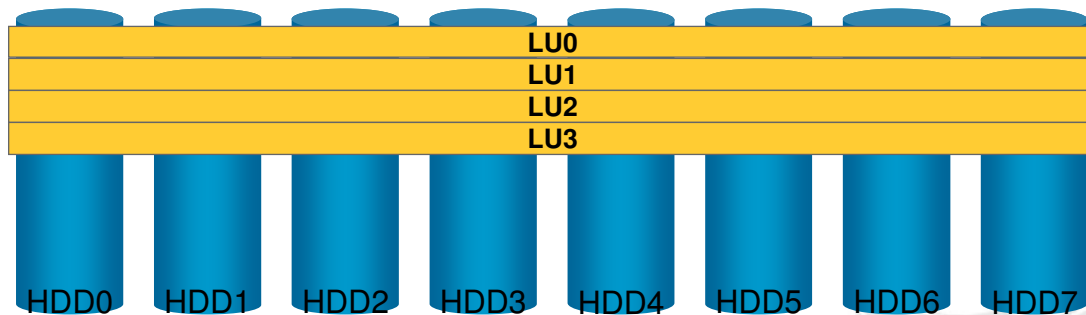
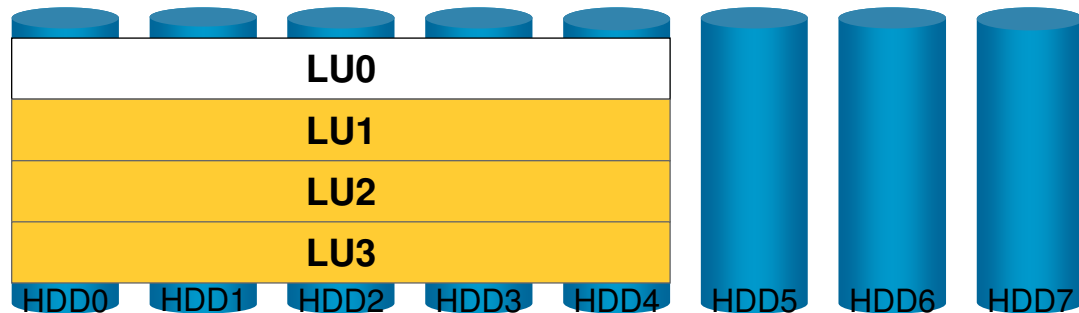
- Use with LUN grow to increase LUN and RAID group capacity.
- Tunable to allow preference to host I/O or to Expansion. Powerful controller minimizes disruptions during RAID group expansion





# Online RAID Group Expansion Specifications

- LUNs are automatically restriped across expanded RAID groups



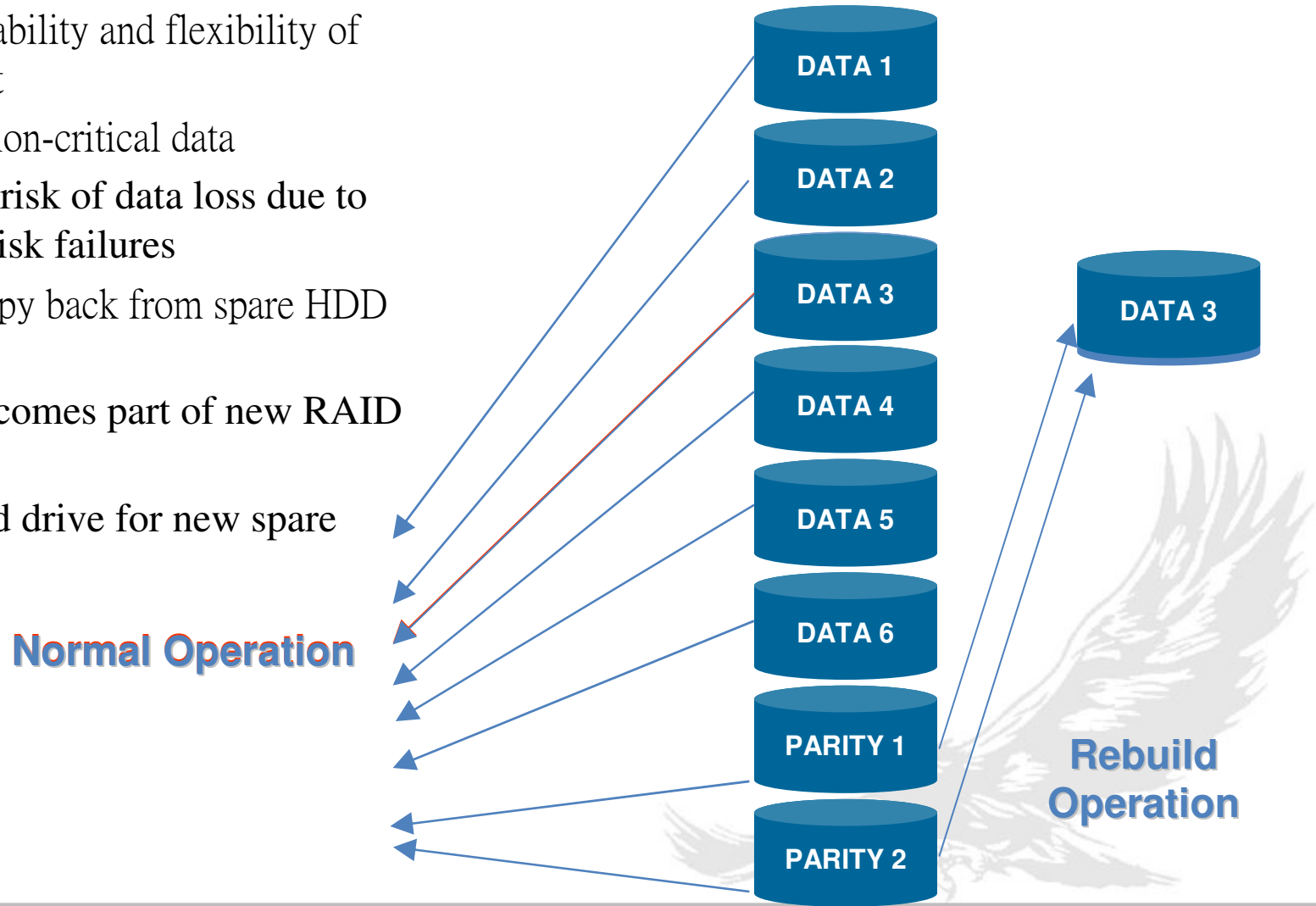
# Dense Expansion Disk Tray (4U)

- Up to 48 high capacity disks
  - 2TB SAS 7200 RPM
  - 2TB SATA 7200 RPM
- Up to 38 high performance disks
  - 600GB 15K RPM
  - 450GB 15K RPM
- Nearly doubles the density of high performance SAS storage when compared to standard disk trays
- Intermix high density SAS and SATA storage in same system
- Reduce data center floor space consumption



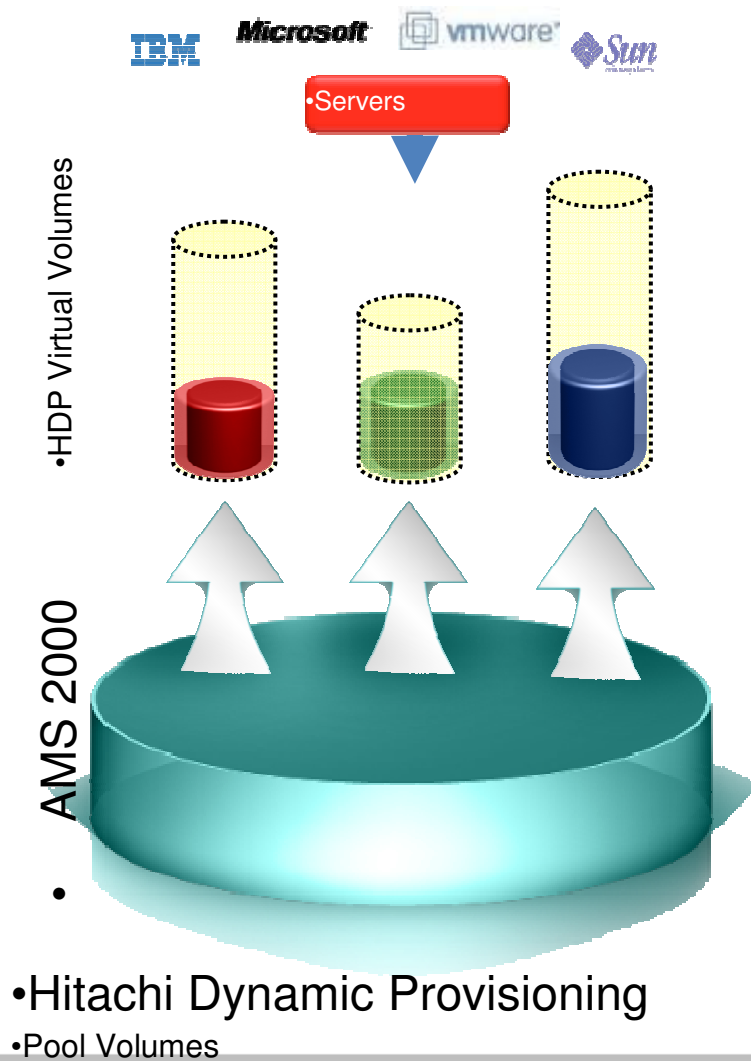
# Global sparing with HDD roaming

- Improved reliability and flexibility of recovery point
- Ideal for mission-critical data
  - Mitigate risk of data loss due to double-disk failures
- No need to copy back from spare HDD after rebuild
  - Spare becomes part of new RAID group
  - Swap bad drive for new spare



# Dynamic Provisioning = Efficient Storage Allocation

Use only what you need where you need it when it's needed



## Challenges

- High cost of storage
- Cumbersome provisioning
- Expensive optimization

## Solution Capabilities

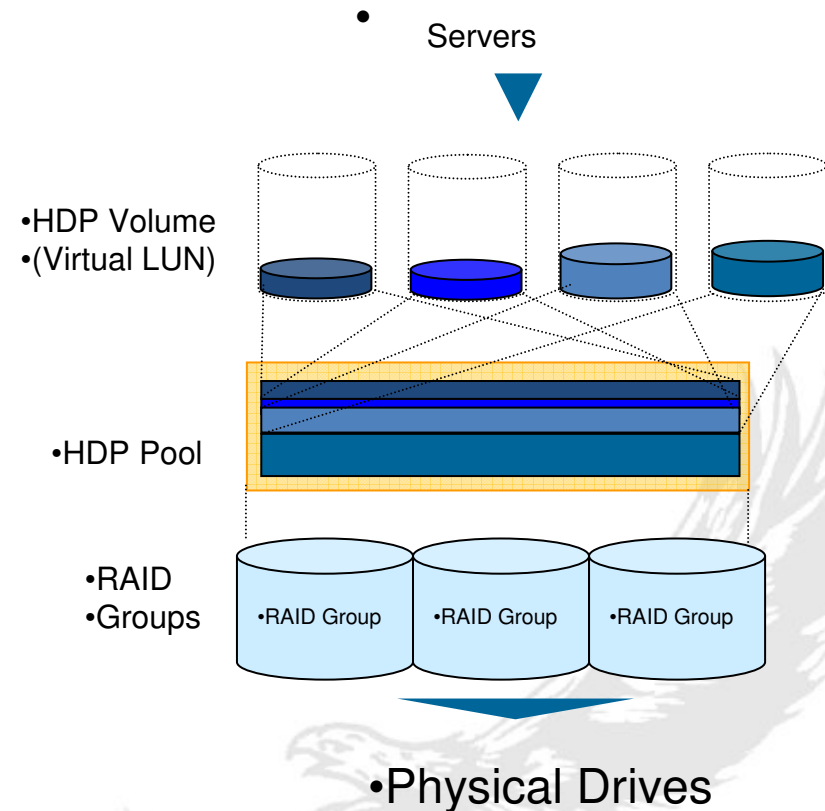
- Simplify provisioning
- Provision only what is used
- Automates performance optimization
- Replication Savings

## Business Benefits

- Reduced storage expense
- Reduced operational expense
- IT Agility

# Hitachi Dynamic Provisioning Capability: Automates performance optimization

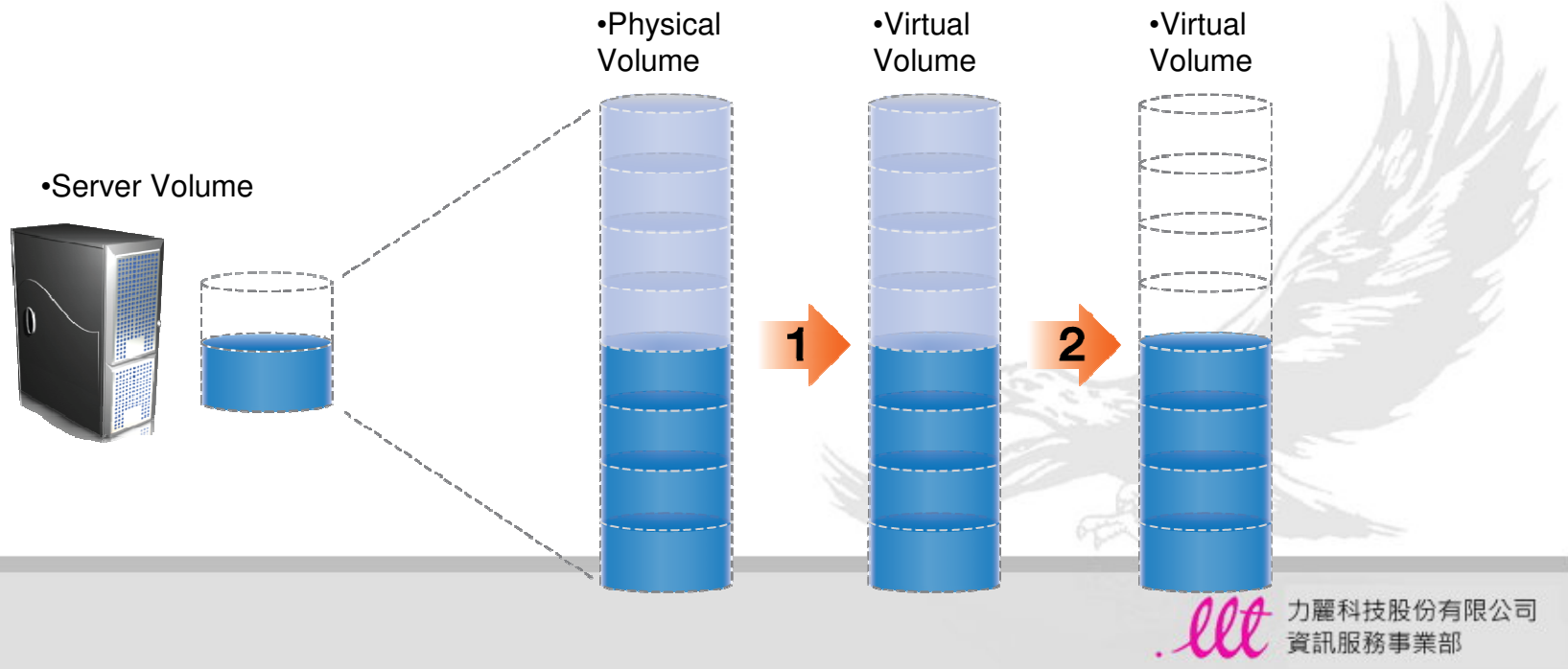
- Dynamic Provisioning software effectively combines many applications' I/O patterns and evenly spreads the I/O activity across available physical resources
- This automatically levels workloads and avoids particular parity groups becoming performance bottlenecks
- Before Dynamic Provisioning, this had to be done manually by a storage expert



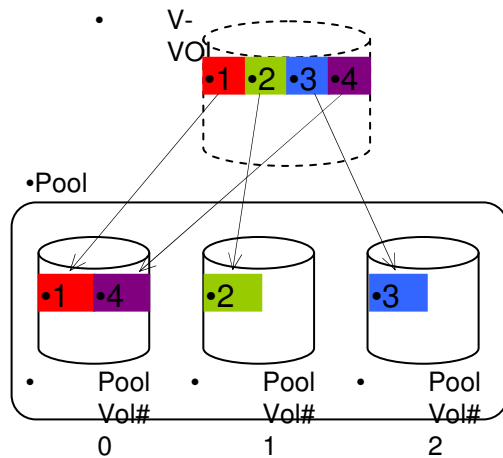


# Get More From Storage Assets with Zero Page Reclaim Facility

- Hitachi Dynamic Provisioning for the AMS2000 supports the capability to do “Zero Page Reclaim” to reduce the DP Pool consumed capacity and improves storage utilization.
- Zero Page Reclaim facility examines the volumes of physical capacity and where the firmware determines that no data other than zeros is found on a Dynamic Provisioning software pool page, the physical storage is unmapped and 'returned' to the pool's free capacity.
- Zero Page Reclaim is intended to be used after initial migration/restore
  - Migrate from the physical volume to the virtual volume (or restore volume from tape)
  - Zero Page Reclaim unused pages return physical storage to a dynamically provisioned pool
  - Note that prior to v8 microcode, the AMS2000 did not zero storage as it was allocated, so for existing volumes less gain will be seen with ZPR than is seen on a USP.

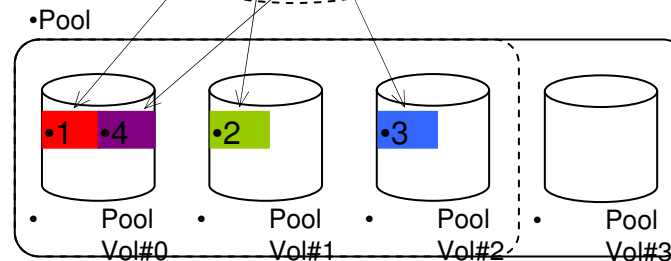


# Improved Performance Optimization: Dynamic Provisioning on AMS2000 supports automatic pool rebalancing



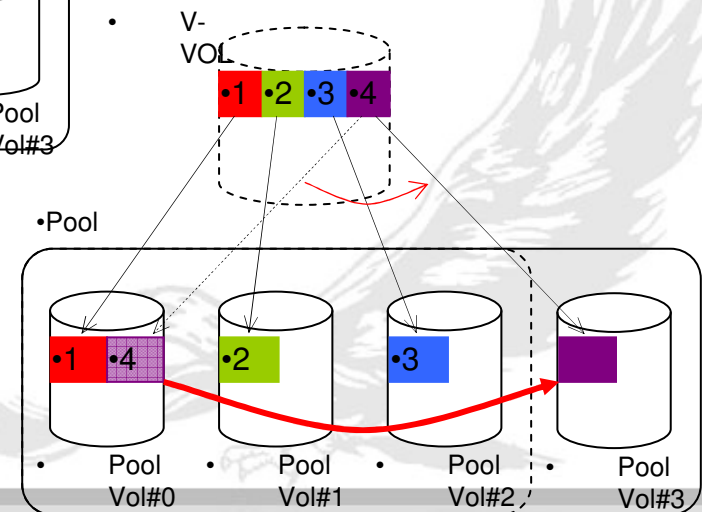
- Automatic rebalancing after virtual storage pool expansion
- When a new RAID Group is added to a DP Pool, pages are actively redistributed among all of the RAID Groups in the pool
- Rebalances pool including rebalancing at individual virtual volume level
- All transparently online with no affect to application I/O

• Add Pool Capacity



- Further simplifies storage provisioning
- Improved performance optimization

• Optimize Po



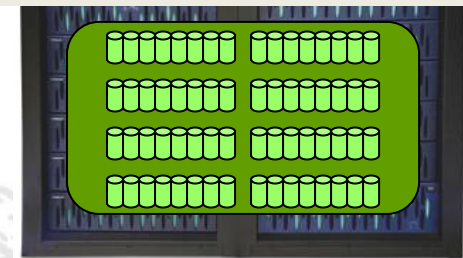
# Hitachi Dynamic Provisioning Components

## Dynamic Provisioning Pool

- **Dynamic Provisioning Pool (DP-Pool)**
  - Real installed capacity
  - Cannot be directly referenced from any hosts
  - DP Pool is composed of 1GB Chunks (32 x 32MB pages) randomly assigned throughout the available DP Pool volumes
  - A 1GB Chunk is assigned to a Virtual-LU
  - DP Pool pages are assigned to Virtual-LUs Just-in-Time
  - DP Pool storage will be shared by all applications whose Virtual-LUs are associated with the DP Pool
  - DP Pool itself can not be replicated and it can not be migrated using the volume migration function



•The DP Pool is comprised of RAID Groups built from physical HDDs

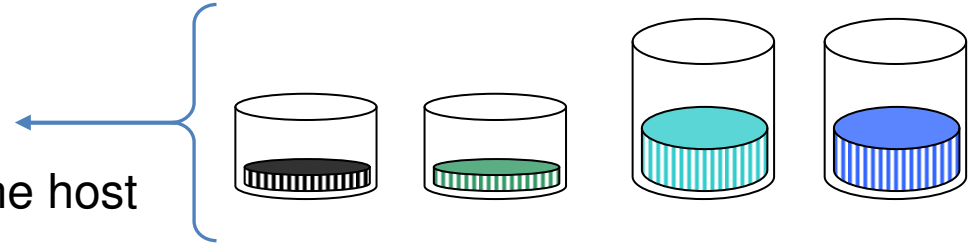


# Hitachi Dynamic Provisioning Components

## Virtual Logical Unit

- Virtual Logical Unit (Virtual-LU)

- Virtual Volume (capacity) that the host discovers
- Must be associated with a DP Pool
- Immediately after definition, the Virtual-LU has no pages assigned from the DP Pool
- Target of Host Reads and Writes
- Real storage capacity is assigned to the Virtual-LU when required for a write
- Is supported as P-VOL or S-VOL for ShadowImage



•The DP Pool is comprised of RAID Groups built from physical HDDs

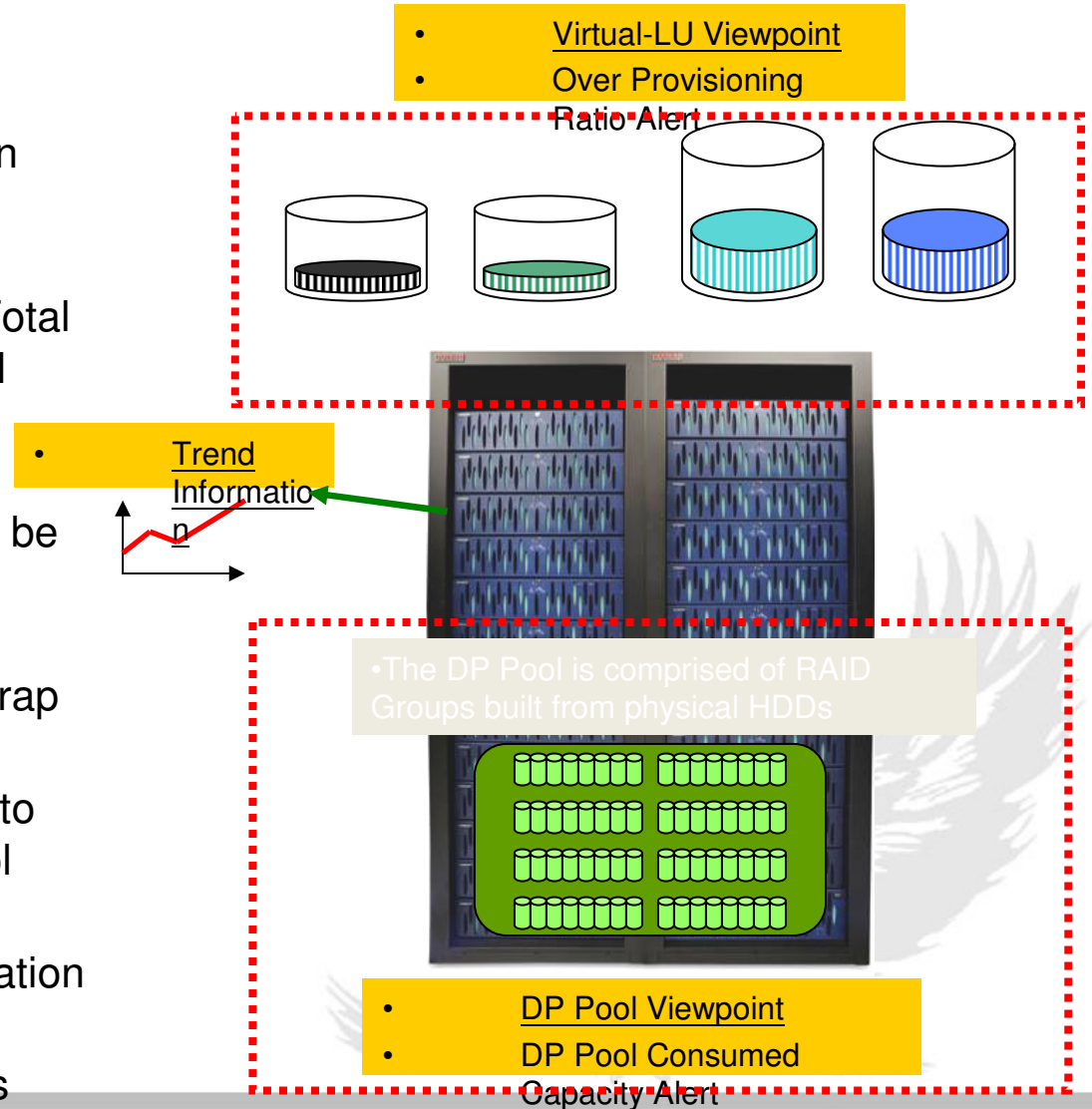


# Hitachi Dynamic Provisioning

## Improved Storage Management Agility via Monitoring

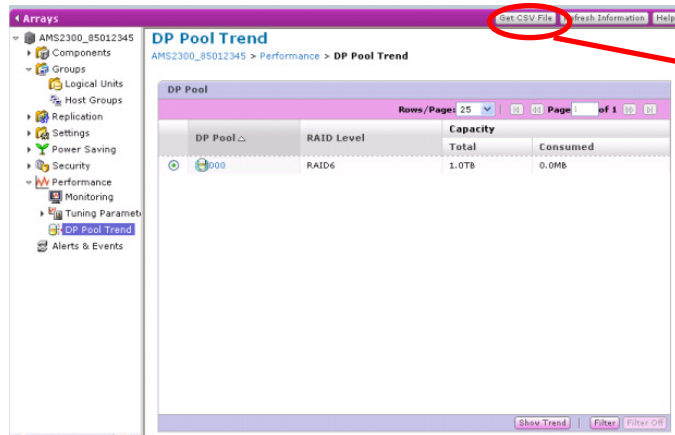
### Capacity Monitoring

- Monitor the DP Pool utilization
- Two customer definable utilization levels may be set per pool to generate alerts
- Monitor over-provisioning ratio (Total virtual volume capacity/Total pool capacity)
- Two customer definable over provisioning ratio thresholds may be set to generate alerts
- Alert options: Blinking LED on system; Email message; SNMP trap issued
- Error return (WRITE PROTECT) to the Write command after DP Pool depletion
- Stores the DP Pool Trend information for the past one year
- Transfer the Trend information as CSV file

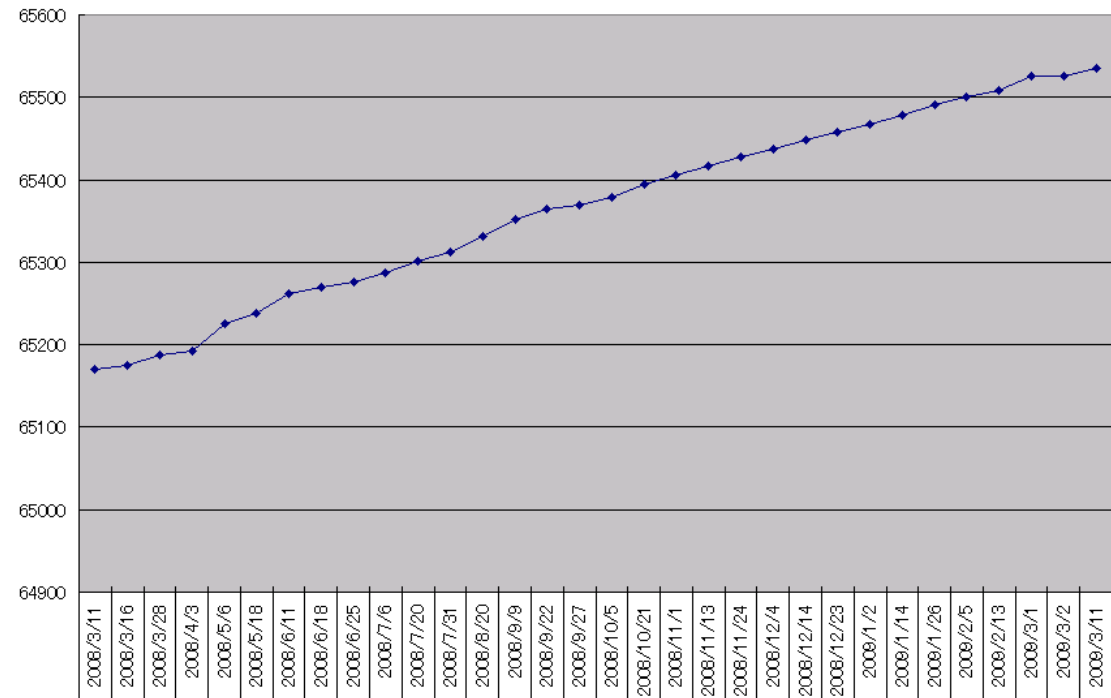


# Hitachi Dynamic Provisioning

## Example of Trend Information Reported



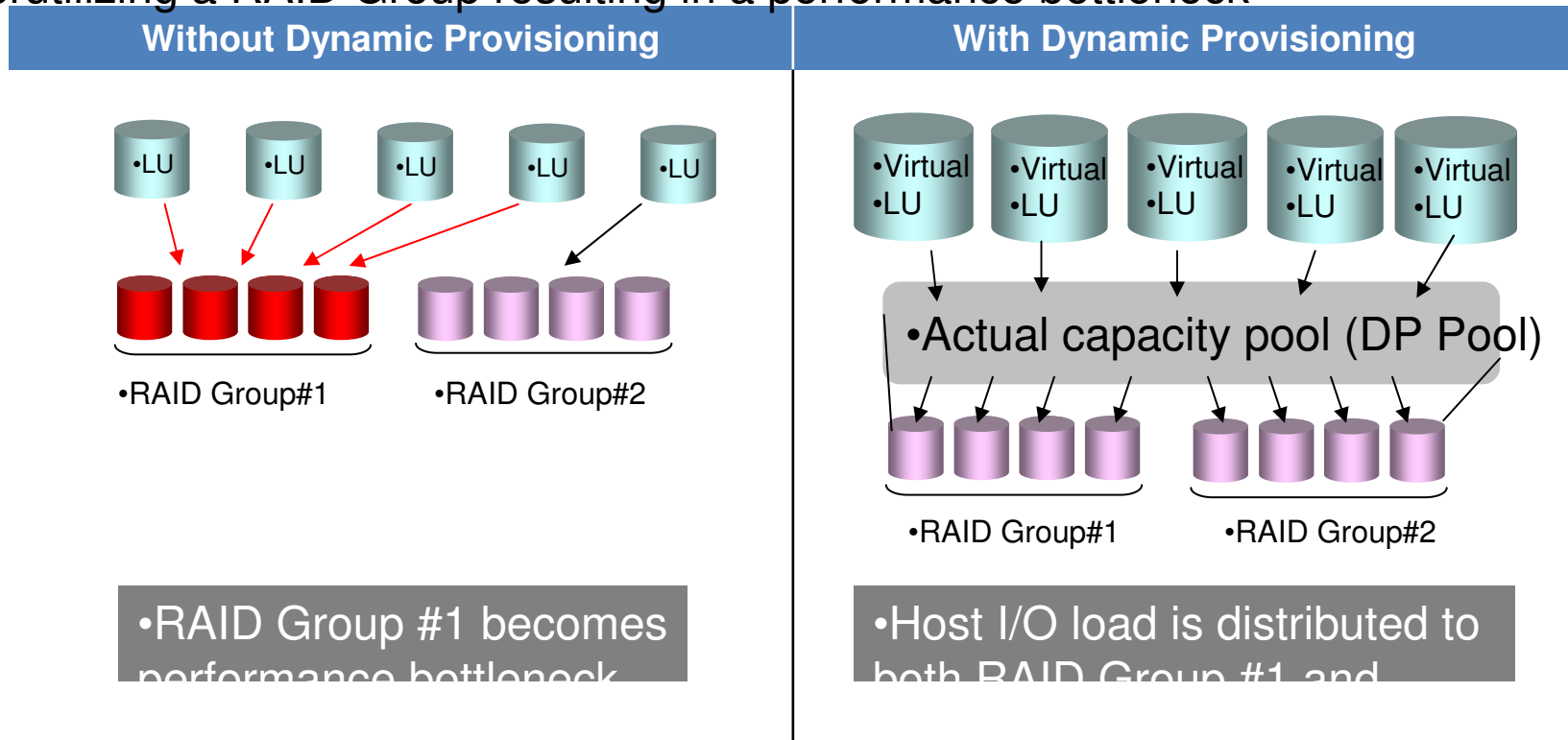
The modal dialog box is titled "Get CSV File" and contains the message "Trend data retrieved successfully." Below the message, it says "Click Get CSV File to save." At the bottom right of the dialog, there is a "Get CSV File" button and a "Close" button. The "Get CSV File" button is circled in red.





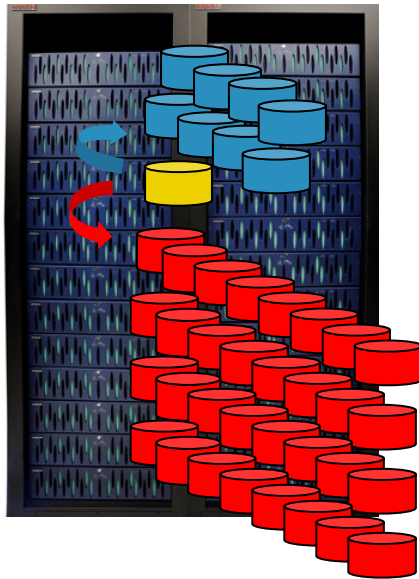
# Hitachi Dynamic Provisioning Delivering Performance Improvements

- When allocating many Virtual LUs to a Dynamic Provisioning Pool that consists of multiple storage system groups, the total Host I/O load is evenly distributed across the pool's RAID Groups
- This “wide striping” implementation automatically levels the I/O load and avoids overutilizing a RAID Group resulting in a performance bottleneck

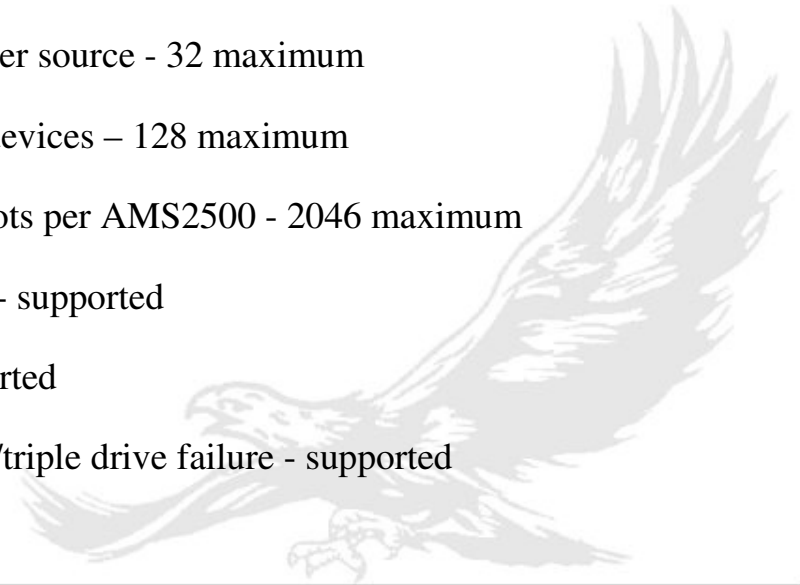


# ShadowImage™ In-System Replication/Copy-on-Write Snapshot Software Cloning

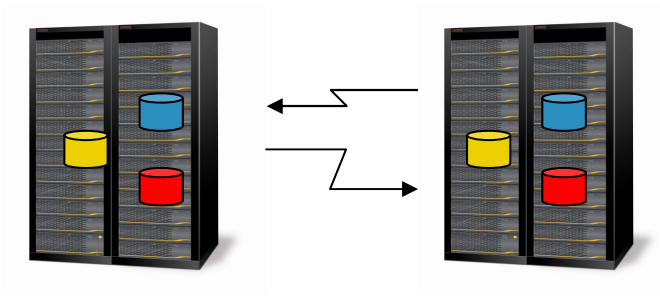
## Hitachi ShadowImage™ In-System Replication software Full Volume Clone/Copy-on-Write (PiT) Snapshot software



- ShadowImage full volume clones per source – 8 maximum
- ShadowImage command devices – 128 maximum
- ShadowImage copy requests per AMS2500 - 2047 maximum
- Copy-on-Write snapshots per source - 32 maximum
- Copy-on-Write command devices – 128 maximum
- Copy-on-Write PiT snapshots per AMS2500 - 2046 maximum
- Reverse resynchronization - supported
- Instant snap restore - supported
- Auto I/O Switch on double/triple drive failure - supported

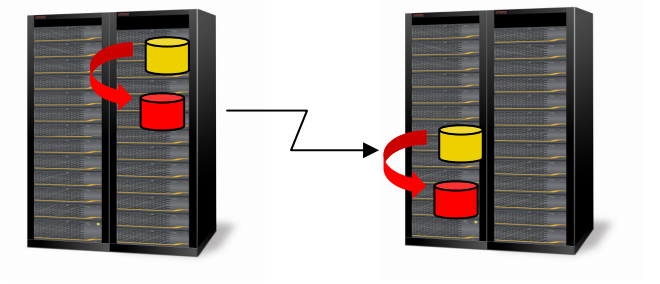


# TrueCopy™ Remote Replication Software for Business Continuity



## TrueCopy Synchronous

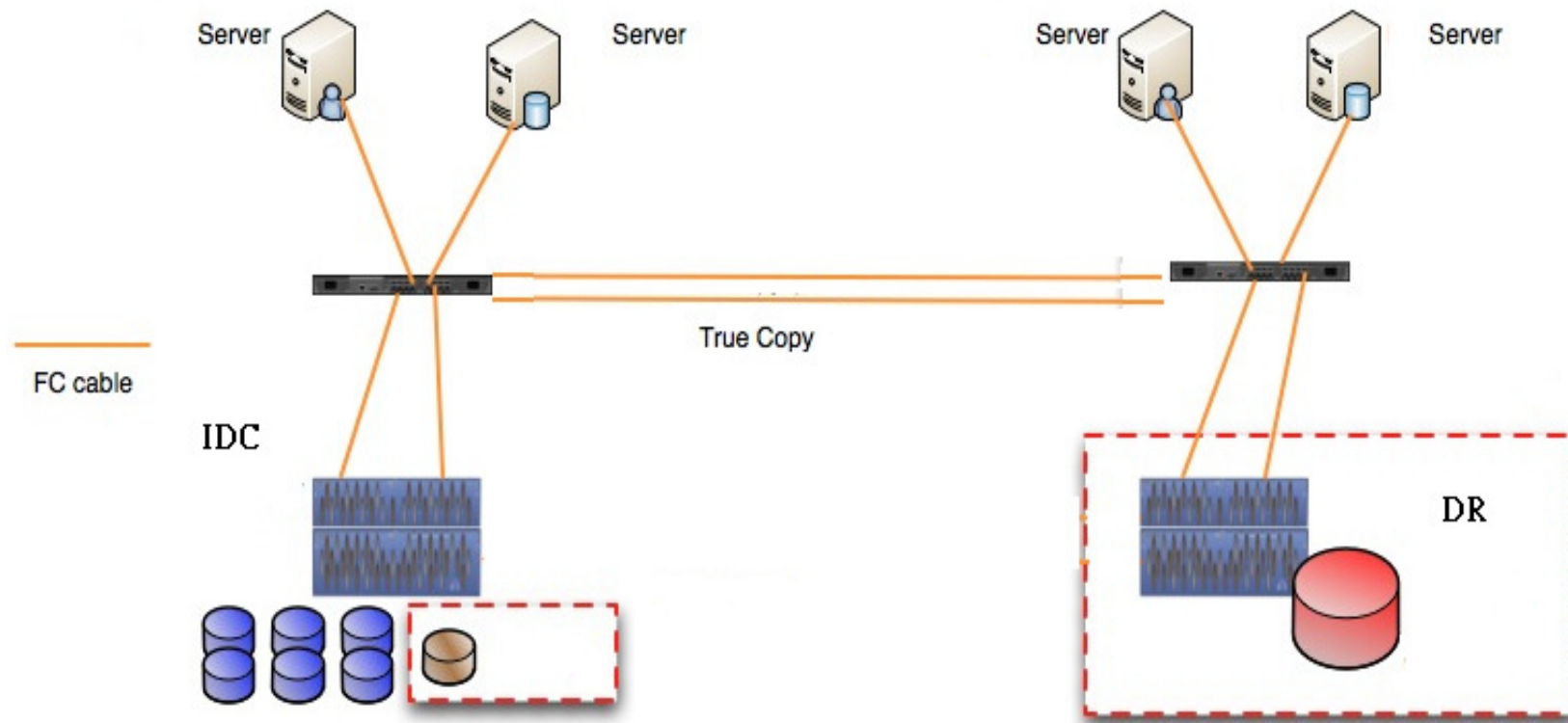
- Bi-directional
- Differential re-synchronization
- Reverse re-synchronization
- R/W Source and Read Target Continuous Access



## TrueCopy Extended Distance (Asynchronous)

- Automated source and remote synchronization
- Automated local and remote RPO snapshots
- Consistency Group support
- Write order fidelity preservation
- Bi-directional
- Local or remote site back-up capability

# TKU AMS Environment





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# 問題討論





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Thank You

