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Hitachi AMS 2000 Family

Dynamic Provisioning Configuration Guide

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MK-09DF8201-04

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Preface

This document describes and provides instructions for using the Hitachi Dynamic Provisioning software.

Please read this document carefully to understand how to use this product, and maintain a copy for reference purposes.

This preface includes the following information:

- Intended audience
- Product version
- Release notes and readme
- Document revision level
- Changes in this revision
- Document organization
- Document conventions
- Convention for storage capacity values
- Accessing product documentation
- Getting help
- Comments

Intended audience

This document is intended for system administrators, Hitachi Data Systems representatives, and Authorized Service Providers who install, configure, and operate Hitachi Adaptable Modular System (AMS) 2000 family storage systems.

Product version

This document applies to Hitachi AMS 2000 Family firmware version 0893 or later.

Release notes and readme

Read the release notes and readme file before installing and using this product. They may contain requirements or restrictions that are not fully described in this document and/or updates or corrections to this document.

Document revision level

Revision	Date	Description
MK-09DF8201-00	August 2009	Initial Release
MK-09DF8201-01	November 2009	MK-09DF8201-01 replaces MK-09DF8201-00
MK-09DF8201-02	January 2010	MK-09DF8201-02 replaces MK-09DF8201-01
MK-09DF8201-03	April 2010	MK-09DF8201-03 replaces MK-09DF8201-02
MK-09DF8201-04	August 2010	MK-09DF8201-04 replaces MK-09DF8201-03

Changes in this revision

- Increasing DP pool capacity (page 2-3): added two bullet points about increasing capacity.
- Table 2-7 (page 2-12): revised information for ShadowImage and TrueCopy or TCE.
- SnapShot (page 2-13): revised second bullet point that Dynamic Provisioning and SnapShot or TCE may not be unlocked at the same time.
- Threshold alerts of the DP pool usage capacity (page 2-14): added new statement before Figure 2-4 (page 2-15) about arrays with firmware versions 0893/A and higher remaining operational.
- Table 3-1 (page 3-2): revised DP-VOL requirements for logical unit types.
- Table 3-2 (page 3-3): revised RAID level of DP RAID group to show that RAID 0 is not supported. Also, for usable threshold, added information about arrays with firmware versions 0893/A and higher.
- Table 3-4 (page 3-6). for creating a DP pool, adding the DP pool capacity, deleting the DP pool capacity, or initializing the DP pool,

changed three instances of “initialization” to “re-initialization.” Also, added new last row to the table about path-switching software.

- Logical Units window (page 4-2): replaced figure.
- DP Pools tab (page 4-3): replaced figure. For Capacity Depleted, added information about arrays with firmware versions 0893/A and higher remaining operational. Added **Reconstruction Progress** verbiage. For buttons on the **DP Pools** tab, added **Reinitialize Pool**.
- Summary table (page 4-10): added **Reconstruction Progress**.
- Reinitializing a DP pool (page 5-6): revised steps 1 and 2. Replaced the figures after steps 3 and 4.
- Creating a DP-VOL (page 5-8): in step 4, added reference to an iSCSI target. Also replaced the figure after step 5.
- Exporting DP pool trend information (page 5-18). revised step 2, the figure following it, and the figures following steps 3 and 4.
- Viewing DP pool trend information in the CSV file (page 5-19): added “Optional prefix” to the file name of the three compressed trend files.
- Reinitializing a DP pool (page 6-8): revised this section, which previously described recovering a DP pool.
- Creating a new DP pool (page 6-5): revised the screen after step 2.
- Changing DP pool thresholds (page 6-6): revised the screen after step 2.
- Saving DP pool trend information to a file (page 6-12): added a second example.
- Checking the progress of DP optimization (page 6-14): revised the example shown.

Document organization

Thumbnail descriptions of the chapters are provided in the following table. Click the chapter title in the first column to go to that chapter. The first page of every chapter or appendix contains links to the contents.

Chapter/Appendix Title	Description
Chapter 1, Introduction	Describes the general features, functions, and benefits of using Hitachi Dynamic Provisioning.
Chapter 2, About Dynamic Provision operations	Explains the DP pool and the DP-VOL used by Dynamic Provisioning, and Dynamic Provisioning functions.
Chapter 3, Preparing for Dynamic Provisioning operations	Explains the requirements and restrictions to use Dynamic Provisioning, and how to install/uninstall and disable/enable it.
Chapter 4, Using the Dynamic Provisioning GUI	Describes features of the Navigator 2 GUI.

Chapter / Appendix Title	Description
Chapter 5, Performing Dynamic Provisioning operations	Provides procedures for performing Dynamic Provisioning operations using the Navigator 2 GUI.
Chapter 6, CLI operations	Provides procedures for performing Dynamic Provisioning operations from the command line using Navigator 2 CLI.
Chapter 7, Troubleshooting	Contains troubleshooting suggestions.

Document conventions

This document uses the following symbols to draw attention to important safety and operational information.

Symbol	Meaning	Description
	Tip	Tips provide helpful information, guidelines, or suggestions for performing tasks more effectively.
	Note	Notes emphasize or supplement important points of the main text.
	Caution	Cautions indicate that failure to take a specified action could result in damage to the software or hardware.

The following typographic conventions are used in this document.

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. Example: Click **OK**.
Italic	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: copy *source-file target-file* Angled brackets (< >) are also used to indicate variables.
screen/code	Indicates text that is displayed on screen or entered by the user. Example: `# pairdisplay -g oradb`
< > angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: `# pairdisplay -g <group>` Italic font is also used to indicate variables.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.
underline	Indicates the default value. Example: [a | b]

Convention for storage capacity values

Physical storage capacity values (e.g., disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 KB	1,000 bytes
1 MB	1,000 KB or $1{,}000^2$ bytes
1 GB	1,000 MB or $1{,}000^3$ bytes
1 TB	1,000 GB or $1{,}000^4$ bytes
1 PB	1,000 TB or $1{,}000^5$ bytes
1 EB	1,000 PB or $1{,}000^6$ bytes

Logical storage capacity values (e.g., logical device capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or 1024^2 bytes
1 GB	1,024 MB or 1024^3 bytes
1 TB	1,024 GB or 1024^4 bytes
1 PB	1,024 TB or 1024^5 bytes
1 EB	1,024 PB or 1024^6 bytes

Accessing product documentation

The AMS 2000 Family user documentation is available on the Hitachi Data Systems Portal: https://portal.hds.com. Please check this site for the most current documentation, including important updates that may have been made after the release of the product.

This documentation set consists of the following documents.

Release notes

- Adaptable Modular Storage System Release Notes
- Storage Navigator Modular 2 Release Notes

Please read the release notes before installing and/or using this product. They may contain requirements and/or restrictions not fully described in this document, along with updates and/or corrections to this document.

Installation and getting started

The following documents provide instructions for installing an AMS 2000 Family storage system. They include rack information, safety information, site-preparation instructions, getting-started guides for experienced users, and host connectivity information. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS2100/2300 Getting Started Guide**, MK-98DF8152

Provides quick-start instructions for getting an AMS 2100 or AMS 2300 storage system up and running as quickly as possible.

☞ **AMS2500 Getting Started Guide**, MK-97DF8032

Provides quick-start instructions for getting an AMS 2500 storage system up and running as quickly as possible.

AMS 2000 Family Site Preparation Guide, MK-98DF8149

Contains initial site planning and pre-installation information for AMS 2000 Family storage systems, expansion units, and high-density expansion units. This document also covers safety precautions, rack information, and product specifications.

AMS 2000 Family Fibre Channel Host Installation Guide, MK-08DF8189

Describes how to prepare Hitachi AMS 2000 Family Fibre Channel storage systems for use with host servers running supported operating systems.

AMS 2000 Family iSCSI Host Installation Guide, MK-08DF8188

Describes how to prepare Hitachi AMS 2000 Family iSCSI storage systems for use with host servers running supported operating systems.

Storage and replication features

The following documents describe how to use Storage Navigator Modular 2 (Navigator 2) to perform storage and replication activities.

Storage Navigator 2 Advanced Settings User's Guide, MK-97DF8039

Contains advanced information about launching and using Navigator 2 in various operating systems, IP addresses and port numbers, server certificates and private keys, boot and restore options, outputting configuration information to a file, and collecting diagnostic information.

Storage Navigator Modular 2 User's Guide, MK-99DF8208

Describes how to use Navigator 2 to configure and manage storage on an AMS 2000 Family storage system.

AMS 2000 Family Dynamic Provisioning Configuration Guide, MK-09DF8201 — this document

Describes how to use virtual storage capabilities to simplify storage additions and administration.

Storage Navigator 2 Storage Features Reference Guide for AMS, MK-97DF8148

Contains concepts, preparation, and specifications for Account Authentication, Audit Logging, Cache Partition Manager, Cache Residency Manager, Data Retention Utility, LUN Manager, Performance Monitor, SNMP Agent, and Modular Volume Migration.

AMS 2000 Family Copy-on-write SnapShot User Guide, MK-97DF8124

Describes how to create point-in-time copies of data volumes in AMS 2100, AMS 2300, and AMS 2500 storage systems, without impacting host service and performance levels. Snapshot copies are fully read/write compatible with other hosts and can be used for rapid data restores, application testing and development, data mining and warehousing, and nondisruptive backup and maintenance procedures.

AMS 2000 Family ShadowImage In-system Replication User Guide, MK-97DF8129

Describes how to perform high-speed nondisruptive local mirroring to create a copy of mission-critical data in AMS 2100, AMS 2300, and AMS 2500 storage systems. ShadowImage keeps data RAID-protected and fully recoverable, without affecting service or performance levels. Replicated data volumes can be split from host applications and used for system backups, application testing, and data mining applications while business continues to operate at full capacity.

AMS 2000 Family TrueCopy Remote Replication User Guide, MK-97DF8052

Describes how to create and maintain multiple duplicate copies of user data across multiple AMS 2000 Family storage systems to enhance your disaster recovery strategy.

AMS 2000 Family TrueCopy Extended Distance User Guide, MK-97DF8054

Describes how to perform bi-directional remote data protection that copies data over any distance without interrupting applications, and provides failover and recovery capabilities.

AMS 2000 Data Retention Utility User's Guide, MK-97DF8019

Describes how to lock disk volumes as read-only for a certain period of time to ensure authorized-only access and facilitate immutable, tamper-proof record retention for storage-compliant environments. After data is written, it can be retrieved and read only by authorized applications or users, and cannot be changed or deleted during the specified retention period.

Storage Navigator Modular 2 online help

Provides topic and context-sensitive help information accessed through the Navigator 2 software.

Hardware maintenance and operation

The following documents describe how to operate, maintain, and administer an AMS 2000 Family storage system. They also provide a wide range of technical information and specifications for the AMS 2000 Family storage systems. The symbol ☞ identifies documents that contain initial configuration information about Hitachi AMS 2000 Family storage systems.

☞ **AMS 2100/2300 Storage System Hardware Guide**, MK-97DF8010

Provides detailed information about installing, configuring, and maintaining AMS 2100 and 2300 storage systems.

☞ **AMS 2500 Storage System Hardware Guide**, MK-97DF8007

Provides detailed information about installing, configuring, and maintaining an AMS 2500 storage system.

☞ **AMS 2000 Family Storage System Reference Guide**, MK-97DF8008

Contains specifications and technical information about power cables, system parameters, interfaces, logical blocks, RAID levels and configurations, and regulatory information about AMS 2100, AMS 2300, and AMS 2500 storage systems. This document also contains remote adapter specifications and regulatory information.

AMS 2000 Family Storage System Service and Upgrade Guide, MK-97DF8009

Provides information about servicing and upgrading AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Power Savings User Guide, MK-97DF8045

Describes how to spin down volumes in selected RAID groups when they are not being accessed by business applications to decrease energy consumption and significantly reduce the cost of storing and delivering information.

Command and Control (CCI)

The following documents describe how to install the Hitachi AMS 2000 Family Command Control Interface (CCI) and use it to perform TrueCopy and ShadowImage operations.

AMS 2000 Family Command Control Interface (CCI) Installation Guide, MK-97DF8122

Describes how to install CCI software on open-system hosts.

AMS 2000 Family Command Control Interface (CCI) Reference Guide, MK-97DF8121

Contains reference, troubleshooting, and maintenance information related to CCI operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

AMS 2000 Family Command Control Interface (CCI) User's Guide, MK-97DF8123

Describes how to use CCI to perform TrueCopy and ShadowImage operations on AMS 2100, AMS 2300, and AMS 2500 storage systems.

Command Line Interface (CLI)

The following documents describe how to use Hitachi Storage Navigator Modular 2 to perform management and replication activities from a command line.

Storage Navigator Modular 2 Command Line Interface (CLI) Unified Reference Guide, MK-97DF8089

Describes how to interact with all Navigator 2 bundled and optional software modules by typing commands at a command line.

Storage Navigator 2 Command Line Interface Replication Reference Guide for AMS, MK-97DF8153

Describes how to interact with Navigator 2 to perform replication activities by typing commands at a command line.

Dynamic Replicator documentation

The following documents describe how to install, configure, and use Hitachi Dynamic Replicator to provide AMS Family storage systems with continuous data protection, remote replication, and application failover in a single, easy-to-deploy and manage platform.

Dynamic Replicator - Scout Release Notes, RN-99DF8211

Dynamic Replicator - Scout Host Administration Guide, MK-98DF8212

Dynamic Replicator - Scout Installation and Configuration Guide, MK-98DF8213

Dynamic Replicator - Scout Quick Start Guide, MK-98DF8214

Dynamic Replicator - Scout Host Troubleshooting Guide, MK-98DF8215

Dynamic Replicator DR-Scout ICAT Utility Guide, MK-98DF8216

Dynamic Replicator - Scout RX Server Deployment Guide, MK-98DF8217

Dynamic Replicator VX Solution for Oracle (Solaris), MK-98DF8218

Dynamic Replicator - Scout Solution for SharePoint 2007, MK-98DF8219

Dynamic Replicator - Scout Solution for MySQL (Windows), MK-98DF8220

Protecting Citrix XenServer Using Hitachi Dynamic Replicator - Scout, MK-98DF8221

Dynamic Replicator Quick Install/Upgrade Guide, MK-98DF8222

Dynamic Replicator - Scout Protecting MS SQL Server, MK-98DF8223

Dynamic Replicator - Scout - Protecting Microsoft Exchange Server, MK-98DF8224

Dynamic Replicator - Scout File Server Solution, MK-98DF8225

Dynamic Replicator - Scout ESX - Protecting ESX Server (RCLI), MK-99DF8226

Getting help

If you need to contact the Hitachi Data Systems support center, please provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The exact content of any messages displayed on the host system(s).
- The exact content of any messages displayed on Storage Navigator Modular 2.
- The Storage Navigator Modular 2 configuration information. This information is used by service personnel for troubleshooting purposes.

The Hitachi Data Systems customer support staff is available 24 hours a day, seven days a week. If you need technical support, please log on to the Hitachi Data Systems Portal for contact information: https://portal.hds.com

Comments

Please send us your comments on this document:doc.comments@hds.com. Include the document title, number, and revision, and refer to specific section(s) and paragraph(s) whenever possible.

Thank you! (All comments become the property of Hitachi Data Systems.)

1

Introduction

This chapter describes the general features, functions, and benefits of using Hitachi Dynamic Provisioning.

The following topics are covered in this chapter:

- Dynamic Provisioning features
- Dynamic Provisioning benefits

Dynamic Provisioning features

Dynamic Provisioning is a new advanced thin-provisioning software product that provides “Virtual Storage Capacity” to simplify administration and addition of storage, eliminate application service interruptions, and reduce costs.

For companies faced with ongoing rapid growth of their data storage requirements and escalating storage and storage management expenses, Dynamic Provisioning software greatly simplifies the application storage provisioning process and saves money on storage purchases.

Dynamic Provisioning allows storage to be allocated to an application without actually being physically mapped until it is used. This *as-needed* method means storage allocations can exceed the amount of storage physically installed. It also decouples the provisioning of storage to an application from the physical addition of storage capacity to the storage system. Both significantly simplify the storage provisioning process.

As it is needed, physical storage is non-disruptively added to the storage system and placed in a central pool available to all thin provisioned volumes. As an application requires additional capacity, the storage system automatically allocates the needed additional physical storage to the volume. Behind the scenes Dynamic Provisioning software monitors storage resources and proactively alerts you before more physical storage is required.

Dynamic Provisioning software also simplifies performance optimization by transparently spreading many hosts’ individual I/O patterns across many physical disks, thereby reducing performance management concerns and optimizing performance/throughput.

With Dynamic Provisioning, overall storage utilization rates improve and the entire storage system is tuned for maximum efficiency. Dynamic Provisioning is also compatible with delivering benefits to a tiered storage environment.

Coupled with the advanced features and reliability of the AMS, Dynamic Provisioning delivers reduced capital and management expenses, and an improved return on your storage investment.

Dynamic Provisioning benefits

In a traditional volume, when you need more storage you must install additional disks and simultaneously change the configuration of both the storage system and the host. This requires extensive careful orchestration, and is disruptive to application I/O.

When configuring additional storage for an application using Dynamic Provisioning software, the administrator defines a virtual volume that draws from the existing Dynamic Provisioning pool without immediately requiring

any additional physical disks. Coordination between the creation of a volume and the physical disk layout is no longer a consideration or constraint.

Table 1-1 shows the benefits of Dynamic Provisioning.

Table 1-1: Dynamic Provisioning Benefits

Benefits	When Using Dynamic Provsioning	When Not Using Dynamic Provisioning
Reduced introduction cost	DP-VOL's total capacity can be larger than the actual disk drive capacity. That is, you can purchase disk drive capacity to match the written data size near-term requirement while defining a larger capacity for the LU to accommodate future long-term requirements. As a result, the system introduction cost can be reduced. Effective capacity reduction depends on the operating system, file system, application, and projected near-term growth requirement.	Initial purchase capacity must accommodate predicted future growth, even if this growth is delayed or never materializes. The cost of the AMS storage system and program product is higher due to larger purchased capacity.
Reduced operation management cost	When the actual disk drive capacity is insufficient to accommodate near-term growth, then adding disk drives is required. It is not necessary to stop the system when adding disk drives. Operation management costs are reduced by eliminating outages to increase LU capacity and disk drive capacity.	It is required to stop the system to add capacity.
Improved disk drive operation efficiency	By configuring the DP pool from two or more RAID groups, the deterioration of performance decreases due to overuse of a single RAID group is avoided.	LUs are normally defined to a single RAID group. Therefore, the load from an application or collection of applications is concentrated on the operating RAID group and performance may deteriorate.

Non-disruptive addition of physical disks

A Dynamic Provisioning volume appears as a Virtual LVI/LUN volume that has no actual storage capacity. Actual storage capacity from the Dynamic Provisioning pool is assigned when the data is written. Because the application only sees the amount of virtual capacity that is allocated to it, additional physical disk capacity can be installed transparently when needed, without interrupting application services.

Improved performance

Dynamic Provisioning software effectively combines many application I/O patterns and spreads the I/O activity across all available physical resources. Prior to Dynamic Provisioning software, optimizing to use all spindles was a complex manual task requiring considerable expertise. Avoiding disk ‘hot spots’ has always been challenging due to the complexity of spreading an

application over many spindles as well as predicting when multiple applications that share a limited number of spindles may generate I/O patterns that cause contention and performance bottlenecks.

Dynamic Provisioning software automatically distributes hundreds of users' I/O patterns evenly over all available spindles and optimizes aggregate throughput to deliver the best performance without requiring individual application balancing and manually matching up drive spindles.

Reduced storage acquisition costs

Defining a volume larger than the physical disk allows you to plan for additional future storage needs during initial installation, while only purchasing the required physical disk capacity at the start and adding physical storage capacity incrementally over time. This also provides savings in space, power, and cooling requirements.

Figure 1-1 shows the difference between purchases made before and after installing Dynamic Provisioning.

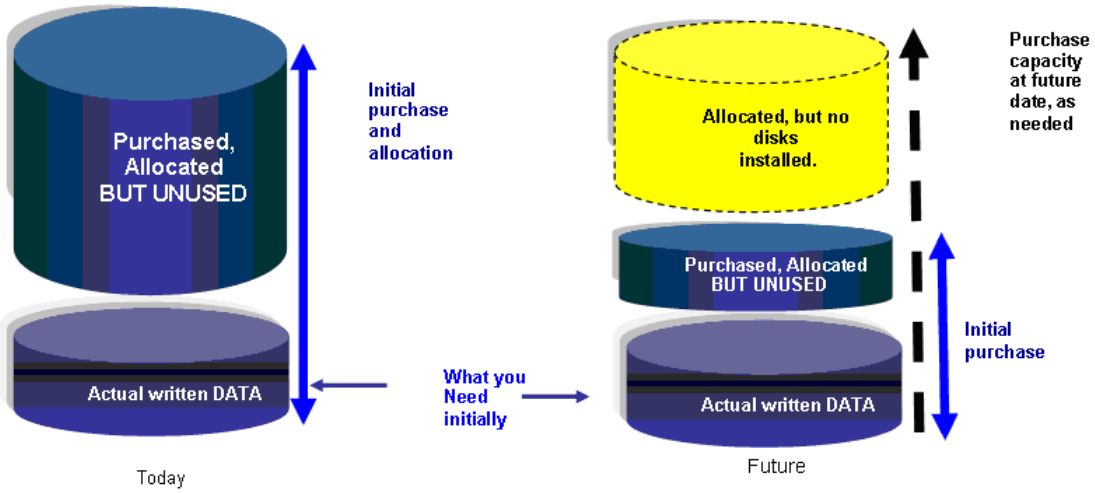

Figure 1-1: Benefits of Dynamic Provisioning

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About Dynamic Provision operations

The following topics are covered in this chapter:

- Dynamic Provisioning components
- Supported configurations
- Interoperability with other program products
- Monitoring resources and tuning

Dynamic Provisioning components

Dynamic Provisioning is comprised of the following components:

- Dynamic Provisioning program product
- DP pool(s)
- DP RAID group(s) dedicated to a DP pool
- DP-VOL(s)

Dynamic Provisioning program product

The Dynamic Provisioning program product operates from the Navigator 2 management console (PC) connected to the AMS 2000 family storage system via a TCP/IP local area network (LAN). When logging in to the AMS storage system from the Navigator 2 PC, you can obtain information on the configuration and status of the AMS storage system and send commands to the storage system.

Relationship between DP pool, RAID group, and DP-VOL

In Dynamic Provisioning, the data in the DP pool is used via the DP-VOL. The DP-VOL is managed in the DP-VOL management area, which manages the mapping information between the virtual-LU and the actual volume in the DP pool. Therefore, at least one DP-VOL and one DP pool are required for using Dynamic Provisioning. A DP pool consists of one or more dedicated RAID groups.

The following figure shows the relationship between the DP pools and the DP-VOL.

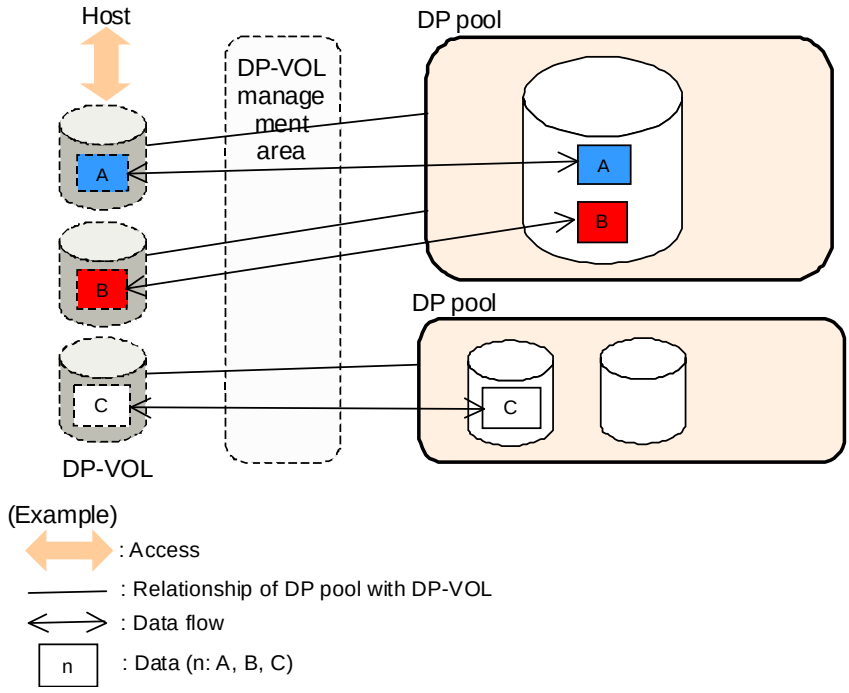


Figure 2-1: Relationship between DP Pools and DP-VOL

DP pools

Dynamic Provisioning requires DP pools. A DP pool consists of one or more dedicated RAID groups. You can create up to 50 DP pools in the AMS 2100 storage system, and 64 DP pools in the AMS 2300 and AMS 2500 storage systems. Each DP pool requires a unique pool ID. The RAID groups to be registered in the DP pools can be created even during system operation.

The DP pool of Dynamic Provisioning and the data pool used by TCE and Copy-on-Write SnapShot cannot be shared.

DP pools are created using Navigator 2. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation. When deleting a DP pool, all the data in the DP pool is deleted. When deleting a DP pool, you must first delete the DP-VOLs belonging to the DP pool.

Increasing DP pool capacity

The total amount of capacity of the DP RAID groups registered in the DP pool is the capacity of that DP pool. You can increase DP pool capacity by adding DP RAID groups to the DP pool. Each DP RAID group is used in sequence as chunks (a chunk is a 1GB allocation unit within the DP pool) are needed to satisfy data writes. Once DP RAID groups have been added, they cannot be removed; therefore, you cannot decrease DP pool capacity.

When increasing DP pool capacity, be sure:

- You add Dynamic Provisioning RAID group units that have the same RAID type as the existing DP RAID group.
- The drive capacity to be added is more than or equal to the drive capacity that configures the existing DP pool.

The upper limit is defined by the size of your AMS storage system. You cannot add capacity that exceeds the size of your AMS storage system.

- AMS 2100: 112 TB
- AMS 2300: 224 TB
- AMS 2500: 448 TB

If the pool is completely used or the pool capacity depletion alert threshold value is exceeded and you cannot increase DP pool capacity, then increase the free capacity by migrating some data to another AMS storage system or delete unnecessary DP-VOLs.

Use Navigator 2 to monitor the free capacity of the DP pool, and grow the DP pool as needed. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

The consumed capacity in the DP pool can be balanced across the DP RAID groups after adding DP pool capacity (see Optimizing a DP pool and Changing DP-VOL capacity). The balancing of consumed capacity effectively balances each DP-VOL's utilization across all the DP pool's RAID groups.

For storage systems with firmware version 0890/A with hardware revision 0200 or later, selecting the Maximum Capacity of the DP Capacity Mode changes the capacity limit value as follows:

- AMS 2100 — approximately 315 TB
- AMS 2300 — approximately 485 TB
- AMS 2500 — approximately 810 TB

Deleting a DP pool

When you delete a DP pool, first delete all the DP-VOLs defined to the DP pool. When all DP-VOLs have been deleted, then delete the DP pool. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

Optimizing a DP pool

If the storage system firmware is Version 0880/A or later, the consumed capacity in the DP pool can be optimized by rebalancing each DP-VOL's allocated pool capacity evenly across each of the DP RAID groups. This is particularly effective after adding a DP RAID group to a DP pool.

After adding a DP RAID group to the DP pool, the usage between DP RAID groups will not be balanced. When optimizing the DP pool, the imbalanced consumed capacity between DP RAID groups can be redistributed. Optimizing can also eliminate capacity taken by binary zero data patterns and combine partially used chunks assigned to a DP-VOL so capacity can be released from DP-VOLs. The released capacity will increase the free capacity in the DP pool.

While optimizing the DP pool, the I/O performance of the host for the DP-VOLs may be slightly affected. The priority “Host Access” minimizes this impact. In addition, optimization will increase the capacity consumed in the pool while DP-VOL data is being relocated between DP RAID groups. The throughput of the optimization process depends on many factors. In the case where there is no host I/O, throughput of optimization is approximately 60 Mb/s.

See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

If reclaiming zero data while optimizing the DP pool, a page (which is a 32 Mb segment of a 1 Gb chunk) consisting solely of binary zeroes will be unmapped. If enough pages across all the chunks owned by a DP-VOL are unmapped, the optimization process recombines allocated pages, thereby releasing a chunk and increasing the free capacity of the DP pool.

There are some advantages to reclaiming zero data while optimizing the DP pool:

- When restoring a volume’s data from backup such as a tape, areas consisting of zero data are reclaimed and capacity can be reduced.
- After Volume Migration from a normal LU to a DP-VOL, the parts of the normal LU that had been binary zeroes can be reclaimed and capacity can be reduced (see Note).

- A ShadowImage pair between a normal LU and a DP-VOL can reclaim capacity from areas of zero data (see Note).

NOTE: If a normal LU was created using the array's firmware version lower than 0880/A, then capacity cannot be reduced subsequent to the Volume Migration or ShadowImage operation because the firmware's format operation of the normal LU wrote a data pattern other than binary zeros.

DP pool optimization status

Table 2-1 shows the DP pool optimization status displayed on Navigator 2.

Table 2-1: DP Pool Optimization Status

Status	Meaning
Normal	Optimization processing is not currently active.
Accepting	Accepts optimization process request.
Pending (n)	Waiting for optimization to start, where (n) indicates the order.
Optimizing (nn%)	Optimizing Dynamic Provisioning, where (nn%) indicates optimization completion percent.
Suspended (nn%)	Optimization process suspended due to a change in the status of the storage system. Optimization resumes automatically when the status changes.
Canceling	User canceled optimization.
Failed (Code-nn: error message)	Optimization failed due to errors on the storage system. Follow the instructions below and optimize again. If optimization fails again, contact customer support. • Failed(Code-01:DP Pool Detachment): Optimization failed because the DP pool with the optimized DP volume is detached. Please optimize again after recovering the DP pool. • Failed(Code-02:DP Pool Depletion): Optimization failed because not enough capacity is available to optimize. Please optimize again after adding the required DP pool capacity. • Failed(Code-03:Destage Time-out):Optimization failed because the host I/O load for optimizing DP volumes and the DP pool to which it belongs is too high. Please optimize again while the host I/O load is low. If it fails again, please turn off the array and turn it on. If the storage system firmware is less than v0880/A, only the Failed status may display. In this case, refer to a Dynamic Provisioning pool status and specify Code-01, Code-02, and/or Code-03. Then, based on the failure factor, perform a recovery with the Dynamic Provisioning pool status.

DP capacity mode

For storage systems with firmware version 0890/A and hardware revision of 0200 or later, the top limit of the DP pool capacity can be changed. Table 2-2 shows the top limit when the mode is changed. The DP Capacity Mode is changed to the maximum capacity when you want to create a DP pool exceeding the normal capacity.

Table 2-2: Maximum Value of DP Pool Capacity by DP Capacity Mode

Storage System	DP Capacity Mode	
	Regular Capacity	Maximum Capacity
AMS 2100	Approximately 112 TB	Approximately 315 TB
AMS 2300	Approximately 224 TB	Approximately 485 TB
AMS 2500	Approximately 448 TB	Approximately 810 TB

Observe the following guidelines:

- Depending on the storage system, the DP Capacity Mode may not be displayed.
- To change the DP Capacity Mode, restart the storage system.
- If you change to Maximum Capacity mode, the user data area decreases compared to the Regular Capacity mode because part of the cache memory becomes the management area for Dynamic Provisioning. Table 2-3 on page 2-7, Table 2-4 on page 2-8, and Table 2-5 on page 2-9 show the amount that cache memory is reduced when changing from **Regular Capacity** mode to **Maximum Capacity** mode. The amount of reduction is approximately:
  - 135 MB for the AMS 2100
  - 180 MB for the AMS 2300
  - 290 MB for the AMS 2500
- To change from **Maximum Capacity** mode to **Regular Capacity** mode, there must be no DP pool.
- If you do not restart the storage system after changing the DP Capacity Mode, the Dynamic Provisioning operations you can perform may be limited.

Table 2-3: Supported Capacity for Regular Capacity Mode

Storage System (Hardware Rev. 0100)	Cache Memory	Management Capacity for Dynamic Provisioning	Capacity Secured for SnapShot or TCE	Capacity Secured for Dynamic Provisioning and TCE or SnapShot	User Data Area when Dynamic Provisioning, TCE, and SnapShot are Disabled	User Data Area when Using Dynamic Provisioning	User Data Area when Using Dynamic Provisioning and TCE or SnapShot
AMS 2100	1 GB/CTL	80 MB	—	—	590 MB	590 MB	NA
	2 GB/CTL		512 MB	580 MB	1,520 MB	1,440 MB	940 MB
	4 GB/CTL		2 GB	2,120 MB	3,520 MB	3,460 MB	1,400 MB
AMS 2300	1 GB/CTL	140 MB	—	—	500 MB	500 MB	NA
	2 GB/CTL		512 MB	660 MB	1,440 MB	1,300 MB	780 MB
	4 GB/CTL		2 GB	2,200 MB	3,280 MB	3,120 MB	1,080 MB
	8 GB/CTL		4 GB	4,240 MB	7,160 MB	7,020 MB	2,920 MB
AMS 2500	2 GB/CTL	300 MB	512 MB	800 MB	1,150 MB	850 MB	NA
	4 GB/CTL		1.5 GB	1,830 MB	2,960 MB	2,660 MB	1,130 MB
	6 GB/CTL		3 GB	3,360 MB	4,840 MB	4,560 MB	1,480 MB
	8 GB/CTL		4 GB	4,400 MB	6,740 MB	6,440 MB	2,340 MB
	10 GB/CTL		5 GB	5,420 MB	8,620 MB	8,320 MB	3,200 MB
	12 GB/CTL		6 GB	6,440 MB	10,500 MB	10,200 MB	4,060 MB
	16 GB/CTL		8 GB	8,480 MB	14,120 MB	14,120 MB	5,940 MB

Table 2-4: Supported Capacity for Regular Capacity Mode

Storage System (Hardware Rev. 0200)	Cache Memory	Management Capacity for Dynamic Provisioning	Capacity Secured for SnapShot or TCE	Capacity Secured for Dynamic Provisioning and TCE or SnapShot	User Data Area when Dynamic Provisioning, TCE, and SnapShot are Disabled	User Data Area when Using Dynamic Provisioning	User Data Area when Using Dynamic Provisioning and TCE or SnapShot
AMS 2100	1 GB/CTL	80 MB	—	—	590 MB	590 MB	NA
	2 GB/CTL		512 MB	580 MB	1,390 MB	1,310 MB	810 MB
	4 GB/CTL		2 GB	2,120 MB	3,360 MB	3,280 MB	1,220 MB
AMS 2300	1 GB/CTL	140 MB	—	—	500 MB	500 MB	NA
	2 GB/CTL		512 MB	660 MB	1,340 MB	1,200 MB	680 MB
	4 GB/CTL		2 GB	2,200 MB	3,110 MB	2,970 MB	930 MB
	8 GB/CTL		4 GB	4,240 MB	6,940 MB	6,800 MB	2,700 MB
AMS 2500	2 GB/CTL	300 MB	512 MB	800 MB	1,150 MB	850 MB	NA
	4 GB/CTL		1.5 GB	1,830 MB	2,780 MB	2,480 MB	950 MB
	6 GB/CTL		3 GB	3,360 MB	4,660 MB	4,360 MB	1,280 MB
	8 GB/CTL		4 GB	4,400 MB	6,440 MB	6,140 MB	2,040 MB
	10 GB/CTL		5 GB	5,420 MB	8,320 MB	8,020 MB	2,900 MB
	12 GB/CTL		6 GB	6,440 MB	9,980 MB	9,680 MB	3,540 MB
	16 GB/CTL		8 GB	8,480 MB	14,060 MB	13,760 MB	5,580 MB

Table 2-5: Supported Capacity for Maximum Capacity Mode

Storage System (with Hardware Revision 0200)	Cache Memory	Management Capacity for Dynamic Provisioning	Capacity Secured for SnapShot or TCE	Capacity Secured for Dynamic Provisioning and TCE or SnapShot	User Data Area when Dynamic Provisioning, TCE, and SnapShot are Disabled	User Data Area when Using Dynamic Provisioning	User Data Area when Using Dynamic Provisioning and TCE or SnapShot
AMS 2100	1 GB/CTL	210 MB	—	—	590 MB	NA	NA
	2 GB/CTL		512 MB	710 MB	1,390 MB	1,180 MB	680 MB
	4 GB/CTL		2 GB	2,270 MB	3,360 MB	3,150 MB	1,090 MB
AMS 2300	1 GB/CTL	330 MB	—	—	500 MB	NA	NA
	2 GB/CTL		512 MB	850 MB	1,340 MB	1,010 MB	490 MB
	4 GB/CTL		2 GB	2,370 MB	3,110 MB	2,780 MB	740 MB
	8 GB/CTL		4 GB	4,430 MB	6,940 MB	6,610 MB	2,510 MB
AMS 2500	2 GB/CTL	580 MB	512 MB	1,082 MB	1,090 MB	NA	NA
	4 GB/CTL		1.5 GB	2,138 MB	2,780 MB	NA	NA
	6 GB/CTL		3 GB	3,660 MB	4,660 MB	4,080 MB	1,000 MB
	8 GB/CTL		4 GB	4,680 MB	6,440 MB	5,860 MB	1,760 MB
	10 GB/CTL		5 GB	5,700 MB	8,320 MB	7,740 MB	2,620 MB
	12 GB/CTL		6 GB	6,720 MB	9,980 MB	9,400 MB	3,260 MB
	16 GB/CTL		8 GB	8,760 MB	14,060 MB	13,480 MB	5,300 MB

You can display the hardware revision when an individual array is selected from the Arrays list using Navigator 2 version 9.00 or later (see Figure 2-2 on page 2-10).

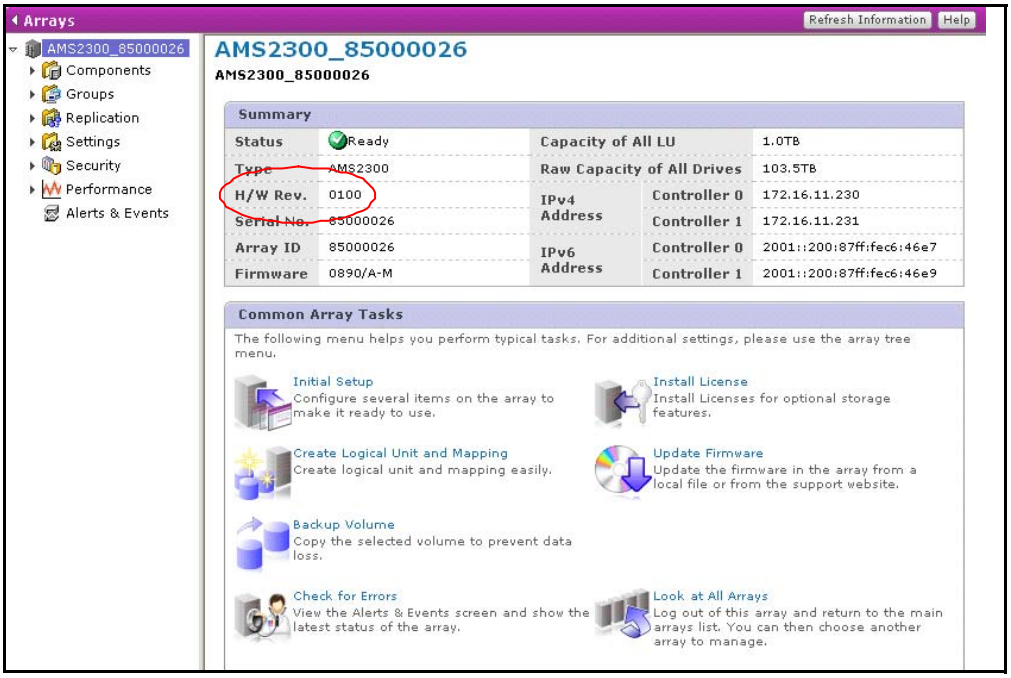


Figure 2-2: Navigator 2 Arrays List

DP-VOLs

The DP-VOL is a virtual LU that consumes and maps physical storage space only for areas of the LU that have had data written. In Dynamic Provisioning, it is required to associate the DP-VOL with a DP pool.

The DP-VOL needs to specify a DP pool number, DP-VOL logical capacity, and DP-VOL number. Many DP-VOLs can be defined for one DP pool. A given DP-VOL cannot be defined to multiple DP pools. AMS 2500/2300 can register up to 4,095 (up to 2,047 for AMS 2100) DP-VOLs. The maximum number of DP-VOLs is reduced by the number of RAID groups.

A DP-VOL is created using Navigator 2. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

Changing DP-VOL capacity

You can dynamically increase or decrease the defined logical capacity of a DP-VOL within certain limits. When decreasing a DP-VOL's logical capacity, any DP pool capacity mapped to the trimmed-away logical capacity is unmapped. Any data present in the formally mapped areas is permanently lost. Subsequent DP pool optimization processing may increase the free capacity of the DP pool.

The Dynamic Provisioning application, operating system, and file system must all be able to recognize the increase or decrease in logical capacity to make it totally dynamic.

Use Navigator 2 to increase or decrease the capacity of the DP-VOL. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

DP pool optimization can reclaim capacity back to the free capacity of the DP pool and rebalance the consumed capacity (see Optimizing a DP pool and Changing DP-VOL capacity).

Deleting a DP-VOL

By deleting a DP-VOL, the DP pool area that the DP-VOL was using is released, increasing the free capacity of the DP pool. See Chapter 5, Performing Dynamic Provisioning operations for GUI operation and Chapter 6, CLI operations for CLI operation.

Supported configurations

The following figure shows the supported Dynamic Provisioning configurations for AMS systems.

Table 2-6: Supported Dynamic Provisioning Configurations

Item	AMS 2100	AMS 2500	AMS 2300
Maximum number of DP-VOLs (The number of LUs is reduced by the number of RAID groups.)	2,048	4,096	4,096
DP-VOL capacity	32 MB to 60 TB	32 MB to 60 TB	32 MB to 60 TB
Maximum number of DP pools	50	64	64
DP pool capacity	Up to the capacity of the AMS	Up to the capacity of the AMS	Up to the capacity of the AMS

Interoperability with other program products

In the AMS storage system where the normal LU and the DP-VOL are mixed, the conventional program products can be used for the normal LU. The DP-VOL has restrictions on which program products can be used. Table 2-7 shows the conditions of using Dynamic Provisioning with other program products.

Table 2-7: Permitted Use of Program Products with Dynamic Provisioning DP VOLs and DP Pools

Program Product	Conditions
ShadowImage	• The DP-VOL can be used for both P-VOL and S-VOL. For details, see Chapter 5, Managing DP-VOLs. • The DP pool and DP RAID group cannot be a P-VOL or S-VOL. • The DP-VOL used by ShadowImage cannot grow or shrink its capacity. • Pairs cannot be created for the DP-VOLs during DP pool optimization. However, when the array firmware is 0890/A or later, pairs can be created for the DP-VOLs during the DP pool optimization.
SnapShot	For array firmware versions lower than 0893/A: • The DP-VOL cannot be used for P-VOL, S-VOL, and data pool. For array firmware versions 0893/A and higher: • The DP-VOL can be used for P-VOL, S-VOL, and data pool. • The DP pool of Dynamic Provisioning cannot be used for P-VOL, S-VOL, and data pool.
TrueCopy or TCE	For array firmware versions lower than 0893/A: • The DP-VOL cannot be used for both P-VOL and S-VOL. For array firmware versions 0893/A and higher: • The DP-VOL can be used for both P-VOL and S-VOL. • The DP pool of Dynamic Provisioning cannot be used for both P-VOL and S-VOL.
LUN Manager and Cache Partition Manager	• The DP-VOL can be assigned to a Cache Partition. • The DP pool and DP RAID group cannot be assigned to a Cache Partition.
Volume Migration	Firmware version below 0880/A: • The DP-VOL cannot be used for a move source or destination. • The DP pool and DP RAID group cannot be used by Volume Migration. Firmware version 0880/A and later: • The above restrictions do not apply. • Volume Migration cannot be created for DP-VOLs during the DP pool optimization. • DP pool optimization will not be performed for DP-VOLs used by Volume Migration.
Cache Residency Manager	• The DP-VOL cannot be used. • The DP pool and DP RAID group cannot be set.
Data Retention Utility	Firmware version below 0880/A: • The DP-VOL cannot be used. • The DP pool of Dynamic Provision cannot be used. Firmware version 0880/A and later: • The above restrictions do not apply.

ShadowImage

Dynamic Provisioning can be used concurrently with ShadowImage. Table 2-3 shows an example.

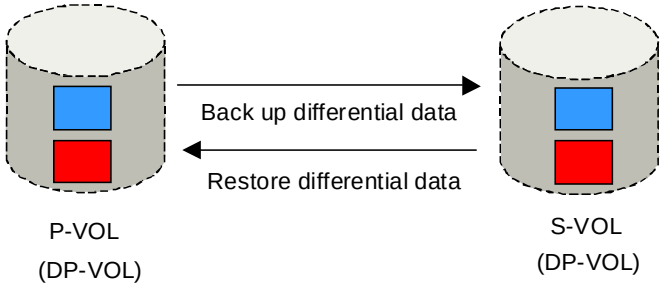


Figure 2-3: Using Dynamic Provisioning with ShadowImage Example

When using Dynamic Provisioning and ShadowImage together, the DP-VOL can be copied.

Table 2-8 shows the combination of the LUs that can be shared when using Dynamic Provisioning and ShadowImage together.

Table 2-8: Shared LUs Using Dynamic Provisioning and ShadowImage Together

Program Product	Conditions	Conditions
DP-VOL	DP-VOL	Can be used.
DP-VOL	Normal LU	Can be used.
Normal LU	DP-VOL	Can be used; however, the complete logical capacity of the DP-VOL will consume an equal amount of DP pool capacity (rounded up to the nearest Gb).

SnapShot

When using both Dynamic Provisioning and SnapShot in an AMS storage system, observe the following guidelines:

- The data pool used by SnapShot and TCE cannot be used as a DP pool of Dynamic Provisioning and the DP pool used by Dynamic Provisioning cannot be used as data pools of SnapShot and TCE.
- Depending on the installed cache memory, Dynamic Provisioning and SnapShot or TCE may not be unlocked at the same time. To unlock Dynamic Provisioning and SnapShot or TCE at the same time, add cache memories.

Monitoring resources and tuning

This section explains the functions to accumulate the DP pool trend information and the statistical information displayed on Performance Monitor. These functions support the management of Dynamic Provisioning.

Managing DP pool capacity

When using the DP-VOL of Dynamic Provisioning, you can monitor DP pool utilization, as well as the total DP-VOL capacity provisioned against the DP pool capacity. If free capacity of the DP pool is exhausted, then disruption to host access can result. Write data to DP-VOLs that cannot be supported with available DP pool capacity will result in those DP-VOLs becoming protected volumes. Host access will not be permitted to those DP-VOLs until DP pool free capacity is restored.

Defining threshold alerts help to monitor consumption of DP pool capacity. If consumption of the DP pool capacity exceeds the Early Alert threshold value defined when the pool was created, a trap is reported to the Simple Network Management Protocol (SNMP). If the consumption of the DP pool continues to increase and exceed the Depletion Alert threshold value, a trap is reported to SNMP. If the total DP-VOL capacity defined exceeds the user-defined DP-VOL Over-provisioning Warning and Limit thresholds then traps are reported to SNMP. These thresholds help monitor the ratio of provisioned application capacity relative to physical capacity. For more information about SNMP traps, see the *Hitachi Storage Navigator 2 Storage Features Reference Guide*.

If the e-mail alert is turned on in Navigator 2 in the DP Pool Property window, Advanced tab, the system sends an e-mail alert warning that capacity exceeded a threshold value. You can also turn on e-mail reports in Navigator 2 by enabling **E-mail Alert Report** in E-mail Alert located under [Array Name] > **Settings**.

See Chapter 4, Using the Dynamic Provisioning GUI for information about monitoring DP pool capacity using the DP Pool Trend window.

You can monitor system performance using Performance Monitor and information on the DP-VOL using Navigator 2. For information about Performance Monitor, see the *Hitachi Storage Navigator 2 Storage Features Reference Guide*.

Threshold alerts of the DP pool usage capacity

Dynamic Provisioning monitors DP pool capacity usage using two thresholds. The value of each threshold can be set as shown below. It can be set freely according to the user's usage condition.

- Early Alert threshold value: A threshold value to warn that the capacity is nearing depletion. This can be set in units of 1% in the 1% to 99% range. The default value is 40%.
- Depletion Alert threshold value: A threshold value to warn that adding capacity is required. This can be set in units of 1% in the 1% to 99% range. The default value is 50%. A new DP-VOL cannot be created against the pool while the threshold is exceeded.

If the DP pool usage exceeds the above-mentioned value, and if the e-mail alert is turned on in Navigator 2 in the DP Pool Property window, Advanced tab, the system sends an e-mail alert warning the user and reports the

SNMP trap. You can also turn on e-mail reports in Navigator 2 by enabling **E-mail Alert Report** in **E-mail Alert** located under [Array Name] > **Settings**.

Figure 2-4 shows the DP pool total capacity of 1 TB and the Early Alert threshold value of 40%. If the DP pool consumed capacity exceeds 40% (400 GB) of the DP pool, it is reported by an e-mail alert and/or SNMP trap. Furthermore, if the DP pool consumed capacity increases and exceeds the Depletion Alert threshold value (e.g., 50%), it is reported again by an e-mail alert and/or SNMP trap. The Depletion Alert threshold value is reported every 6 hours unless the DP pool unconsumed capacity is increased.

Arrays with firmware versions 0893/A and higher can remain operational, although a warning message appears when defining or increasing DP-VOLs, DP Optimization, or LU mapping to a host group or iSCSI target group at the time of depletion or Depletion Alert status. If this occurs, we recommend you increase capacity immediately.

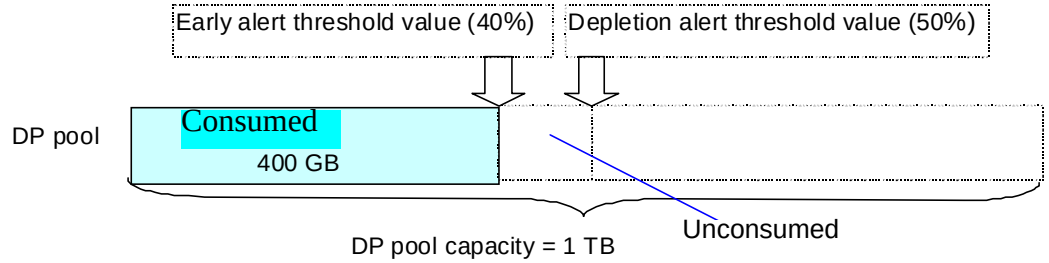


Figure 2-4: DP Pool Capacity If Early Alert Threshold Value is 40%

Because normal operation relies on the condition that the DP pool is not totally depleted, do not allow the DP pool to be completely consumed. If the DP pool is totally depleted, DP-VOLs may be assigned protected status inhibiting reads and writes, applications may terminate abnormally, or system failures may occur.

DP-VOL over-provisioning thresholds

The setting capacity of the DP-VOL in the DP pool is monitored by two over-provisioning threshold values: Warning and Limit. The value of each over-provisioning threshold can be set as follows.

- Warning threshold value: This can be set in units of 1% in the 50% to 1000% range. The default value is 100%.
- Limit threshold value: This can be set in units of 1% in the 50% to 1000% range. The default value is 130%. While the threshold is exceeded, a new DP-VOL cannot be created against the pool.

If the total logical capacity associated with a pool compared to the physical pool capacity exceeds the above-mentioned values, and the e-mail alert is turned on in Navigator 2 in the DP Pool Property window, Advanced tab, the systems sends an e-mail alert warning and reports the SNMP trap.

Figure 2-5 shows the DP pool capacity of 40 TB and an over-provisioning Warning alert threshold value of 100%. When total DP-VOL capacity of 40 TB is defined, it matches the Warning alert of 100% of Pool capacity and causes the warning report by e-mail and SNMP trap. If the Limit threshold

value is set to 130% and DP-VOLs are created or extended to cause the total DP-Vol capacity to reach 52TB, the limit is reported by e-mail and SNMP trap. If the Limit threshold value is exceeded, creation and extension of DP-VOLs is not allowed for the pool until the DP pool capacity is increased.

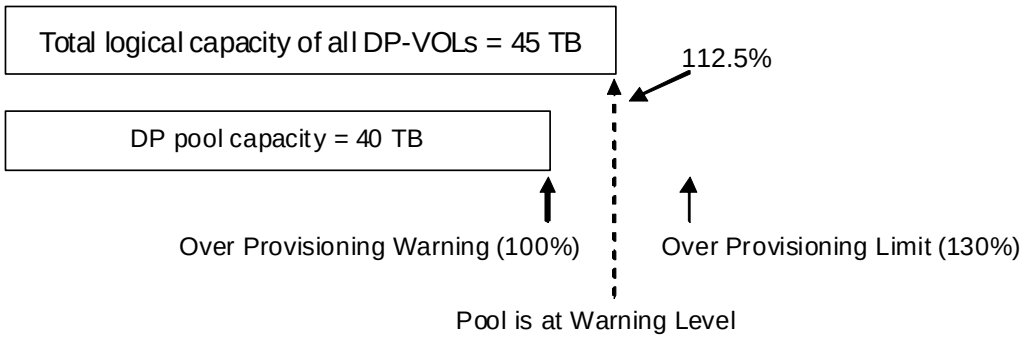


Figure 2-5: DP Pool Capacity when Over-provisioning Warning Threshold Value is 100%

Monitoring DP pool usage rates

A DP pool's consumed capacity and a DP-VOL's consumed capacity can be viewed in the DP pool window and the LUN property window, respectively. Using the DP pool window lets you monitor the free capacity of the DP pool and estimate the need to increase capacity in the DP pool. The LUN property window provides information about how much DP pool capacity is occupied by a DP-VOL.

Table 2-9: Viewing Method of the DP Pool Usage

Viewing Items	Viewing Method
Consumed Capacity of DP-VOL	The amount of pool capacity assigned to a DP-VOL can be displayed per DP-VOL.
Consumed Capacity of DP pool	The DP pool consumed capacity can be displayed per DP pool.

Figure 2-6 shows an example of the change in DP pool usage rates.

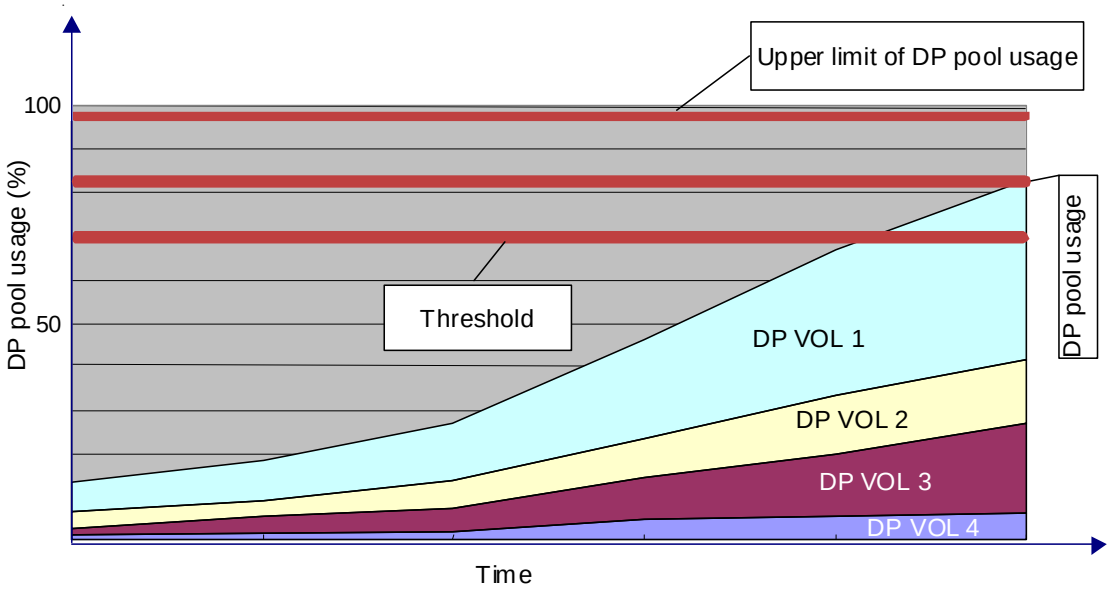


Figure 2-6: Time Change in DP Pool Usage Rate Example

Performance management

The performance management for the DP-VOL can be performed by collecting monitoring information. Analyzing monitoring information helps you understand the load of the DP pool (access frequency, trend of DP pool usage growth rate, and access load of disk drives) and the load of the DP-VOL (access frequency, trend of the DP pool assignment rate) and use them for tuning the appropriate pool capacity and assignment of DP-VOLs to DP pools.

Monitoring information includes:

- Access frequency of DP-VOL, Read Hit rate, and Write Hit rate (Performance Monitor statistics)
- Usage rate of RAID group of the DP pool
- DP-VOL usage (ratio of data stored) and time passage of DP pool usage

Figure 2-7 shows the I/O usage rate. Dynamic Provision does not report overall DP Pool usage. It reports individual RAID group usage information. Therefore, you need to consider DP Pool usage as the sum of the RAID group usage values.

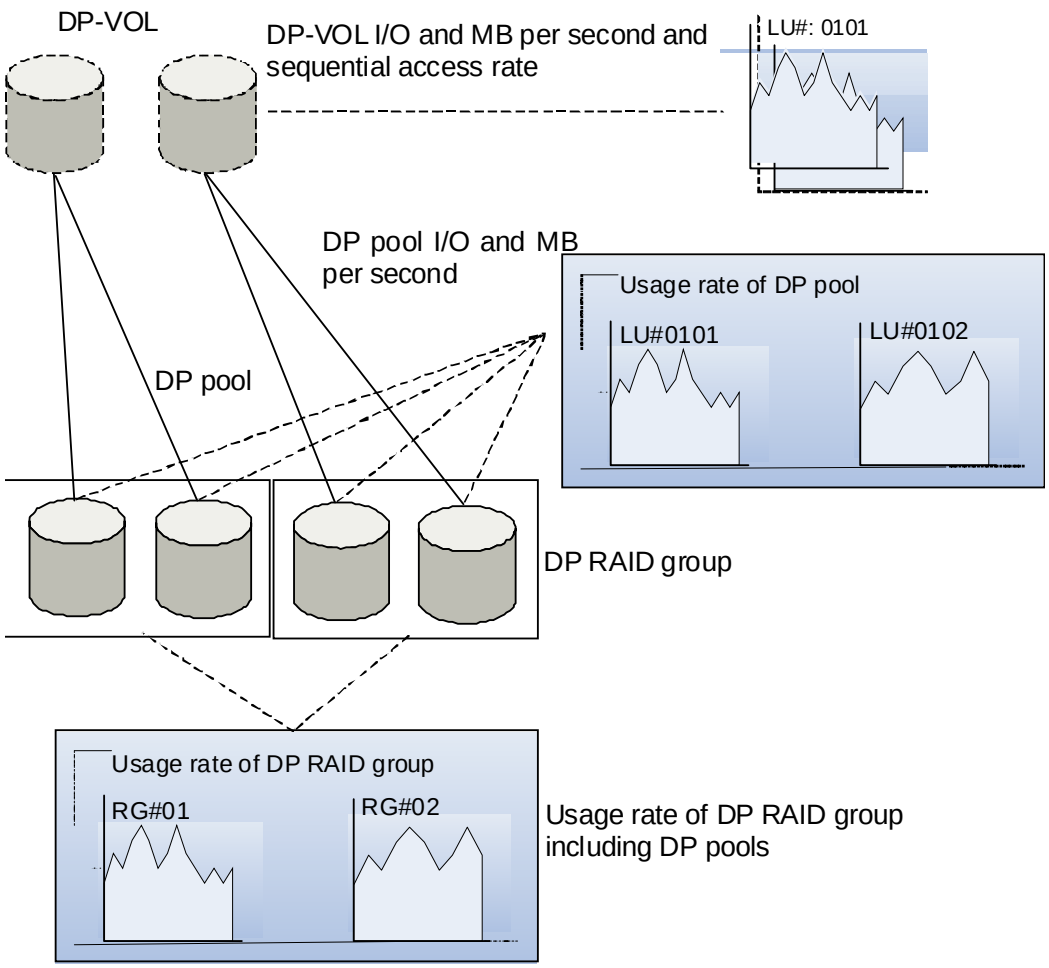


Figure 2-7: Managing Usage Rates and I/O

DP pool status

Table 2-10 shows the DP pool status displayed on Navigator 2.

Table 2-10: DP Pool Status

Status	Meaning
Normal	There are no problems reported by the DP RAID groups.
Regression	A failure has occurred in a DP RAID group and is being repaired.
Detached	The DP pool is blocked.

3

Preparing for Dynamic Provisioning operations

This chapter explains the requirements and restrictions in using Dynamic Provisioning, and how to install/uninstall and disable/enable Dynamic Provisioning. Please read it before using Dynamic Provisioning.

The following topics are covered in this chapter:

Requirements and restrictions

A license key or license file of the Hitachi AMS storage system (dual controller configuration) including disk drives and the Dynamic Provisioning program product used on Navigator 2 PC are required for operating Dynamic Provisioning. The system requirements for using Dynamic Provisioning are listed in the following tables.

DP-VOL and DP pool requirements

Table 3-1 shows DP-VOL requirements. Table 3-2 on page 3-3 shows DP pool requirements.

CAUTION! You can shrink the capacity of the DP-VOL online. Reducing the logical capacity of a DP-VOL will permanently lose any data present in the capacity trimmed away. Many operating systems, file systems, and volume managers do not support the shrinking of a LUN. For example, you cannot use shrink with a LUN that is a Windows 2008 Dynamic Disk.

Table 3-1: DP-VOL Requirements

Item	Requirements

Logical unit type	DP-VOL. The following restrictions apply to DP-VOLs:
	• A DP-VOL cannot be created in the RAID group.
	• You cannot specify the following logical units as DP-VOL:
	  • LU used by TrueCopy and TCE (arrays with firmware lower than 08993/A).
	  • Unified LU.
	  • LU defined by Cache Residency Manager.
	  • LU already registered in SnapShot and TCE (arrays with firmware lower than 08993/A).
	  • LU used as SnapShot P-VOLs or S-VOLs (arrays with firmware lower than 08993/A).
	  • Data Retention Utility LUs with a Protect, Read Only, or S-VOL Disable attribute.
	• You cannot set a DP-VOL in blocked status.
	• A new DP-VOL cannot be set if it exceeds the Depletion threshold value or the over-provisioning threshold Limit value. Arrays with firmware versions 0893/A and higher can remain operational, although a warning message appears when defining or increasing DP-VOLs, DP Optimization, or LU mapping to a host group or iSCSI target group at the time of depletion or Depletion Alert status. If this occurs, we recommend you increase capacity immediately.

Data allocation unit	Maps 32 MB of capacity at a time to a DP-VOL. Allocates at least 1 GB area at a time in the DP pool for writing from the host. Thirty-two uniquely mapped areas of 32 MB each are formed from the 1 GB allocated DP pool capacity.
Logical unit capacity	32 MB to 60 TB. The recommended maximum LU size is 10 TB.

Table 3-1: DP-VOL Requirements (Continued)

Item	Requirements
Logical unit initialization	It is already formatted at the time of the DP pool creation. Therefore, a special operation is not necessary for creating the DP-VOL. Use this if recovering failures by the DP-VOL.
Maximum LU number	Per one DP pool: • AMS 2500 and AMS 2300: Maximum 4,095 • AMS 2100: Maximum 2,047 Per one AMS storage system: • AMS 2500 and AMS 2300: Maximum (4,096, minus the number of installed RAID groups) • AMS 2100: Maximum (2,048, minus the number of installed RAID groups)
Growth capacity	You can grow the capacity of the DP-VOL online. The recommended maximum LU size is 10 TB.
Shrink capacity	You can shrink the capacity of the DP-VOL online. Reducing the logical capacity of a DP-VOL will permanently lose any data present in the capacity trimmed away. For storage system firmware Version 0880/A or later, the consumed DP pool capacity can be reclaimed and rebalanced after reducing (shrinking) DP-VOL logical capacity (see Changing DP-VOL capacity on page 5-11).
Deleting	You can delete a DP-VOL.

Table 3-2: DP Pool Requirements

Item	Requirements
RAID level of DP RAID group	RAID 0 is not supported. Only the DP RAID group of the same RAID level can be registered in the same DP pool.
Disk drive type	SAS, SATA, and SSD can be used for the disk drive type. However, the DP RAID group consisting of different types of drives cannot be mixed in the same DP pool.
DP pool deletion	When the DP-VOL is defined, all DP-VOLs must be deleted to delete the DP pool.
DP pool capacity	Up to the total AMS storage system capacity.
DP pool number	Maximum: 64 (50 for AMS 2100) DP pool IDs (0 to 63 or 0 to 49) are assigned as DP pool identifies.

Table 3-2: DP Pool Requirements (Continued)

Item	Requirements
Usable threshold	The DP pool usage is monitored by two threshold values: • Early Alert: Set in units of 1% in the 1% to 99% range. The default is 40%. • Depletion Alert: Set in units of 1% in the 1% to 99% range. The default is 50%. A new DP-VOL cannot be created against the pool while the threshold is exceeded. If the DP pool usage exceeds the above-mentioned values, and the e-mail alert is turned on in Navigator 2 in the DP Pool Property window, Advanced tab, the system sends an e-mail alert warning and reports the SNMP trap. The Depletion Alert threshold value is reported once in 6 hours unless the DP pool unconsumed capacity is increased. Creation of DP-VOLs is restricted until DP pool available capacity is increased. Arrays with firmware versions 0893/A and higher can remain operational, although a warning message appears when defining or increasing DP-VOLs, DP Optimization, or LU mapping to a host group or iSCSI target group at the time of depletion or Depletion Alert status. If this occurs, we recommend you increase capacity immediately
Over-provisioning threshold	The total logical capacity of all DP-VOLs assigned to the DP pool is managed by two over-provisioning threshold values. The total logical capacity as a percent of total pool capacity is monitored by the thresholds: • Warning: Set in units of 1% in the 50% to 1000% range. The default is 100%. • Limit: Set in units of 1% in the 50% to 1000% range. The default is 130%. While the threshold is exceeded, a new DP-VOL cannot be created against the pool. If the over-provisioning level exceeds the above-mentioned values, and the e-mail alert is turned on, the system sends an e-mail alert to warn users and reports the SNMP trap. This customizable threshold value option is noticed only when the e-mail alert is turned on in the DP Pool Property window Advanced tab in Navigator 2.
Growth capacity	You can grow the capacity of the DP pool online. The addition of disk drives to a pool must match the RAID level of the RAID group. The top limit of the maximum value of the DP pool capacity can be changed by changing the DP Capacity Mode in storage systems with firmware version 0890/A of hardware revision 0200 or later.

Requirements for using Dynamic Provisioning

To use Dynamic Provisioning, the firmware necessary for Dynamic Provisioning must be installed. In addition, the hardware necessary for defining DP pools must be available.

License requirements

All AMS family storage systems purchased following the initial release of Hitachi Dynamic Provisioning will automatically include a license key that may be installed to enable the product functionality.

Customers of AMS storage systems purchased prior to the initial release of Hitachi Dynamic Provisioning must purchase the program product to obtain the license key.

Operating system and file system capacity

The capacity reduction benefits achieved by using Dynamic Provisioning depend on the operating system and file system in use.

Table 3-3 is a representative list of operating systems and file systems that have the capacity reduction benefit. For more information, contact the Hitachi Support Center.

Table 3-3: Operating System and File System Capacity

Operating System	File System	Metadata Writing	DP Pool Capacity Consumed
Windows Server™ 2003	NTFS	Writes metadata to first block.	Space savings can be realized. This is basic disk only. If the dynamic disk is used, writes meta-data to another first block.
Windows Server 2008	NTFS	Writes metadata to first block.	Space savings can be realized. This is basic disk only. If the dynamic disk is used, writes meta-data to another first block.
Linux	XFS	Writes metadata in Allocation Group Size intervals.	Space savings can be realized. Depends upon allocation group size. The amount of pool space consumed will be approximately: (DP-VOL size) * (32 MB / Allocation Group Size) rounded up to the next GB level.
	Ext2 Ext3	Writes the metadata in 128-MB intervals.	Space savings can be realized. About 33% of the size of the DP-VOL. The default block size for these file systems is 4 KB. This results in 33% of the DP-VOL acquiring DP pool pages. If the file system block size is changed to 2 KB or less then the DP-VOL Page consumption becomes 100%.
Solaris	UFS	Writes the metadata in 52-MB intervals.	No space savings.
	VxFS	Writes metadata to first block.	Space savings can be realized.
AIX	JFS	Writes metadata in 8-MB intervals.	No space savings. If you change the Allocation Group Size settings when you create the file system, the metadata can be written to a maximum interval of 64 MB. Approximately 65% of the pool is used in this case.
	JFS2	Writes metadata to first block.	Space savings can be realized.
	VxFS	Writes metadata to first block.	Space savings can be realized.

Table 3-3: Operating System and File System Capacity (Continued)

Operating System	File System	Metadata Writing	DP Pool Capacity Consumed
HP-UX	JFS (VxFS)	Writes metadata to first block.	Space savings can be realized.
	HFS	Writes metadata in 10-MB intervals.	No space savings.

VMware/VMFS needs the **zeroedthick** option (default) to provide optimum space saving.

If the DP-VOL is extremely small, the capacity reduction benefit decreases, even in the above-mentioned file systems that have reduction benefits. For example, if the DP-VOL capacity is 100 MB in Windows 2003 or NTFS, the assignment of the first page (32 MB) occurs from an allocation of 1 GB. Therefore, DP-VOL minimum logical capacity is recommend to be 1 GB.

Precautions

Observe the precautions in Table 3-4 when using Dynamic Provisioning.

CAUTION! You can shrink the capacity of the DP-VOL online. Reducing the logical capacity of a DP-VOL will permanently lose any data present in the capacity trimmed away. Many operating systems, file systems, and volume managers do not support the shrinking of a LUN. For example, you cannot use shrink with a LUN that is a Windows 2008 Dynamic Disk.

Table 3-4: Dynamic Provisioning Precautions

Situation	Precaution
Deleting DP pool capacity	A RAID group, once registered in the DP pool, cannot be released from the DP pool. To reduce DP pool capacity, create a second, smaller DP pool, and copy the DP-VOLs between the pools.
Adding capacity to the DP pool	The host I/O performance deteriorates while an added RAID group is formatted after adding capacity. Check formatting progress in the Status column of the DP pool.
Decreasing DP-VOL consumed capacity	Depending on the I/O pattern, the free capacity may not be reclaimed but continues to be reserved for future capacity needs of the DP-VOL. When reclaiming the consumed capacity of a DP-VOL, host I/O performance deteriorates because the reclaimed area is formatted after decreasing. Check formatting progress in the Status column of the DP pool where the DP-VOL belongs. If a Windows 2008 dynamic disk is used by the master boot record, you cannot shrink capacity of a DP-VOL.
Deleting a DP-VOL	The host I/O performance deteriorates because the deleted area is formatted after deleting. Check the formatting progress in the Status column of the DP pool where the DP-VOL concerned belongs.

Table 3-4: Dynamic Provisioning Precautions (Continued)

Situation	Precaution
Deleting a DP-VOL, shrinking a DP-VOL capacity, or formatting a DP-VOL	When the mapped capacity of a DP-VOLs is multiple terabytes, the overhead needed to delete, shrink, or format the DPVOL should be considered. Typical processing time to unmap capacity from a DPVOL is about 2.5 seconds for every 10 terabytes. For overall best system responsiveness, these actions should be performed once host I/O to the array is stopped. Typical processing time to unmap capacity from a DPVOL is about 2.5 seconds for every 10 terabytes.
Creating a DP pool, adding the DP pool capacity, deleting the DP pool capacity, or initializing the DP pool	When a DP pool is created or capacity is added, formatting occurs for the DP pool. If host I/O is performed during the formatting, the usable capacity may become depleted. Since the formatting progress is displayed when checking the Status column of the DP pool, check whether the sufficient usable capacity is secured according to the formatting progress, and then start the operation. If DP pool creation, capacity addition, deletion, or re-initialization is executed, all host I/Os for the array may stop temporarily for a few seconds. The typical processing time for executing DP pool creation, addition, deletion, or re-initialization is about three seconds with the capacity of 16 TB. Therefore, when performing the operation on 16 TB or more for DP pool creation, capacity addition, deletion, or re-initialization, it is recommended you stop all host I/Os for the array before performing this operation.
Optimizing a DP pool	DP pool optimization does not start until the DP pool formatting status is complete. Because rebalancing of the page may fail when competing with the host I/O, the DP-VOLs whose host I/O is highly -loaded may not be equal. Optimizing the DP pool is time consuming and may take one week if actual allocation of capacity is 10 TB. When there is no host I/O in conflict with optimization, throughput is approximately 60 Mb/s. Because the DP pool is used for page migration, the consumed capacity and reclaimed capacity of the DP pool temporarily increases during page migration. As a result: • The sum total value of the total capacity of DP pools and the used amount of DP-VOLs in the pool may not be matched. • Reclaimable capacity may remain for a while after the optimization completes, but it will be reclaimed as time goes by. • Optimization temporarily increases pool utilization; therefore, it should not be tried if there is only a small amount of available capacity. Instead, add pool capacity before trying to perform an Optimization operation. The storage system firmware cannot be updated while optimizing the DP pool. Therefore, stop optimizing the DP pool to update the firmware. If Optimization is stopped or cancelled there will be some reclaimable capacity that has not been added back to the available pool capacity. Optimization must be run to completion, when convenient, to reclaim this capacity.

Table 3-4: Dynamic Provisioning Precautions (Continued)

Situation	Precaution
Using path-switching software	When the path-switching software checks the path, the consumed capacity of the DP pool may temporarily increase or decrease by 1 GB per LU, and the DP pool may be depleted temporarily, depending on its free capacity. Check the free capacity of the DP pool in advance

Installing Dynamic Provisioning

Because Dynamic Provisioning requires a separate license key, Dynamic Provisioning cannot usually be selected (locked) when first using the disk array. To make Dynamic Provisioning available, you must install Dynamic Provisioning and make its function selectable (unlocked).

Dynamic Provisioning can be installed from Navigator 2. This section describes the installation procedures performed using the Navigator 2 GUI. For installation procedures using the Navigator 2 CLI, see Chapter 6, CLI operations.

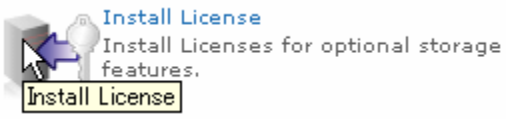
Installation notes

- Before installing or uninstalling Dynamic Provisioning, verify that the AMS storage system is operating in a normal state. If a failure such as a controller blockade has occurred, installation or uninstallation cannot be performed.
- Before installing, uninstalling, or changing Dynamic Provisioning, check that the spin-down instruction from the optional Power Saving program has not been issued or has completed (no RAID group in the Power Saving Status of Normal (Command Monitoring) exists). If Dynamic Provisioning is installed, uninstalled, or changed during a spin-down on the disk array, the spin down may fail. If the spin-down fails, perform the spin-down again.
- When installing, uninstalling, enabling, or disabling of Dynamic Provisioning where the disk array is used on the remote side of TrueCopy or TCE, the following occurs with the restart of the disk array.
  - The paths of both TrueCopy or TCE are blocked. When a path is blocked, a trap occurs, that is, a notification to the SNMP Agent Support Function. Inform the departments concerned of the above beforehand. The path of TrueCopy or TCE is recovered from the blockade automatically after the disk array is restarted.
  - When the pair status of TrueCopy or TCE is Paired or Synchronizing, it is changed to Failure.
  - When it is necessary to restart the disk array, then install, uninstall, enable, or disable Dynamic Provisioning after changing the pair status of TrueCopy or TCE to Split.
- Be careful that the cache partition information is initialized as described under Using Cache Partition Manager on page 3-11 when Dynamic Provisioning is installed with Cache Partition Manager already in use.

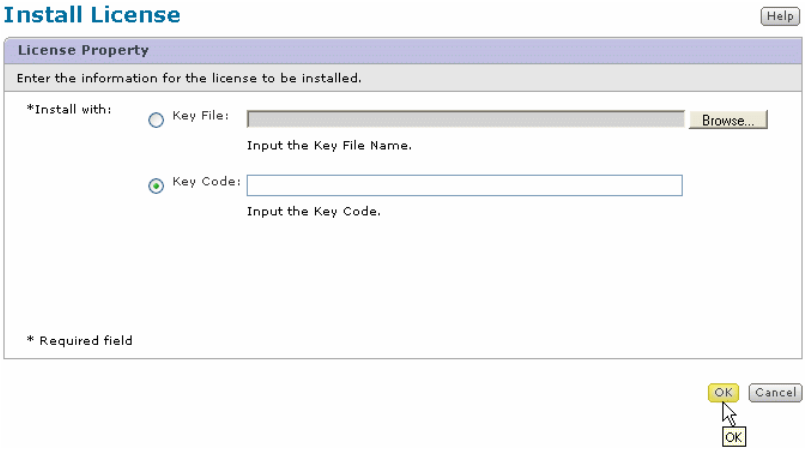
- Dynamic Provisioning and SnapShot or TCE cannot be unlocked at the same time in AMS 2500 in which cache memory of 2 GB/CTL is installed. To unlock Dynamic Provisioning and SnapShot or TCE at the same time, add cache memory.
- The key code or key file is required.

To install Dynamic Provisioning

1. Start Navigator 2.
2. Log in as a registered user to Navigator 2.
3. Select the AMS storage system in which you will install Dynamic Provisioning.
4. Click **Show & Configure Array**.
5. Select **Install License** in the **Common Array Task**.



6. In the **Install License** window.

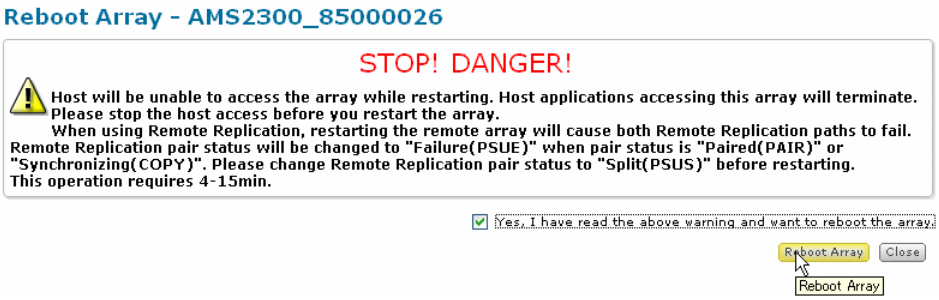


   - To install the option using the key code, select **Key Code** and then type the key code.
   - To install the option using the key file, select **Key File** and type or browse the path for the key file.

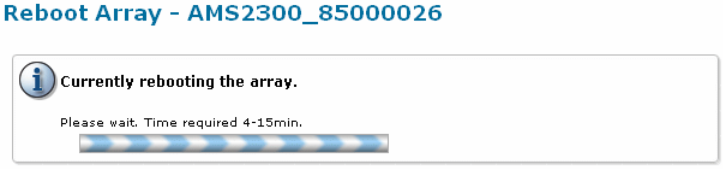
7. Click **OK**.
8. In the Install License message, click **Confirm**.

9. In the Install License message, click **OK**.

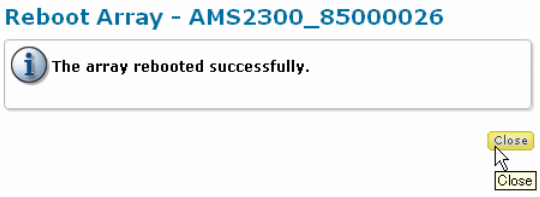
10. In the Reboot Array message, check the confirmation check box and click **Reboot Array**.



NOTE: To install the option, reboot the array. The host/application cannot access the storage system until the reboot is complete and the system restarts. Be sure the host stops accessing data before restarting. It can take up to 15 minutes for the storage system to restart, depending on the condition of the storage system. If it does not respond after 15 minutes or more, check the condition of the array.



11. In the Reboot Array message, click **Close**.



Installation of Dynamic Provisioning is now complete.

Using Cache Partition Manager

Dynamic Provisioning uses a part of the cache area to manage the internal resources. When this happens, the cache capacity that Cache Partition Manager can use therefore decreases.

Ensure that the cache partition information is initialized as shown in Figure 3-1 and Figure 3-2 when Dynamic Provisioning is installed and Cache Partition Manager is already in use.

- All the logical units are moved to the master partitions on the side of the default owner controller.
- All sub-partitions are deleted and the size of the each master partition is reduced to half of the user data area after the installing Dynamic Provisioning.

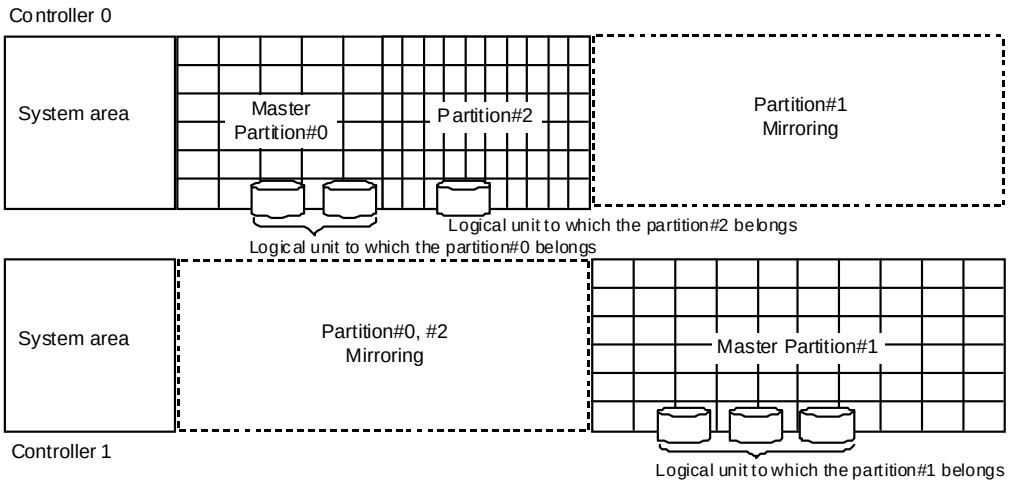


Figure 3-1: When Cache Partition Manager is Used

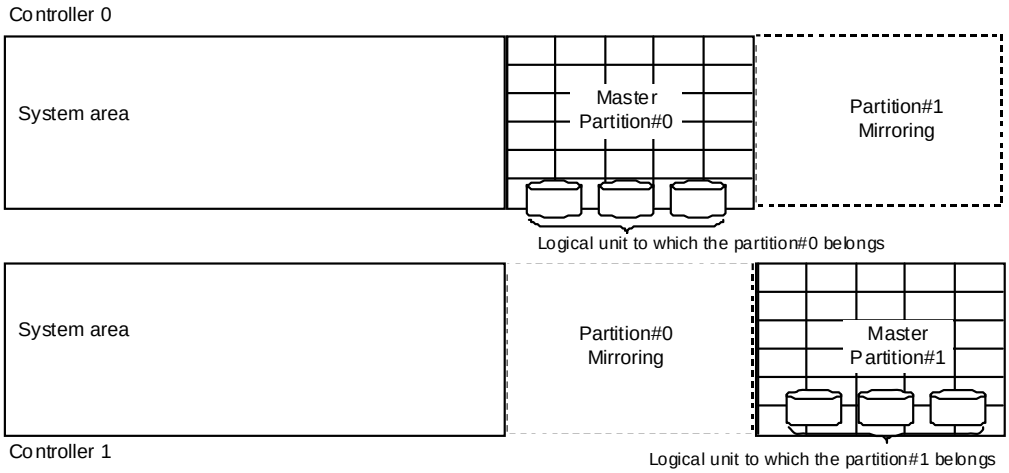


Figure 3-2: Where Dynamic Provisioning is Installed while Cache Partition Manager is Used

Uninstalling Dynamic Provisioning

To uninstall Dynamic Provisioning, the key code is required. Once uninstalled, Dynamic Provisioning cannot be used (locked) until it is again installed using the key code or key file.

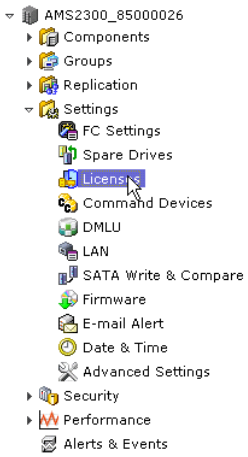
Dynamic Provisioning can be uninstalled from Navigator 2. This section describes the uninstall procedure performed using the Navigator 2 GUI. For uninstall procedures using the Navigator 2 CLI, see Chapter 6, CLI operations.

Prerequisites

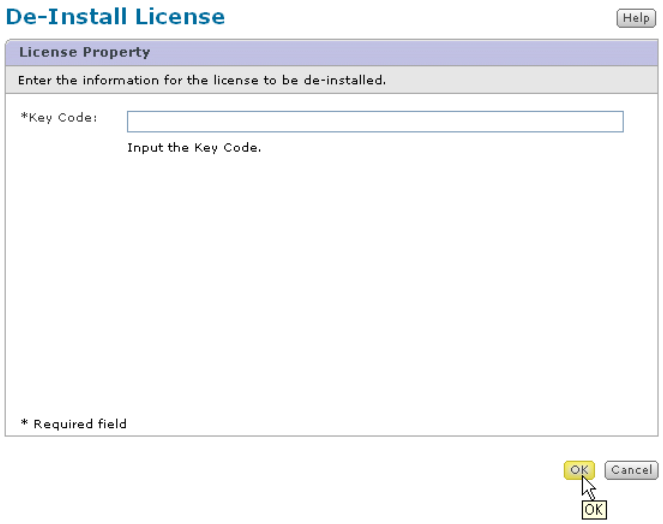
- When the DP-VOL is mapped, release the mapping information.
- Delete all the DP-VOLs (see Deleting a DP-VOL from a DP pool on page 5-10).
- Delete all the DP pools for Dynamic Provisioning (see Deleting a DP pool on page 5-5).

To uninstall Dynamic Provisioning

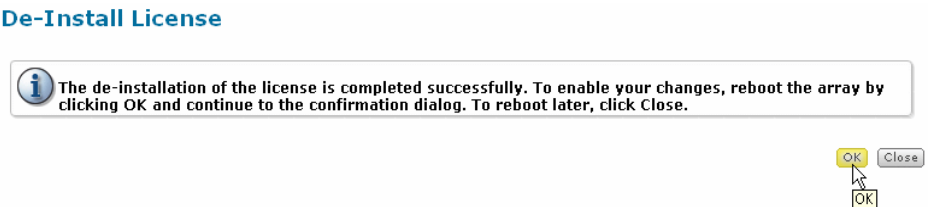
1. Start Navigator 2 and log in.
2. Select the AMS storage system in which you will uninstall Dynamic Provisioning.
3. Click **Show & Configure Array**.
4. Select **Licenses** in the **Settings** tree view.



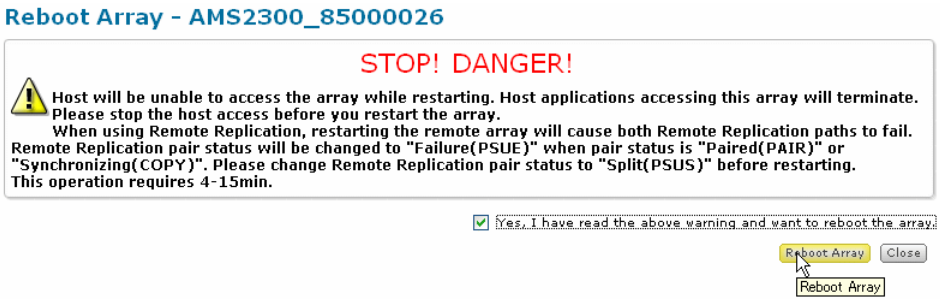
5. In the **Licenses** list, click **De-install License**.
6. In the De-Install License window, type the key code and click **OK**.



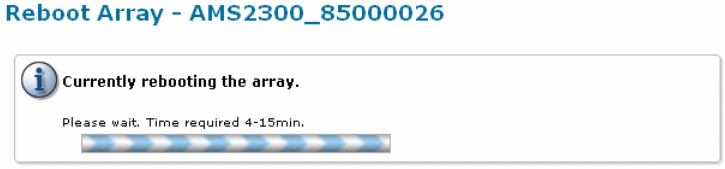
7. In the De-Install License confirmation message, click **OK**.



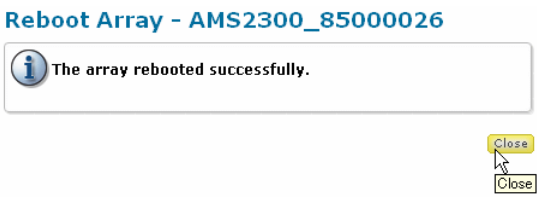
8. In the installation confirmation message, check the warning check box and click **Reboot Array**.



NOTE: To install the option, reboot the array. The host/application cannot access the storage system until the reboot is complete and the system restarts. Be sure the host stops accessing data before restarting. It can take up to 15 minutes for the storage system to restart, depending on the condition of the storage system. If it does not respond after 15 minutes or more, check the condition of the array.



9. In the message confirming that the restart is successful click **Close**.



Uninstallation of Dynamic Provisioning is now complete.

Enabling or disabling Dynamic Provisioning

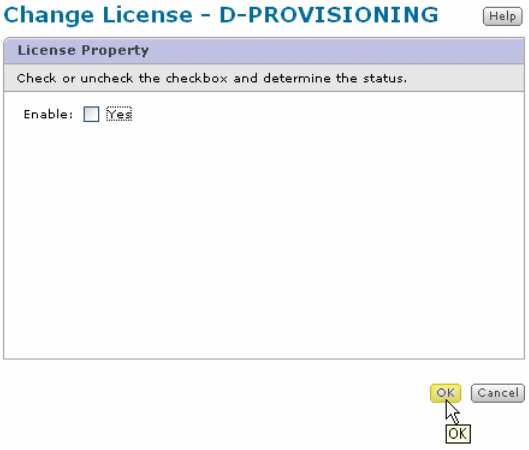
After Dynamic Provisioning is installed, it can be enabled or disabled.

Prerequisites for disabling Dynamic Provisioning

- When the DP-VOL is mapped, release the mapping information.
- Delete all the DP-VOLs (see Deleting a DP-VOL from a DP Pool).
- Delete all the DP pools for Dynamic Provisioning (see Deleting a DP Pool).

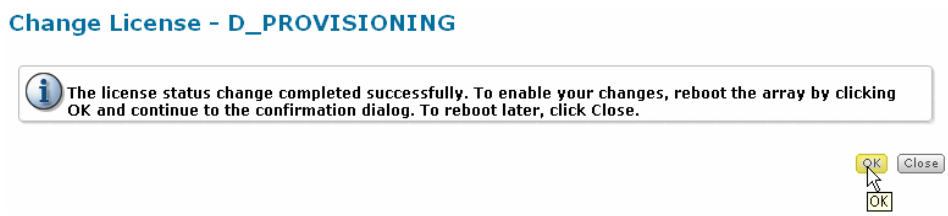
To enable or disable Dynamic Provisioning

1. Start Navigator 2.
2. Log in as registered user to Navigator 2.
3. Select the AMS storage system in which you will set Dynamic Provisioning.
4. Click **Show & Configure Array**.
5. Select **Licenses** in the **Settings** tree view.
6. Select **D_PROVISIONING** in the **Licenses** list.
7. Click **Change Status**.
8. In the Change License window:



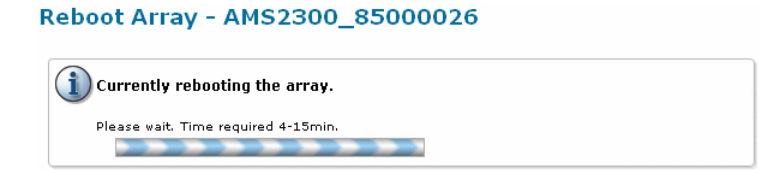
- To enable Dynamic Provisioning, check **Enable**.
- To disable Dynamic Provisioning, uncheck **Enable**.
- Click **OK**.

9. In the Change License message, click **OK**.

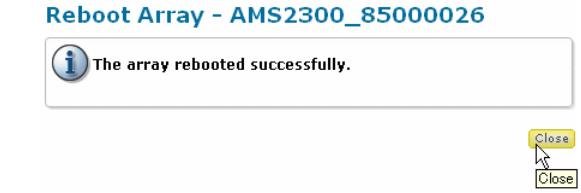


10. In the Reboot Array message, check the warning check box and click **Reboot Array**.

NOTE: To install the option, reboot the array. The host/application cannot access the storage system until the reboot is complete and the system restarts. Be sure the host stops accessing data before restarting. It can take up to 15 minutes for the storage system to restart, depending on the condition of the storage system. If it does not respond after 15 minutes or more, check the condition of the array.



11. In the Reboot Array message, click Close.



Enabling or disabling of Dynamic Provisioning is now complete.

4

Using the Dynamic Provisioning GUI

This chapter describes operations using Navigator 2 GUI.

The following topics are covered in this chapter:

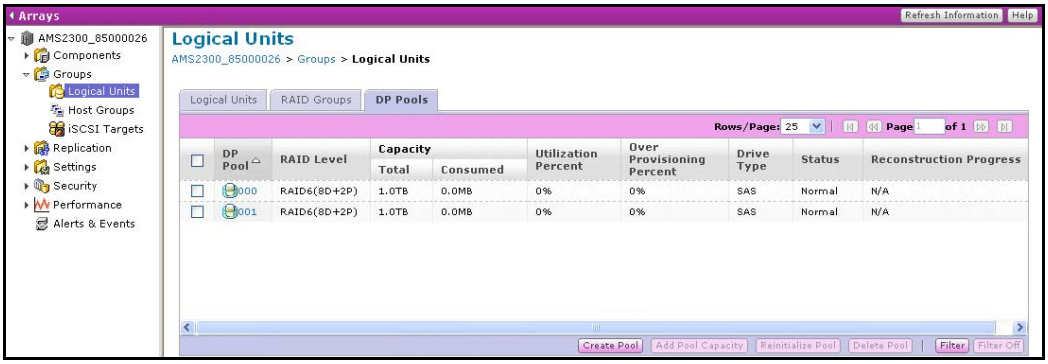
Logical Units window

Use this window to view information about the logical units registered in the group. This window uses these tabs:

- Logical Units tab
- DP Pools tab

Logical Units tab

This tab shows information about the existing logical units contained in the RAID Group. Use this tab to view logical unit information, create an LU, format an LU, delete an LU, or change LU capacity.

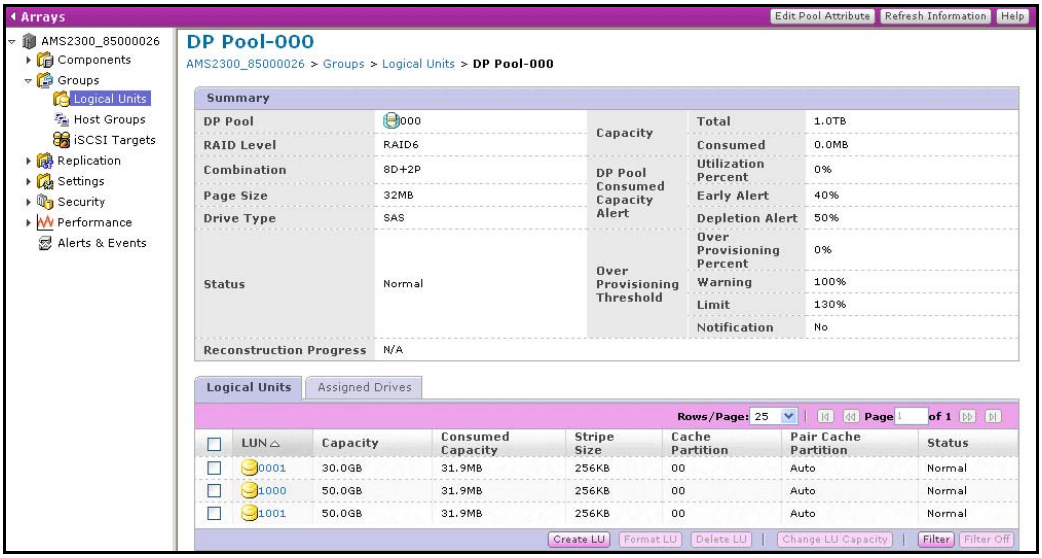


Item	Description
Rows/Pages	Use this list to select the number of items to display on this tab. The tab can display from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
Logical unit check box	Click to select a LUN to edit properties.
LUN	Numerical identifier of the logical unit. Select the icon to view LUN properties.
Capacity	Total capacity of the logical unit.
Consumed Capacity	Amount of total capacity already consumed in the DP-VOL. N/A for non-DP-VOL LUNs.
RAID Group	RAID group number of the logical unit. N/A for DP-VOLs.
DP Pool	DP pool number. N/A for non-DP-VOLs.
RAID Level	RAID level (1 through 6) and drive combination assigned to the logical unit.
Stripe Size	The size (in KB) of the data stripe on the HDU (hard drive unit) that is assigned to the logical unit.
Cache Partition	The number of the cache partition assigned to the logical unit. The range is 0 to nn.

Item	Description
Pair Cache Partition	The number of cache partition pairs assigned to the logical unit. • Auto (default). The LU is automatically assigned to the appropriate cached partition number. • 0 to nnn
Drive Type	Type of drive. • SAS: Serial Attached SCSI • SATA: Serial Advanced Technology Attachment
Status	The status of the logical unit. • Normal • Unmounted • Detached • Detached (Unmounted) • Mounted
Create LU	Click to open the Create Logical Unit to create a logical unit (DP-VOL).
Format LU	Click to format a selected logical unit.
Delete LU	Click to delete a selected logical unit.
Change LU Capacity	Click to change the capacity of a selected logical unit.
The recommended maximum LU size is 10 TB.	
Filter	Use to reduce the items displayed.
Filter Off	Turn off the filter.

DP Pools tab

This tab provides information about the DP pools in the logical unit. Use this tab to view DP pool information and to create a pool, delete a pool, or add pool capacity.



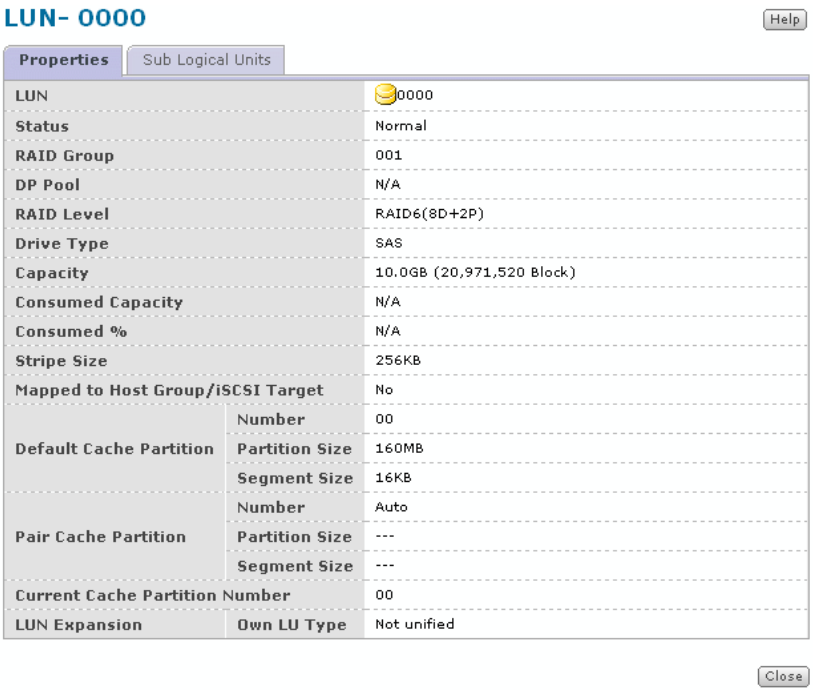
Item	Description
Rows/Pages	Use this list to select the number of items to display on this tab. The tab can display from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
DP Pool check box	Select to delete a DP pool or edit its properties.
DP Pool	Number identifier of the DP pools. Select a DP pool to view the DP pool properties, delete a pool, or add pool capacity. Click the DP Pool number to open the DP Pool Window that shows the properties of the selected DP pool.
RAID Level	RAID level (1 through 6) and drive combination assigned to the DP pool.
Capacity	Capacity information for this DP pool. • Total: Total capacity assigned to DP pool. • Consumed: Amount of capacity already consumed of the total capacity of the DP pool.
Utilization Percent	DP pool consumed capacity utilization (in percent).
Over Provisioning Percent	Total DP-VOL logical capacity as a percentage of DP pool capacity.
Drive Type	Type of drive contained in the RAID group. • SAS: Serial Attached SCSI • SATA: Serial Advanced Technology Attachment You cannot mix drive types within the same DP pool.
Status	DP pool status, DP pool format status, and DP pool capacity status. • Normal: The DP pool is normal (no formatting). • Normal (Formatting (nn%)): DP pool formatting is in progress • Early Alert Over: DP pool utilization level exceeds the Early Alert threshold. • Depletion Alert Over: DP pool utilization level exceeds the Depletion Alert threshold. • Capacity Depleted: Available DP pool capacity is exhausted. You cannot create or grow DP-VOLs. Successful Host access is compromised while a DP pool available capacity is exhausted. Arrays with firmware versions 0893/A and higher can remain operational, although a warning message appears when defining or increasing DP-VOLs, DP Optimization, or LU mapping to a host group or iSCSI target group at the time of depletion or Depletion Alert status. If this occurs, we recommend you increase capacity immediately.
Reconstruction Progress	Shows the DP pool reconstruction progress.
Create Pool	Click to open the Create DP Pool window to create a new DP pool.
Reinitialize Pool	Click when recovering a DP pool.

Item	Description
Delete Pool	Click to delete a selected DP pool.
Add Pool Capacity	Opens the Add DP Pool Capacity window to add capacity to a DP pool.
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

LUN Properties window

LUN Properties tab

This tab shows the properties of a selected logical unit.



Item	Description
LUN	Numerical identifier of the logical unit
Status	Status of the logical unit
RAID Group	RAID group number
DP Pool	DP pool number
RAID Level	RAID level (1 through 6) and drive combination assigned to the logical unit
Drive Type	Type of drive. • SAS: Serial Attached SCSI • SATA: Serial Advanced Technology Attachment
Capacity	Total capacity (in GB) of the logical unit.
Consumed Capacity	Amount of the total pool capacity already consumed.
Consumed %	Amount of pool capacity consumed as a percent of logical DP-VOL capacity.
Stripe Size	The size (in KB) of the data stripe on the HDU that is assigned to the LUN.
Mapped to Host Group/iSCSI Target	Indicated whether the logical unit is mapped to a host group/ iSCSI target. • No • Yes

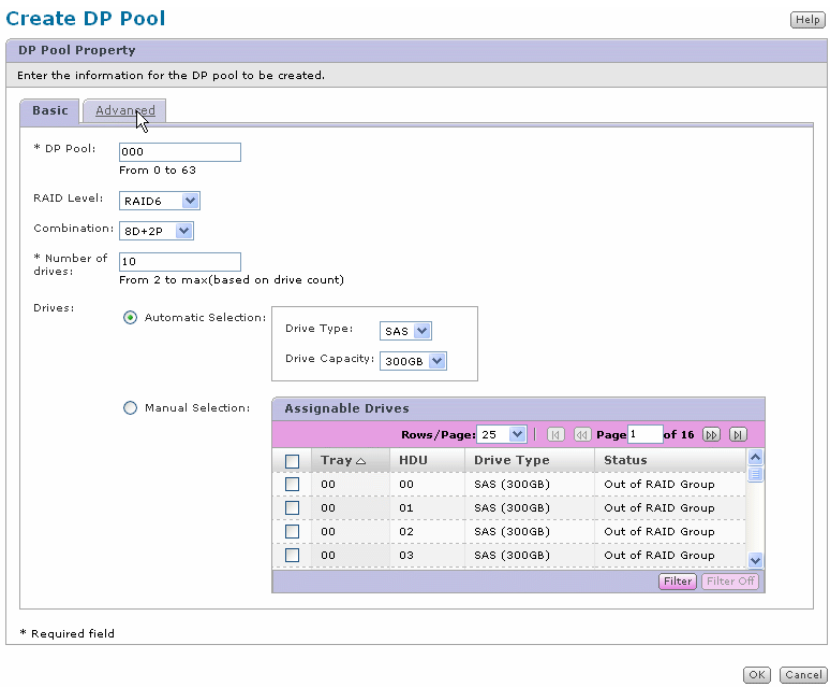
Item	Description
Default Cache Partition	Information about the default cache partition. • Number: Numerical identifier of the default cache partition • Partition Size: Size (in MB) of the default cache partition. • Segment Size: Size (in KB) of the default cache partition segment.
Pair Cache Partition	Information about the pair cache partition. • Number: Numerical identifier of the pair cache partition • Partition Size: Size (in MB) of the pair cache partition. • Segment Size: Size (in KB) of the pair cache partition segment.
Current Cache Partition	Numerical identifier of the current cache partition.
LUN Expansion	Always “Not unified.”
Close	Closes this tab.

Create DP Pool window

Use the tabs in this window to create a DP pool.

- Basic Tab
- Advanced Tab

Basic tab

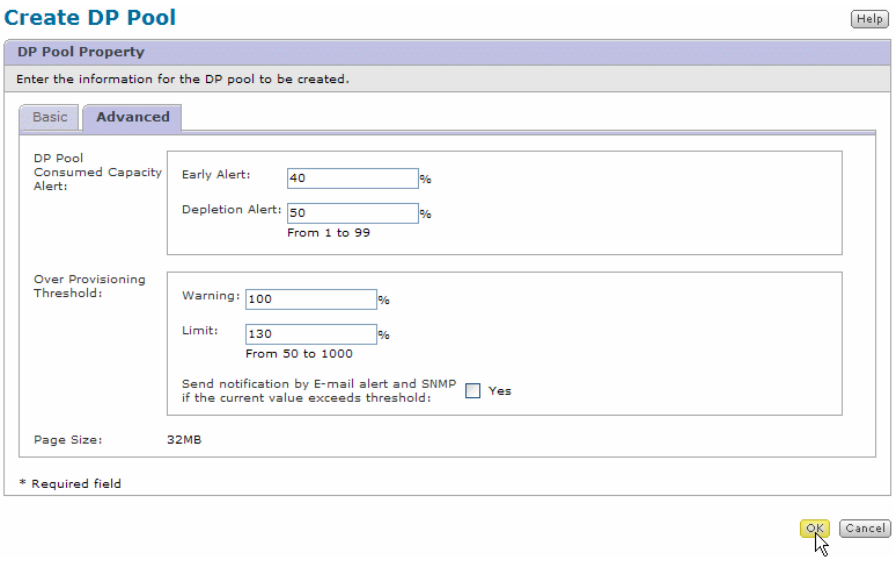


Item	Description
DP Pool	Type a number identifier, from 0 to 63, for the DP pool. Do not use a number already in use.
RAID Level	Select a RAID level (1 through 6).

Item	Description
Combination	Select a RAID combination.
Number of drives	Type the number of drives to be added for this pool. Specify the number based on a single RAID Combination.
Automatic Selection	If you select this option, then also select a **Drive Type** and a **Drive Capacity**.
Manual Selection	If you select this option, then also specify a **Tray** and a **HDU** combination from the **Assignable Drives** list.

Advanced tab

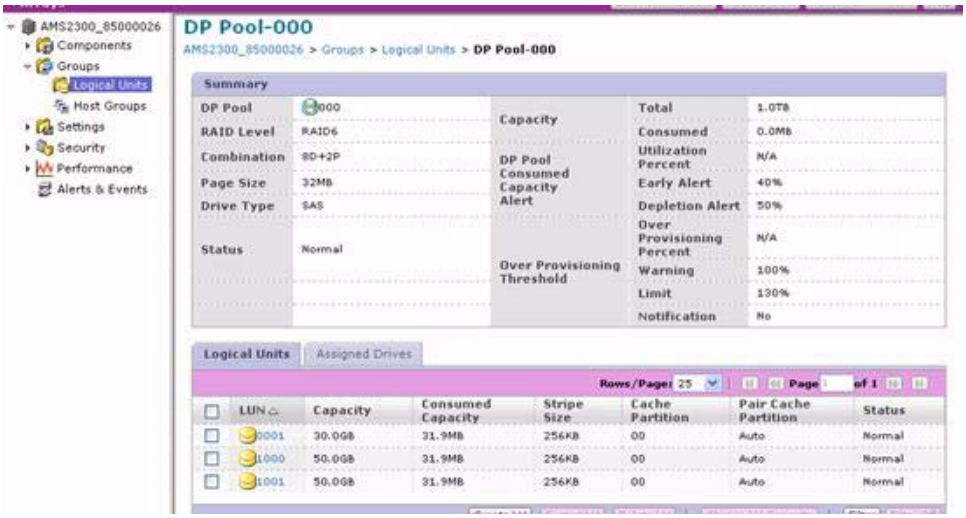
Use this tab to set the consumed capacity and over-provisioning thresholds, and to set up e-mail and SNMP alerts to warn if threshold values are reached.



Item	Description
DP Pool Consumed Capacity Alert	Use the default values or set user-selected values. • Early Alert: Threshold value for an Early Alert for this DP pool. This is an initial warning and must be less than the Depletion Alert value. The range of values is from 1 to 99%; the default value is 40%. We recommend that you set this threshold based on the time it may require to order and set up additional drives before adding to the DP pool. • Depletion Alert: Threshold value for a Depletion Alert for this DP pool. This warning signals that available space in the DP pool is too low. The AMS storage system provides warnings every 6 hours if this state continues. The range of values is from 1 to 99(%); the default is 50%. We recommend that you set this threshold based upon the rate that pool space is consumed and the administration reaction time to add additional pool capacity. A new DP-VOL cannot be created against the pool while the threshold is exceeded.
Over Provisioning Threshold	Use the default values or set user-selected values. • Warning: Threshold value for an over-provisioning Warning for this DP pool. The range of values is from 50 to 1000%; the default is 100%. • Limit: Threshold value for the over-provisioning Limit for this DP pool. The Limit value must be greater than the Warning value. The range of values is from 50 to 1000%; the default is 130%. While the threshold is exceeded, a new DP-VOL cannot be created against the pool. We recommend that the Limit value be set at a level that meets the administrator's judgement of good risk management. Initial values of near 100% are appropriate. Once local experience has determined a safe level of capacity savings expectations based on actual data then the Limit threshold can be increased.
Send notification by E-mail alert and SNMP if alert value is exceeded	Check Yes to enable e-mail alerts.
Page size	Size of a data unit to configure this DP pool (fixed at 32 MB)

DP Pool window

This window summarizes information about the DP pools. Select a DP pool to view the summary information. You can also create an LU or change the properties of the selected DP pool.



This window contains these components:

- Summary table
- Logical Units tab
- Assigned Drives tab

Summary table

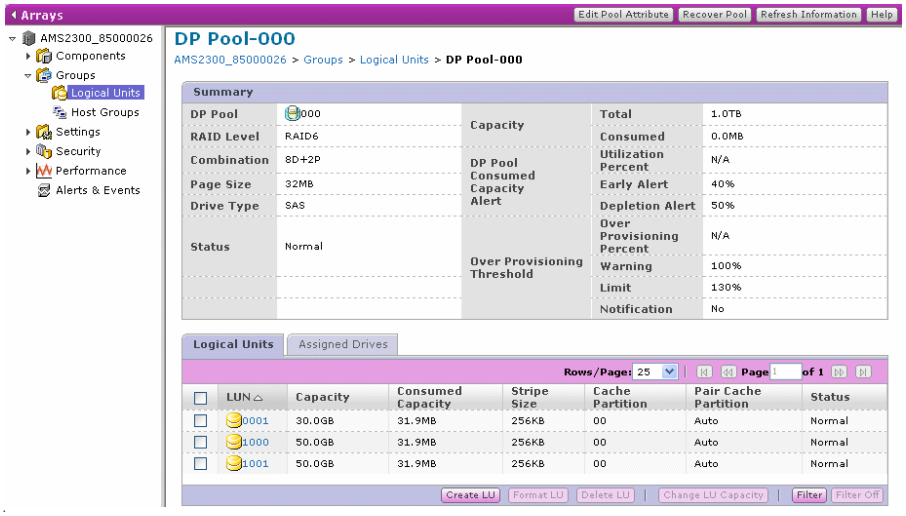
This table in the DP Pool window provides summary information about the selected DP pool.

Item	Description
Edit Pool Attributes	Opens the Edit DP Pool Attribute window where you can change the DP pool attribute properties.
Recover Pool	Recovers a DP pool that has failed. This is an abnormal operation and should be performed with care. Note: Failure in this context is a pool that has a RAID group that has failed (multiple HDD failure) and cannot be repaired. Failure is not a depleted pool.
Refresh Information	Updates the display with any changes to the pool or LUs since the last refresh.
Help	Opens the online help system.
DP Pool	DP pool number. Click the icon to view or change the properties of this DP pool.
RAID Level	RAID level (1 through 6) assigned to the DP RAID group for this DP pool.
Combination	The RAID configuration, which is a RAID combination of drives configured for this DP pool. • D: Data • P: Parity
Page Size	Size of a data unit to configure this DP pool (fixed at 32 MB)
Drive Type	Drive type of this DP pool: • SAS: Serial Attached SCSI • SATA: Serial Advanced Technology Attachment

Item	Description
Status	Status of this DP pool: • Normal: The standard (normal) status. • Regression: At least one drive in the RAID group of a DP pool has failed. • Detached: At least one RAID group in a DP pool has failed.
Reconstruction Progress	Shows the DP pool reconstruction progress.
Capacity	Capacity information for this DP pool: • Total: Total capacity (in TB) assigned to this DP pool. • Consumed: Amount of capacity already consumed of the total pool capacity.
DP Pool Consumed Capacity Alert	Capacity alerts for this DP pool: • Utilization Percent: Current utilization (in percent). • Early Alert: DP pool consumed capacity alert threshold value for an Early Alert for this pool. • Depletion Alert: DP pool consumed capacity alert threshold for a Depletion Alert for this DP pool.
Over Provisioning Threshold	Over-provisioning thresholds for this DP pool: • Over Provisioning Percent: Current over provisioning level (in percent). • Warning: Over-provisioning threshold value for a Warning for this DP pool. • Limit: Over-provisioning threshold value for a Limit for this DP pool. • Notification: Indicates whether an e-mail alert indicating an SNMP Agent trap will be generated to the user if any of the above threshold values are exceeded. This feature can be turned on and off in Navigator 2 in the DP Pool Property window, Advanced tab. • Yes: An e-mail alert will be generated. • No: An e-mail alert will not be generated.
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

Logical Units tab

This tab in the DP Pool window lists the logical units (DP-VOLs) created in the RAID group. Use this tab to create an LU, edit cache partitions, format an LU, delete an LU, and change LU capacity.

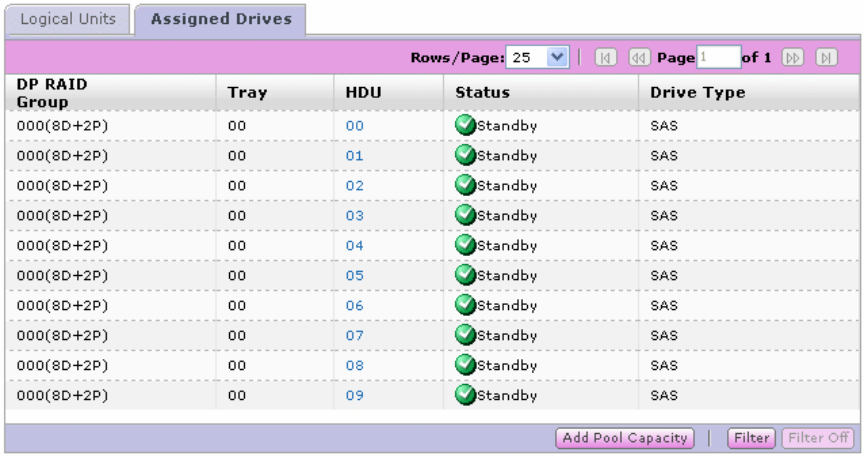


Item	Description
Rows/Pages	Use this list to select the number of items to display on this tab. The tab can display from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
LUN	The identifier of the DP-VOL.
Capacity	Total capacity assigned to the DP-VOL.
Consumed Capacity	Amount of capacity already consumed of the total capacity assigned to this DP-VOL.
Stripe Size	The size of the data stripe on the HDU (hard drive unit) that is assigned to the DP-VOL.
Cache Partition	The number of the cache partition assigned to the DP-VOL. The range is 0 to nn.
Pair Cache Partition	The number of cache partition pairs assigned to the DP-VOL. • Auto (default). The DP-VOL is automatically assigned to the appropriate cache partition number. • 0 to nnn
Status	The status of the DP-VOL. • Unformat • Regression • Detached
Create LU	Click to open the Create Logical Unit window to create a DP-VOL.
Edit Cache Partition	Click to edit the cache partition of the selected DP-VOL.
Format LU	Click to format a selected DP-VOL.

Item	Description
Delete LU	Click to delete a selected DP-VOL. By deleting a DP-VOL, the DP pool area that the DP-VOL was using is released, increasing the free capacity of the DP pool. The page assigned to the DP-VOL is also deleted and formatted.
Change LU Capacity	Click to open the Change Logical Unit Capacity window to change the capacity of a selected DP-VOL.
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

Assigned Drives tab

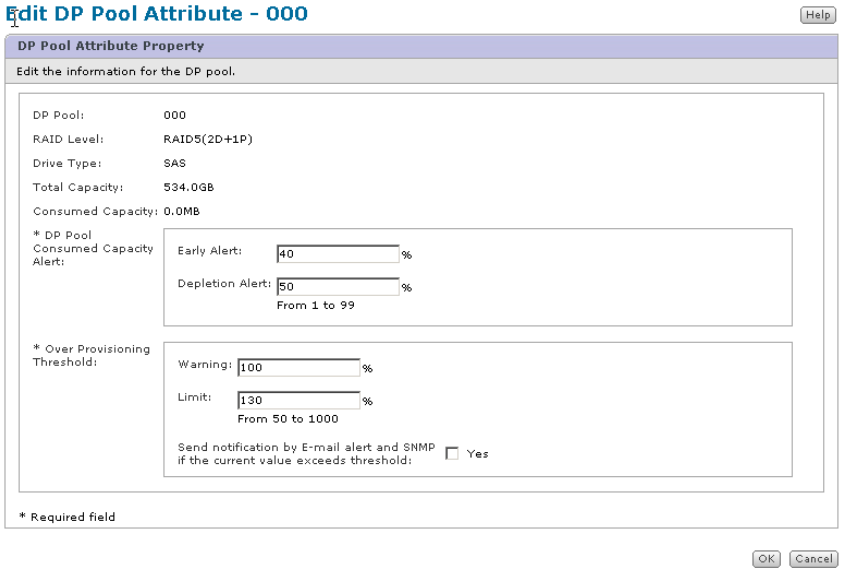
This tab in the DP Pool window provides information about the drives assigned to the DP RAID groups in the DP pool.



Item	Description
Rows/Pages	Use this list to select the number of items to display on this tab. The tab can display from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
DP RAID Group	This identifies the RAID group assigned to the DP pool.
Tray	Tray number
HDU	Sequential hard drive unit number
Status	Drive status. • Standby • Normal • Unmounted • Detached • Detached (Unmounted) • Mounted
Drive Type	Type of drive. • SAS: Serial Attached SCSI • SATA: Serial Advanced Technology Attachment

Item	Description
Add Pool Capacity	Click to add DP pool capacity.
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

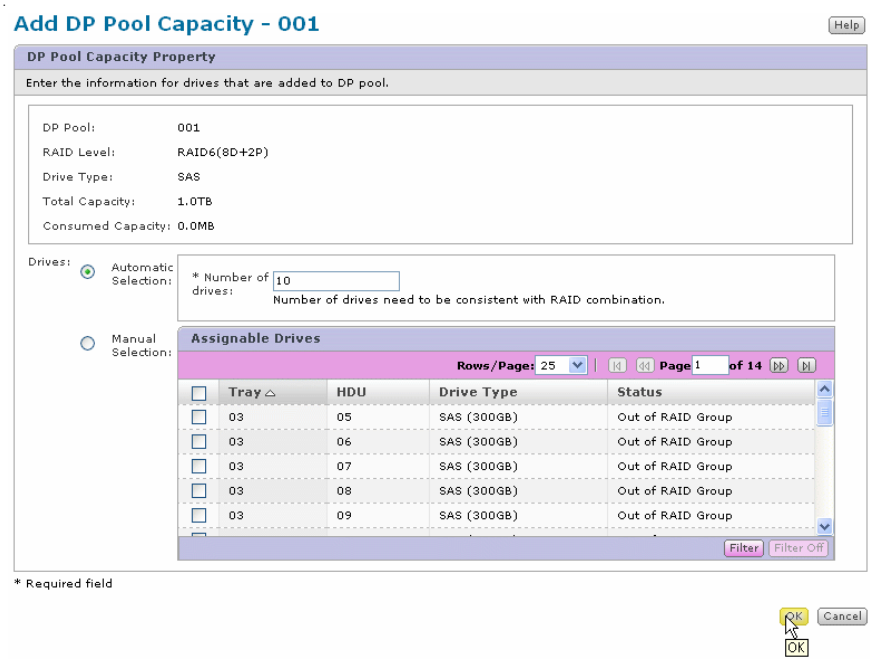
Edit DP Pool Attribute window



Item	Description
DP Pool	Identifier of this DP pool
RAID Level	Raid level (1 through 6) and drive combination assigned to this DP pool.
Drive Type	Drive type of this DP pool.
Total Capacity	Total capacity assigned to this DP pool.
Consumed Capacity	Amount of total capacity already consumed.

Item	Description
DP Pool Consumed Capacity Alert	Use the default values or set user-selected values. • Early Alert: Threshold value for an Early Alert for this DP pool. This is an initial warning of high pool utilization level and must be less than the Depletion Alert value. The range of values is from 1 to 99%; the default value is 40%. We recommend that you set this threshold based on the time it may require to order and set up additional drives before adding to the DP pool. • Depletion Alert: Threshold value for a Depletion Alert for this DP pool. This warning signals that available space in the DP pool is too low. The AMS storage system provides warnings every 6 hours if this state continues. The range of values is from 1 to 99(%); the default is 50%. We recommend that you set this threshold based upon the rate that pool space is consumed and the administration reaction time to add additional pool capacity. A new DP-VOL cannot be created against the pool while the threshold is exceeded.
Over Provisioning Threshold	Use the default values or set user-selected values. • Warning: Threshold value for an over-provisioning Warning for this DP pool. The range of values is from 50 to 1000%; the default is 100%. • Limit: Threshold value for the over-provisioning Limit for this DP pool. The Limit value must be greater than the Warning value. The range of values is from 50 to 1000%; the default is 130%. While the threshold is exceeded, a new DP-VOL cannot be created against the pool. We recommend that the Limit value be set at a level that meets the administrator's judgement of good risk management. Initial values of near 100% are appropriate. Once local experience has determined a safe level of capacity savings expectations based on actual data then the Limit threshold can be increased.
Send notification by E-mail alert and SNMP if alert value is exceeded	Check Yes to enable e-mail alerts.

Add DP Pool Capacity window



Item	Description
DP Pool	Identifier of this DP pool
RAID Level	Raid level (1 through 6) and drive combination assigned to this DP pool.
Drive Type	Drive type of this DP pool.
Total Capacity	Total capacity assigned to this DP pool.
Consumed Capacity	Amount of total capacity already consumed.
Automatic Selection	If you select this option, the number of drives is based on the RAID combination. The added capacity will be automatically selected.
Manual Selection	If you select this option, then specify a Tray and a HDU combination from the Assignable Drives list.

DP Pool Trend window

Use this window to view trend information for the DP pools and their utilization rates in the selected AMS storage system.

:

Item	Description
Rows/Pages	Use this list to select the number of items to display, from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
DP Pool select	Select a DP pool and click Show Trend to view trend information about the selected DP Pool.
DP Pool	A list of the DP pools in the AMS storage system. You can sort the list by clicking the arrow in the heading.
RAID Level	RAID level (1 through 6) and drive combination assigned to the DP pool
Capacity	Capacity information for this DP pool. • Total: Total capacity assigned to this DP pool. • Consumed: Amount of capacity already consumed of the total capacity assigned to the DP pool.
Show Trend	Select a DP pool and click this button to view trend information about the selected DP pool.
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

DP Optimization window

Use this window to view Dynamic Provisioning optimization information.

Item	Description
Rows/Pages	Use this list to select the number of items to display, from 25 to 1000 items per page.
Forward and back buttons	Click to move back or forward a page, or to the first or last page.
Page x of 1	The page number of the current display.
LUN select	Select a LUN and click Optimize DP to optimize the selected LUN. Best practice is to optimize one LUN at a time.
Items Under **Summary**	
Priority	Shows the priority of the DP optimization.
DP Capacity Mode	Shows the DP Capacity Mode.
Items on DP Optimization Window	
LUN	Numerical identifier of the logical unit. Select the icon to view LUN properties.
DP Pool	DP pool number associated with the LUN.
RAID Level	RAID level (1 through 6) and drive combination assigned to the DP pool.
Capacity	Capacity information for the DP pool: • Total: Total logical capacity of the DP-VOL. • Consumed: Amount of capacity already consumed of the total capacity assigned to the DP-VOL. • Reclaimed: Capacity reclaimed after optimization.
Status	DP-VOL status. • Normal • Optimizing • Waiting Optimization • Pending Optimization • Canceling Optimization • Failed

Item	Description
Optimize DP	Click to optimize the DP pool.
Cancel Optimization	Click to cancel DP optimization. If Optimization is cancelled, there will be some reclaimable capacity that has not been added back to the available pool capacity. Optimization must be run to completion, when convenient, to reclaim this capacity.
Change Priority	Click to set or change the priority of DP optimization.
Change Capacity Mode	Click to change the DP Capacity Mod. (The Change Capacity Mode button appears only when the array hardware revision is 0200.)
Filter	Use to reduce the number of the items appearing in the window.
Filter Off	Turn off the filter and display all items in the window.

5

Performing Dynamic Provisioning operations

This chapter provides procedures for performing Dynamic Provisioning operations using the Navigator 2 GUI.

The following topics are covered in this chapter:

- Dynamic Provisioning work flow
- Managing DP pools
- Managing DP-VOLs
- Optimizing DP
- Managing DP pool information
- Setting up e-mail notifications and SNMP traps

Dynamic Provisioning work flow

Figure 5-1 shows the Dynamic Provisioning workflow:

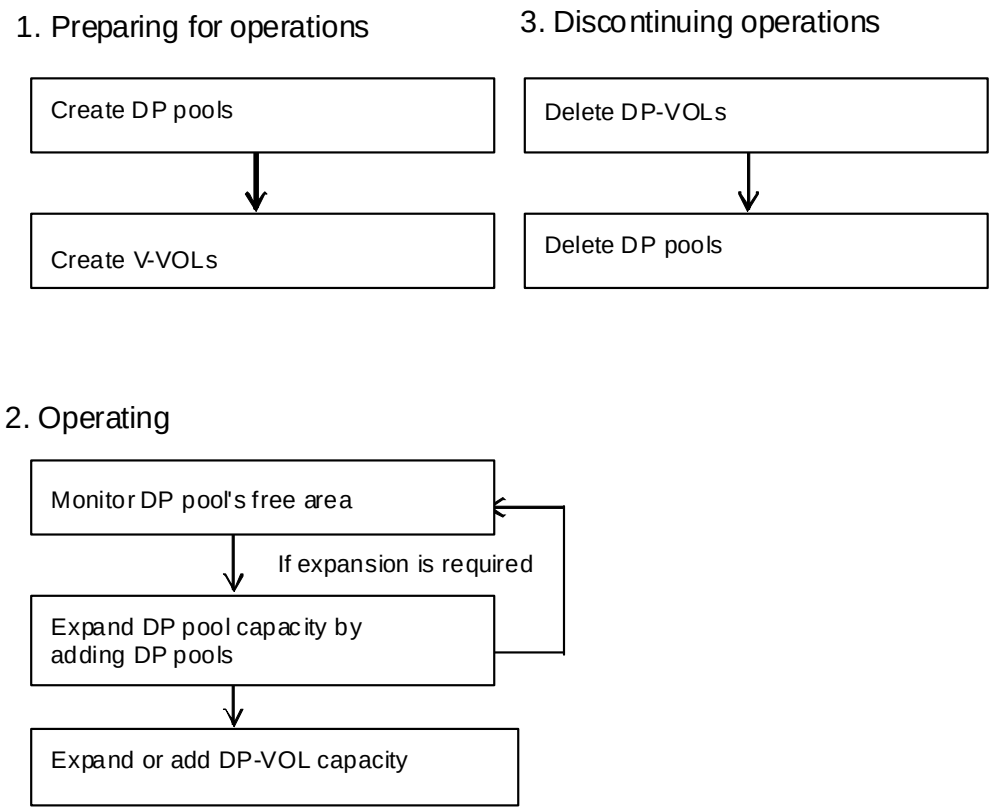


Figure 5-1: Dynamic Provisioning Work Flow

Managing DP pools

This section describes the following topics:

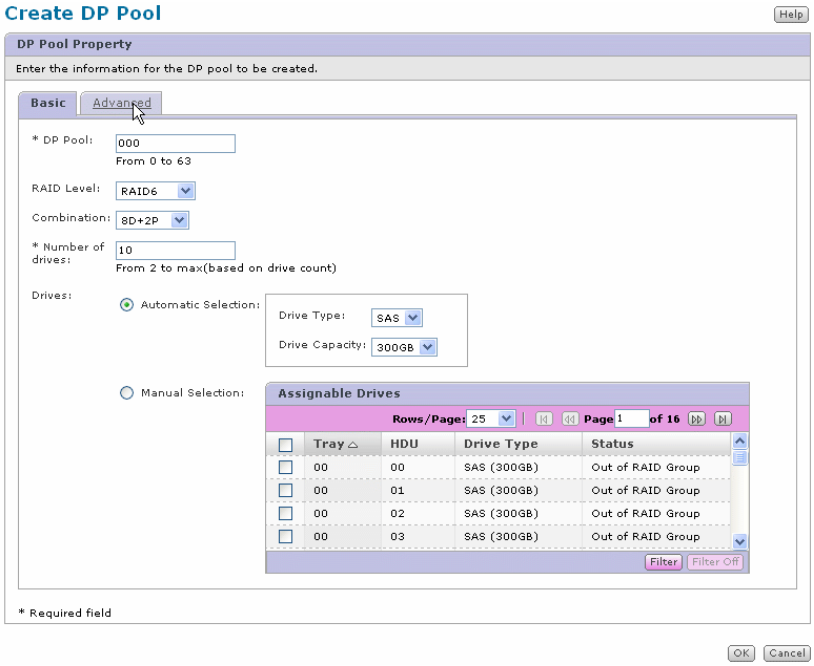
- Creating a DP pool
- Changing DP pool thresholds
- Deleting a DP pool
- Reinitializing a DP pool
- Adding DP pool capacity

Creating a DP pool

When creating many DP pools or adding hard disk drives (HDUs) of large capacity to the DP pool, it may take a long time to complete processing. The time to create DP pools depends on the number and capacity of the DP pools to be created, the number and capacity of the HDUs to be added to the DP pool, etc.

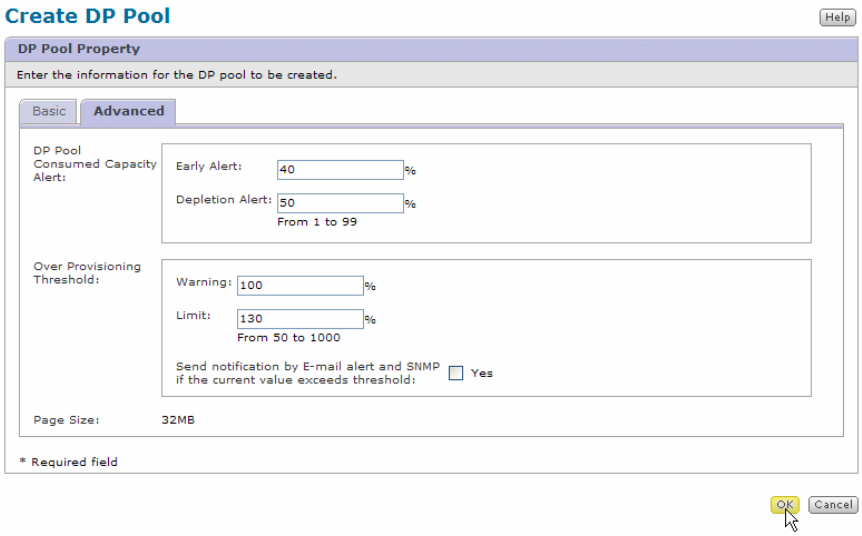
To create a DP pool

1. On the **DP Pools** tab, click **Create Pool**.
2. In the Create DP Pool window, complete the **Basic** tab.



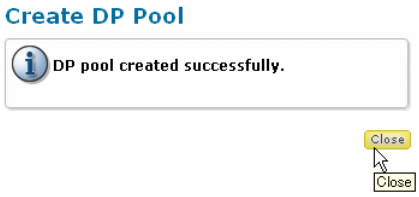
- In **DP Pool**, type a DP pool number between 0 to 63. Do not use a number that is already used.
  - AMS 2300/2500: Enter integers from 0 to 63.
  - AMS 2100: Enter integers from 0 to 49
- In **RAID Level**, select a RAID level. Be sure you have enough drives available to support the desired RAID level.
- In **Combination**, select a RAID combination.
- In **Number of drives**, type the number of drives that match the selection made in **Combination** above. If 8D+2P is specified, for example, type **10**.
- In **Drives**, select one of two drive selection techniques:
  - Automatic Selection: If you select this option, then select a **Drive Type** and a **Drive Capacity**.
  - Manual Selection: If you select this option, specify a **Tray** and a **HDU** combination from the **Assignable Drives** list.

3. Complete the **Advanced** tab.



- In **DP Pool Consumed Capacity Alert**, type the **Early Alert** and the **Depletion Alert** percentages or use the default values.
- In **Over Provisioning Threshold**, change the **Warning** and the **Limit** percentages, if desired, or use the default values.
- To enable Over Provisioning e-mail alerts, check **Send notification by E-mail alert and SNMP if the current value exceeds threshold**.
- Click **OK**.

4. When a message appears, click **Close**.



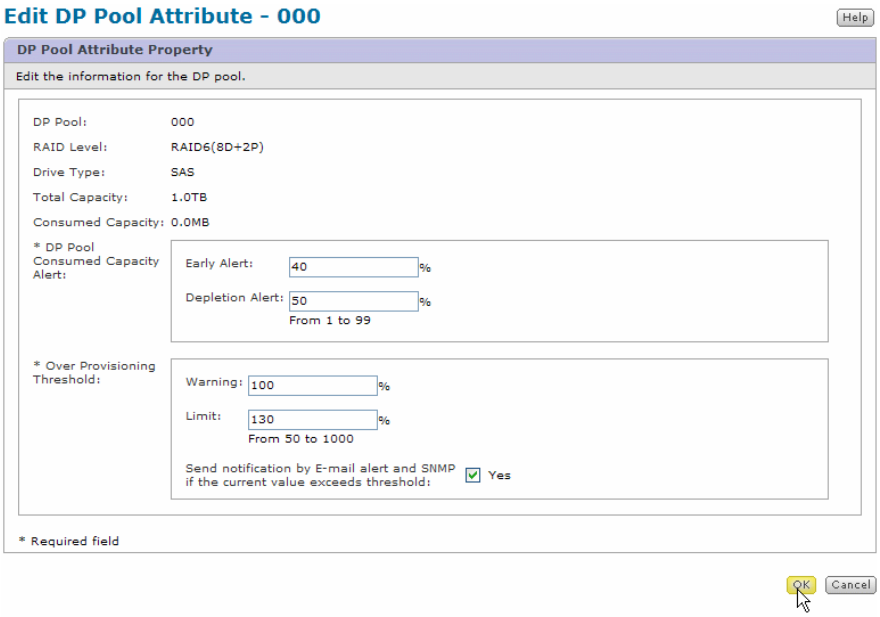
Creating a DP pool is now complete. You can create a DP-VOL.

Changing DP pool thresholds

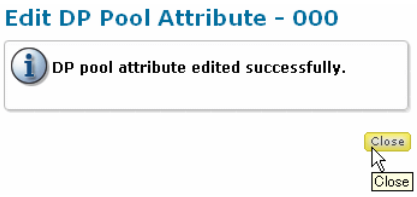
After creating a DP pool, the only DP pool settings that can be changed are the threshold values.

To change DP pool thresholds

1. In the DP Pool Properties window, click **Edit Pool Attribute**. The Edit DP Pool Attribute window opens.



2. In **DP Pool Consumed Capacity Alert**, change the values for the **Early Alert** and the **Depletion Alert**, if desired, or use the defaults.
3. In **Over Provisioning Threshold**, change the values of the **Warning** and the **Limit**, if desired, or use the defaults.
4. To enable e-mail alerts for the over-provisioning threshold, check **Send notification by E-mail alert and SNMP if the current value exceeds threshold**.
5. Click **OK**.
6. Click **Close** in the confirmation message.



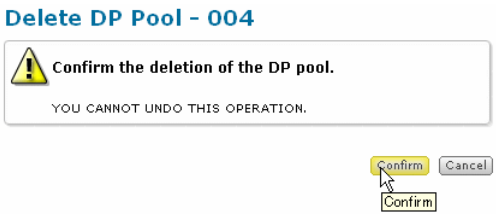
Deleting a DP pool

Usually only one DP pool is deleted at a time in normal practice. However, it is possible to delete multiple DP pools at the same time, if needed.

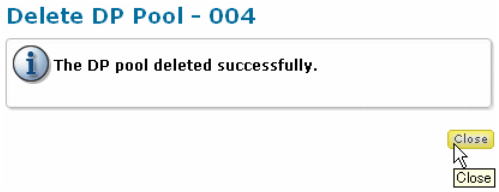
NOTE: Before deleting a DP pool, delete the DP-VOL defined using the DP pool (see Deleting a DP-VOL from a DP pool on page 5-10).

To delete a DP pool

1. In the DP Pool window, select one or more DP pools on the **Logical Units** tab, then click **Delete Pool**.
2. Click **Confirm** in the confirmation message.



3. Click Close in the confirmation message.



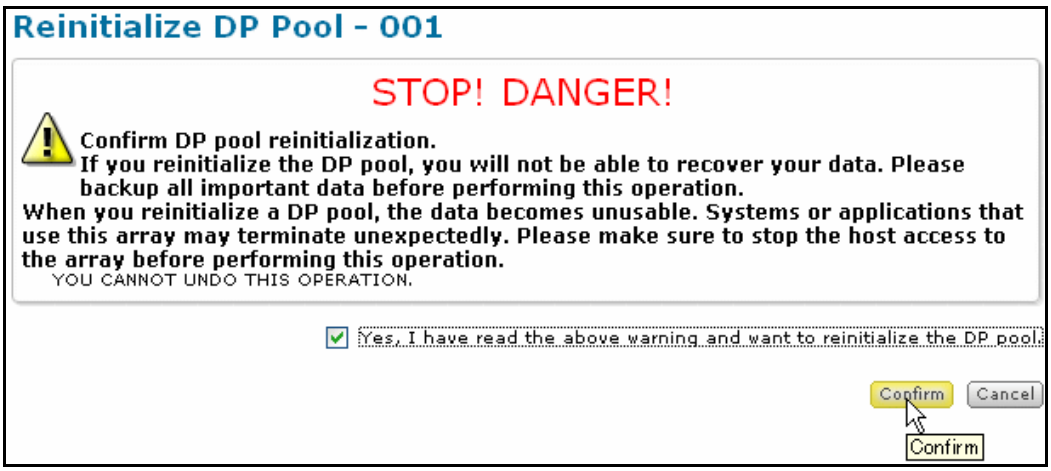
Reinitializing a DP pool

You can recover a DP pool to reset a pool after a failure. This is an abnormal operation and should be performed with care. Before attempting to recover a DP pool, you should back up all important data and stop host access to the AMS storage system. All data stored in DP-VOLs using the pool will be lost if DP Pool recovery is performed. DP pool recovery is appropriate only after a serious malfunction renders the pool inoperable.

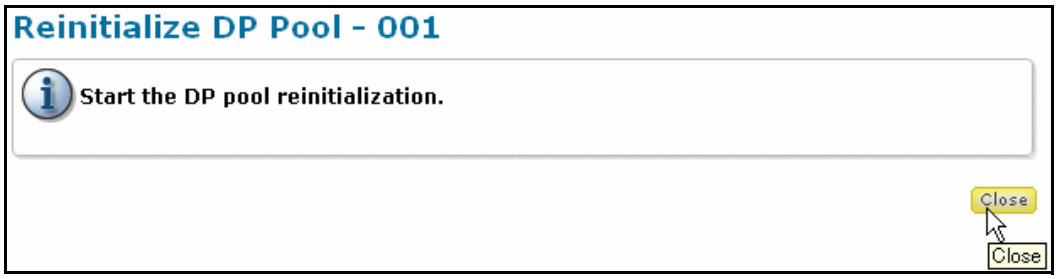
If the DP-VOL is blocked due to an HDU failure, recover the HDU in which the failure occurs. If the status of the DP-VOL is unformatted, format the LU.

To recover a DP pool

1. Select the DP Pool you want to recover.
2. Click **Reinitialize Pool**.
3. Read the warning message, check the check box, and click **Confirm**. Otherwise, click **Cancel** if you need to first back up your data or stop host access to the AMS storage system.



4. Click **Close** in the confirmation message.



Adding DP pool capacity

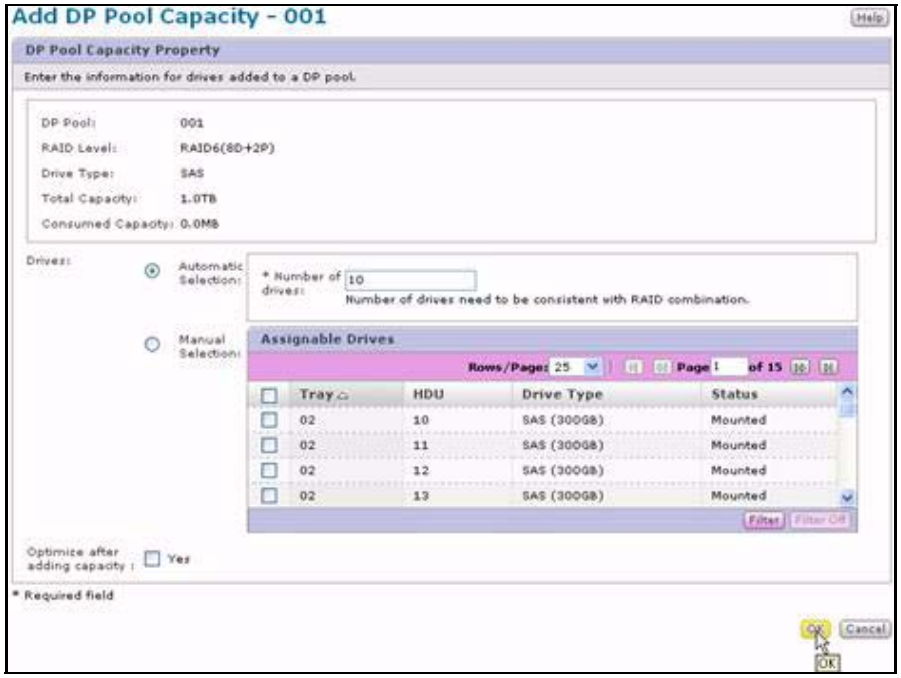
You can grow DP pool capacity by adding one or more DP RAID groups to the DP pool. The total amount of capacity of the DP RAID groups registered in the DP pool is the capacity of that DP pool. Monitor the free capacity of the usable DP pool, and then grow the DP pool as needed.

If you have just added a DP pool, you cannot add a DP RAID group to the DP pool while the DP pool is being formatted. Wait until formatting is complete before attempting to add another DP RAID group.

When adding capacity to a DP pool, the RAID level of the capacity that you are adding must match the RAID level and RAID combination of the existing DP pool, for example, add RAID1 to a RAID1 DP pool, add RAID 5 to a RAID5 DP pool.

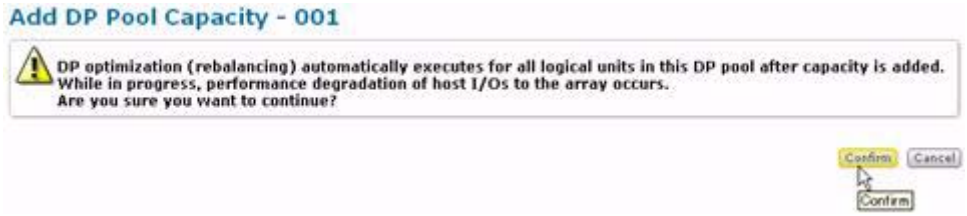
To add DP pool capacity

1. In the **DP Pools** tab, select the DP pool that needs more capacity, and click **Add Pool Capacity**.
2. In the **Drives** section of the Add DP Pool Capacity Property window, select how you want to assign the drives:

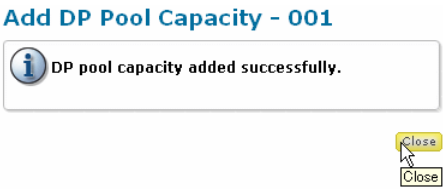


- If **Automatic Selection**: In **Number of drives**, type the number of drives to be added that match the combination shown in the RAID Level above. If 8D+2P is specified, for example, type **10**.
- If **Manual Selection**: Specify a **Tray** and an **HDU** from the **Assignable Drives** list. This should be the same as the RAID combination of the pool.

3. To optimize automatically after adding DP pool capacity, select **Optimize after adding capacity**. When checked, the storage system performs DP optimization automatically after adding DP pool capacity.
4. Click **OK**.
5. Read the warning message and click **Confirm**.



6. In the confirmation message, click **Close**.



Managing DP-VOLs

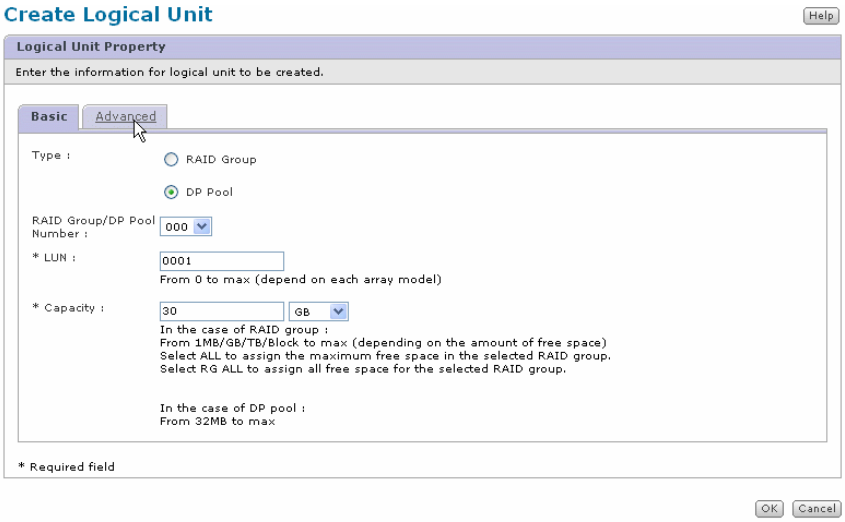
This section describes the following topics:

- Creating a DP-VOL
- Deleting a DP-VOL from a DP pool
- Changing DP-VOL capacity

Creating a DP-VOL

To create a DP-VOL

1. In the **Logical Units** tab, click **Create LU**. The Create Logical Unit window opens.
2. On the **Basic** tab:



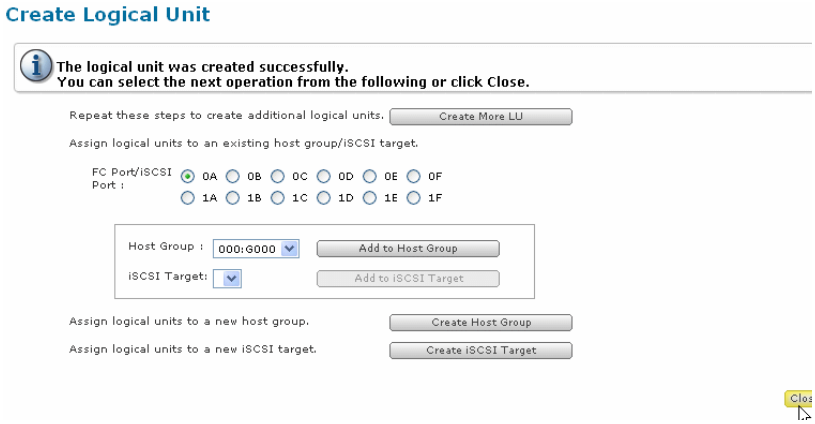
- In **Type**, select **DP Pool**.
- In the **RAID Group/DP Pool Number** list, select a DP pool number.
- In **LUN**, specify a logical unit number to assign to the new DP-VOL.
- Select the logical unit capacity unit from the list, then type the capacity amount that you want to assign to the new DP-VOL.

NOTE: The recommended maximum LU size is 10 TB.

3. The **Advanced** tab does not provide any additional options for creating a DP-VOL.

4. Click **OK**. The logical unit (DP-VOL) is created successfully.

5. In the confirmation message, assign the created logical unit to the port and host group or iSCSI target, if necessary.
   - To create another LU, click **Create More LU**.
   - To terminate creating an LU, click **Close**.



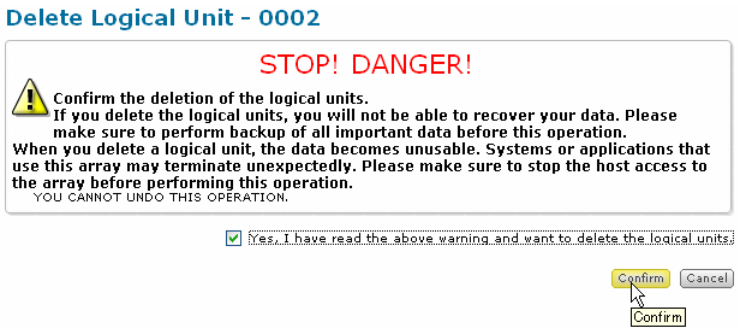
6. In the **Logical Units** tab, confirm that the DP-VOL was created.

Deleting a DP-VOL from a DP pool

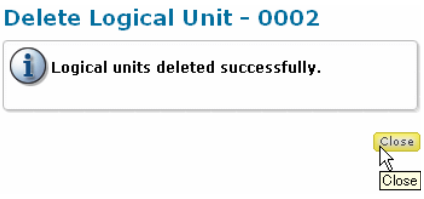
When deleting a DP-VOL (LU) from a DP pool, the DP pool areas that the DP-VOL was using are released, increasing the free capacity of the DP pool. The DP pool areas formerly assigned to the DP-VOL are also formatted back to zeroes.

To delete a DP-VOL from a DP pool

1. In the **Logical Units** tab, select the **LUN** that you want to delete, and then click **Delete LU**.
2. In the confirmation message, check the check box and click **Confirm**.



3. In the delete confirmation message, click **Close**.



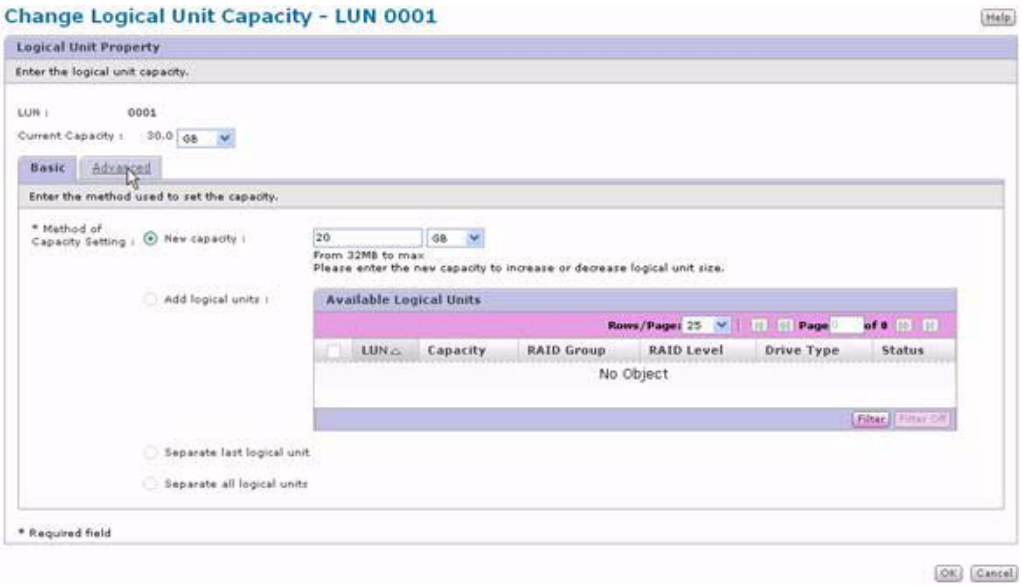
4. Confirm the deleted logical unit is not displayed.

Changing DP-VOL capacity

You can increase or decrease the capacity of the DP-VOL while the AMS storage system is operational. The procedure to change the capacity of the DP-VOL is the same as for changing capacity for a normal LU.

To change DP-VOL capacity

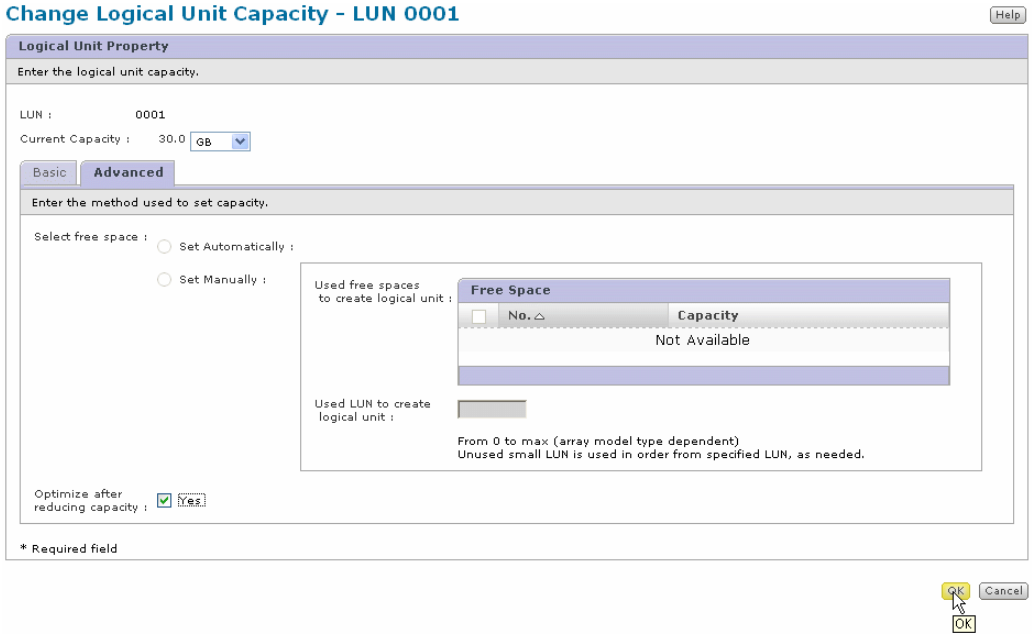
1. In the **Logical Units** tab, select the **LUN** for which you want to change the capacity, and click **Change LU Capacity**. The Change Logical Unit Capacity window opens.



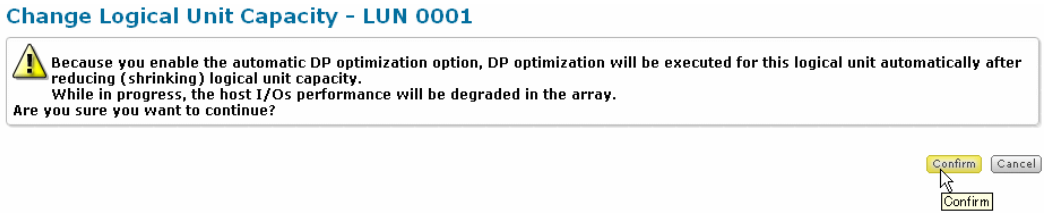
2. On the **Basic** tab, in **Method of Capacity Setting**, select a method:
   - If **New capacity**, select the capacity unit from the list, type the capacity amount. This is the only method allowed for changing a DP-VOL logical capacity.
   - If **Add logical units**, in **Available Logical** units, select the LUN to be unified. This method is not allowed with DP-VOLs.
   - If **Separate last logical unit**, the last unified LU will be separated. This method is not allowed with DP-VOLs.
   - If **Separate all logical units**, all unified LUs will be separated. This method is not allowed with DP-VOLs.

NOTE: The recommended maximum LU size is 10 TB.

3. Click the **Advanced** tab.

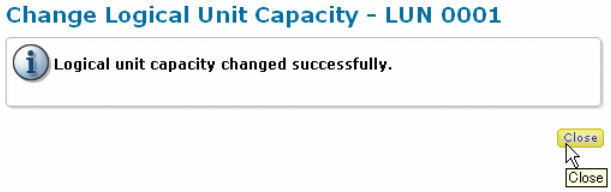


4. On the **Advanced** tab, select **Yes** to **Optimize after reducing capacity** if the DP-VOL should return capacity back to the DP Pool that had been formally assigned to the area of the DP-VOL being trimmed away.
5. Click **OK**.
6. If you selected **Optimize after reducing capacity**, the following warning message appears. Click **Confirm**.



7. If you decreased the existing capacity, a warning message appears.
   - To shrink the capacity, check the check box and click **Confirm**.
   - To cancel this operation, click **Cancel**.

8. In the changed confirmation message, click **Close**.



Optimizing DP

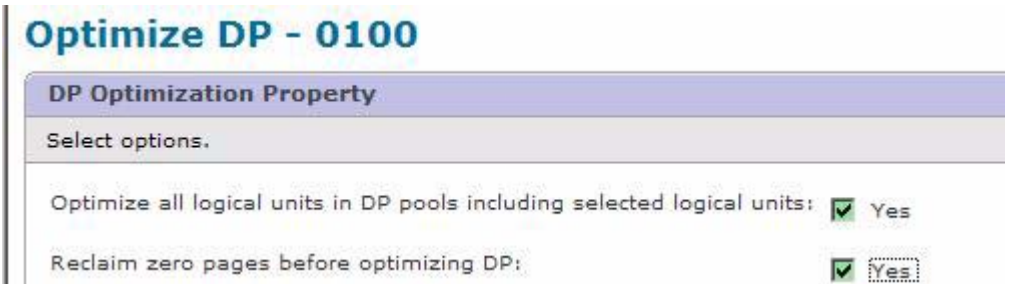
This section describes the following topics.

- Optimizing the DP pool
- Canceling DP optimization
- Changing optimization priority

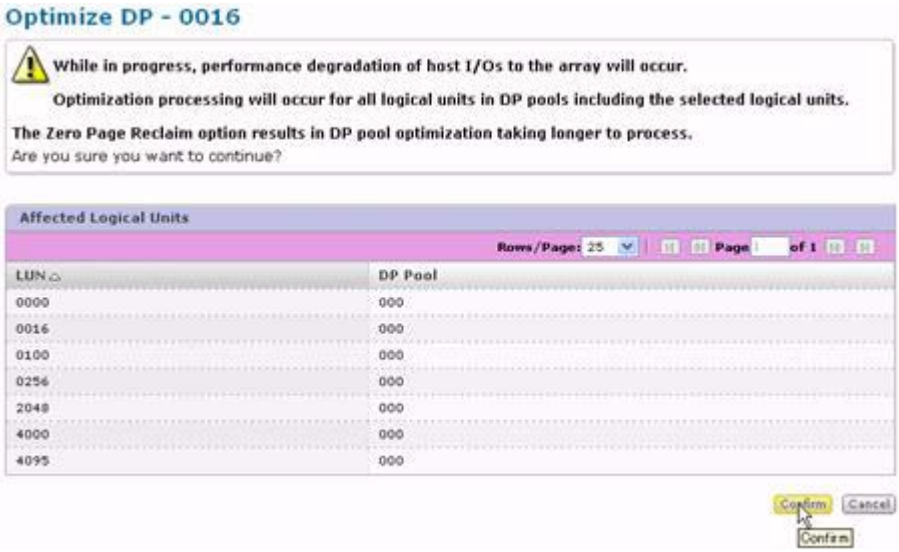
Optimizing the DP pool

To optimize the DP pool

1. From the **Performance** menu, select **DP Optimization**.
2. Select the LUN or LUNs for which you want to optimize in the DP pool. Selecting all LUNs in the DP pool will return any uneeded capacity from the DP-VOLs back to the DP pool and rebalance the entire DP pool across the DP RAID groups.
3. Click **Optimize DP**.
4. In the **DP Optimization Property** dialog box, specify the optimization options and click **OK**.



5. In the confirmation message, **Confirm** to continue.



6. When the operation finishes successfully, click **Close**.

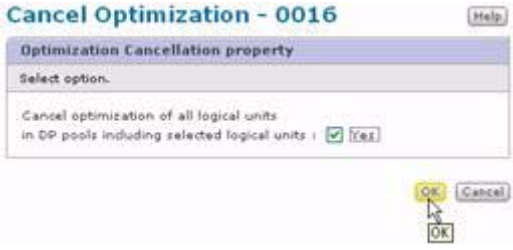
Canceling DP optimization

To cancel DP optimization

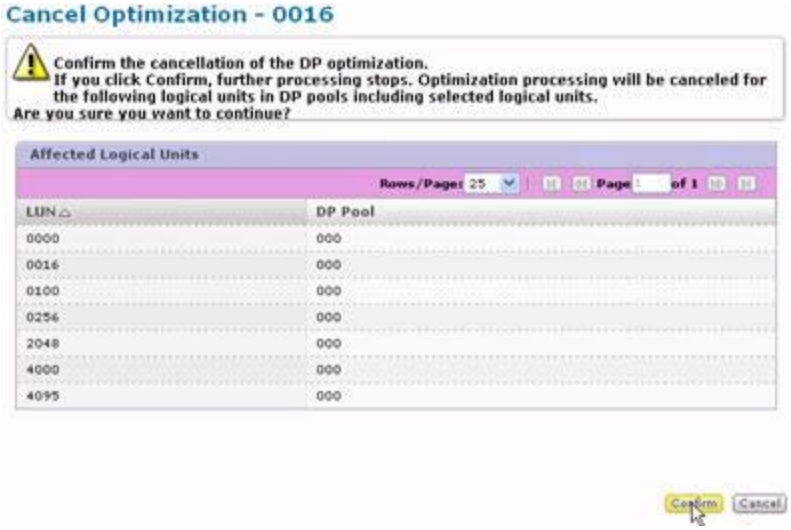
1. From the **Performance** menu, select **DP Optimization**.
2. Select the LUN or LUNs for which you want to cancel DP optimization
3. Click **Cancel Optimization**.

NOTE: If Optimization is cancelled, there will be some reclaimable capacity that has not been added back to the available pool capacity. Optimization must be run to completion, when convenient, to reclaim this capacity.

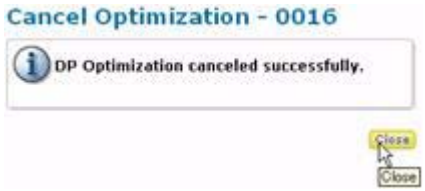
4. In the Optimization Cancellation property dialog box, specify the cancelation options and click **OK**.



5. In the confirmation message, click **Confirm** to continue.



6. When the operation finishes successfully, click **Close**.

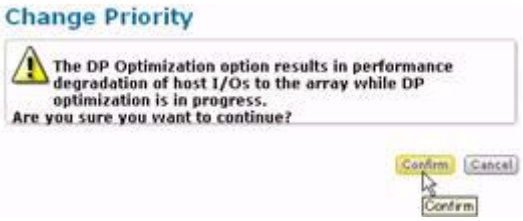


Changing optimization priority

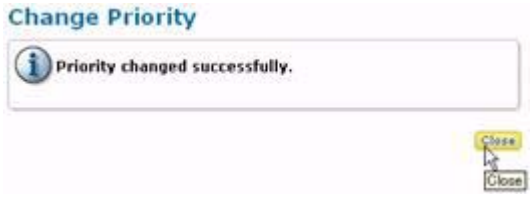
To change optimization priority

1. From the **Performance** menu, select **DP Optimization**.
2. Click **Change Priority**.
3. In the Priority Property dialog box, specify the priority option and click **OK**.

4. In the confirmation message, click **Confirm** to continue.



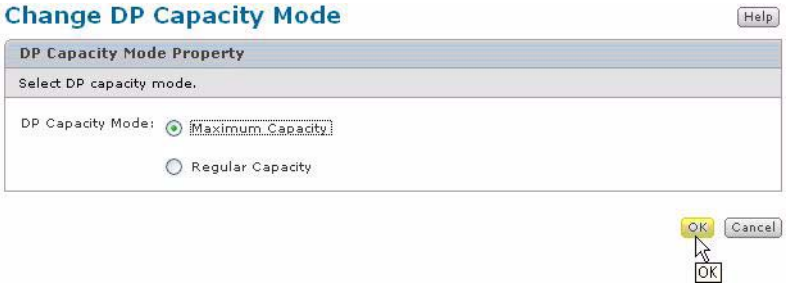
5. When the operation finishes successfully, click **Close**.



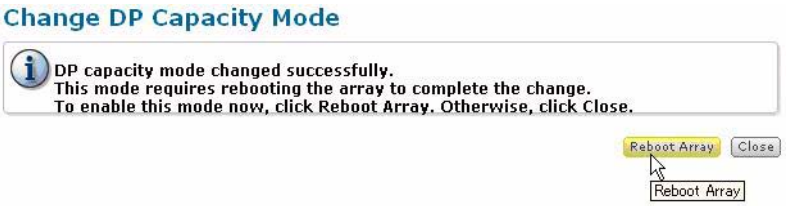
Changing DP capacity mode

To change the DP Capacity Mode when the array's hardware revision is 0200

1. From the **Performance** menu, select **DP Optimization**.
2. Click **Change Capacity Mode**. The Change DP Capacity Mode dialog box appears.



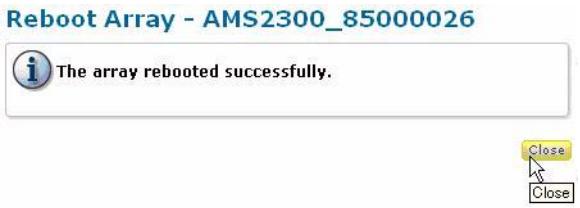
3. When the following message appears, click **Reboot Array**.



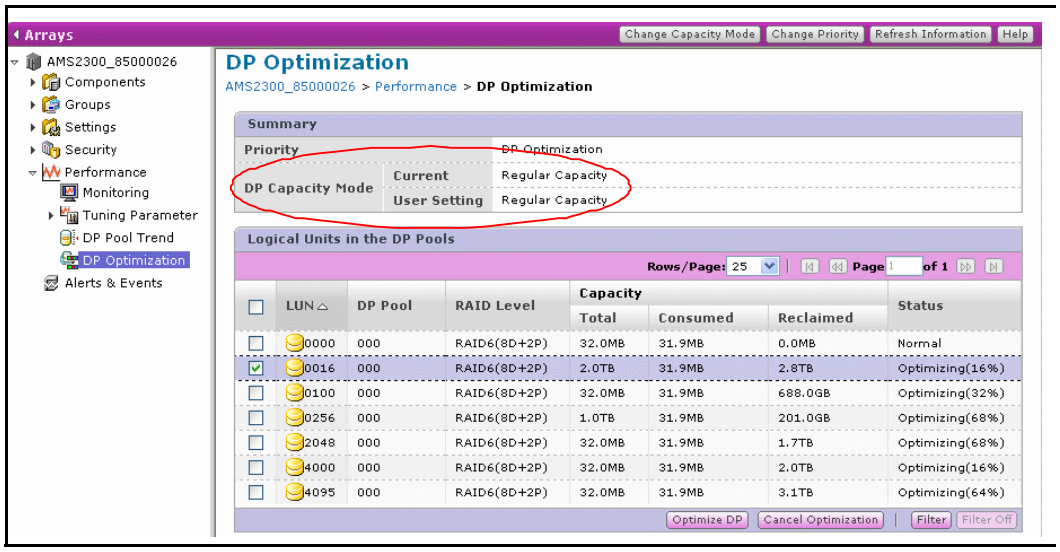
4. When a message confirms that the DP Capacity Mode changed, check the check box and click **Reboot Array**.

5. To set the option, be sure the host stops accessing data and then restart the storage system. The setting will not take effect when the system reboots. The storage system cannot access the host until the reboot completes and the system restarts. The restart usually takes from 4 to 15 minutes. However, it may take time for the storage system to respond, depending on its status. If it does not respond after 15 minutes or more, check the status of the storage system.

6. When a message states that the restart is successful, click **Close**.



7. After rebooting the array, confirm that the Current value of the DP Capacity Mode changed to the set mode in the DP Optimization screen. If it did not change to the set mode, reboot the array once again. If it has still not changed to the set mode, see Chapter 7, Troubleshooting.



Managing DP pool information

This section describes the following topics:

- Viewing DP pool trend information
- Exporting DP pool trend information

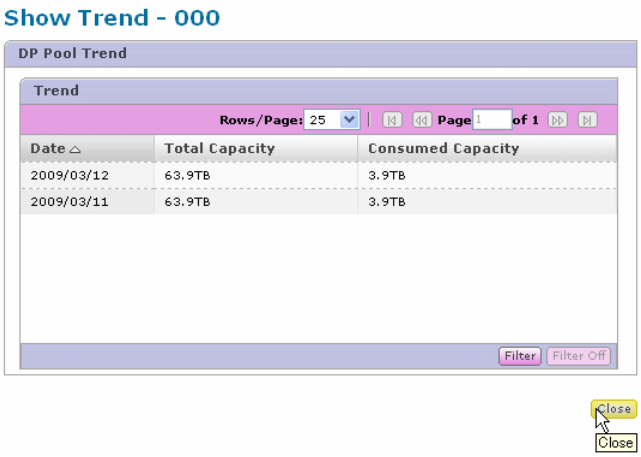
Viewing DP pool trend information

You can view information on the total and consumed capacity of a DP pool.

To view DP pool trend information

1. From the **Performance** menu, select **DP Pool Trend**.
2. In the DP Pool Trend window, select the **DP Pool** that you want to view, and click **Show Trend**.

3. In the DP Pool Trend window, review and confirm the trend information for the selected DP pool, then click **Close**.

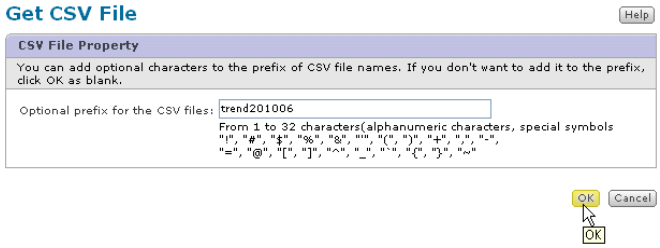


Exporting DP pool trend information

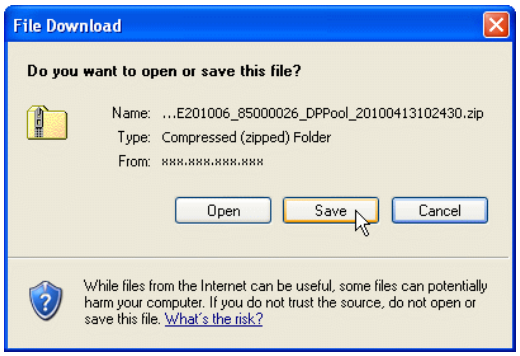
After viewing the DP pool trend information, you can export the information to a CSV file.

To export the DP pool trend information

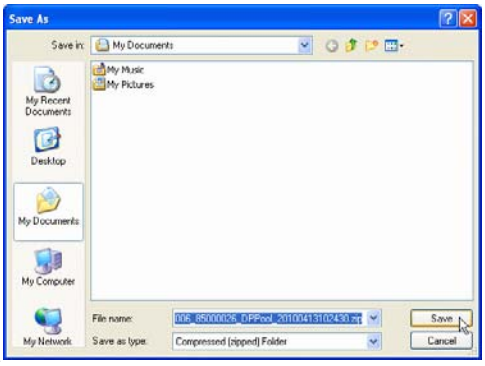
1. In the DP Pool Trend window, click **Get CSV File**.
2. Specify the prefix for the CSV file if necessary, and then click **OK**. The Get CSV File message appears.



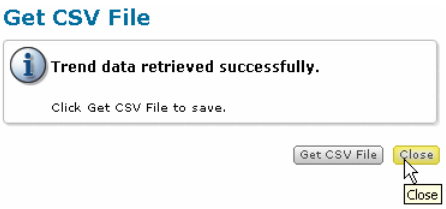
3. In the File Download dialog, click **Save**.



4. In the Save As dialog, specify the **Save in**, **File name** and **Save as type** information, and then click **Save**.



5. In the Save As dialog, specify the **Save in**, **File name**, and **Save as type** information, and then click **Save**.
6. When the Get CSV File message appears, click **Close**.



7. In the confirmation message, click **OK**. The information is saved in a Zip file.

Viewing DP pool trend information in the CSV file

After saving DP pool trend information in a CSV file, you can view the contents with a standard text editor.

To view DP pool trend information

1. Navigate to the folder where you saved the file and unzip the trend.zip file. The file contains the following three CSV text files.
   - Optional prefix_array serial number_DPPool_Consumed_yyyyMMddmmss.csv - this is the DP pool consumed capacity information
   - Optional prefix_array serial number_DPPool_LU_yyyyMMddmmss.csv - this is the DP-VOL information.
   - Optional prefix_array serial number_DPPool_Total_yyyyMMddmmss.csv - this is the total DP pool capacity information.
2. Use a standard text editor to view the contents of the CSV text files.
   - DP pool consumed capacity information output format:

Table 5-1: When One or More Items of the Trend Information Exist

DP Pool Consumed Capacity	File header
From:2009/04/14	Oldest trend collection day
To:2009/04/15	Most recent trend collection day
No.[1],Date[2],0,1,2,...,62,63[3]	Where: [1] Serial number [2] Collection date (Christian era, month, day) [3] DP pool number
0,2009/04/15,100,10000,900,...,100,1000	
1,2009/04/14, -,1000,900,...,100,1000	
2,2009/04/13, -,1000,900,..., -,1000	
	(DP pools currently defined are all output)
	The DP pools existed in the past but currently deleted are not output. When the information in the past does not exist, a hyphen is displayed. The unit of the displayed capacity is GB.

Table 5-2: When No Trend Information Exists (One or More items of the DP Pool Exist)

DP Pool Consumed Capacity	File Header
From:	Oldest trend collection day (The date column is blank)
To:	Most recent trend collection day (The date column is blank)
No.,Date,0,2	
---No Information---	A message is displayed (---No Information---) showing that there is no trend information.

Table 5-3: When No Trend Information Exists (No DP Pool Exists)

DP Pool Consumed Capacity	File Header
From:	Oldest trend collection day (The date column is blank)
To:	Most recent trend collection day (The date column is blank)
No.,Date	
---No Information---	A message is displayed (---No Information---) showing that there is no trend information.

- DP-VOL information output format:

Table 5-4: When One or More Items of the DP-VOL Exist

Logical Unit in the DP Pool	File Header
Date:2009/04/16	The output date of the CSV file
DP Pool[1],LUN[2],Total Capacity[3],Consumed(%)[4]	Where: [1] DP pool number (The DP pools in which the DP-VOLs are defined are all output) [2] LU number (The defined DP-VOLs belonging to the DP pool number are all output) [3] Capacity (The value converted into TB, GB, or MB is displayed to the first decimal place in units) [4] Usage (unit: %)
0,1,200.0GB,40	
0,1,1.5TB,40	
10,2,33.0MB,30	
10,13,300.0GB,10	

Table 5-5: When No DP-VOL Exists

Logical Unit in the DP Pool	File Header
Date:2009/04/16	The output date of the CSV file
DP Pool,LUN,Total Capacity,Consumed(%)	
---No Information---	A message is displayed (---No Information---) showing that there is no DP-VOL.

- Total DP pool capacity output format:

Table 5-6: When One or More Items of the Trend Information Exist

DP Pool Total Capacity	File Header
From:2009/04/14	Oldest trend collection day
To:2009/04/15	Most recent trend collection day
No.[1],Date[2],0,1,2,...,62,63[3]	Where: [1] Serial number [2] Collection date (Christian era, month, day) [3] DP pool number
0,2009/04/15,100,10000,900,...,100,1000	
1,2009/04/14, -,1000,900,...,100,1000	
2,2009/04/13, -,1000,900,..., -,1000	
	(DP pools currently defined are all output)
	The DP pools existed in the past but currently deleted are not output. When the information in the past does not exist, a hyphen is displayed. The unit of the displayed capacity is GB.

Table 5-7: When No Trend Information Exists (One or More Items of the DP Pool Exists)

DP Pool Total Capacity	File Header
From:	Oldest trend collection day (The date column is blank)
To:	Most recent trend collection day (The date column is blank)
No.,Date,0,2	
---No Information---	A message is displayed (---No Information---) showing that there is no trend information.

Table 5-8: When No Trend Information Exists (No DP pool Exists)

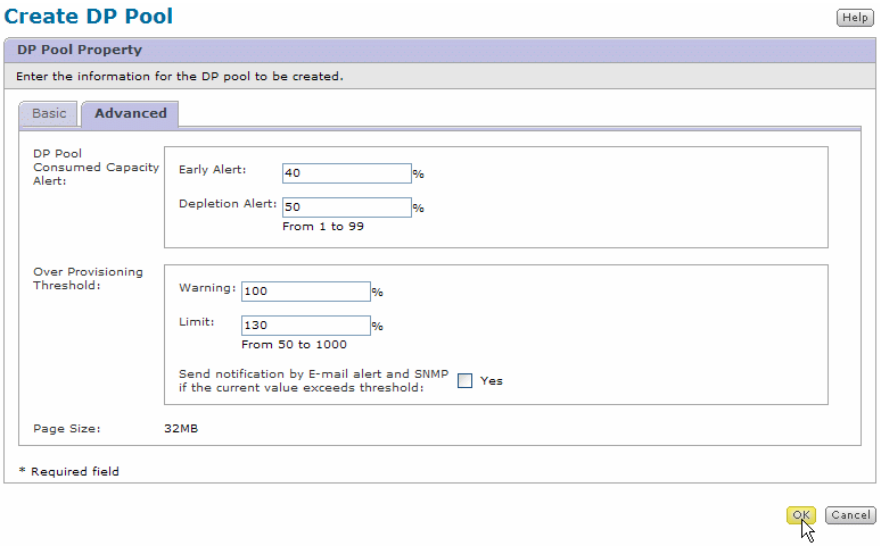
DP Pool Total Capacity	File Header
From:	Oldest trend collection day (The date column is blank)
To:	Most recent trend collection day (The date column is blank)
No.,Date	
---No Information---	A message is displayed (---No Information---) showing that there is no trend information.

Setting up e-mail notifications and SNMP traps

When the e-mail alert is turned on in Navigator 2, the system sends an e-mail alert warning that capacity is about to exceed threshold values.

To set up e-mail alerts and SNMP reporting

1. Open the DP Pool Property window.
2. Click the **Advanced** tab.



3. Check **Send notification by E-mail alert and SNMP if the current value exceeds threshold**.
4. Click **OK**.

6

CLI operations

This chapter provides procedures for performing Dynamic Provisioning operations from the command line using Navigator 2 Command Line Interface.

The following topics are covered in this chapter:

- Installing Dynamic Provisioning
- Managing DP pools from the command line
- Managing DP-VOLs from the command line
- Managing DP pool information
- Optimizing DP

Installing Dynamic Provisioning

Before installing Dynamic Provisioning, refer to the notes and prerequisites in Installing Dynamic Provisioning.

A key code or key file is required to install Dynamic Provisioning.

To install Dynamic Provisioning

1. From the command prompt, register the AMS storage system in which Dynamic Provisioning is to be installed, and then connect to the array.
2. Issue the **auopt** command to install Dynamic Provisioning. An example is shown below.

Example:

```
% auopt -unit array-name -lock off -keycode manual-attached-keycode
Are you sure you want to unlock the option?
 (y/n [n]): y
The option is unlocked.
In order to complete the setting, it is necessary to reboot the subsystem.
Host will be unable to access the subsystem while restarting. Host applications
that use the subsystem will terminate abnormally. Please stop host access before
 you restart the subsystem.
Also, if you are logging in, the login status will be canceled when restarting begins.
When using Remote Replication, restarting the remote subsystem will cause both
Remote Replication paths to fail.
Remote Replication pair status will be changed to “Failure(PSUE)” when pair status is
“Paired(PAIR)” or “Synchronizing(COPY)”. Please change Remote Replication
pair status to “Split(PSUS)” before restart.
Do you agree with restarting? (y/n [n]): y
Are you sure you want to execute? (y/n [n]): y
Now restarting the subsystem. Start Time hh:mm:ss Time Required 4 - 15min.
The subsystem restarted successfully.
%
```

3. Issue the **auopt** command to confirm whether Dynamic Provisioning has been installed. An example is shown below.

Example:

```
% auopt -unit array-name -refer
Option Name          Type          Term    Status
D_PROVISIONING     Permanent    ---      Enable
%
```

Dynamic Provisioning is installed and the status is Enabled. Installation of Dynamic Provisioning is now complete.

Enabling or disabling Dynamic Provisioning

Dynamic Provisioning can be enabled or disabled when it is installed.

Prerequisites for disabling Dynamic Provisioning

- When the DP-VOL is mapped, release the mapping information.
- Delete all the DP-VOLs (see Deleting a DP-VOL from a DP pool on page 6-10).
- Delete all the DP pools for Dynamic Provisioning (see Deleting a DP pool on page 6-7).

To enable or disable Dynamic Provisioning

1. From the command prompt, register the AMS storage system in which the status of the feature is to be changed, and then connect to the array.
2. Issue the **auopt** command to change the status (enable or disable). The following is an example of changing the status from enable to disable. To change the status from disable to enable, enter **enable** after the **-st** option.

Example:

```
% auopt -unit array-name -option D_PROVISIONING -st disable
Are you sure you want to disable the option?
 (y/n [n]): y
The option has been set successfully.
In order to complete the setting, it is necessary to reboot the subsystem.
Host will be unable to access the subsystem while restarting. Host applications
that use the subsystem will terminate abnormally. Please stop host access before you
restart the subsystem.
Also, if you are logging in, the login status will be canceled when restarting begins.
When using Remote Replication, restarting the remote subsystem will cause both
Remote Replication paths to fail.
Remote Replication pair status will be changed to “Failure(PSUE)” when pair status is
“Paired(PAIR)” or “Synchronizing(COPY)”. Please change Remote Replication
pair status to “Split(PSUS)” before restart.
Do you agree with restarting? (y/n [n]): y
Are you sure you want to execute? (y/n [n]): y
Now restarting the subsystem. Start Time hh:mm:ss Time Required 4 - 15min.
The subsystem restarted successfully.
%
```

3. Issue the **auopt** command to confirm whether the status has been changed. An example is shown below.

Example:

```
% auopt -unit array-name -refer
Option Name          Type           Term       Status
D_PROVISIONING     Permanent       ---         Disable
%
```

Enabling or disabling Dynamic Provisioning is now complete.

Uninstalling Dynamic Provisioning

To uninstall Dynamic Provisioning, the key code provided with the optional feature is required. Once uninstalled, Dynamic Provisioning cannot be used (locked) until it is again installed using the key code or key file.

Prerequisites

- When the DP-VOL is mapped, release the mapping information.
- Delete all the DP-VOLs (see Deleting a DP-VOL from a DP pool on page 6-10).
- Delete all the DP pools for Dynamic Provisioning (see Deleting a DP pool on page 6-7).

To uninstall Dynamic Provisioning

1. From the command prompt, register the AMS storage system in which Dynamic Provisioning is to be uninstalled, and then connect to the array.
2. Issue the **auopt** command to uninstall Dynamic Provisioning. An example is shown below.

Example:

```
% auopt -unit array-name -lock on -keycode manual-attached-keycode
Are you sure you want to lock the option?
 (y/n [n]): y
The option is locked.
In order to complete the setting, it is necessary to reboot the subsystem.
Host will be unable to access the subsystem while restarting. Host applications
that use the subsystem will terminate abnormally. Please stop host access before
 you restart the subsystem.
Also, if you are logging in, the login status will be canceled when restarting begins.
When using Remote Replication, restarting the remote subsystem will cause both
Remote Replication paths to fail.
Remote Replication pair status will be changed to “Failure(PSUE)” when pair status is
“Paired(PAIR)” or “Synchronizing(COPY)”. Please change Remote Replication pair
status to “Split(PSUS)” before restart.
Do you agree with restarting? (y/n [n]): y
Are you sure you want to execute? (y/n [n]): y
Now restarting the subsystem. Start Time hh:mm:ss Time Required 4 - 15min.
The subsystem restarted successfully.
%
```

3. Issue the **auopt** command to confirm whether Dynamic Provisioning has been uninstalled. An example is shown below.

Example:

```
% auopt -unit array-name -refer
DMEC002015: No information displayed.
%
```

Uninstalling Dynamic Provisioning is now complete.

Managing DP pools from the command line

The **audppool** command operates DP pool. To refer the **audppool** command and its options, type **audppool -help** or **auman audppool** at the command prompt.

This section discusses the following topics:

- Creating a new DP pool
- Changing DP pool thresholds
- Deleting a DP pool
- Reinitializing a DP pool
- Adding DP pool capacity

Creating a new DP pool

The time to create DP pools depends on the number and capacity of the DP pools to be created, the number and capacity of the HDUs to be added to the DP pool, etc. When creating many DP pools or adding HDUs of large capacity to the DP pool, it may take a long time to complete all the processing.

To create a DP pool

1. From the command prompt, issue the **audppool** command to create a DP pool using these settings:
   - Registered array name: AMS_2300
   - DP pool number: 0
   - RAID level: 6
   - Combination: 6D+2P
   - HDU type: SAS
   - HDU capacity: 300 GB
   - HDU selection method: Auto
   - HDU number (drive count; Specify as “Combination of pools concerned x 1"): 8
   - DP pool consumed capacity alert: Default settings
   - Over-provisioning threshold: Default settings

Example:

```
% audppool -unit AMS_2300 -add -dppoolno 0 -RAID6 -combination 6:2 -type SAS
        -drvcapa 300 -drive auto -drivecount 8 -notification enable
The drive will be selected automatically.
Are you sure you want to set a DP pool? (y/n [n]): y
The DP pool has been set successfully.
%
```

2. Issue the **audppool** command to confirm the created DP pool.

Example:

```
% audppool -unit AMS_2300 -refer -t
 DP    RAID
 Pool  Level       Total Capacity       Consumed Capacity       Type  Status
                                              Reconstruction Progress
   0    6( 6D+2P)          1.0 TB              0.0 TB      SAS   Normal
                                              N/A

%
```

Creating a DP pool is now complete. You can create a DP-VOL.

Changing DP pool thresholds

After creating a DP pool, the only DP pool attributes that can be changed are the threshold values.

To change DP pool thresholds

1. From the command prompt, issue the **audppool** command to change the DP pool attributes using these settings:
   - Registered array name: AMS_2300
   - DP pool number: 0
   - Depletion Alert: 50%

Example:

```
% audppool -unit AMS_2300 -chg -dppoolno 0 -depletion_alert 50

Are you sure you want to change the DP pool attribute? (y/n [n]): y
DP pool attribute changed successfully.
%
```

2. Issue the **audppool** command to confirm the DP pool attribute.

Example:

```
% audppool -unit AMS_2300 -refer -detail -dppoolno 0 -t
DP Pool : 0
  RAID Level                : 6(6D+2P)
  Page Size                 : 32MB
  Type                      : SAS
  Status                    : Normal
  Reconstruction Progress : N/A
  Total Capacity            : 1.0 TB
  Consumed Capacity         : 0.0 TB
  DP Pool Consumed Capacity Alert
    Early Alert             : 40%
    Depletion Alert   : 50%
  Over Provisioning Threshold
    Warning                 : 100%
    Limit                   : 130%
    Notification            : Enable
  Defined LU Count          : 0
  Drive Configuration
    DP RAID Group    Unit  HDU  Type  Capacity  Status
      0( 6D+2P)        0    0  SAS   300GB     Standby
      0( 6D+2P)        0    1  SAS   300GB     Standby
       :
       :
  Logical Unit
                          Consumed                Stripe         C
ache         PairCache
    LU      Capacity          Capacity       Consumed %  Size           P
artition      Partition  Status

%
```

Deleting a DP pool

Usually only one DP pool is deleted in normal practice. However, it is possible to delete multiple DP pools at the same time, if needed.

NOTE: Before deleting a DP pool, delete all the DP-VOLs defined to the DP pool (see Deleting a DP-VOL from a DP pool on page 6-10).

To delete a DP pool

1. From the command prompt, issue the **audppool** command to delete a DP pool using these settings. To delete two or more DP pools, enter a space between a pool number.
   - Registered array name: AMS_2300
   - DP pool number: 2

Example:

```
% audppool -unit AMS_2300 -rm -dppoolno 2
Are you sure you want to delete the specified DP pool(s)? (y/n [n]): y
The DP pool 2 has been deleted.
DP pool(s) have been deleted successfully.
%
```

Reinitializing a DP pool

You can recover a DP pool to reset the DP pool after a failure. This is an abnormal operation and should be performed with care. Before attempting to recover a DP pool, you should back up all important data and stop host access to the AMS storage system.

If the DP-VOL is blocked due to an HDU failure, recover the HDU in which the failure occurs. If the status of the DP-VOL is unformatted, perform the LU format.

To recover a DP pool

From the command prompt, issue the **audppool** command to reinitialize a DP pool using these settings:

- Registered array name: AMS_2300
- DP pool number: 2

Example:

```
% audppool -unit AMS_2300 -recover -dppoolno 2
Confirm DP pool reinitialization.
If you reinitialize the DP pool, you will not be able to recover your data.
Please backup all important data before performing this operation.
When you reinitialize a DP pool, the data becomes unusable. Systems or applicati
ons that use this array may terminate unexpectedly. Please make sure to stop the
 host access to the array before performing this operation.
Are you sure you want to reinitialize the specified DP pool? (y/n [n]): y
Start the DP pool reinitialization.
%
```

Adding DP pool capacity

You can grow DP pool capacity by adding DP RAID groups to the DP pool. The total amount of capacity of the DP RAID groups registered in the DP pool is the capacity of that DP pool. Monitor the free capacity of the usable DP pool, and grow the DP pool as needed.

To add DP pool capacity

From the command prompt, issue the **audppool** command to add DP pool capacity using these settings:

- Registered array name: AMS_2300
- DP pool number: 2

- Adding HDU number (drive count; specify as “Combination of pools concerned x 1”): 8

Example:

```
% audppool -unit AMS_2300 -chgsize -dppoolno 2 -drivecount 8
Are you sure you want to add the capacity of DP pool? (y/n [n]): y
The capacity of DP pool has been added successfully.
%
```

2. To optimize the DP pool when adding DP pool capacity, specify the **-dpoptimize** option in the **audppool** command.

Example:

```
% audppool -unit AMS_2300 -chgsize -dppoolno 2 -drivecount 8 -dpoptimize
Are you sure you want to add the capacity of DP pool? (y/n [n]): y
DP optimization (rebalancing) automatically executes for all logical units in
this DP pool after capacity is added.
While in progress, performance degradation of host I/Os to the array occurs.
Do you want to continue processing? (y/n [n]): y
The capacity of DP pool has been added successfully.
%
```

Managing DP-VOLs from the command line

Use the **auluadd**, **auluref**, **auludel**, and/or **aulusizechg** commands to operate the DP-VOL. To refer to the commands and their options, at the command prompt, type **command name -help** or **auman command name**.

This section discusses the following topics:

- Creating a DP-VOL
- Deleting a DP-VOL from a DP pool
- Changing DP-VOL capacity

Creating a DP-VOL

To create a DP-VOL

1. From the command prompt, issue the **auluadd** command to create a DP-VOL using these settings:
   - Registered array name: AMS_2300
   - DP pool number: 0
   - DP-VOL capacity: 500 GB
   - LUN: 1000

Example:

```
% auluadd -unit AMS_2300 -lu 1000 -size 500g -dppoolno 0
Are you sure you want to set the logical unit?
 (y/n [n]): y
The logical unit has been set successfully.
%
```

2. Issue the **auluref** command to confirm the DP-VOL is created.

Example:

```
% auluref -unit AMS_2300 -g
                  Stripe  RAID     DP    RAID
  LU      Capacity      Size     Group    Pool    Level          Type    Status
 1000      500.0 GB      256KB    N/A       0      6( 6D+2P)     SAS     Normal
%
```

Deleting a DP-VOL from a DP pool

By deleting a DP-VOL from a DP pool, the DP pool area that the DP-VOL was using is released, increasing the free capacity of the DP pool. The areas assigned to the DP-VOL are also formatted.

To delete a DP-VOL

From the command prompt, issue the **auludel** command using the following settings:

- Registered array name: AMS_2300
- LUN: 1000

Example:

```
% auludel -unit AMS_2300 -lu 1000
The specified logical unit(s) will be deleted.
The specified logical unit(s) have already been formatted.
Are you sure you want to delete the specified logical unit(s)? (y/n [n]): y
If you delete the logical unit(s), you will not be able to recover your data, Please make
sure to perform backup of all important data before this operation.
When you delete your logical unit, the data becomes unusable. Systems or
applications that use this subsystem will terminate abnormally. Please make sure to
stop host access to the subsystem before performing this operation.
Are you sure you want to delete the specified logical unit(s)? (y/n [n]): y
The specified logical unit(s) will be deleted.
Are you sure you want to execute? (y/n [n]): y
The logical unit 1000 has been deleted.
The logical unit(s) have been deleted successfully.
%
```

Changing DP-VOL capacity

You can increase or decrease the capacity of the DP-VOL in which the AMS storage system is operational. The procedure to change the capacity of the DP-VOL is the same as for changing capacity for a normal LU.

To change the DP-VOL capacity

1. From the command prompt, issue the **auluchgsize** command using these settings:
   - Registered array name: AMS_2300
   - LUN: 1000
   - New size: 1 TB:

Example:

```
% auluchgsize -unit AMS_2300 -lu 1000 -size 1t
Are you sure you want to grow the logical unit?
(y/n [n]): y
The logical unit has been grown successfully.
%
```

2. To optimize the DP pool when reducing DP-VOL capacity, specify the **-dpoptimize** option in the **auluchgsize** command.

Example:

```
% auluchgsize -unit AMS_2300 -lu 1000 -size 500g -dpoptimize
Are you sure you want to shrink the logical unit? (y/n [n]): y
DP optimization automatically executes for this logical unit after reducing
(shrinking) logical unit capacity.
While in progress, performance degradation of host I/Os to the array occurs.
Do you want to continue processing? (y/n [n]): y
If you shrink the logical unit, you will not be able to recover your data for the
reduction. Please make sure to perform backup of all important data before this
operation.
When you shrink the logical unit, the data becomes unusable. Systems or applications
that use this array will terminate abnormally. Please make sure to stop the host access
to the array before performing this operation.
Are you sure you want to shrink the logical unit? (y/n [n]): y
The specified logical unit will be shrunk.
Are you sure you want to execute? (y/n [n]): y
The logical unit has been shrunk successfully.
%
```

3. Issue the **auluref** command to confirm the DP-VOL has been grown or shrunk.

Example:

```
% auluref -unit AMS_2300 -g
                    Stripe      RAID     DP      RAID
LU      Capacity    Size        Group    Pool    Level         Type    Status
1000   1024.0 GB    256KB       N/A      0       6( 6D+2P)     SAS     Normal
```

Managing DP pool information

The **audptrend** command operates the DP pool trend information. To refer to the command and its options, at the command, type **audptrend -help** or **auman audptrend**.

This section discusses the following topics:

- Viewing DP pool trend information
- Saving DP pool trend information to a file

Viewing DP pool trend information

To view the DP pool trend information

From the command prompt, issue the **audptrend** command using these settings:

- Registered array name: AMS_2300
- DP pool number: 0

Example:

```
% audptrend -unit AMS_2300 -refer -dppoolno 0
DP Pool   : 0
                Total      Consumed
  Date        Capacity    Capacity
  2009/03/15    63.9 TB     4095 GB
  2009/03/14    63.9 TB     4095 GB
```

Saving DP pool trend information to a file

To output the DP pool trend information to a file

From the command prompt, issue the **audptrend** command using these settings:

- Registered array name: AMS_2300
- Array serial number: 85001234
- Output destination: C:\tmp

Example:

```
% audptrend -unit AMS_2300 -export -path C:\tmp
The trend of DP pool will be output to the file.
Are you sure you want to continue? (y/n [n]): y
The trend of DP pool has been outputted to the file.
Output File Name : 85001234 DPPool LU_20090316072440.CSV
Output File Name : 85001234_DPPool_Total_20090316072440.CSV
Output File Name : 85001234 DPPool_Consumed_20090316072440.CSV
%
```

When you specify the prefix for the CSV file (in this example, the prefix characters are trend201006):

```
% audptrend -unit AMS_2300 -export -path C:\tmp -prefix trend201006
The trend of DP pool will be output to the file.
Are you sure you want to continue? (y/n [n]): y
The trend of DP pool has been outputted to the file.
Output File Name : trend201006_85000026_DPPool_LU_20100413104807.CSV
Output File Name : trend201006_85000026_DPPool_Total_20100413104807.CSV
Output File Name :
trend201006_85000026_DPPool_Consumed_20100413104807.CSV
%
```

Optimizing DP

The **audpoptimize** command performs the DP pool optimization. To refer the command and its options, type **audpoptimize -help** or **auman audpoptimize** at the command prompt.

This section discusses the following topics:

- Canceling DP optimization
- Checking the progress of DP optimization
- Changing optimization priority

Optimizing the DP pool

To optimize the DP pool

1. From the command prompt, issue the **audpoptimize** command using these settings:
   - Registered array name: AMS_2300
   - DP-VOLs LUN: 2 and 3

Example:

```
% audpoptimize -unit AMS_2300 -start -lu 2 3
Are you sure you want to start the DP optimization? (y/n [n]): y
While in progress, performance degradation of host I/Os to the array will occur.

Do you want to continue processing? (y/n [n]): y
The DP optimization started successfully.
```

2. To reclaim the zero page, issue the **audpoptimize** command adding the **-zeropagereclaim** option.

Example:

```
% audpoptimize -unit AMS_2300 -start -lu 2 3 -zeropagereclaim
Are you sure you want to start the DP optimization? (y/n [n]): y
While in progress, performance degradation of host I/Os to the array will occur.

The Zero Page Reclaim option results in DP pool optimization taking longer to process.
Do you want to continue processing? (y/n [n]): y
The DP optimization started successfully.
%
```

3. To optimize all DP-VOLs, issue the **audpoptimize** command adding the **-allindppool** option. If you specify the normal LU, a command error occurs.

Example:

```
% audpoptimize -unit AMS_2300 -start -lu 2 3 -allindppool
Are you sure you want to start the DP optimization? (y/n [n]): y
While in progress, performance degradation of host I/Os to the array will occur.

Optimization processing will occur for all logical units in DP pools including t
he specified logical units.
  LUN   DP Pool
    2        0
    3        0
Do you want to continue processing? (y/n [n]): y
The DP optimization started successfully.
```

Canceling DP optimization

To cancel the DP optimization

1. From the command prompt, issue the **audpoptimize** command adding the **-cancel** option.

Example:

```
% audpoptimize -unit AMS_2300 -cancel -lu 2 3
Are you sure you want to cancel the DP optimization? (y/n [n]): y
The DP optimization has been canceled successfully.
```

Checking the progress of DP optimization

To check the progress of DP optimization

1. From the command prompt, issue the **audpoptimize** command adding the **-referl** option.

Example:

```
% audpoptimize -unit AMS_2300 -refer
Priority : DP Optimization
DP Capacity Mode
 Current      : N/A
 User Setting : N/A
       DP    RAID        Total     Consumed   Reclaimed
 LUN   Pool  Level       Capacity  Capacity   Capacity     Status
   2     0   6( 8D+2P)    2.0 TB    8.0 GB    0.0 MB     Normal
   3     0   6( 8D+2P)    1.0 TB  512.0 GB    0.0 MB     Optimizing(34%)
%
```

Changing optimization priority

To change optimization priority

1. From the command prompt, issue the **audpoptimize** command adding the **-chg** and **-priority** options.

Example:

```
% audpoptimize -unit AMS_2300 -chg -priority host
Are you sure you want to change the priority of DP optimization? (y/n [n]): y
The DP optimization option results in performance degradation of host I/Os to the
array while DP optimization is in progress.
Do you want to continue processing? (y/n [n]): y
The priority of DP optimization has been changed successfully.
%
```

Changing DP capacity mode

To change the DP Capacity Mode when the array's hardware revision is 0200

1. From the command prompt, issue the **audpoptimize** command with the **-chg** and **-capacitymode** options:

Example:

```
% audpoptimize -unit AMS_2300 -chg -capacitymode maximum
Are you sure you want to change the DP capacity mode? (y/n [n]): y
The DP capacity mode has been changed successfully.
In order to complete the setting, it is necessary to reboot the subsystem.
Host will be unable to access the subsystem while restarting. Host applications
that use the subsystem will terminate abnormally. Please stop host access before
 you restart the subsystem.
Also, if you are logging in, the login status will be canceled when restarting b
egins.
When using Remote Replication, restarting the remote subsystem will cause both R
emote Replication paths to fail.
Remote Replication pair status will be changed to "Failure(PSUE)" when pair stat
us is "Paired(PAIR)" or "Synchronizing(COPY)". Please change Remote Replication
pair status to "Split(PSUS)" before restart.
Do you agree with restarting? (y/n [n]): y
Are you sure you want to execute? (y/n [n]): y
Now restarting the subsystem. Start Time hh:mm:ss Time Required 4 - 15min.
The subsystem restarted successfully.
%
```

2. After rebooting the array, confirm that the Current value of the DP Capacity Mode changed to the set mode in the DP Optimization screen. If it did not change to the set mode, reboot the array once again. If it has still not changed to the set mode, see Chapter 7, Troubleshooting.

Example:

```
% audpoptimize -unit AMS_2300 -refer
Priority : DP Optimization
DP Capacity Mode
 Current        : Regular Capacity
 User Setting : Maximum Capacity
         DP    RAID         Total      Consumed   Reclaimed
  LUN    Pool  Level        Capacity   Capacity   Capacity      Status
    2     0    6( 8D+2P)     2.0 TB     8.0 GB     0.0 MB     Normal
    3     0    6( 8D+2P)      1.0 TB     512.0 GB   0.0 MB     Optimizing(34%)
%
```

7

Troubleshooting

Table 7-1 provides troubleshooting information for Dynamic Provisioning operations.

Table 7-1: Troubleshooting for Dynamic Provisioning

Problems	Causes and Solutions
Cannot install Dynamic Provisioning.	Cause: • The necessary cache memory is not installed. Solution: • Install the cache memory necessary for installing Dynamic Provision.
DP pool usage rate exceeds the threshold value(s).	Causes: • The amount of pool capacity consumed by all the DP-VOLs is large. • DP pool capacity is too low. • The threshold value of the DP pool is too small. Solutions: • Increase the DP pool capacity (see Adding DP pool capacity on page 6-8). This approach may require installation of new HDUs. • Increase the threshold value of the DP pool (see Changing DP pool thresholds on page 5-4). • You may delete unnecessary DP-VOLs. This frees up capacity in the DP pool. If the free capacity of the DP pool is insufficient, back up the data residing on the DP-VOL by copying it to the normal LU, then delete the DP-VOL.
The Over Provisioning percent exceeds the threshold value(s).	Cause: • The total logical capacities of the DP-VOLs is greater than the Over Provisioning thresholds percentages times the DP Pool capacity. Solutions: • Increase the DP pool capacity (see Adding DP pool capacity on page 6-8). • Increase the Over Provisioning threshold value(s) of the DP pool (see Changing DP pool thresholds on page 5-4). • Shrink the logical capacity of DP-VOLs that have been unnecessarily made too large (see Changing DP-VOL capacity on page 5-11). Note that shrinking the logical capacity of a DP-VOL can make the LUN unusable and lose data.

Table 7-1: Troubleshooting for Dynamic Provisioning (Continued)

Problems	Causes and Solutions
Cannot create the DP-VOL.	Cause: • The DP pool has been completely depleted. • The DP-VOL deletion processing of the target DP-VOL number is running in the background. Solution: • Add capacity to the DP pool. Contact the Hitachi Data Systems Technical Support Center. • Wait 10 minutes and then perform the processing again. If it still cannot be created, contact the Hitachi Data Systems Technical Support Center.
Cannot add a DP pool.	Causes: • The HDU requirements by the DP pool cannot be met. • The DP pool is blocked. Solutions: • Check whether the available HDUs meet the requirements of the DP RAID group for the DP pool (see DP-VOL and DP pool requirements on page 3-2). • Contact the Hitachi Data Systems Technical Support Center.
A DP pool is blocked. You cannot make pool modifications.	Cause: • A failure occurred in two or more HDUs. (RAID 6 would be the “more” situation. Blocked will appear as I/O errors.) Solution: • Contact the Hitachi Data Systems Technical Support Center.
A DP-VOL is blocked.	Cause: • A failure occurred in two or more HDUs. Solutions: • Check whether the DP pool for which the DP-VOL is defined is blocked. • Contact the Hitachi Data Systems Technical Support Center.
A DP pool cannot be recovered.	Causes: • The blocked part in the AMS storage system is still undergoing recovery operations. • A DP pool is blocked. Solutions: • After waiting for a while, click Refresh Information on the upper right of the HSNM2 window, and then check the DP pool status in the DP Pool window. • Contact the Hitachi Data Systems Technical Support Center.
An error occurred in the host application using a DP-VOL.	Causes: • Free space of the DP pool is insufficient. • A blocked DP pool. • A DP-VOL capacity is insufficient. Solution: • Check the free capacity of the DP pool and increase the DP pool capacity. • Grow a DP-VOL capacity. • Contact the Hitachi Data Systems Technical Support Center.

Table 7-1: Troubleshooting for Dynamic Provisioning (Continued)

Problems	Causes and Solutions
When the host computer tries to access the port, an error occurs and the host cannot access the port.	Cause: • A blocked part is in the DP pool concerned. • A controller is blocked. Solution: • Contact the Hitachi Data Systems Technical Support Center.
When you are operating Navigator 2, a time out occurs frequently.	Cause: • The load on the AMS storage system is too heavy such that Navigator 2 computer cannot respond to the AMS storage system. • The period of time until when time-out occurs is set too short. Solution: • Wait a while, then try the operation again. • Increase the time-out period in Navigator 2.
A DP-VOL capacity cannot be increased or shrunk.	Solution: • The Over Provisioning Limit threshold has been reached. Retry the operation in about 10 minutes. • Contact the Hitachi Data Systems Technical Support Center.
Backup and restore of a DP-VOL consumes capacity.	When using Dynamic Provisioning, if restore is performed from the backup data, the actual capacity defined as the DP-VOL is consumed. To use Dynamic Provisioning effectively, either perform the copy in file units from the application to the DP-VOL or use the zero page reclaim feature of Optimize after restoring the LU.
DP pool cannot be optimized (expected capacity cannot be reclaimed).	Cause: • Competing with host I/Os. • The processing to reclaim the capacity failed. There is insufficient free capacity in the pool to support the optimize operation. Solution: • Perform the optimization when host I/Os load is light. • If there is no host I/O, the capacity is reclaimed as time goes by. The standard time to wait for reclaiming capacity when optimization completes is shown below. 10 GB: about 3 minutes 100 GB: about 30 minutes • Add capacity to the pool (additional DP RAID group).
DP pool optimization ended abnormally	Cause: • DP pool is blocked. • DP pool capacity was consumed. • De-stage timeout of the DP management information occurred. Solution: • Add capacity to the pool. Contact the Hitachi Data Systems Technical Support Center.

Table 7-1: Troubleshooting for Dynamic Provisioning (Continued)

Problems	Causes and Solutions
DP pool optimization is not started (optimization status is still Pending)	Cause: • After adding capacity to a DP pool, the DP pool formatting operation may still be executing. • An optimization process for a DPVOL to reclaim pool capacity is underway. The optimization process may be due to shrinking the DPVOL logical capacity. This optimization operation formats pages before they are released to the pool free capacity. • Optimization processing preparation phase will take more time, as the Pool used capacity increases. Solution: • Check the DP pool status and confirm that DP pool formatting is completed. If not, wait until it completes. The DP pool optimization starts automatically after the format operation has completed. • The typical time to format pages after reducing the mapped capacity of a DPVOL is about 100 GB per hour. The DP pool optimization automatically starts after the format operation has completed. • The typical time to prepare the optimization operation depends on the amount of pool capacity used. This amount of time is about .5 TB per hour. The DP pool optimization starts automatically after the preparation phase has completed.
DP pool optimization status (Suspended(100%)	Cause: • Displayed when waiting for the final processing during optimization completion processing. This is not an abnormal status. Solution: • The status recovers in about 10 seconds. Wait a minute or two and then check the status again.
The DP capacity mode cannot be changed	Cause: • The storage system is not rebooted. • The storage system is not supporting the DP capacity mode (hardware revision is 0100). • The cache memory capacity is insufficient. Solution: • Reboot the storage system. • Confirm the storage system revision supporting the DP capacity mode (hardware revision is or is not 0200). • Increase the cache memory capacity.

If you cannot solve a problem using the above suggestions, or if you encounter a problem not listed, please contact the Hitachi Data Systems Technical Support Center (see Accessing product documentation).

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