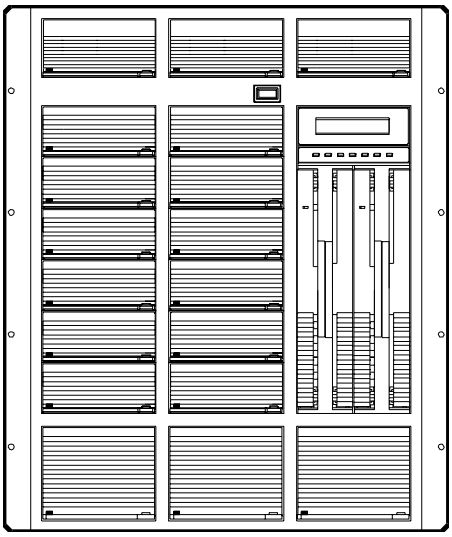
HP SureStore E Disk Array 12H

System Administrator's Guide for HP-UX, MPE, and Microsoft® Windows NT®



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Typographical Conventions

NOTE! Notes contain important information.

CAUTION! Caution messages indicate procedures which, if not observed, could result in damage to your equipment or loss of your data.

WARNING! Warning messages indicate procedures or practices which, if not observed, could result in personal injury.

About this Book

This book describes the tasks and tools involved in managing the HP SureStore E Disk Array 12H on HP-UX, MPE, and Windows NT®. This material is intended for system administrators and others involved in the installation, operation, and management of network storage. The content of this book is organized as follows:

The first section describes the tasks involved in managing the HP SureStore E Disk Array 12H on HP-UX.

- Chapter 1 provides an overview of the management tools, system requirements, and software installation.
- Chapter 2 describes how to use the HP-UX System Administration Manager (SAM) to manage the disk array.
- Chapter 3 describes how to manage the disk array using the HP-UX ARM command line utilities.
- Chapter 4 explains how to use the ARDIAG Offline Diagnostic to isolate and solve disk array problems.

The next section describes the tasks involved in managing the HP SureStore E Disk Array 12H on MPE.

- Chapter 5 provides an overview of the management tools, system requirements, and software installation.
- Chapter 6 describes how to manage the disk array using the MPE ARM command line utilities.
- Chapter 7 explains how to use the ARDIAG Offline Diagnostic to isolate and solve disk array problems.

The last section describes management of the HP SureStore E Disk Array 12H on Windows NT.

- Chapter 8 provides an overview of the system requirements and software installation.
- Chapter 9 describes how to use the AutoRAID Manager for Windows to manage the disk array.
- Chapter 10 describes how to manage the disk array using the Windows NT ARM command line utilities.

During installation of the AutoRAID Manager for Windows NT software, an electronic copy of this book in Adobe® Acrobat® format is included in the `Program Files\AutoRAID\Doc` directory (default location).

Supporting Documentation

The following documentation is included with the HP SureStore E Disk Array 12H and should be available for reference when installing and managing the disk array.

- *HP SureStore E Disk Array 12H User's and Service Manual*, part number C5445-90901

For Windows NT users, an electronic copy of this book in Adobe® Acrobat® format is included in the `Program Files\AutoRAID\Doc` directory.

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HP on the World Wide Web

The latest information about your HP SureStore E Disk Array 12H is available on the HP web site at www.hp.com/go/support

Check our web site for

- Updated editions of product documentation
- Firmware and software upgrades
- Current supported system configurations
- General information for optimizing the operation of your disk array

Table of Contents

Chapter 1. Managing the HP SureStore E Disk Array 12H on HP-UX

This chapter introduces the tools available for managing your HP SureStore E Disk Array 12H on HP-UX. These tools provide complete control over all aspects of disk array operation.

The following information is included in this chapter:

- A brief description of each management tool
- Which tools can be used for each management task.
- Instructions for installing the disk array management software

Disk Array Management Tools

Three disk array management tools are available for managing the disk array — two online tools and the disk array control panel.

System Administration Manager (SAM)

Most of the common tasks involved in managing the disk array can be performed using the HP-UX System Administration Manager, or SAM. This allows you to manage the host system and the disk array using the same tool.

AutoRAID Management (ARM) utilities

Included with the disk array is a set of ARM utilities, which provide advanced capabilities for managing the disk array. Although you will primarily use SAM to manage the disk array, you will need to use the ARM utilities to perform functions such as formatting or diagnostics.

Disk array control panel

An alternative to the online management tools is the disk array control panel. Although you can use the disk array control panel to perform most of the management tasks available through the ARM utilities, the added convenience and functionality provided by SAM and the ARM utilities make them better tools for managing the disk array.

Which Tools to Use for Each Task

The various management tasks have been divided between SAM and the command- line utilities. In general, the more common tasks are available from SAM while the more advanced tasks are performed from the ARM utilities. Most tasks can also be performed using the disk array control panel.

Table 1. Tools and Tasks

Tasks	Tools		
	SAM	ARM Utilities	Control Panel
Including a disk	Yes	Yes (arraycfg)	Yes
Checking disk array status	Yes	Yes (arraydsp)	Yes
Creating/deleting LUNs	Yes	Yes (arraycfg)	Yes
Renumbering LUNs	No	Yes (arraycfg)	Yes
Starting/canceling a Rebuild	No	Yes (arrayrbld)	Yes
Downing (excluding) a disk	Yes	Yes (arraycfg)	No
Formatting a LUN or array	No	Yes (arrayfmt)	Yes
Shutting down the disk array	No	Yes (arraymgr)	Yes
Changing operating settings	Yes	Yes (arraymgr)	Yes
Changing SCSI settings	No	Yes (arraymgr)	Yes
Monitoring performance	No	Yes (arraydsp)	No
Switching primary controller	Yes	Yes (arraymgr)	Yes
Testing a disk	No	Yes (drivetest)	No
Displaying disk test results	No	Yes (dteststat)	No
Displaying disk array serial numbers	Yes	Yes (arraydsp)	Yes
Changing controller SCSI ID	No	Yes (arraymgr)	Yes
Resetting/restarting the disk array	No	Yes (arraymgr)	Yes
Setting data resiliency	No	Yes (arraymgr)	No
Creating a disk array alias	No	Yes (arraymgr)	No
Recovering data maps	No	Yes (arrayrecover)	Yes

Installing the Disk Array Management Software

The AutoRAID Manager (ARM) disk array management software is distributed on the IPR (Independent Product Release) CD-ROM (B6191AA). The IPR CD-ROM should have been ordered and delivered with your disk array.

The IPR CD-ROM includes an instruction sheet for installing the software. Follow the instructions to install the ARM software.

NOTE! The HP SureStore E Disk Array 12H disk array requires IPR CD-ROM release IPR9810 or later. Earlier releases of the IPR CD-ROM do not contain the required software.

At the time of printing the following ARMServer patches were available:

PHCO_15699 for HP-UX 10.X
PHCO_15700 for HP-UX 11.0

The latest patches are available from the HP Patch web site:
(www.hp.com/go/support)
which will indicate if the above patches have been superceded.

Operating System Support

The HP SureStore E Disk Array 12H is currently supported on the following HP-UX releases:

- 10.01
- 10.10
- 10.20
- 11.0

IPR Program

To provide you with the latest software patches and drivers, Hewlett-Packard offers the Independent Product Release (IPR) program. As a subscriber to this program you will receive a complete collection of all updated patches and drivers at regular intervals, thus ensuring you always have the latest software. Using the latest software upgrades will ensure optimal performance of the disk array and other hardware peripherals.

Contact your Hewlett-Packard sales representative for more details on subscribing to the IPR program.

Tips for Configuring the Disk Array On HP-UX

Before installing a new disk array, you should determine what is more important for your operating environment — performance or capacity. This decision will influence how you configure the disk array hardware and LVM. There are several configuration options that impact the performance of the disk array. Table 2 identifies the various configuration options, their impact on disk array performance, and any considerations regarding disk array capacity.

NOTE! Overall system performance is a complex issue influenced by many factors. The configuration options described here will increase the *potential* performance of the disk array. However, the actual performance of the disk array will be determined largely by host demand. AutoRAID technology is particularly suited to I/O-intensive application environments such as OLTP and NFS. It is in these environments that the performance benefits offered by AutoRAID will be fully realized.

Table 2. Configuration Options

Configuration Option	Impact on Performance and Capacity
Number of LUNs per disk array	**Performance**. Increase the number of LUNs per disk array to improve performance. More LUNs increases the size of the I/O command queue allocated by HP-UX, which increases throughput. The recommended number of LUNs is 4 to 6. **Capacity**. To allow for future capacity expansion, avoid creating the maximum number of LUNs (8) on the disk array. New capacity is made available through the creation of a new LUN. If the maximum number of LUNs have already been created, it will be necessary to delete and recreate an existing LUN to increase capacity.
Number of disk arrays per SCSI host adapter	**Performance**. Limit the number of disk arrays per host adapter to improve performance. The recommended configuration for maximum performance is: NIO adapter - 3 disk arrays GSC adapter - 8 disk arrays **Capacity**. If maximum capacity is more important than performance, connect the maximum number of disk arrays to each adapter.

Configuration Option	Impact on Performance and Capacity
Number of disk drives	**Performance**. Increase the number of disk mechanisms in the disk array for maximum performance. As the number of individual disks is increased, the number of potential I/Os that can be performed simultaneously increases as well. This will improve performance in environments that place heavy I/O demand on the disk array. **Capacity**. The capacity of a disk array that is fully populated with disk mechanisms can only be increased by replacing lower capacity disks with higher capacity disks.
Unallocated disk array capacity	**Performance**. Unallocated capacity is used as additional RAID 0/1 space. The amount of RAID 0/1 space required to maintain optimal performance is determined by the write working set parameter. **Capacity**. To create the maximum amount of storage capacity, allocate all available capacity to LUNs.
LVM configuration	**Performance**. To improve performance, configure LVM as follows: • Stripe logical volumes across LUNs on different disk arrays. Including LUNs on different disk arrays will improve throughput by spreading I/Os across arrays. • Divide LUN access between both disk array controllers. Mapping every LUN to the same controller does not utilize the two data paths available on the disk array. The default path is through the primary disk array controller, but this can be changed to the secondary controller when adding the physical volume to an LVM volume group. The process for changing the path differs for each version of HP-UX: **HP-UX 10.1**. From the Disk Devices list, select the disk hardware path through the secondary controller before adding the disk to a volume group. **HP-UX 10.2**. When adding the disk to a volume group, in the "Creating A Volume Group" dialog change the hardware path to the secondary controller **Capacity**. These LVM configurations have no impact on disk array capacity configuration.

Chapter 2. Using the HP-UX System Administration Manager

Most disk array management can be done using the HP-UX System Administration Manager, or SAM. Using SAM you can:

- Check disk array status
- Change configuration settings
- Manage the disk array LUNs
- Add a disk to the array configuration
- Set the rebuild priority

You must login as superuser or root to use SAM or the disk array utilities.

LUNs and Logical Drives. To maintain consistency with HP-UX terminology, the term LUN is used to refer to a disk array logical drive. The two terms are used interchangeably and refer to the same logical entity on the disk array.

NOTE! Before SAM can be used to manage the HP SureStore E Disk Array 12H, the AutoRAID Manager (ARM) utility software must be installed as described in "Installing the Disk Array Management Software".

To run the SAM disk array management utilities:

1. Run SAM by typing `sam` at the system prompt.
2. On the main SAM screen, select "Disks and File Systems."
3. On the "Disks and File Systems" screen, select "Disk Devices." A list of disk devices including arrays will be displayed.

You are now ready to work with the disk array. The remaining procedures in this chapter assume that you have already performed these steps.

Selecting Hardware Paths on HP-UX 10.20

On dual controller disk arrays, each controller provides a separate hardware path to the disk array. The host identifies one of these paths as the default hardware path and will use the default as the primary data path for access to the LUNs created on the disk array.

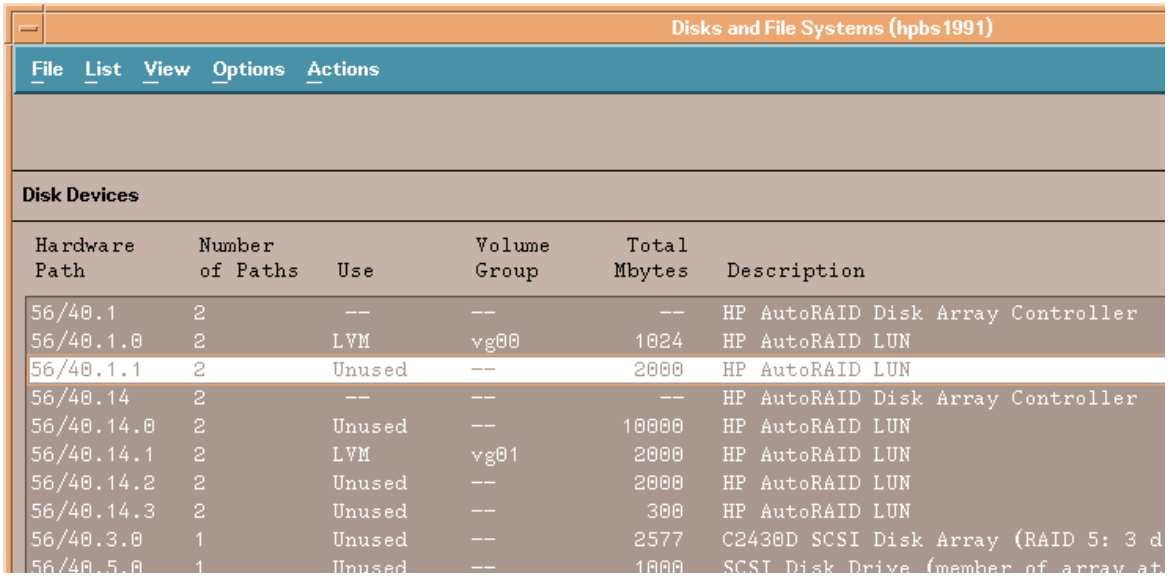
To improve disk array performance, the paths to the LUNs on the disk array should be shared by both controllers. Dividing the primary data paths across both controllers balances the I/O load and optimizes disk array performance. The primary hardware path to each LUN is established when adding the LUN to a volume group.

On HP-UX 10.01 and 10.10, both controller hardware paths are displayed on the Disk Devices windows. The hardware path for a LUN is established by selecting the appropriate path.

On HP-UX 10.20 and later, only the primary controller hardware path is displayed in the Disk & File Systems window (with an indication that there are two paths to the device). This makes the selection of an alternate path to the LUN a bit more involved. The following steps should clarify the process of defining an alternate path for a LUN.

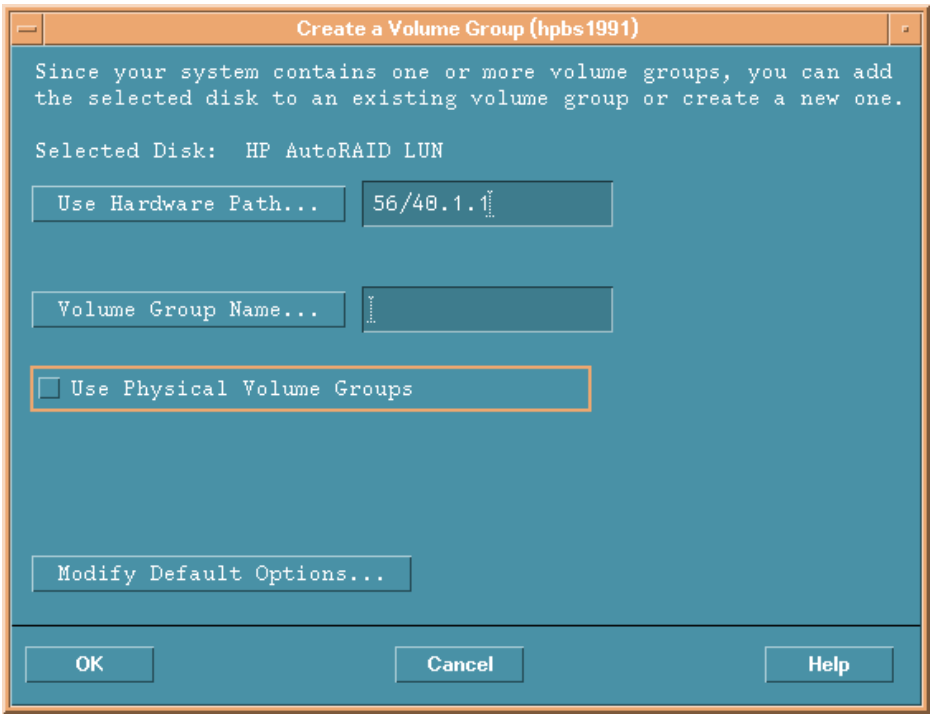
To select an alternate hardware path:

1. From the Disk & File Systems window select the LUN you want to add.

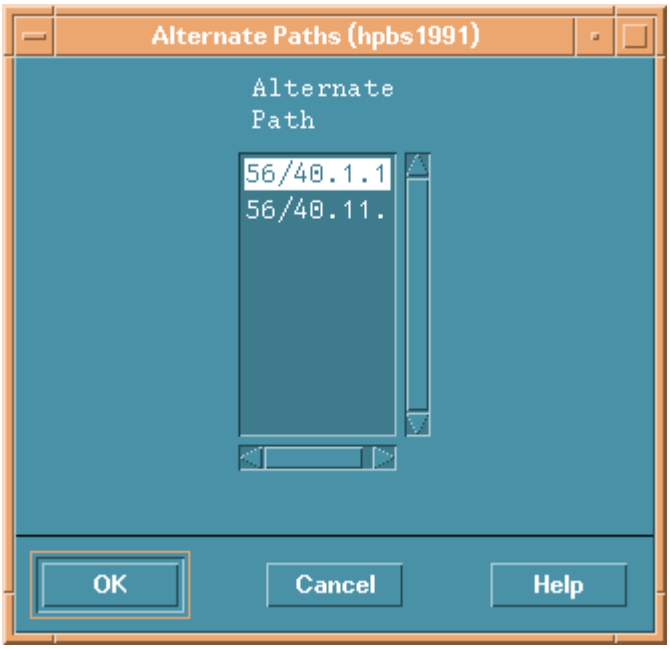


2. From the Actions menu select “Add…” , and then select “Using The Logical Volume Manager”.

3. The Create a Volume Group window indicates the default hardware path to the LUN. Click the Use Hardware Path… button to change the path.



4. From the Alternate Paths window, select the alternate (non-default) hardware path to the LUN. Click OK.



Configuring a New Disk Array

After installing a new disk array, you can perform the initial configuration using the disk array utilities. This establishes the desired operating environment for the disk array.

To configure a new disk array:

1. Plan your capacity management strategy.

   Decide how you want to use the capacity of the disk array. Factors such as data redundancy and performance influence how you manage the capacity. To support your strategy, it may be necessary to disable Active Hot Spare, Auto Include, or Auto Rebuild. See "Managing Disk Array Capacity" in the *HP SureStore E Disk Array 12H User's and Service Manual* for help in planning your strategy. Also see "Tips for Configuring the Disk Array On HP-UX" in Chapter 1 of this guide.

2. If necessary, change disk array configuration settings to implement your capacity management strategy.

   If the planning in step 1 requires you to change any of the default configuration settings, do so now. These include Active Hot Spare, Auto Rebuild, and Auto Include. For more information, see "Changing Disk Array Configuration Settings" in this chapter.

3. Check the available unallocated capacity on the disk array. See "Checking Disk Array Status" in this chapter.

4. Create each LUN on the disk array.

   This required step makes disk array capacity available to your operating system, and it must be repeated for each LUN you are creating. For more information, see "Creating a LUN" in this chapter.

Checking Disk Array Status

One of the most important management tasks is monitoring the operation and status of the disk array. Because it is a vital piece of your system, it is important to know how well the disk array is operating and if any problems or failures have occurred.

To view disk array component status:

1. Select the desired disk array controller from the list displayed on the screen.
2. Select “Actions” on the menu bar.
3. Select “View More Information . . .”

Changing Disk Array Configuration Settings

There are a number of configuration settings that control the operation of the disk array. These settings are usually established during installation, and once set, should rarely have to be changed.

The default settings have been selected to provide the best operation for most systems. However, if you determine that any setting does not meet your needs, you can easily change it.

Table 3 lists the various settings that can be changed with SAM, including factors you may want to consider before changing them.

Table 3. Disk Array Configuration Settings

Setting	Default	Comments and Considerations
Active Spare	On	Active Spare provides optimum protection against disk failure. Disabling Active Spare will make additional capacity available to the host, but at the expense of maintaining full data redundancy.
Rebuild Priority	High	Rebuild Priority determines how quickly a Rebuild completes. It allows you to balance the servicing of host I/Os with the rebuilding of the disk array. The same rebuild priority is used for both Auto Rebuilds and manual Rebuilds.
Auto Include	On	Auto Include simplifies the task of adding a new disk to your array. Disabling it will require you to manually include each disk you install in the array.

NOTE! The Rebuild type (automatic or manual) is displayed but cannot be changed using SAM.

To change configuration settings:

1. Select the desired disk array controller from the list on the screen.
2. Select “Actions” on the menu bar.
3. Select “Disk Array Maintenance.”
4. Select “Modify Array Configuration . . .”
5. Click setting boxes to make changes.
6. Click “OK” to effect the change, or “Cancel” to ignore.

Managing LUNs (Logical Drives)

An important part of managing the disk array involves defining and maintaining the optimal LUN structure for the disk array. Your system requirements will influence the LUN structure you choose.

Managing LUNs is a part of the overall task of managing the disk array capacity. For more information on managing array capacity to meet your system needs, see “Managing Disk Array Capacity” in the *HP SureStore E Disk Array 12H User’s and Service Manual*.

Checking LUN Configuration

Anytime you are managing LUNs, you may find it convenient to check the current LUN configuration and the available capacity.

The current LUN definitions can be seen on the standard “Disk Devices” screen. The available capacity is displayed as “Unallocated” on the “View Array Status Information” screen. See “Checking Disk Array Status” in this chapter.

Creating a LUN

Only capacity assigned to LUNs is visible to the HP-UX operating system. When creating LUNs, consider the following factors:

- Any size limitations imposed by the operating system, for example, LVM.
- Your backup strategy. If you do unattended backup to a device such as tape, you may want to avoid creating a LUN that is larger than the capacity of the media. This allows you to backup an entire LUN without changing media.
- Configuring the LUN into LVM for maximum performance as described in Table 2.

NOTE! Before creating a LUN, check your operating system documentation for any additional information or steps that may be required to create a LUN.

To create a LUN:

1. Select the desired disk array controller from the list on the screen.
2. Select “Actions” on the menu bar.
3. Select “Disk Array Maintenance.”
4. Select “Bind LUN . . .”
5. Set the LUN size (not greater than unallocated capacity).
6. Select “OK.”
7. Note the new LUN definition in the list of disks and arrays.

Deleting a LUN

CAUTION! All data on a LUN is lost when it is deleted. Make sure you backup any important data on the LUN before deleting it.

When a LUN is deleted, its capacity is returned to the pool of unallocated capacity. Deleting a LUN is a good way of freeing up capacity for the Active Hot Spare or for RAID 0/1 space to improve disk array performance.

NOTE! Before deleting a LUN, check your operating system documentation for any additional information or steps that may be required to delete a LUN.

To delete a LUN:

1. From the list of disks and arrays, select the LUN to be deleted.
2. Select “Actions” from the menu bar.
3. Select “Disk Array Maintenance.”
4. Select “Unbind LUN...”
5. Select “OK” to confirm the request.
6. Note the removal of the LUN from the list of disks and arrays.

Adding a Disk

At some time you will probably want to add another disk to your array. Features such as hot-pluggable disks and Auto Include simplify the process of adding a disk to the array even while it is operating. A disk can be added to the array without disrupting host operation.

After you have added a new disk, you have three options on how to use it:

- Increase capacity - you can use the disk to increase the capacity available to the operating system by creating a new LUN.
- Improve performance - you can use the disk to improve disk array performance by simply leaving it as unallocated capacity.
- Enable Active Spare - you can use the additional capacity to enable Active Spare if the disk array does not currently have the capacity to implement this feature.

To add a disk to the array:

1. Make sure the new disk has been inserted into the array cabinet.
2. If Auto Include is on, the disk is automatically added to the array and you can skip to the next step. If Auto Include is off, manually include the disk as described in the next section, "Including a Disk."

NOTE! In some situations, the array will not include a disk automatically, even if Auto Include is enabled. This will happen if the new disk's status is not Normal. See "Auto Include" in the *HP SureStore E Disk Array 12H User's and Service Manual* for more information about when this might occur.

3. Depending on how the new disk will be used, perform the appropriate next step:
   - To use the disk to increase capacity, create a LUN using all or a portion of the disk capacity. For more information, see "Creating a LUN" in this chapter.
   - To use the disk to increase performance, leave the disk capacity unallocated.
   - To use the disk capacity for Active Spare, enable the Active Spare feature if disabled.

Including a Disk

A disk must be included in the disk array configuration before it can be used by the disk array. There are two ways to include a disk:

- You can enable Auto Include, which will automatically include a disk when it is inserted into the disk array enclosure.
- You can manually include each new disk.

For convenience, Auto Include is enabled by default on a new disk array. For information on disabling Auto Include, see "Changing Disk Array Configuration Settings" in this chapter.

After including a disk, you must decide how you want to use it. For more information, see the preceding section, "Adding a Disk."

To manually include a disk:

1. Select the desired disk array controller from the list on the screen.
2. Select "Actions" on the menu bar.
3. Select "Disk Array Maintenance."
4. Select "Include Disk . . ."

   Disks not currently included will be highlighted on the display.
5. Select one of the highlighted disks to include.
6. Click "OK" to effect the change.

Downing (Excluding) a Disk

Downing (or excluding) a disk is typically done in preparation for testing the disk. After the disk is downed, testing can be done without impacting disk array operation. If testing reveals that the disk is good, the disk can be included back in the array configuration.

Downing a disk has the same effect as if the disk failed or was physically removed from the cabinet. If Auto Rebuild is enabled, the disk array will immediately begin a Rebuild when a disk is downed.

The down operation can be either destructive or nondestructive. The type of down performed determines whether the disk array will assume there is any valid data on the disk if it is returned to the array configuration. If a destructive down is performed, the disk array will assume no data on the disk is valid. If the down is nondestructive, the disk array will assume any data on the disk that was not updated in the disk's absence is valid.

To protect data availability, the disk array will normally not let you down a disk if doing so would result in loss of data redundancy or data unavailability. However, you can override this protection by specifying the appropriate Exclusion Restriction. You can choose to down the disk even if a loss of redundancy would result, but not data unavailability. Or you can down the disk even if data unavailability would occur.

NOTE.	Two disks on the disk array are used to store the information for recovering data maps if they are lost. The disk array will not let you down one of these RDM disks.

To down a disk:

1. Select the desired disk array controller from the list on the screen.
2. Select "Actions" on the menu bar.
3. Select "Disk Array Maintenance."
4. Select "Exclude Disk..."
5. Select the disk to exclude.
6. Select the desired "Exclusion Restriction".
7. Select "Assume Valid Data Next Time" to make the exclude nondestructive. If this option is not selected, the exclude will be destructive.
8. Click "OK" to effect the change, or click "Apply" to select another disk to exclude.

After testing, a downed disk can be returned to the disk array configuration by manually including it. For more information, see the preceding section, "Including a Disk".

Rebuilding the Disk Array

To maintain data redundancy in the event of a disk failure, it is important to rebuild the disk array as quickly as possible. The Auto Rebuild feature does this automatically, so it is enabled by default. For optimum data protection it recommended that Auto Rebuild remain enabled.

If you would like more control over the Rebuild process, you can disable Auto Rebuild using the ARM utilities. This will allow you to manually start a Rebuild at the time you choose. A manual Rebuild is initiated using the ARM utilities. See "Rebuilding the Disk Array Manually" in the next chapter for more information.

A Rebuild impacts disk array performance while it is in progress, so before starting a Rebuild make sure the appropriate rebuild priority is set.

For convenience and maximum protection against disk failure, Auto Rebuild is enabled by default on a new disk array.

Setting Rebuild Priority

The rebuild priority determines how quickly a Rebuild completes. It allows you to balance the servicing of host I/Os with the rebuilding of the disk array. The same rebuild priority is used for both Auto Rebuilds and manual Rebuilds. A high rebuild priority ensures the Rebuild will be completed at the same priorities as host I/Os. A low rebuild priority gives priority to host I/Os in relation to the Rebuild.

To ensure that a Rebuild completes without disrupting data storage, the rebuild priority is set to high by default on new disk arrays.

To set the rebuild priority:

1. Select the desired disk array controller from the list.
2. Select "Actions" on the menu bar.
3. Select "Disk Array Maintenance."
4. Select "Modify Array Configuration . . ."
5. Select desired rebuild priority (high or low).
6. Select "OK" to effect the change.

Switching Primary Controllers

In dual-controller disk array configurations, the array automatically switches to the secondary controller if the primary controller fails. However, you can switch controllers manually if necessary. This will cause the secondary controller to assume the role of primary controller.

To switch primary controllers:

1. Select the desired disk array controller from the list.
2. Select “Actions” on the menu bar.
3. Select “Disk Array Maintenance.”
4. Select “Modify Array Configuration . . .”
5. Select desired primary controller.
6. Select “OK” to effect the change.

Chapter 3. Using the ARM Command Line Utilities for HP-UX

The AutoRAID software includes a set of AutoRAID Manager (ARM) command line utilities. These commands provide the ability to manage the disk array from the HP-UX command prompt rather than from SAM.

The ARM commands can be used to perform a number of tasks that cannot be performed using SAM. These tasks are intended for advanced users and involve procedures such as diagnostics, performance monitoring, setting SCSI values, and disk array maintenance.

CAUTION! Many of the tasks available in SAM can also be performed using the ARM utilities. These tasks are described on the following pages. It is recommended that these tasks be performed using SAM to ensure predictable results and proper operation of the disk array. You should consider using an ARM utility for these tasks only if you clearly understand how the utility works and what effect it has on disk array operation. Improper use of the ARM utilities can cause undesirable results, including loss of data.

LUNs and Logical Drives. To maintain consistency with HP-UX terminology, the term LUN is used to refer to a disk array logical drive. The two terms are used interchangeably and refer to the same logical entity on the disk array.

Information in man pages

The procedures in this chapter summarize the use of the ARM utilities. Detailed information about the ARM command line utilities and their proper usage is included in the HP-UX operating system man pages. A man page also exists for ARMServer, the server portion of the disk array management software.

To access HP-UX man pages information, type:

```
man <commandname>
```

Substitute one of the following ARM utility names for commandname.

```
ARMServer
arraycfg
arraydsp
```

```
arrayfmt
arraylog
arraymgr
arrayrbld
arrayrecover
download
drivetest
dteststat
logprint
```

Command Syntax Conventions

The following symbols are used in the command descriptions and examples:

Symbol	Meaning
<>	Integer value, whose units are not defined.
|	"Exclusive OR." Exactly one of the parameters displayed will be used.
[ ]	Items enclosed are optional.
{ }	Items enclosed are required.

The ARMServer Process

The ARMServer process is the server portion of the ARM software. It monitors the operation and performance of the disk array, and services external requests from clients executing disk array commands. The ARMServer process monitors disk array performance and status, maintains disk array logs, initiates diagnostics, and allows clients to examine and change the disk array configuration.

The ARMServer process must be running to allow management of the disk array using the ARM command line utilities. Because of its importance in managing the disk arrays, the ARMServer process is launched automatically when the system is booted. Host I/Os to the disk array are not dependent on the ARMServer process and are serviced regardless of whether the ARMServer process is running or not.

The Array Monitor Daemon (arraymond)

The Array Monitor Daemon, known as the `arraymond` process, runs at regular intervals (every fifteen minutes) to retrieve disk array status information. The arraymond process uses the `arraydsp` ARM utility, and therefore requires the ARMServer process to be running. By retrieving status from the disk array at regular intervals, `arraymond` can alert the system operator to any array problems.

The `arraymond` process is included with the ARM software and is installed with the other software components. Like ARMServer, the `arraymond` process is launched automatically when the system is booted.

Routing arraymond Error Messages

By default, the status messages generated by `arraymond` are sent to the system console and emailed to `root`. The destination for the error messages can be rerouted by editing the contents of the destination configuration file, `etc/hpC2400/arraymon.dest`. This file identifies the destinations for all error messages.

The first line in the file identifies a computer screen (`/dev/console`) or none (`/dev/null`), if no screen messages are desired. The rest of the file identifies electronic mail addresses.

The following example of an `arraymon.dest` file directs the `arraymond` process to send its error messages to the system console and to also mail the messages to three people on other systems.

```
/dev/console
root
bob@hpdml69
alex@hpdmm99
```

Selecting a Disk Array to Manage

When using the ARM utilities, the <array-id> field is used to identify the disk array. The <array-id> field can contain the disk array serial number, the raw device file name of any LUN on the array, or an alias text string assigned to the array using the `arraymgr` command.

For example, assume a disk array has a serial number of 00786B5C0000, special raw device file `/dev/rdsk/c2t0d0` is defined for this array, and it has an alias of autoraid4. To check the available unallocated capacity on this particular disk array, you could use any of the following commands:

```
arraydsp 00786B5C0000
```

or

```
arraydsp /dev/rdsk/c2t0d0
```

or

```
arraydsp autoraid4
```

The serial number of all arrays in the system can be obtained using the command

```
arraydsp -i
```

For more information see "Displaying Disk Array Serial Numbers" in this chapter.

A list of all special device filenames assigned to the disk array can be displayed using the following command:

```
ioscan -fn -C disk
```

Many commands affect the operation of the entire disk array, regardless of whether the <array-id> field contains the array serial number or a special device file name. Commands that involve only a specific LUN on the array will include an option (-L LUN) for identifying the LUN involved. For example, to format LUN 3 on a disk array that is referenced by `/dev/rdsk/c2t0d0`, you would use the following command:

```
arrayfmt -L 3 /dev/rdsk/c2t0d0
```

Configuring a New Disk Array

After installing a new disk array, you can perform the initial configuration using the ARM utilities. This establishes the operating environment for the disk array.

To configure a new disk array:

1. Plan your capacity management strategy and LUN configuration.

   Decide how you want to use the disk array capacity. Factors such as data redundancy and performance influence how you manage the capacity. See "Managing the Disk Array Capacity" in the *HP SureStore E Disk Array 12H User's and Service Manual* for help in planning your strategy. Also see "Tips for Configuring the Disk Array On HP-UX" in Chapter 1 of this guide.

2. Display the serial number of the disk array by typing:

   ```
   arraydsp -i
   ```

   The serial number provides a way to identify disk arrays when using the ARM utilities. Record the serial number for future reference, or set a shell variable to hold this value, for example:

   ```
   export ID=00786B5C0000
   ```

   or

   ```
   export ID=/dev/rdsk/c2t0d0
   ```

3. If the planning in step 1 requires you to disable any of the configuration settings to implement your capacity management strategy, do so now. These settings include Active Hot Spare, Auto Rebuild, and Auto Include. Change the configuration settings by typing:

   ```
   arraymgr -h { on|off } <array-id>    (Active Spare)
   arraymgr -a { on|off } <array-id>    (Auto Rebuild)
   arraymgr -i { on|off } <array-id>    (Auto Include)
   ```

NOTE! Only one setting can be changed on each command line.

4. Check the available unallocated capacity on the disk array by typing:

   ```
   arraydsp $ID
   ```

   The total unallocated capacity available for creating LUNs will be displayed. Make sure there is adequate capacity to create the LUN structure you need.

5. Create each LUN on the disk array by typing:

   ```
   arraycfg -L LUN -a capacity <array-id>
   ```

Example:

```
arraycfg -L 0 -a 1000 00786B5C0000
```

This command creates LUN 0 with a capacity of 1000 Mbytes on the array identified by serial number 00786B5C0000.

This step makes disk array capacity available to your operating system, and it must be repeated for each LUN to be created. Make sure you observe any operating system limitations on LUN size or number. For more information, see “Creating a LUN” in this chapter.

Checking Disk Array Status

One of the most important management tasks is monitoring the status, operation, and configuration of the disk array. It is important to know how well the disk array is operating and if any problems or failures have occurred. Using the ARM `arraydsp` command, you can easily check all aspects of disk array operation and configuration. The `arraydsp` command options, summarized in Table 4, allow you to display information about each disk array hardware component, as well as information about the logical configuration of the disk array.

Table 4. arraydsp Options for Displaying Disk Array Status

Option	Status Information Displayed
`none`	General information about the disk array
`-l [LUN]`	Information for the specified LUN
`-a`	All information displayed for options -l, -d, -c, -s, -v, and -h
`-c`	Array controller status
`-d`	Disk status
`-h`	Hardware status
`-i`	Serial numbers for all disk arrays
`-m`	Display performance metrics
`-R`	Rescan for SureStore E (AutoRAID) disk arrays recognized by the host.
`-r`	Make performance recommendations
`-S`	Generate raw output, used in combination with other options
`-s`	General configuration information. For a complete description of all the configuration settings, see "Viewing the Disk Array General Configuration Settings" at the end of this chapter.
`-v`	Capacity information

Displaying Disk Array Serial Numbers

The serial numbers of all disk arrays connected to the host can be displayed by typing:

```
arraydsp -i
```

Missing Disk Arrays? If you know there are disk arrays connected to the host but they are not displayed in response to the arraydsp command, check the following:

- Make sure all disk arrays are properly connected to the host. This includes proper termination of the SCSI bus.
- Make sure all disk arrays are turned on and operating properly.
- Make sure the ARMServer process is running. ARMServer must be running to execute this or any other ARM command. You can easily check to see if the ARMServer process is running using the following command: -ps ef | grep ARM
- Rescan for disk arrays by typing: arraydsp -R. This will update the ARMServer information to reflect the current system configuration.
- Execute the ioscan -fn -C disk command and ensure that the software state for all active disk arrays is "CLAIMED".

Changing Disk Array Configuration Settings

A number of configuration settings control the operation of the disk array. These settings are usually established during installation and once set, should rarely need to be changed.

The default settings have been selected to provide the best operation for most systems. However, if you determine that any setting does not meet your needs, you can easily change it.

Table 5 lists the various settings, including factors you may want to consider when changing them.

Table 5. arraymgr Disk Array Configuration Settings

Setting	Default	Command Option	Comments and Considerations
Active Spare	On	-h	Active Hot Spare provides optimum protection against disk failure. Disabling Active Hot Spare will make additional capacity available to the host, but at the expense of maintaining full data redundancy.
Auto Rebuild	On	-a	Auto Rebuild provides optimum protection against disk failure by rebuilding a failed disk as quickly as possible. Disabling Auto Rebuild gives you more control over the rebuild process, but it can leave the disk array vulnerable to a second disk failure until a Rebuild is performed manually.
Auto Include	On	-i	Auto Include simplifies the task of adding a new disk to your array. Disabling it will require you manually to include each disk you install in the array.
Rebuild Priority	High	-p	Rebuild priority determines how quickly a Rebuild operation will complete.

To change Active Spare, Auto Rebuild, or Auto Include settings, type:

```
arraymgr { -h | -a | -i } { on|off } <array-id>
```

To change Rebuild Priority setting, type:

```
arraymgr -p { high|low } <array-id>
```

Managing LUNs (Logical Drives)

An important part of managing the disk array involves defining and maintaining the optimal LUN structure for your system. Your system requirements and limitations will influence the LUN structure you choose.

Managing LUNs is a part of the overall task of managing disk array capacity. For more information on managing disk array capacity to meet your system needs, refer to the *HP SureStore E Disk Array 12H User's and Service Manual*.

Checking LUN Configuration

When you are managing LUNs, you may find it convenient to check the current LUN configuration and the available capacity.

To check the current LUN configuration and the available capacity, type:

```
arraydsp -l [LUN] <array-id>
```

Creating a LUN

Only capacity assigned to LUNs is visible to the operating system. When selecting the size for your LUNs, consider the following factors:

- Any size limitations imposed by the operating system, for example, LVM.
- Your backup strategy. If you do unattended backup to a device such as a tape, you may want to avoid creating a LUN that is larger than the capacity of the tape media. This allows you to back up an entire LUN without changing tapes.
- Configuring the LUN into LVM for maximum performance as described in Table 2.

NOTE! Before creating a LUN, check your operating system documentation for any additional information or steps that may be required to create a LUN.

To create a LUN, type:

```
arraycfg -L LUN -a capacity <array-id>
```

`LUN` must be an unused value between 0 and 7
`Capacity` must be less than or equal to the currently available unallocated capacity

NOTE! The following commands require LUN exclusive access. This means nothing, including LVM, can access the LUN while the command is running. If LVM is used, the volume group containing the LUN must be deactivated for the command to run.

```
Delete LUN
Format LUN
Renumber LUN
```

Renumbering a LUN

NOTE! Before renumbering a LUN, check your operating system documentation for any additional information or steps that may be required to renumber a LUN.

To renumber a LUN, type:

```
arraycfg -L LUN -r newLUN <array-id>
```

LUN is the LUN to be renumbered
newLUN is a new available LUN number

Deleting a LUN

When a LUN is deleted, its capacity is returned to the pool of unallocated capacity space. Deleting a LUN is a good way of freeing up capacity for the Active Hot Spare or for simply adding more unallocated capacity to improve disk array performance.

CAUTION! All data on a LUN is lost when it is deleted. Make sure you backup any important data on the LUN before deleting it.

NOTE! Before deleting a LUN, check your operating system documentation for any additional information or steps that may be required to delete a LUN.

To delete a LUN, type:

```
arraycfg -L LUN -d <array-id>
```

LUN is the LUN to be deleted

Adding a Disk

At some time, you may want to add another disk to your array. Features such as hot-pluggable disks and Auto Include simplify the process of adding a disk to the array even while it is operating. A disk can be added to the array without disrupting current I/O operations.

After you have added a new disk, you have three options on how to use it:

- **Increase capacity** - use the disk to increase the capacity available to the operating system by creating a new LUN.
- **Improve performance** - use the disk to improve the disk array performance by simply leaving it as unallocated capacity.
- **Enable Active Spare** - use the additional capacity to enable Active Hot Spare if the disk array does not currently have the capacity to support this feature. This also improves performance as the spare space is used as RAID 0/1 space until it is needed.

To add a disk to the array:

1. Make sure the new disk has been physically inserted into the array.
2. If Auto Include is on, the disk is automatically added to the array and you can skip to the next step. If Auto Include is off, manually include the disk as described in the next section, "Including a Disk."

NOTE! In some situations, the array will not include a disk automatically, even if Auto Include is enabled. This will occur if the new disk's status is something other than Normal. See "Auto Include" in the *HP SureStore E Disk Array 12H User's and Service Manual* for more information about when this might occur.

3. Depending on how you intend to use the new disk, perform the appropriate next step:
   - To use the disk to increase capacity, create a LUN using all or a portion of the disk capacity. For more information, see "Creating a LUN" in this chapter.
   - To use the disk to increase performance, leave the disk capacity unallocated.

- To use the disk capacity for an Active Hot Spare, enable the Active Hot Spare feature if not currently enabled. For more information, see "Changing Disk Array Configuration Settings" in this chapter.

Including a Disk

A disk must be included in the disk array configuration before it can be used by the disk array. There are two ways to include a disk:

- You can enable Auto Include, which will automatically include a disk when it is inserted into the disk array enclosure.
- You can manually include each new disk.

For convenience, Auto Include is enabled by default on a new disk array. For information on disabling Auto Include, see "Changing Disk Array Configuration Settings" in this chapter.

After including a disk, you must decide how you want to use it. For more information, see the preceding section, "Adding a Disk."

To manually include a disk, type:

```
arraycfg -D slot -a <array-id>
```

`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Rebuilding the Disk Array

To maintain data redundancy in the event of a disk failure, it is important to rebuild the disk array as quickly as possible. Auto Rebuild does this automatically, and it is enabled by default. For optimum data protection it recommended that Auto Rebuild remain enabled.

If you want more control over the Rebuild process, you can disable Auto Rebuild. This will allow you to manually start a Rebuild at the time you choose. A Rebuild impacts disk array performance while it is in progress, so before starting a Rebuild make sure the appropriate Rebuild Priority is set. See "Setting Rebuild Priority" in this chapter.

For convenience and maximum protection in the event of a disk failure, Auto Rebuild is enabled by default on a new disk array. For information on disabling Auto Rebuild, see "Changing Disk Array Configuration Settings" in this chapter.

Rebuilding the Disk Array Manually

If you have chosen to disable Auto Rebuild, you will have to start the Rebuild manually. The Rebuild will begin immediately and continue to completion. If no Rebuild is necessary, the command will be ignored.

To start a Rebuild manually, type:

```
arrayrbld -r <array-id>
```

Setting Rebuild Priority

The rebuild priority determines how quickly a Rebuild completes. It allows you to balance the servicing of host I/Os with the rebuilding of the disk array. The same rebuild priority is used for both Auto Rebuilds and manual Rebuilds.

To set the rebuild priority, type:

```
arrayrbld -P { high|low } <array-id>
```

Checking the Progress of a Rebuild

You can easily check the progress of a Rebuild. This allows you to determine approximately when a Rebuild will complete.

To check the progress of a Rebuild, type:

```
arrayrbld -p <array-id>
```

Canceling a Rebuild

A Rebuild can be canceled only if it was started manually. A Rebuild that was started by Auto Rebuild cannot be canceled. If a Rebuild is canceled, it must be started over again and any progress made during the first Rebuild will be lost.

When canceling a Rebuild, the Rebuild may not stop immediately. This occurs if the disk array is busy servicing higher priority I/O requests from the host. The Rebuild will be canceled when the disk array has serviced all higher priority commands.

To cancel a manual Rebuild, type:

```
arrayrbld -c <array-id>
```

Analyzing Disk Array Performance

The disk array monitors and stores a number of metrics that reflect how the disk array is performing. The disk array management software periodically retrieves these performance metrics and stores them for your viewing. The ARM software can also analyze the performance metrics to identify any potential performance problems. Based on this analysis, recommendations are made on how to improve disk array performance.

Checking the metrics regularly is a quick and easy way for you to monitor the performance of the disk array and identify any problems that may be developing. You may choose to display only the recommendations, or you may want to view the metrics for further analysis.

For a complete description of each performance metric, refer to the *HP SureStore E Disk Array 12H User's and Service Manual*. You can also view the `arraydsp` man page for a complete explanation of all the performance command options.

To analyze disk array performance, type:

```
arraydsp { -r stime etime} | { -m stime etime [int] } <array-id>
```

Command Examples

The following command displays performance recommendations for disk array serial number `00786B5C0000`. Performance is analyzed for the time period starting at 8:00 AM and ending at 5:00 PM (1700) on March 15. The format of the `stime` and `etime` arguments is `mmddhhmm[yy]`.

```
arraydsp -r 03150800 03151700 00786B5C0000
```

The following command displays the performance metrics for disk array serial number 00786B5C0000. Metrics are displayed for the time period starting at 11:00 AM and ending at 6:00 PM on April 6. A display interval of 30 minutes is specified.

```
arraydsp -m 04061100 04061800 2 00786B5C0000
```

Selecting a Time Period for Analysis

When analyzing performance, you must define the time period over which the analysis will be performed. A starting time (`stime`) and ending time (`etime`) establish the analysis period. For the best results, select a time period when performance may be a concern. This will produce the most meaningful analysis and recommendations.

For example, if the heaviest load on the disk array occurs between the hours of 8:00 AM and 5:00 PM, restrict the analysis to this time period. If you include periods of less activity, the analysis may yield different results and consequently different recommendations. This occurs because activity is averaged over the entire analysis period, and periods of less activity will offset the effects of busier periods.

Typically, you should select a period of time that represents normal system operation. Avoid any unusual events such as a Rebuild or changes made to array capacity. If you select a time period that includes an event that may distort the analysis, the utility will alert you and will not provide any recommendations.

You can also control the display interval using the `int` option. This allows you to control how much detail you get when displaying the metrics. The display interval is the number of 15-minute increments.

Checking the Working Set Metric

A key factor in monitoring and maintaining optimal performance of the disk array is the Working Set metric. To ensure that disk array performance is maintained, you should access the performance metrics regularly and check the Working Set value.

The Working Set performance metric is derived from the Write Working Set parameter. It indicates the ratio of the Write Working Set size to the amount of RAID 0/1 space available. For a detailed explanation of the Write Working Set and its impact on performance, refer to the *HP SureStore E Disk Array 12H User's and Service Manual.*

To maintain performance, the amount of RAID 0/1 space should equal or exceed the Write Working Set, resulting in a Working Set value less than or equal to 1. A Working Set value greater than 1 indicates that the Write Working Set is larger than the available RAID 0/1 space and the disk array is servicing writes from RAID 5 space.

If the Working Set consistently exceeds 1, the amount of RAID 0 /1 space available should be increased to improve performance. This can be accomplished in several ways as described in the following section.

If the Working Set is consistently much less than 1, some of the RAID 0/1 capacity can be allocated to a new LUN without impacting performance. The remaining RAID 0/1 space should be adequate to accommodate the Write Working Set.

Performing Disk Array Maintenance Tasks

There are several tasks that you may have to perform in the on-going management of the disk array. These maintenance tasks are typically performed infrequently and may involve taking the disk array off line.

Shutting Down the Disk Array

CAUTION! When an array shutdown is performed, the disk array becomes unavailable to the host system. An array that is shutdown appears to the operating system as if its power has been turned off. As with any disk subsystem, it is essential that file system and LVM access to the disk array be correctly removed before shutting down or powering off the disk array.

Before an array Shutdown is performed, all mounted file systems and LVM logical volumes mapped to the disk array must be unmounted. The `umount` operation synchronizes data in the HP-UX internal buffers with the data stored on the disk array.

The disk array must be Shutdown prior to performing any maintenance. The Shutdown process copies vital data mapping information from the controller NVRAM to the disks. This protects the data mapping information should the contents of the NVRAM be lost or corrupted due to battery failure. Shutdown then takes the disk array off line, making all data unavailable to the host. The disk array can still be managed and tested, but all data is inaccessible while the disk array is Shutdown.

Shutdown is initiated automatically each time the disk array is turned off using the power switch, so it is usually not necessary to initiate a Shutdown using the ARM utility.

To Shutdown the disk array, type:

```
arraymgr -s shut <array-id>
```

Restarting the Disk Array

Following Shutdown, the disk array can be brought back on line by performing a restart. This makes the data on the disk array available to the host once again.

To restart the disk array, type:

```
arraymgr -s start <array-id>
```

After the array completes initialization, file system and LVM logical volumes mapped to the disk array must be mounted for HP-UX to access the disk array.

Resetting the Disk Array

The disk array can be reset if there is a problem with SCSI channel communication. A reset will interrupt access to the disk array temporarily, so it should be done only when attempting to solve a problem with the disk array.

To reset the disk array, type:

```
arraymgr -R <array-id>
```

Downing (Excluding) a Disk

Downing (or excluding) a disk is typically done in preparation for testing the disk. After the disk is downed, testing can be done without impacting disk array operation. If testing reveals that the disk is good, the disk can be included back in the array configuration.

Downing a disk has the same effect as if the disk failed or was physically removed from the cabinet. If Auto Rebuild is enabled, the disk array will immediately begin a Rebuild when a disk is downed.

The `-v` option identifies the down operation as either destructive or nondestructive. This determines whether the disk array will assume there is any valid data on the disk if it is returned to the array configuration. If a destructive down is performed (`-v` not specified), the disk array will assume no data on the disk is valid. If the down is nondestructive (`-v` specified), the array will assume any data on the disk that was not updated in the disk's absence is valid.

To down a disk, type:

```
arraycfg -D slot -d [-v] [-R|-Z] <array-id>
```

To protect data availability, the disk array will not let you down a disk if doing so would result in loss of data redundancy or data unavailability. However, you can override this protection by specifying the appropriate ARM options. The `-R` option allows the disk to be downed even if a loss of redundancy would result, but not data unavailability. The `-Z` option allows the disk to be downed even if data unavailability would occur. A complete description of the options is included in the `arraycfg` man page.

NOTE.	Two of the disks in the disk array are used to store recovery map information. The disk array will not allow you to down either of these drives unless you use the -R or -Z option.

After testing, a downed disk can be returned to the disk array configuration by manually including it. For more information, see "Including a Disk" in this chapter.

Testing a Disk

Diagnostics allow you test the operation and integrity of a disk. Three different types of testing can be performed:

- **Write/Read/Verify** - a destructive test that will destroy data on the disk being tested. The disk must be downed before beginning the test.
- **Read/Verify** - a nondestructive test that will not alter any data on the disk being tested. It is not necessary to down the disk before performing a read/ verify test.
- **Self-test** - a nondestructive internal test that checks the operation of the disk.

To perform a write/read/verify test of a disk, type:

```
drivetest -D slot -w percent <array-id>
```

To perform a read/verify test of a disk, type:

```
drivetest -D slot -r percent <array-id>
```

To perform a self-test of a disk, type:

```
drivetest -D slot -s <array-id>
```

`percent` is the percent (0 to 100) of the disk to be tested
`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Displaying Test Results

After the disk testing is complete, the test results can be displayed for analysis by using the `dteststat` utility.

To display the results of a disk test, type:

```
dteststat [-D slot] <array-id>
```

If the `-D` option is not specified, results will be displayed for all disks in the array that have been tested.

Canceling a Disk Test

If you do not want to wait for a disk test to complete, you can cancel it using the `dteststat` command and testing will stop immediately.

To cancel a disk test in progress, type:

```
dteststat -D slot -c <array-id>
```

Printing ARMServer Log Contents

The contents of the various log files maintained by ARMServer can be printed using the `logprint` command. The contents of the logs may be useful in identifying any possible problems that may be occurring with the disk array.

For a detailed explanation of the log contents output, see the `logprint` man page

To print the contents of the ARMServer logs, type:

```
logprint[-d log_directory_name] [-s start_time] [-e stop_time]
[-t record_type...] [-a array_serial_number]
```

`log_directory_name` identifies the location of the log files
`start_time` and `stop_time` limit the output to events between the specified times
`record_type` identifies the type of record(s) to print. Records include system usage log (`usage`), disk error log (`disk`), controller error log (`ctrlr`), system change log (`change`), and performance log (`perf`)
`array_serial_number` limits the output to only those entries associated with the specified disk array.

Displaying Hardware Logs

In addition to the logs maintained by ARMServer, hardware logs are also stored on the disk array. The `arraylog` command provides access to the controller and disk logs maintained by the disk array. These logs contain information useful for diagnosing and troubleshooting the disk array. The logs can also be cleared using `arraylog`. The arraylog options for accessing the disk array hardware logs are listed in Table 6.

Table 6. arraylog Options for Displaying Log Contents

Option	Description
-u	Display the contents of the disk array controller usage log.
-e	Display the contents of the disk array controller event log.
-d slot	Display the contents of the log for the disk installed in the cabinet slot identified by slot. Slot numbers must be of the form "An" or "Bn", where A or B correspond to a cabinet column, and n corresponds to a shelf position (1-6).
-C {-c | -d slot}	Clear the specified logs. If -c is specified, clear the disk array controller usage and event logs. Both logs will be cleared when using this option. It is not possible to clear just one of the logs. If -d is specified, clear the log for the disk installed in the cabinet slot identified by slot.

To display the contents of a hardware log, type:

```
arraylog [-u] [-e] [ -d slot ] <array-id>
```

To clear the hardware logs, type:

```
arraylog [-C{-c|-d slot}] <array-id>
```

Formatting the Disk Array

Should it become necessary to do so, you can format the entire disk array, or a single LUN. Formatting destroys all data on the array or LUN involved. Formatting an array first requires that all LUNs be deleted.

To format the entire disk array, type:

```
arrayfmt -F [-h] <array-id>
```

To format a LUN, type:

```
arrayfmt -L LUN <array-id>
```

Changing SCSI Settings

The SCSI settings control the transfer of information over the SCSI channel connecting the host and the disk array. The default SCSI settings listed in Table 9 have been chosen to work with all supported SCSI adapters, and in most cases should not be changed.

NOTE! Before changing any SCSI setting, you should understand what the SCSI setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect SCSI setting may make it impossible for the host and disk array to communicate properly. In this case, it will be necessary to use the disk array control panel to return the SCSI setting to its original value to reestablish communication.

To change SCSI settings, type:

```
arraymgr { -W | -T | -P | -m | -r } {on|off} <array-id>
```

Changing the Controller SCSI ID

Changing the SCSI ID directly impacts the operating system's ability to access the disk array. Before performing this task, check your operating system documentation for information on how to change the SCSI ID of a disk subsystem.

To change the controller SCSI ID, type:

```
arraymgr -C {X|Y} addr <array-id>
```

`addr` is the new address (0 – 15) for the indicated controller

Switching Primary Controllers

In dual-controller disk array configurations, the array automatically switches to the secondary controller if the primary controller fails. However, you can switch controllers manually if necessary. This will cause the secondary controller to assume the role of primary controller.

To switch primary controllers, type:

```
arraymgr -c { X | Y } <array-id>
```

Setting Data Resiliency

The data map contents stored in the disk array controller NVRAM is copied to two disks on the array at regular intervals to protect against map loss. The interval at which the disks are updated with recovery map information is controlled using the data resiliency setting. Selecting a data resiliency setting involves making a tradeoff between data protection and performance. The more frequently the recovery maps are updated, the more impact it may have on performance.

To set the data resiliency mode, type:

```
arraymgr -J {SingleController | Secure | Normal | HighPerformance} <array-id>
```

The data resiliency settings are described in Table 7.

Table 7. Data Resiliency Settings

Setting	Description
SingleController	This setting should only be used if the disk array is operating with one controller. This suppresses the single controller warning messages that are normally generated when the disk array is operating with one controller. This setting will affect I/O performance. This is the default setting for single controller mode.
Secure	Continually updates the disks with any changes in the controller maps. This is the highest level of data protection, but it may result in decreased I/O performance.
Normal	Updates the maps on the disks at regular intervals (typically 4 seconds). This option offers both data protection and good performance. This is the default setting for dual controller mode.
HighPerformance	Updates the disk maps only during shutdown of the disk array. This is the lowest level of data protection, but it offers the highest level of performance.

Creating a Disk Array Alias

An alias can be created to identify the disk array. The alias provides an alternative to the disk array serial number and raw device file name that can also be used to identify the array.

Aliasing can be used in a variety of ways to help identify disk arrays in large systems. For example, by assigning numbers to racks and to the shelf positions within the racks, each disk array can be uniquely identified using an appropriate alias. If a rack is assigned number 12, the disk array installed on shelf 3 of the rack could be identified using an alias of R12_S03. This technique simplifies locating the disk array should it need service.

To create a disk array alias, type:

```
arraymgr -D alias_name <array-id>
```

`alias_name` can be up to 12 characters in length and can include upper case letters, numbers, spaces, number sign (#), underscore (_), and period (.).

Recover

If the disk array is not shutdown properly, it is possible that the data maps in NVRAM memory will be lost. For this reason, the disk array allows the data maps to be periodically written to the disk drives. If the maps are lost, an error code such as “No Address Table” will appear on the display. If your disk array is a boot device, you may have to recover the maps by using the front panel command called “Recover” under the “Cntrl Changes” menu. The Recover command is only supported in controller firmware versions later than HP40, and any patch delivered after IPR9808 release.

Downloading Firmware

The `download` command copies new firmware code to the controller(s) or individual disk mechanisms in the disk array. Firmware also can be copied from a primary array controller to a secondary controller.

The `ARMServer` and `arraymond` processes continue to run while the download is in progress. However, these processes may not be able to access the array during the download because the download operation shuts down the disk array. This may cause warning messages such as the following to be displayed:

```
access error:  Unable to get status from disk array on <raw disk
file name> at <machine name>
```

These warning messages can be ignored.

CAUTION! The firmware code is copied from the primary controller to the secondary controller, so before performing this task make sure the controller that has the desirable code is designated the primary controller. See "Switching Primary Controllers" for instructions on changing the state of the controller.

To download firmware to a disk, type:

```
download -D slot codefilename <array-id>
```

`slot` identifies the cabinet shelf containing the disk drive
`codefilename` identifies the file containing the firmware code

To download firmware to the disk array controllers, type:

```
download -C codefilename <array-id>
```

`codefilename` identifies the file containing the firmware code

To download firmware from the primary controller to the secondary controller, type:

```
download -M <array-id>
```

Firmware Download Procedure With LVM

When LVM has access to the disk array the procedure described below should be followed to perform the download. This procedure works for single or multi-host configurations.

CAUTION! In multi-host configurations, other hosts must not access the disk array while the download is in progress. Data can be lost if write requests are made to the disk array while a download is in progress.

If the arraymond process is running, it can disrupt the download. Make sure you kill the arraymond process before starting a download.

If the root or opt file system is contained on the array, the offline diagnostic (ARDIAG) must be used to download the firmware. If the stand, var, usr, tmp file system or swap partition are contained on the disk array, the download must be performed in single user mode or off line, using ARDIAG.

NOTE! The download process automatically shuts down the array. The array Shutdown will not succeed unless all file systems have been unmounted and LVM access to the array has been deactivated.

To download firmware to the array controllers or to the disk mechanism:

1. Unmount all logical volumes mapped to the disk array.
2. Deactivate all LVM volume groups containing logical volumes mapped to the disk array.
3. Download the controller or disk mechanism firmware.
4. Reactivate the LVM groups deactivated in step 2.
5. Remount the LVM logical volumes unmounted in step 1.

For example, if two LVM logical volumes (`lvol1` and `lvol2`) are defined on the disk array and both logical volumes are contained in the volume group `vg02`, the steps to download the firmware are:

1. Umount the logical volumes.

```
umount /dev/vg02/lvol1
umount /dev/vg02/lvol2
```

2. Deactivate the volume group.

```
vgchange -a n /dev/vg02
```

3. Load the controller firmware.

```
download -C firmware.file 000000123456
```

4. Reactivate the volume group.

```
vgchange -a y /dev/vg02
```

5. Mount the logical volumes.

```
mountall
```

If the disk array has LUNs that are being used as raw devices, for example a database system doing “raw” I/O, the array should be disconnected from all systems except the one doing the download. An alternative to disconnecting the systems is to use the HP-UX `shutdown (1m)` command to halt the other systems until the download is complete.

Recovering Data Maps

If the data maps stored in the disk array controller NVRAM are lost, the `arrayrecover` command can be used to reconstruct the maps. The data maps are reconstructed using the latest recovery maps stored on two of the disk drives.

The recovery operation involves performing a parity scan on the contents of the entire disk array to validate the accuracy of the maps and to correct any drive parity inconsistencies. This process can take up to several hours depending on the amount of data on the disk array.

To start the map recovery process, type:

```
arrayrecover [[-s] | [-l[c]] | [-p] | [-v volume_set_ID]] [-c] <array-id>
```

The command options for `arrayrecover` are listed in Table 8.

Table 8. arrayrecover Command Options

Option	Description
-c	Used with other options, this will cause continuous polling during the recovery. The recovery is monitored and the current progress is displayed at regular intervals.
-l	Displays the array controller logs on standard output.
-lc	Displays the array controller logs on standard output, and then clears the logs.
-p	Begin the recovery in non-interactive mode. If there are multiple volume sets on the disk array, a list of the volume set numbers will be displayed. If there is only one volume set on the disk array, the recovery will be done on it. This option provides a mechanism to pass volume set information to a script designed to perform a recovery.
-s	Returns the recoverability status of the disk array, as well as the status of a recovery in progress. The status indicates if recovery is needed, and what percentage of the entire recovery has been completed. When used with the -c option, status will be returned at regular intervals allowing continuous monitoring of the recovery progress.
-v volume_set_ID	Starts a recovery on the volume set indicated by volume-set-id. This option is intended for use only in environments where there are multiple volume sets on the disk array.

Viewing the Disk Array General Configuration Settings

Checking the general configuration settings allows you to view the current settings for all the disk array operating parameters. The settings include the current status of the array, the array configuration, and the SCSI configuration settings.

A description of each setting is included in Table 9. The default settings have been selected to optimize disk array operation on HP-UX.

NOTE!	Before changing any setting, you should understand what the setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect setting may make it impossible for the host and the disk array to communicate properly.

To view the general configuration settings, type:

```
arraydsp -s <array-id>
```

A complete list of the settings will be displayed.

Table 9. General Configuration Settings

Parameter	Default Setting	Description
Overall State of Array	READY	Specifies the current state of the array
Active Hot Spare Desired	ENABLED	Indicates whether the array should reserve space within which to perform a rebuild process.
Auto Include	ENABLED	Indicates the action to be taken when a drive is physically inserted into the array.
Auto Rebuild	ENABLED	Indicates the action to be taken when a drive becomes unusable.
Rebuild Priority	HIGH	Indicates the priority the rebuild process is given with respect to host I/O.

Parameter	Default Setting	Description
Capacity Depletion Threshold	0%	Indicates the amount of space below which the disk array should signal a Capacity Depletion warning. For example, if this field is set to 99% then when the disk array reaches 99% capacity, a Capacity Depletion warning will be indicated. 0% means that Capacity Depletion warnings will not be issued.
Write Working Set Interval	8640 seconds	Indicates the period (in ten second intervals) over which write performance measurements should be gathered. For example, 8640 X 10 = 86400 seconds = 24 hours.
Language	ENGLISH	Indicates the language used when displaying information on the front panel.
Log Full Warning	DISABLED	Indicates whether the disk array should assert a warning when some portion of the controller log is full. When enabled, the disk array will assert a Log Full Warning when one of the disk array log pages fills, or a log parameter reaches its maximum value. When disabled, no Log Full Warning will be indicated.
Volume Set Partitioning	DISABLED	Indicates whether the disk array should boot when half or more of the previously available drives are unavailable (i.e., there is no drive quorum). Enabled indicates that volume set partitioning should be allowed. Disabled, the system will remain in the No Quorum state when the required quorum is not available.
Format Pattern Fill	DISABLED	Indicates whether the disk array will fill in incomplete RAID blocks with a format pattern when performing new writes. Some operating systems (not HP-UX and not NT) expect that SCSI format commands completely reinitialize data to a non-random pattern. When using the array with one of those operating systems, pattern filling should be enabled.
Disk array Type ID	12	Uniquely identifies the disk array hardware configuration. This field can be used to find the number of drives and SCSI channels supported within the disk array.
LUN Creation Limit	8	Controls the range of LUNs that may be created.
Maximum LUN Creation Limit	8	Specifies the maximum supported value for the LUN Creation Limit.

Parameter	Default Setting	Description
Array SCSI configuration:	N/A	N/A
Controller X SCSI Address		Indicates the SCSI bus address to be used by controller X. Changes in this field will take affect only after controller X is reset.
Controller Y SCSI Address		Indicates the SCSI bus address to be used by controller Y. Changes in this field will take affect only after controller Y is reset.
Write Cache	ENABLED	Indicates whether the disk array should cache write data. This field may be ignored depending on the map resiliency mode. Series 800 systems normally disable this field, and series 700 systems enable this field. Generally, write cache is used even though a host system automatically disables this field.
Read Cache	DISABLED	Indicates whether the disk array should cache read data. Note: This field does not represent what is actually happening. The disk array uses read cache algorithms. This field is put in place to facilitate some third party operating systems.
SCSI Parity Checking	ENABLED	Indicates whether the disk array should check SCSI bus parity. Disabled means that bus parity checking is disabled. Enabled indicates that bus parity checking is enabled.
SDTR	ENABLED	Indicates whether the disk array should initiate SDTR (Synchronous Data Transfer Request). Disabled, indicates the disk array will not initiate SDTR. Enabled indicates the disk array will initiate SDTR.
WDTR	ENABLED	Indicates whether the disk array should initiate WDTR (Wide Data Transfer Request). Disabled, indicates the disk array will not initiate WDTR. Enabled indicates the disk array will initiate WDTR.
Terminator Power	ENABLED	Indicates whether the disk array should provide power for the SCSI bus terminators. Disabled, indicates the disk array will not provide termination power. Enabled indicates the disk array will provide termination power.

Parameter	Default Setting	Description
Unit Attention	ENABLED	Indicates whether the disk array should signal a Unit Attention condition immediately following power-on or reset. Disabled, indicates the disk array will not signal unit attention. Enabled indicates the disk array will signal unit attention.
Disable Remote Reset	ENABLED	Controls the bus reset behavior of the second controller when a SCSI reset (reset signal, BDR or Reset Disk array command) is received in the first controller. When this bit is disabled, the second controller will assert the bus reset signal to indicate that all outstanding requests were cleared in response to the reset. When this bit is enabled, the second controller will not assert the SCSI reset signal to indicate the commands were cleared. Hosts that cannot tolerate target bus resets should enable this setting.
Secondary Controller Offline	DISABLED	Controls the behavior of the secondary controller with respect to bus selection. When disabled, any secondary controller present will respond to host selection. When enabled, the secondary controller will remain off-line until a failure of the primary controller is detected (at which point it becomes primary). Only the primary controller will go on-line.
Very Early Busy	DISABLED	Controls the behavior of the disk array with respect to SCSI bus selection during the early stages of the initialization sequence (i.e., from about three seconds after reset until about fifteen seconds prior to initialization completion). When disabled, the disk array will ignore SCSI bus selection until the late stages of initialization. When enabled, the disk array will accept selection during early initialization and will return BUSY status until the late stages of initialization.
Queue Full Threshold	1952	Specifies the target queue depth beyond which the disk array will return QUEUE FULL status to subsequent host requests.

Parameter	Default Setting	Description
Maximum Queue Full Threshold	1952	Specifies the maximum supported value for the Queue Full Threshold parameter. Attempts to set the QFT parameter to values higher than the MQFT will fail with CHECK CONDITION status and ILLEGAL REQUEST, INVALID FIELD IN PARAMETER LIST sense indications.
Simplified Resiliency Setting	Normal	Determines the values of the following eight parameters. This field regulates the mode of data resiliency that the disk array will operate in. The “Normal” mode is set at the factory when dual controllers are ordered with the array.
Single Controller Warning	ENABLED	Indicates whether the disk array should assert a warning when only one controller is present. When enabled, the disk array will assert a Single Controller Warning when there are not two controllers present in the array disk array. When disabled, no Single Controller Warning will be indicated.
Lock Write Cache On	TRUE	Controls the modification of the Write Cache setting. When LCWO is set to true, then the host cannot change the Write Cache setting. When LWCO is false, the host will be able to change Write Cache setting.
Disable NVRAM on WCE False	FALSE	Enables the disk array response to the Write Cache setting. If false, NVRAM use does not depend on the Write Cache setting, and will be enabled if no other condition inhibits it. If true, then NVRAM is disabled when Write Cache is disabled
Disable NVRAM with One Ctrlr	TRUE	Couples the use of NVRAM to the presence of an operational dual controller. If true and no operational dual controller is present, then NVRAM use is disabled. Otherwise NVRAM use does not depend on the presence of the second controller, and will be enabled if no other condition inhibits it.
Disable NVRAM on UPS absent	FALSE	Couples use of NVRAM to the presence of an operational UPS or BBU. At the time of printing, this field is reserved for future functionality with UPS and is disabled in all resiliency modes.

Parameter	Default Setting	Description
Force Unit Access Response	2	Controls the array's response to the FUA bit. The FUA bit is a command from the host when Write Cache is enabled. It gives the host an opportunity to flush write cache on command: If this field is 0, then the FUA bit is ignored. If this field is 1, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed. If this field is 2, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed along with the map journal before completing the write request. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored.
Disable Read Hits	FALSE	Controls the array's ability to satisfy read commands from write cache contents during FUA processing. If NVRAM use is disabled due to the chosen map resiliency mode, then read data is never satisfied out of write cache.
Resiliency Threshold	4	Specifies the maximum time between delivery of the response to a write command to the host, and initiation of associated writes out of write cache and map journal to disks. This time is specified in seconds. This maximum time is submitted to the scheduler for implementation. Depending on the priority of other events in the scheduler, the desired time may not be implemented. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored. The 0 value of this field is not the same as disabling NVRAM use. A value of 0h indicates that no maximum time will be enforced and that no recovery image will be available.

Simplified Resiliency Setting

The simplified resiliency setting is derived from several other fields. Collectively these settings control how data resiliency is managed. Table 10 identifies the field settings for each of the resiliency modes.

There are four modes of data resiliency: Normal, SingleController, Secure, and HighPerformance. The default setting is Normal for dual controller disk arrays. If the disk array has been ordered with a single controller, the default for this settings is SingleController.

For information on changing the data resiliency mode, see “Setting Data Resiliency” in this chapter.

Table 10. Simplified Data Resiliency Settings

Normal Mode Parameter	**Default Setting**	**Simplified Resiliency Setting Results**			
Single Controller Warning	ENABLED	700 Series Workstation		800 Series Multi-Purpose	
Lock Write Cache On	TRUE	Single Controller	Dual Controller	Single Controller	Dual Controller
Disable NVRAM on WCE False	FALSE	Not Supported	Data map and write cache information is scheduled to flush to the disk every four seconds.	Not Supported	Data map and write cache information is scheduled to flush to the disk every four seconds.
Disable NVRAM with One Ctrlr	TRUE				
Disable NVRAM on UPS absent	FALSE				
Force Unit Access Response	2				
Disable Read Hits	FALSE				
Resiliency Threshold	4				
SingleController Mode Parameter	**Default Setting**	**Simplified Resiliency Setting Results**			
Single Controller Warning	DISABLED	700 Series Workstation		800 Series Multi-Purpose	
Lock Write Cache On	FALSE	Single Controller	Dual Controller	Single Controller	Dual Controller
Disable NVRAM on WCE False	TRUE	Data map and write cache information is scheduled to flush to the disk once every second.	Not Supported	Data map and write cache information is scheduled to flush to the disk once every second.	Not Supported
Disable NVRAM with One Ctrlr	TRUE				
Disable NVRAM on UPS absent	FALSE				
Force Unit Access Response	2				
Disable Read Hits	FALSE				
Resiliency Threshold	1				

Secure Mode					
Parameter	**Default Setting**	**Simplified Resiliency Setting Results**			
Single Controller Warning	ENABLED	700 Series Workstation		800 Series Multi-Purpose	
Lock Write Cache On	FALSE	Single Controller	Dual Controller	Single Controller	Dual Controller
Disable NVRAM on WCE False	TRUE	Not Supported	Data map and write cache information is scheduled to flush to the disk once every second.	Not Supported	Data map and write cache information is scheduled to flush to the disk once every second.
Disable NVRAM with One Ctrlr	TRUE				
Disable NVRAM on UPS absent	FALSE				
Force Unit Access Response	2				
Disable Read Hits	FALSE				
Resiliency Threshold	1				
HighPerformance Mode					
Parameter	**Default Setting**	**Simplified Resiliency Setting Results**			
Single Controller Warning	ENABLED	700 Series Workstation		800 Series Multi-Purpose	
Lock Write Cache On	TRUE	Single Controller	Dual Controller	Single Controller	Dual Controller
Disable NVRAM on WCE False	FALSE	Not Supported	Data Resiliency disabled	Not Supported	Data Resiliency disabled
Disable NVRAM with One Ctrlr	TRUE				
Disable NVRAM on UPS absent	FALSE				
Force Unit Access Response	0				
Disable Read Hits	FALSE				
Resiliency Threshold	0				

Chapter 4. Using the ARDIAG Offline Diagnostic on HP-UX

This chapter defines the AutoRAID supported offline diagnostic commands for Series 700 and Series 800 HP-UX systems. This functionality will be a combination of the support media offline diagnostic environment (***ODE***) commands and commands issued from the AutoRAID front panel.

Operating environment

ARDIAG will only operate under ODE and thus it only operates in an offline environment. When ARDIAG is executed, ODE handles all the I/O with the user and it handles several higher level commands like LOG, HELP, etc.

NOTE. There should be no I/O activity on the SCSI bus when using ARDIAG. When operating in a multi-initiator environment, make sure none of the host systems are trying to access the disk array. Bus activity make cause ARDIAG to not see the disk array.

Support Software

ARDIAG requires all the software needed for ODE to run as ARDIAG relies on ODE to load and run. Additionally, ARDIAG needs the MAPPER SL and the DIODE SL from the protocol level down.

Minimum hardware

For ARDIAG to run properly, a working I/O subsystem and at least one SureStore E (AutoRAID) Disk Array is needed. ARDIAG must also meet ODE's hardware requirements (for example a working console). ARDIAG and ODE will use no more than 4 MB of main memory.

Minimum software

ODE, MAPPER SL and DIODE SL are needed to execute ARDIAG correctly.

Definition of Terms

The following terms are used in this chapter.

HP-UX	Hewlett-Packard's version of the UNIX® Operating System.
SIO	"Server I/O". The driver environment for the current Series 800 HP-UX system. Proprietary, non-reentrant, port-server drivers. Communication is via message passing.
WSIO	"Work Station I/O". The driver environment for the current Series 700 HP-UX system. Reentrant, procedure-based drivers. Communication is via procedure entry points.
SERIES 700	HP-UX PA-RISC workstations. These systems utilize the ***WSIO*** subsystem.
SERIES 800	HP-UX PA-RISC multi-user systems. These systems utilize the ***SIO*** subsystem.
ISL	"Initial System Loader" This is the first piece of software loaded from outside the SPU and executed during the boot process.
ODE	"Offline Diagnostic Environment" The software architecture consisting of several modules to provide diagnostic functionality via ***ISL*** support media for Series 700 and Series 800 HP-UX 10.0+ systems.
LIF	"Logical Interchange Format" A standard disk format that may be used for interchange of files among various HP computer systems. A LIF volume contains a header (identifying it as a LIF volume) and a directory that defines the contents of the volume. A boot device with a valid LIF is assumed to have bootable media.
SOM	"Spectrum Object Module" A SOM is the smallest unit that may be generated by a compiler, and it may exist as a single entity or as part of a collection.

ARDIAG Operational Commands

Table 11 lists the ARDIAG operational commands and their descriptions.

Table 11. ARDIAG Operational Commands

Command	Description
CLRLOG	Allows the user to clear the specified target's internal logs.
CREATELUN	Allows the user to create a LUN via the specified controller path to the disk array.
DELETELUN	Allows the user to delete a LUN via the specified controller path to the disk array.
DESCRIBE	Displays LUN configurations and warning states.
DOWNLOAD	Allows the user to download firmware to the specified controller or internal disk.
FORMAT	Allows the user to format the specified target.
INQUIRY	Issues an Inquiry to an array controller or an internal disk.
READLOG	Allows the user to read the specified target's internal logs.
RECOVER	Allows the user to restore controller map information in the specified SureStore E (AutoRAID) Disk Array.
REQSENSE	Issues a Request Sense on the specified target.
RESTART	Allows the user to bring the array out of the Shutdown state via the specified controller path.
REVISION	Displays controller, drives and software revisions.
ROMT	Read/Verify test to the specified internal mechanism..
SETOPTIONS	Allows the user to view and set specific options for the array controller.
SHUTDOWN	Allows the user to put the array into a Shutdown state via the specified controller path .
WRTMT	Destructive write/read and verify test to the specified internal mechanism.

ARDIAG Interface Commands

Table 12 lists the ARDIAG test module interface commands and their descriptions.

Table 12. ARDIAG Interface Commands

Command	Description
DISPMAP	Displays a list of AutoRAID controllers.
DISPMECH	Displays the disk mechanisms within the selected disk array.
RANGE	Environment variable that represents a range of blocks to test.
SHOWENV	Displays all environment variables.
TESTDISK	Points to the disk array on which to execute commands.
TESTLEVEL	Points to a physical mechanism within the disk array on which to execute commands.

Operational Command Descriptions

CLRLOG

The CLRLOG command allows the user to clear the internal logs of the specified target.

Synopsis

```
CLRLOG
```

Output

```
ARDIAG> CLRLOG
Clearing the contents of array controller log at Indx <0>.
*********************************************************
Successful Completion
```

DELETELUN

The DELETELUN command allows the user to delete a LUN from the specified disk array.

Synopsis

```
DELETELUN
```

Output

```
ARDIAG> DELETELUN
Enter the number of the LUN to delete: [default = 0]
*********************************************************
*                    DATA LOSS WARNING!                 *
*********************************************************
Continuing with DELETELUN WILL DEFINITELY RESULT IN DATA LOSS.
 All information stored on the LUN to be deleted will be lost
and the physical storage previously used will be freed...
*********************************************************
Lun 2 selected
Delete selected lun [default = [n]?]y
Lun 2 was successfully deleted.
```

Additional notes:

- Any problems detected by the DELETLUN command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

DESCRIBE

The DESCRIBE command allows the user to display the configuration and warning states of the currently selected array. Information displayed includes replaceable FRUs and their states, subsystem and physical drive data and LUN configurations.

Synopsis

```
DESCRIBE
```

Output

```
ARDIAG> DESCRIBE
Configuration information for the controller in slot X:

Component              Instance      State
--------------------   -----------   ---------------
Fan                    F1            Good
Fan                    F2            Good
Fan                    F3            Good
Power Supply           P1            Good
Power Supply           P2            Good
Power Supply           P3            Good
Controller             X             Good
Controller             Y             Good
Controller X Battery   1             Good
Controller X Battery   2             Good
Controller Y Battery   1             Good
Controller Y Battery   2             Good

Memory                 Instance   Size          State
--------------------   --------   ---------     ---------------
Controller X DRAM      1          32MB          Good
Controller X NVRAM     1          32MB          Good
Controller X NVRAM     2          32MB          Good
Controller Y DRAM      1          32MB          Good
Controller Y NVAM      1          32MB          Good
Controller Y NVRAM     2          32MB          Good

Total Memory:                     192MB

Test
Level  FRU    Slot   State       Warning Indications
-----  -----  ----   --------    ----------------------
  0    CNTRL   Y     Warning     Redundancy Loss
  1    MECH    A1    Included
  2    MECH    B1    Downed
  3    MECH    A2    Failed
  4    MECH    B2    Included
  5    MECH    A3    Included
```

```
  6    MECH    B3    Included
  7    MECH    A4    Included
  8    MECH    B4    Included

Lun   Capacity
---   --------
0     2.0 GB
1     1.5 GB
2     1.5 GB
3     1.5 GB
4     3.5 GB
7     100 MB
```

DOWNLOAD

The DOWNLOAD command allows the user to download firmware to the specified target(s).

Synopsis

```
DOWNLOAD
```

Additional information

DOWNLOAD to the array controller:

- The DOWNLOAD process must be performed using the primary controller. The primary controller is identified using the INQUIRY command. If the secondary controller is identified, you must change the controller selection using the TESTDISK command. The TESTLEVEL command must be set to zero to indicate a controller selection.
- A *presently installed* secondary controller is *automatically* updated with the new firmware image *after* a successful DOWNLOAD to the primary controller. Thus there is no interaction needed to update the *presently installed* secondary controller.
- A *newly installed* secondary controller can be *interactively* updated to the firmware image that is presently in the primary controller using the DOWNLOAD command.
- After successful DOWNLOAD, the REVISION command can be used to verify firmware revision. Reset ARDIAG to update DISPMAP revision information.

DOWNLOAD to an internal disk:

- The DOWNLOAD process to an internal disk can be performed through either the primary or secondary controller. The internal disks are identified using the REVISION command, which will display the disks within the array along with their corresponding TESTLEVEL identifier. The TESTLEVEL command must be set to a value from one to twelve to indicate the appropriate disk selection.

Output

Example 1: Controller

```
ARDIAG> testlevel 0
TESTLEVEL = 0
ARDIAG> download
************************************************************
*                  Array Controller DOWNLOAD               *
************************************************************
The following options are available for DOWNLOAD to the array controller:
   1 - Download a firmware image file to the primary controller with an
automatic update of same firmware to the secondary controller.
   2 - Update the secondary controller with the same firmware as the
primary controller.
Choose [1]: 2
The primary controller is at XXXX
Do you want to do the update (y/[n])? y
Please be patient.  The firmware download process may take several
minutes.
WARNING!
IF YOU INTERRUPT THIS PROCESS, THE DEVICE COULD BE RENDERED INOPERATIVE!!
Shutting down the array...
Mirroring the microcode image...
Please wait while the array performs a reset...
************************************************************
*            Firmware Download Successful                  *
************************************************************
ARDIAG>
```

Example 2: Internal disk drive

```
ARDIAG> testlevel 1
TESTLEVEL = 1
ARDIAG> download
Enter the firmware file name
    ['?' displays the files. Default quits]: ?
File name        Intended Product ID           Rev.   Size
---------------- ------------------------ ------ --------
Z1CS             HPC3586A     disk array      Z1CS   1048576
SEA5400          SEAGATEST31230N disk drive   0284    261632
S2G7200          Generic Disk                 1208    261632
S4G7200          ST15150W disk drive          1207    261632
Legend:
File name           = name of the firmware file
Intended Product ID = firmware file's intended product name
Rev.                = firmware Revision of the firmware file
Size                = exact byte size of the firmware image

Enter the firmware file name
    ['?' displays the files. Default quits]: sea5400
WARNING!
Firmware file SEA5400 was made for a SEAGATEST31230N disk drive.
TESTDISK selects a Unknown Product.

STOP! CONTINUING MAY PERMANENTLY DESTROY ALL DATA ON DISK.
Do you still want to continue (y/[n])? Y
```

```
************************************************************
* About to update Unknown Product currently at
* firmware revision 0256 with new firmware revision 0284.
************************************************************
Notes for this firmware release (from SEA5400):
1G and 2G 5400 RPM Seagate
Do you want to do the update (y/[n])? y
Please be patient.  The firmware download process may take several
minutes.
WARNING!
IF YOU INTERRUPT THIS PROCESS, THE DEVICE COULD BE RENDERED INOPERATIVE!!
Shutting down the array...
Downloading the firmware image...
If this is the last firmware download you want to perform on this array,
you can reset the array, which causes firmware changes on the disks to
take effect.  If you have more downloads to do, you will save time by
waiting to do the reset after the last one.  Note that a download to the
array controller causes an automatic reset.
Do you want to perform a reset ([y]/n)? y
Please wait while the array performs a reset...
************************************************************
*             Firmware downloaded SUCCESSFULLY!
************************************************************
ARDIAG>
```

FORMAT

The FORMAT command allows the user to format the specified target.

Synopsis

```
FORMAT
```

Output

Example 1: Controller

```
ARDIAG> TESTLEVEL 0
ARDIAG> FORMAT
************************************************************
*                 Array Subsystem FORMAT                   *
************************************************************
                     N O T I C E                            Use of this
command is not recommended except where a full subsystem backup of user
data is available or when a new, uninitialized subsystem is being
prepared for use. As a precaution, this command will NOT allow a format
to an array containing any LUNs. The DELETELUN command must be used to
remove all existing LUNs.
************************************************************
Do you want to continue (y/[n])? y

Checking the array subsystem for LUNs...
There are no LUNs presently configured on the selected array.
The selected array subsystem is allowed a format.
Do you want to continue (y/[n])? y
FORMATTING...
************************************************************
*                 FORMAT Successfully Completed            *
************************************************************
ARDIAG>
```

Example 2: Internal disk drive

```
ARDIAG> TESTLEVEL 1
ARDIAG> FORMAT
************************************************************
*                Internal Disk Drive FORMAT                *
************************************************************
*                     W A R N I N G !                      *
************************************************************
* FORMAT cannot continue without a loss of redundancy on the disk array
selected!  Failure of a disk before redundancy is restored will result in
DATA LOSS.  Although continuation of this FORMAT will NOT result in
direct data loss, it may take several hours before redundancy is restored
and a disk failure can be tolerated without data loss.
************************************************************
Do you want to continue (y/[n])? y
************************************************************
*                          N O T I C E                     *
************************************************************
* The following FORMAT will require approximately ONE HOUR to complete.
During this period you will be unable to perform any other diagnostic
activities.
************************************************************
Do you want to continue (y/[n])? y
FORMATTING...
************************************************************
*              FORMAT Successfully Completed               *
************************************************************
ARDIAG>
```

Additional notes:

- Any problems detected by the FORMAT command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

INQUIRY

The INQUIRY command allows the user to view SCSI Inquiry data from the specified target.

Synopsis

```
INQUIRY
```

Output

```
ARDIAG> INQUIRY
Performing Inquiry at TestLevel Indx 0
*********************************************************
Peripheral Qualifier: Requested LUN is supported
Peripheral Device Type: Direct-access device
Medium is NOT removable
Device-type Modifier = 0(0x0)
ISO Version = 0  |  ECMA Version = 0 |  ANSI Version = 2
Device complies to present SCSI-2
Device does NOT support TERMINATE I/O PROCESS message
INQUIRY data format is as specified in SCSI-2
Other supported features:
16-bit wide data transfer, Synchronous data transfer, Tagged Command
 Queuing
This device responds to a RESET condition with a SOFT RESET alternative
Vendor Identification: HP
Product Identification: C3586A
Product Revision Level: ZPRF
Requested Lun is Supported
Product Serial Number is ffffffffffffffffffffffffffffff
Controller Pair Serial Number is
ffffffffffffffffffffffffffffffffffffffffffff
Backplane Serial Number is 007870ca0000
Requested Lun is Supported
Manufacturing Product Code is ManProdCod
Firmware Revision is 5D03159518
Number of Supported Logical Units = 32
Lun     Capacity (Logical Blocks)
===     ========================
0       2097152
1       4194304
2       6291456
```

READLOG

The READLOG command allows the user to read the internal logs of the specified target.

Synopsis

```
READLOG
```

Output

The following are examples of the READLOG command.

```
ARDIAG> READLOG
```

Example 1: Controller

```
ARDIAG> readlog
Contents of array controller log at TestLevel Indx 0
****************************************************
Vendor ID = HP
Product ID = C3586A
Usage Log
ECC Error Count   = 0 (0x0)

  Select number to indicate display option for Event Log Information
  Number              Display Option
  ******              **************
    1                 Event Type Tables
    2                 Chronological
    3                 Both Event Type Tables & Chronological

   Note - Event Type Tables and Chronological are the same information;
they are just displayed differently.
    default[3] - Both
1
```

```
DRIVE ERROR EVENT TABLE
*********************************************************
* Time  * Module *  Event * Event * Slot * Sense * ASC * ASCQ * LBA  *
* Stamp * ID     *  Code  * Count *      * Key   *     *      *      *
*****************************************************************
  28279    0x4      0x0 0x1f   30      A2     0x5    0x24  0x0     N/A

CONTROLLER ERROR EVENT TABLE
*************************************************************************
* Time  * Module *  Event * Event * Component   * FRU *    Abterm     *
* Stamp * ID     *   Code * Count * Specific ID *     *    Code       *
*************************************************************************
  30367    0x40    0x0 0x87   1       0x7        0x81     NORMAL

SYSTEM CHANGE EVENT TABLE
*************************************************************************
* Time  * Module *  Event * Event * FRU *      Device ID Number       *
* Stamp * ID     *   Code * Count *     *                             *
*************************************************************************
  28254    0x1e   0x0 0x56     1     0x0           0       1
  30345    0xe    0x0 0xb1     1     0x0           0       1
  30348    0x30   0x0 0x8a     1     0x0           0       0
  30350    0xe    0x0 0xb1     1     0x0           0       1
  30510    0xe    0x0 0xb1     1     0x0           0       1
  30515    0x30   0x0 0x8b     1     0x0           0       0
  30515    0x30   0x0 0x89     1     0x0           0       0
  30515    0x30   0x0 0xb5     1     0x0           0       0
```

Example 2: Internal disk drive

```
ARDIAG> testlevel 4
TESTLEVEL = 4
ARDIAG> readlog
Contents of drive log at TestLevel Indx 4
*************************************************************************
Vendor ID =  HP
Product ID = 1.050 GB 3rd ###

Page Code 0  Supported Log Sense Pages
================================================
Page Code 2 Error Counter Page (Write) Page [Write Errors]
Page Code 3 Error Counter Page (Read) Page [Read Errors]
Page Code 5 Error Counter Page (Verify) Page [Verify Errors]
Page Code 6 Non-Medium Error Page [Non-Medium]
Page Code 37 Vendor Unique or Non SCSI-2 Standard [Vendor Unique]
Page Code 3e Vendor Unique or Non SCSI-2 Standard [Vendor Unique]

Page Code 2  Write Errors
=====================================================
Errors Corrected With Possible Delays        =    0
Total Errors Corrected By Applying Retries   =    0
Total Errors Corrected                       =    0
Total Times Correction Algorithm Processed   =    0
Total Bytes Processed                        =   (0x00000000200d6200)
Total Uncorrected Errors                     =    0
```

```
Page Code 3  Read Errors
=======================================================
Errors Corrected Without Substantial Delay   =    4
Errors Corrected With Possible Delays        =    0
Total Errors Corrected By Applying Retries   =    0
Total Errors Corrected                       =    4
Total Times Correction Algorithm Processed   =    4
Total Bytes Processed                        =   (0x000000000de82c00)
Total Uncorrected Errors                     =    0

Page Code 5  Verify Errors
=======================================================
Errors Corrected Without Substantial Delay    =    0
Errors Corrected With Possible Delays         =    0
Total Errors Corrected By Applying Retries    =    0
Total Errors Corrected                        =    0
Total Times Correction Algorithm Processed    =    0
Total Bytes Processed                         =   (0x0000000000000000)
Total Uncorrected Errors                      =    0

Page Code 6  NonMedium Errors
=======================================================
Errors Corrected Without Substantial Delay    =   334

Page Code 37      Addr     |          Hexadecimal   |   ASCII
-------------------------------------------------------------------------
 0    (0x0   ) | 0x37 0x00 0x00 0x1e 0x00 0x00 0x80 0x02 | 7.......
 8    (0x8   ) | 0x01 0x3e 0x00 0x01 0x80 0x02 0xff 0xff | .>......
 16   (0x10  ) | 0x00 0x02 0x80 0x02 0x00 0x00 0x00 0x03 | ........
 24   (0x18  ) | 0x80 0x02 0x00 0x00 0x00 0x04 0x80 0x02 | ........
 32   (0x20  ) | 0x00 0x00                               | ..

Page Code 3e      Addr     |       Hexadecimal      |   ASCII
-----------------------------------------------------------------
 0    (0x0   ) | 0x3e 0x00 0x00 0x08 0x00 0x00 0x00 0x04 | >.......
 8    (0x8   ) | 0x00 0x00 0x97 0xf1                     | ....
```

RECOVER

The RECOVER command allows the user to restore controller map information in the specified SureStore E (AutoRAID) Disk Array.

Synopsis

```
RECOVER
```

Output

```
ARDIAG>testdisk 1
Array state is No Address Table
The following warnings are currently in effect:
   Disk Warning
   Capacity Warning

ARDIAG>testlevel 0

TESTLEVEL = 0

ARDIAG> recover

The logs should be cleared before executing this command.

Do you want to abort to clear logs ([y]/n)? no

There is only one volume set in the array.

0)    "   125B0       D")
         Disks: A1  A2  A3
Proceed with recover operation ([y]/n)? yes
Recovery Progress = 1 Percent
Recovery Progress = 2 Percent
Recovery Progress = 3 Percent
.
.
.
```

```
Recovery Progress = 97 Percent
Recovery Progress = 98 Percent
Recovery Progress = 99 Percent

Wait, This will take several minutes.

Attempting to check completion status of the recover operation.

The array state has changed!
The previous state was No Address Table. The new state is Ready.
The array warnings has changed!
The previous warnings were:
   Disk Warning
   Capacity Warning

Now there are no warnings.
```

Additional Notes

Read controller logs to assess the completion status of the command based on the number of ECC errors or event counts.

REQSENSE

The REQSENSE command allows the user to view SCSI Sense data from the specified target.

Synopsis

```
REQSENSE
```

Output

```
ARDIAG> REQSENSE
Performing Request Sense at TestLevel Indx 0
*****************************************************************
Error Code: 112 (0x70)  |  Segment Number = 0 (0x0)
File mark bit is OFF    |  End of medium bit is 1349672
The Incorrect Length Indicator is OFF
Sense Key: NO SENSE (0x0)
The information field is NOT SCSI-2 compliant
    Information field bytes: 0x0  0x0  0x0  0x0
    Information as an int = 0 (0x0)
Command Specific Information field bytes: 0x0  0x0  0x0  0x0
    Command Specific Info as an int = 0 (0x0)
Additional sense code = 0 (0x0) and qualifier = 0 (0x0)
    Translates to: No additional sense information
Field replaceable unit code = 0 (0x0)
Sense Key Specific field is NOT valid
    Sense key specific field = 0x0  0x0  0x0
Module Identifier is 0 (0x0)
Error Number is 0 (0x0)
```

RESTART

The RESTART command allows the user to bring the specified disk array out of the Shutdown state.

Synopsis

```
RESTART
```

Output

```
ARDIAG> RESTART
This command will issue a hard reset to the array controller(s)
Ready to restart the array [default = [n]]?
 The array is starting up...
Please wait while the array performs a reset...
A two minute time-out is imposed here but 90 second reset times are more
typical.
Array has been successfully restarted.
```

Additional notes:

- Any problems detected by the RESTART command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

REVISION

The REVISION command allows the user to display the internal drive's firmware revisions on the specified SureStore E (AutoRAID) Disk Array.

Synopsis

```
REVISION
```

Output

```
ARDIAG> REVISION
Test
Level  FRU    Slot   Vendor ID   Product ID          Rev
-----  -----  ----   ---------   ----------------    ----
  0    CNTRL   Y     HP          Arrays R Us         YPR1
  1    MECH    A1    HP          1.050 GB 3rd ###    0256
  2    MECH    B1    HP          2.13 GB 2nd ###     0256
  3    MECH    A2    HP          1.050 GB 3rd ###    0256
  4    MECH    B2    HP          2.13 GB 2nd ###     0256
  5    MECH    A3    HP          1.050 GB 3rd ###    0256
  6    MECH    B3    HP          2.13 GB 2nd ###     0256
  7    MECH    A4    HP          1.050 GB 3rd ###    0256
  8    MECH    B4    HP          2.13 GB 2nd ###     0256

ARDIAG>
```

ROMT

The ROMT command allows the user to perform a read only media test on the specified target.

Synopsis

```
ROMT
```

Output

```
ARDIAG> romt
**************************************************************************
*                              W A R N I N G !                           *
**************************************************************************
This test cannot continue without a loss of redundancy on the AutoRAID
Array being tested! Redundancy will be restored when the test completes.
 However, failure of another disk during the test will result in data
 unavailability until the test completes.
**************************************************************************
Do you want to continue (y/[n])? y
Testing block 0.
percent
complete
100%
Test complete.
```

```
Testing subrange 1000/1200.
percent
complete
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %
90 %
100%
Test complete.
Testing block 45000.
percent
complete
100%
Test complete.

ARDIAG>
```

SETOPTIONS

The SETOPTIONS command allows the user to view and set specific options for the array controller.

Synopsis

```
SETOPTIONS
```

Output

```
ARDIAG> SETOPTIONS
Current information for the controller in slot X:
Subsystem Parameter           Value Subsystem Parameter           Value
------------------            ----- ------------------            -----
1 Subsystem State             Ready 15 Termination Power           ON
2 Active Hot Spare            OFF   16 Unit Attention              ON
3 Volume Set Partitioning     ON    17 Controller X Address        0
4 Rebuild in Progress         OFF   18 Controller Y Address        1
5 Auto-Rebuild                ON    19 Enable Manual Override      OFF
6 Auto-Include                ON    20 Manual Override Destination OFF
7 Balance in Progress         OFF   21 Format Pattern Fill         ON
8 Optimize in Progress        ON    22 Disable Remote Reset        OFF
9 Migrating Write Destination OFF   23 Language                 English
10 Log Full Warning           ON    24 Capacity Depletion Threshold 0
11 Rebuild Priority           OFF   25 Rebuild Progress              0
12 Parity                     ON    26 Write Working Set Interval    0
13 SDTR                       ON    27 Subsystem Identifier         13
14 WDTR                       ON
Select the number of the parameter to modify.[Default quits]:  2

Allowed values for Active Hot Spare
0 - OFF
1 - ON

Select the number of new parameter value.[Default quits]:  1
```

```
Modify the parameter with the selected value?(y/[n])?  y
Subsystem Parameter           Value Subsystem Parameter           Value
------------------            ----- ------------------            -----
1 Subsystem State             Ready 15 Termination Power           ON
2 Active Hot Spare            ON    16 Unit Attention              ON
3 Volume Set Partitioning     ON    17 Controller X Address        0
4 Rebuild in Progress         OFF   18 Controller Y Address        1
5 Auto-Rebuild                ON    19 Enable Manual Override      OFF
6 Auto-Include                ON    20 Manual Override Destination OFF
7 Balance in Progress         OFF   21 Format Pattern Fill         ON
8 Optimize in Progress        ON    22 Disable Remote Reset        OFF
9 Migrating Write Destination OFF   23 Language                 English
10 Log Full Warning           ON    24 Capacity Depletion Threshold 0
11 Rebuild Priority           OFF   25 Rebuild Progress             0
12 Parity                     ON    26 Write Working Set Interval   0
13 SDTR                       ON    27 Subsystem Identifier        13
14 WDTR                       ON
```

Additional notes:

- Any problems detected by the SETOPTIONS command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.
- Table 13 contains a list of the subsystem states displayed by the SETOPTIONS command and the naming convention used in AutoRAID documents. Several of the subsystem state names displayed by the SETOPTIONS command have been abbreviated.

Table 13. Subsystem States

SCSI Specification	Front Panel Display	ARDIAG Set Options Display
Ready	Ready	Ready
Warning	Warning	Warning
Not Enough Drives	Not Enough Disks	NtEnDsk
No Quorum	No Quorum	NoQuorm
No Map	No Address Table	Nomap
Shutting Down	Shutdown Started	Shtgdwn
Shut Down	Shutdown Complete	Shutdwn
Starting Up	Initializing	Strtgup
No Code	No Code	Nocode
RESERVED	N/A	Resrved
Shutdown Warning	Shutdown Warning	Shtwrn
RESERVED	N/A	Resrved
Mismatched Code	Firmware Needed	FWneed
Controller Mismatch	Cntrl Mismatch	CTLmis

SHUTDOWN

The SHUTDOWN command allows the user to put the specified disk array into the Shutdown state.

Synopsis

```
SHUTDOWN
```

Output

```
ARDIAG> SHUTDOWN
Are you sure that you want to shutdown the array [default = [n]]?
Shutting down the array...
The array at testdisk 0 is now in the shutdown state.
```

Additional notes:

- Any problems detected by the SHUTDOWN command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

WRTMT

The WRTMT command allows the user to perform a destructive write/read and verify test on the specified target.

Synopsis

```
WRTMT
```

Output

```
ARDIAG> wrtmt
You must set the range variable before performing this task!
SOFTWARE ERROR(S) DETECTED BY ARDIAG
ARDIAG> range 0,1000/1200,45000
The selected disk has blocks from 0 to 4165271
RANGE: 0,1000/1200,45000
ARDIAG> wrtmt
**********************************************************************
*                              W A R N I N G !                       *
**********************************************************************
* This test cannot continue without a loss of redundancy on the AutoRAID
* Array being tested!  Failure of a disk before redundancy is restored
* will result in DATA LOSS.  Although continuation of this test will NOT
* result in direct data loss, it may take several hours before redundancy
* is restored and a disk failure can be tolerated without data loss.
**********************************************************************


Do you want to continue (y/[n])? y
The following data pattern options are available:
     1 - Random pattern (0x00 to 0xFF)
     2 - User defined
     3 - Abort the test
Choose [1]: 2
Enter the pattern in hex format (0 to FF) [A5]: dd
The write data pattern will be 0xDD
Testing block 0.
percent
complete
100%
Test complete.
```

```
Testing subrange 1000/1200.
percent
complete
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %
90 %
100%
Test complete.

Testing block 45000.
percent
complete
100%
Test complete.

ARDIAG>
```

Interface command descriptions

DISPMAP

The DISPMAP command allows the user to display all available disk arrays on the system.

Synopsis

```
ARDIAG
```

Output

```
ARDIAG> dispmap
Test
Disk Path            Product String                   Rev    Size
---- --------------- -------------------------------- -----  -----
*0   56/40.1.0       HPC3586 AUTORAID disk array      ZPRF   1.0 GB

Legend:
TestDisk - Indx of the array listed. This is flagged with a '*'
           if it is marked for testing.

NOTE:
  The size of disk may not match the Information Specified by
  the vendor due to difference in calculation methods.
```

DISPMECH

The DISPMECH command allows the user to display physical mechanisms within a selected disk array.

Synopsis

```
DISPMECH
```

Output

```
ARDIAG> DISPMECH
Path        Product String               Rev   Size
----------- --------------------------   ----  -----
* 56/40.1.0 HPC3586 AUTORAID disk array  ZPRF  1.0 GB

PHYSICAL MECHANISMS WITHIN THE SELECTED ARRAY
Test
Level  FRU    Slot   Drive State       Initialization State
----   -----  -----  ----------------  --------------------
  0    CNTRL   X
  1    MECH    A1    Ready             Ready
  2    MECH    B1    Ready             Ready
* 3    MECH    A2    Ready             Ready
  4    MECH    B2    Ready             Ready
  5    MECH    A3    Ready             Ready
  6    MECH    B3    Ready             Ready
  7    MECH    A4    Ready             Ready
  8    MECH    B4    Ready             Ready

Legend:
TestLevel -Indx of the FRU listed. This is flagged with a '*'
           if it is marked for testing.
```

RANGE

The RANGE environment variable allows the user to set the desired range of blocks for testing.

Synopsis

```
RANGE {start[/end]{, start[/end]}}
```

Output

```
ARDIAG> RANGE 300/500,1000/2000
Range: 300/500,1000/2000

ARDIAG> RANGE
Range: 300/500,1000/2000
ARDIAG> RANGE 10,20/30,50
Range: 10,20/30,50

ARDIAG>
```

SHOWENV

The SHOWENV command allows the user to view the current values of the environment variables TESTDISK, TESTLEVEL and RANGE.

Synopsis

```
SHOWENV
```

Output

```
ARDIAG> SHOWENV
TESTDISK :  0
TESTLEVEL 3
RANGE : 200/600
```

TESTDISK

The TESTDISK environment variable allows the user to reference a particular disk array for test.

Synopsis

```
TESTDISK <Indx>
```

Output

```
ARDIAG> TESTDISK 2
```

TESTLEVEL

The TESTLEVEL environment variable allows the user to reference a physical mechanism within a SureStore E (AutoRAID) Disk Array for test.

Synopsis

```
TESTLEVEL <Indx>
```

Output

```
ARDIAG> TESTLEVEL 2
```

ODE interface

The following examples illustrate ARDIAG functioning within ODE.

The user runs ODE at the ISL prompt.

```
ISL> ODE
**********************************************************************
******                                                          ******
******            OFFLINE DIAGNOSTIC ENVIRONMENT                 *****
******                                                          ******
******     (C) copyright Hewlett-Packard Co 1994                 *****
******                All Rights Reserved                       ******
******                                                          ******
******                                                          ******
******                TC Version XX.XX.XX                       ******
******                 SysLib Version XX.XX.XX                  ******
******                                                          ******
******                                                          ******
**********************************************************************
Type HELP for command information
ODE> help
BASIC COMMANDS
--------------------------
HELP - Prints detailed information when “help <command>” or “help
       <variable>” is typed.
LS - Lists modules available on the boot media.
<MODULE NAME> - Load and initialize the module.
RUN - Run module (after setting environment variables)
CONTROL-Y | CONTROL-C - Abort an ODE command; pause a module.
RESUME - Restart a paused module.
DISPLOG - After running a module, display  the contents of the log.
EXIT - Return to the next higher level prompt.
ENVIRONMENT VARIABLES
```

```
SHOWSTATE - Display the values of the following environment variables:
LOOP - Run a test this many times.
ERRPRINT [ON | OFF] - Print low level error messages.
ERRNUM [ON | OFF] - Print one-line, numbered errors.
ERRPAUSE [ON | OFF] - Pause module on error.
ERRONLY [ON | OFF] - Print only error messages.
INFOPRINT [ON | OFF] - Print informational messages.
ISOPRINT [ON | OFF] - Print fault isolation messages.
ISOPAUSE [ON | OFF] - Pause module when isolation message is generated.
LOGSIZE - Set the size of the message log.
DEFAULT - Reset environment variables to default state.


ODE> ls
Modules on this boot media are:
filename  type    size    created  description
-----------------------------------------------------------------
ARDIAG    XXXX    XXX      XXXX       XXXXXX
```

ARDIAG interface to ODE

```
ODE> ARDIAG
**********************************************************************
******                                                          ******
******                          ARDIAG                          ******
******                                                          ******
******             (C) copyright Hewlett-Packard Co 1996        ******
******                All Rights Reserved                       ******
******                                                          ******
******                                                          ******
******                                                          ******
******                       Version XX.XX.XX                   ******
******                                                          ******
******                                                          ******
**********************************************************************


Please wait while I scan the device busses...
Test
Disk Path            Product String                       Rev    Size
---- --------------- ---------------------------------- -----  -----
*0    56/40.1.0       HPC3586 AUTORAID disk array        ZPRF   1.0 GB
Legend:
TestDisk - Indx of the array listed. This is flagged with a '*'
           if it is marked for testing.

NOTE:
  The size of disk may not match the Information Specified by
  the vendor due to difference in calculation methods.
ARDIAG> help
```

```
            ARDIAG Utility  Help Menu
-------------------------------------------------------------------------
  UTILINFO   - Shows commands that do the most common ARDIAG tasks.
  HELP       - This menu, or use HELP <help item> for more detailed help
  DISPMAP    - Display the disk arrays found
  DISPMECH   - Display the selected disk array and internal disks
  DISPFILES  - Display the firmware images found
  DOWNLOAD   - Download the image file to the desired disk array
               controller or internal disk.
  TESTDISK   - Select the array to be tested.
  TESTLEVEL  - Select the FRU within the disk array to be tested.
  RANGE      - Select range of blocks to be tested by ROMT and WRTMT
  SHOWENV    - Display the current settings for TESTDISK and RANGE.
  READLOG    - Read the internal logs of the desired disk array
               controller or internal disk.
  CLRLOG     - Clear the internal logs of the desired disk array
               controller or internal disk.
  REQSENSE   - View SCSI Sense data of the desired disk array
               controller or internal disk.
  INQUIRY    - View SCSI Inquiry data of the desired disk array
               controller or internal disk.
  DESCRIBE   - View Configuration data of the desired disk array.
  REVISION   - View revision information of the desired disk array.
  WRTMT      - Perform a DESTRUCTIVE write/read test on the desired disk
  ROMT       - Perform a read only test on the desired disk.
  CREATELUN  - Adds a LUN to the selected disk array.
  DELETELUN  - Removes a LUN from the selected disk array.
  SHUTDOWN   - Puts the selected disk array into the shutdown state.
  SETOPTIONS - View and modify SCSI mode parameters on the selected
               array controller.
  RECOVER    - Reconstruct data mapping and array configuration.
Continue ([y]/n)? n
```

Chapter 5. Managing the HP SureStore E Disk Array 12H on MPE

This chapter introduces the tools available for managing your HP SureStore E Disk Array 12H on MPE. These tools provide complete control over all aspects of disk array operation.

The following information is included in this chapter:

- A brief description of each management tool
- Which tools can be used for each management task.
- Instructions for installing the disk array management software

Disk Array Management Tools

Two disk array management tools are available for managing the disk array—an online tool and the disk array control panel.

AutoRAID Management (ARM) utilities

Included with the disk array is a set of ARM utilities, which provide advanced capabilities for managing the disk array. You will need to use the ARM utilities to perform functions such as formatting or diagnostics.

Disk array control panel

An alternative to the online management tool is the disk array control panel. Although you can use the disk array control panel to perform most of the management tasks available through the ARM utilities, the added convenience and functionality provided by the ARM utilities make them better tools for managing the disk array.

Which Tools to Use for Each Task

The various management tasks are performed using the command- line utilities. In general, the more common tasks are available from the ARM utilities. Most tasks can also be performed using the disk array control panel.

Table 14. Tools and Tasks

Tasks	Tools	
	ARM Utilities	Control Panel
Including a disk	Yes (arraycfg)	Yes
Checking disk array status	Yes (arraydsp)	Yes
Creating/deleting LUNs	Yes (arraycfg)	Yes
Renumbering LUNs	Yes (arraycfg)	Yes
Starting/canceling a Rebuild	Yes (arrayrbld)	Yes
Downing (excluding) a disk	Yes (arraycfg)	No
Formatting a LUN or array	Yes (arrayfmt)	Yes
Shutting down the disk array	Yes (arraymgr)	Yes
Changing operating settings	Yes (arraymgr)	Yes
Changing SCSI settings	Yes (arraymgr)	Yes
Monitoring performance	Yes (arraydsp)	No
Switching primary controller	Yes (arraymgr)	Yes
Testing a disk	Yes (drivetest)	No
Displaying disk test results	Yes (dteststat)	No
Displaying disk array serial numbers	Yes (arraydsp)	Yes
Changing controller SCSI ID	Yes (arraymgr)	Yes
Resetting/restarting the disk array	Yes (arraymgr)	Yes
Setting data resiliency	Yes (arraymgr)	No
Creating a disk array alias	Yes (arraymgr)	No
Recovering data maps	Yes (arrayrecover)	Yes

Installing the Disk Array Management Software

The AutoRAID Manager (ARM) disk array management software is distributed on the World Wide Web.

NOTE! At the time of printing the following ARMServer patches were available:

The latest patches are available from the HP Patch web site:

(www.hp.com/go/support)

which will indicate if the above patches have been superceded.

Operating System Support

The ARMServer software is supported on MPE/iX 6.0 C.60.00 and requires the following patches:

- MPEKXU3
- ARMKXW5

Tips for Configuring the Disk Array On MPE

Before installing a new disk array, you should determine what is more important for your operating environment—performance or capacity. This decision will influence how you configure the disk array hardware. There are several configuration options that impact the performance of the disk array. Table 15 identifies the various configuration options, their impact on disk array performance, and any considerations regarding disk array capacity.

NOTE! Overall system performance is a complex issue influenced by many factors. The configuration options described here will increase the *potential* performance of the disk array. However, the actual performance of the disk array will be determined largely by host demand. AutoRAID technology is particularly suited to I/O-intensive application environments such as OLTP and NFS. It is in these environments that the performance benefits offered by AutoRAID will be fully realized.

Table 15. Configuration Options

Configuration Option	Impact on Performance and Capacity
Number of LUNs per disk array	**Performance**. Increase the number of LUNs per disk array to improve performance. More LUNs increases the size of the I/O command queue allocated, which increases throughput. The recommended number of LUNs is 4 to 6. **Capacity**. To allow for future capacity expansion, avoid creating the maximum number of LUNs (8) on the disk array. New capacity is made available through the creation of a new LUN. If the maximum number of LUNs have already been created, it will be necessary to delete and recreate an existing LUN to increase capacity.
Number of disk arrays per SCSI host adapter	**Performance**. Limit the number of disk arrays per host adapter to improve performance. **Capacity**. If maximum capacity is more important than performance, connect the maximum number of disk arrays to each adapter.

Configuration Option	Impact on Performance and Capacity
Number of disk drives	**Performance**. Increase the number of disk mechanisms in the disk array for maximum performance. As the number of individual disks is increased, the number of potential I/Os that can be performed simultaneously increases as well. This will improve performance in environments that place heavy I/O demand on the disk array. **Capacity**. The capacity of a disk array that is fully populated with disk mechanisms can only be increased by replacing lower capacity disks with higher capacity disks.
Unallocated disk array capacity	**Performance**. Unallocated capacity is used as additional RAID 0/1 space. The amount of RAID 0/1 space required to maintain optimal performance is determined by the write working set parameter. **Capacity**. To create the maximum amount of storage capacity, allocate all available capacity to LUNs.

Configuring AutoRAID SCSI LUNs for MPE/iX

This section will explain how to configure the AutoRAID using the MPE/iX SYSGEN along with a list of configuration requirements.

Configuration Requirements

There are two configuration requirements MPE/iX has that the user should be aware of before starting the SYSGEN configuration:

- SCSI LUN 0 on the AutoRAID should be configured first. LUN 0 will be used by the ARM utility for communications with the AutoRAID.
- SCSI LUN 0 should have the lowest LDEV number configured compared to the LDEVs assigned to SCSI LUN-1 through 7.

  For example:

LDEV 30	SCSI LUN 0
LDEV 32	SCSI LUN 1
LDEV 33	SCSI LUN 3
LDEV 35	SCSI LUN 4
LDEV 37	SCSI LUN 5
LDEV 38	SCSI LUN 6
LDEV 39	SCSI LUN 7

NOTE! The LDEV assignment does not have to be contiguous, but only the lowest LDEV should be assigned to the lowest number SCSI LUN. Configuration to a non-existent SCSI LUN is not recommended.

MPE/iX SYSGEN Configuration

The following example illustrates how to configure an MPE/iX logical device (LDEV) to a SCSI LUN. It assumes the configuration of an LDEV to a physical I/O path of 10/16/4.1.0.

NOTE! To obtain the path, use the offline utility ODE and run mapper.

To configure any device on an MPE/iX system, use the SYSGEN configuration from the MPE/iX system prompt as follows:

```
:SYSGEN
```

Within the IO area of SYSGEN, configure the upper level hardware first. For example, a 969KS/100 has two levels of bus converters, which appear in the path prior to specifying the HP-PB slot number.

The following is a SYSGEN list path(lp) from the io prompt:

io> lp 10

PATH:	10	LDEV:	
ID:	A2372-6003	TYPE: BC	
PMGR:	BUS_CONV_MGR	PMGRPRI:	2
LMGR:		MAXIOS:	0

io> lp 10/16

PATH:	10/16	LDEV:	
ID:	A2372-60003	TYPE: BC	
PMGR:	BUS_CONV_MGR	PMGRPRI:	2
LMGR:		MAXIOS:	0

Device Adapter Configuration:

Configure the HP-PB Fast/Wide SCSI adapter using the SYSGEN ID of HP28696:

io> ap 10/16/4 id = hp28696a

io> lp 10/16/4

PATH:	10/16/4	LDEV:	
ID:	HP28696A	TYPE: DA	
PMGR:	FWSCSI_DAM	PMGRPRI:	6
LMGR:		MAXIOS:	0

SCSI Target Configuration:

The next item to configure is the SCSI Target ID (TID). Since the AutoRAID is a multi-lun device, the TID will be the same for each LDEV connected to any single AutoRAID. The SCSI Target will represent the path to the controller that the SCSI cable is connected to.

NOTE: The setting of the initial SCSI TARGET(TID) and the SCSI LUN values on the AutoRAID can be set by the front panel control. See *User's and Service Manual* for information on how to use the front panel.

The SCSI Target ID of the controller is represented within SYSGEN using the ID of PSEUDO.

io> ap 10/16/4.1 id=pseudo

io> lp 10/16/4/1

PATH:	10/16/4/1	LDEV:	
ID:	PSEUDO	TYPE: DA	
PMGR:	TRANSPARENT_MGR	PMGRPRI:	6
LMGR:		MAXIOS:	0

LDEV (SCSI LUN) Configuration

The next and last item to configure is the LDEV number. If this is the first time the user is performing this to an AutoRAID, then LUN 0 should be configured. As mention in the first note in this chapter, the user is required to have LUN 0 be the lowest LDEV number.

NOTE! The SYSGEN product ID for ALL AutoRAID devices is **HPDARRAY**.

To configure the LDEV number to the AutoRAID as follows:

```
io> ad 30 id=hpdarray path=10/16/4.1.0
io>  ld 30
```

LDEV: 30 DEVNAME	OUTDEV:	0	MODE:
ID: HPDARRAY	RSIZE:	128	DEVTYPE: DEVC
PATH: 10/16/4.1.0	MPETYPE	4	MPESUBTYPE: 2
CLASS: DISC SPOOL			

Once LUN 0 has been configured, adding more LDEVs is done by using only the add device command (ad). The following is an example of adding LDEV 31 and LDEV 32:

```
io> ad 31  id=hpdarray  path=10/16/4.1.1
io> ad 32  id=hpdarray  path=10/16/4.1.2
```

For more information on the SYSGEN configuration, refer to *the MPE/iX System Startup, Configuration, and Shutdown Reference Manual*, part number (36650-90042).

Chapter 6. Using the ARM Command Line Utilities for MPE

The AutoRAID software includes a set of AutoRAID Manager (ARM) command line utilities. These commands provide the ability to manage the disk array from the MPE command prompt.

The ARM commands can be used to perform a number of tasks. These tasks are intended for advanced users and involve procedures such as diagnostics, performance monitoring, setting SCSI values, and disk array maintenance.

LUNs and Logical Drives. To maintain consistency with MPE terminology, the term LUN is used to refer to a disk array logical drive. The two terms are used interchangeably and refer to the same logical entity on the disk array.

Setting Up MPE POSIX Shell

To set up the MPE POSIX shell to execute the ARM command line utilities, refer to the following example:

```
1. :SETCATALOG HPPXUDC;APPEND;SYSTEM
2. :SH
3. >cd /opt/hparray/bin
```

Information in man pages

The procedures in this chapter summarize the use of the ARM utilities. Detailed information about the ARM command line utilities and their proper usage is included in the MPE operating system man pages. A man page also exists for ARMServer, the server portion of the disk array management software.

To access MPE man pages information, type:

```
man <commandname>
```

Substitute one of the following ARM utility names for commandname.

```
ARMServer
arraycfg
arraydsp
arrayfmt
arraylog
arraymgr
arrayrbld
arrayrecover
download
drivetest
dteststat
logprint
```


Command Syntax Conventions

The following symbols are used in the command descriptions and examples:

Symbol	Meaning
<>	Integer value, whose units are not defined.
|	"Exclusive OR." Exactly one of the parameters displayed will be used.
[ ]	Items enclosed are optional.
{ }	Items enclosed are required.

The ARMServer Process

The ARMServer process is the server portion of the ARM software. It monitors the operation and performance of the disk array, and services external requests from clients executing disk array commands. The ARMServer process monitors disk array performance and status, maintains disk array logs, initiates diagnostics, and allows clients to examine and change the disk array configuration.

The ARMServer process must be running to allow management of the disk array using the ARM command line utilities. Because of its importance in managing the disk arrays, the ARMServer process should be launched automatically when the system is booted. Host I/Os to the disk array are not dependent on the ARMServer process and are serviced regardless of whether the ARMServer process is running or not.

Selecting a Disk Array to Manage

When using the ARM utilities, the <array-id> field is used to identify the disk array. The <array-id> field can contain the disk array serial number or an alias text string assigned to the array using the `arraymgr` command.

For example, assume a disk array has a serial number of 00786B5C0000 is defined for this array, and it has an alias of autoraid4. To check the available unallocated capacity on this particular disk array, you could use any of the following commands:

```
arraydsp 00786B5C0000
```

or

```
arraydsp autoraid4
```

The serial number of all arrays in the system can be obtained using the command

```
arraydsp -i
```

For more information see “Displaying Disk Array Serial Numbers” in this chapter.

Configuring a New Disk Array

After installing a new disk array, you can perform the initial configuration using the ARM utilities. This establishes the operating environment for the disk array.

To configure a new disk array:

1. Plan your capacity management strategy and LUN configuration.

   Decide how you want to use the disk array capacity. Factors such as data redundancy and performance influence how you manage the capacity. See "Managing the Disk Array Capacity" in the *HP SureStore E Disk Array 12H User's and Service Manual* for help in planning your strategy. Also see "Tips for Configuring the Disk Array On MPE" of this guide.

2. Display the serial number of the disk array by typing:

   ```
   arraydsp -i
   ```

   The serial number provides a way to identify disk arrays when using the ARM utilities. Record the serial number for future reference, or set a shell variable to hold this value, for example:

   ```
   export ID=00786B5C0000
   ```

3. If the planning in step 1 requires you to disable any of the configuration settings to implement your capacity management strategy, do so now. These settings include Active Hot Spare, Auto Rebuild, and Auto Include. Change the configuration settings by typing:

   ```
   arraymgr -h { on|off } <array-id>    (Active Spare)
   arraymgr -a { on|off } <array-id>    (Auto Rebuild)
   arraymgr -i { on|off } <array-id>    (Auto Include)
   ```

NOTE! Only one setting can be changed on each command line.

4. Check the available unallocated capacity on the disk array by typing:

   ```
   arraydsp $ID
   ```

   The total unallocated capacity available for creating LUNs will be displayed. Make sure there is adequate capacity to create the LUN structure you need.

5. Create each LUN on the disk array by typing:

```
arraycfg -L LUN -a capacity <array-id>
```

Example:

```
arraycfg -L 0 -a 1000 00786B5C0000
```

This command creates LUN 0 with a capacity of 1000 Mbytes on the array identified by serial number 00786B5C0000.

This step makes disk array capacity available to your operating system, and it must be repeated for each LUN to be created. Make sure you observe any operating system limitations on LUN size or number. For more information, see "Creating a LUN" in this chapter.

Checking Disk Array Status

One of the most important management tasks is monitoring the status, operation, and configuration of the disk array. It is important to know how well the disk array is operating and if any problems or failures have occurred. Using the ARM `arraydsp` command, you can easily check all aspects of disk array operation and configuration. The `arraydsp` command options, summarized in Table 16, allow you to display information about each disk array hardware component, as well as information about the logical configuration of the disk array.

Table 16. arraydsp Options for Displaying Disk Array Status

Option	Status Information Displayed
`none`	General information about the disk array
`-l [LUN]`	Information for the specified LUN
`-a`	All information displayed for options -l, -d, -c, -s, -v, and -h
`-c`	Array controller status
`-d`	Disk status
`-h`	Hardware status
`-i`	Serial numbers for all disk arrays
`-m`	Display performance metrics
`-R`	Rescan for SureStore E (AutoRAID) disk arrays recognized by the host.
`-r`	Make performance recommendations
`-S`	Generate raw output, used in combination with other options
`-s`	General configuration information. For a complete description of all the configuration settings, see "Viewing the Disk Array General Configuration Settings" at the end of this chapter.
`-v`	Capacity information

Displaying Disk Array Serial Numbers

The serial numbers of all disk arrays connected to the host can be displayed by typing:

```
arraydsp -i
```

Missing Disk Arrays? If you know there are disk arrays connected to the host but they are not displayed in response to the arraydsp command, check the following:

- Make sure all disk arrays are properly connected to the host. This includes proper termination of the SCSI bus.
- Make sure all disk arrays are turned on and operating properly.
- Make sure the ARMServer process is running. ARMServer must be running to execute this or any other ARM command. You can easily check to see if the ARMServer process is running using the following command: -ps ef | grep ARM
- Rescan for disk arrays by typing: arraydsp -R. This will update the ARMServer information to reflect the current system configuration.

Changing Disk Array Configuration Settings

A number of configuration settings control the operation of the disk array. These settings are usually established during installation and once set, should rarely need to be changed.

The default settings have been selected to provide the best operation for most systems. However, if you determine that any setting does not meet your needs, you can easily change it.

Table 17 lists the various settings, including factors you may want to consider when changing them.

Table 17. arraymgr Disk Array Configuration Settings

Setting	Default	Command Option	Comments and Considerations
Active Spare	On	-h	Active Hot Spare provides optimum protection against disk failure. Disabling Active Hot Spare will make additional capacity available to the host, but at the expense of maintaining full data redundancy.
Auto Rebuild	On	-a	Auto Rebuild provides optimum protection against disk failure by rebuilding a failed disk as quickly as possible. Disabling Auto Rebuild gives you more control over the rebuild process, but it can leave the disk array vulnerable to a second disk failure until a Rebuild is performed manually.
Auto Include	On	-i	Auto Include simplifies the task of adding a new disk to your array. Disabling it will require you manually to include each disk you install in the array.
Rebuild Priority	High	-p	Rebuild priority determines how quickly a Rebuild operation will complete.

To change Active Spare, Auto Rebuild, or Auto Include settings, type:

```
arraymgr { -h | -a | -i } { on|off } <array-id>
```

To change Rebuild Priority setting, type:

```
arraymgr -p { high|low } <array-id>
```

Managing LUNs (Logical Drives)

An important part of managing the disk array involves defining and maintaining the optimal LUN structure for your system. Your system requirements and limitations will influence the LUN structure you choose.

Managing LUNs is a part of the overall task of managing disk array capacity. For more information on managing disk array capacity to meet your system needs, refer to the *HP SureStore E Disk Array 12H User's and Service Manual*.

Checking LUN Configuration

When you are managing LUNs, you may find it convenient to check the current LUN configuration and the available capacity.

To check the current LUN configuration and the available capacity, type:

```
arraydsp -l [LUN] <array-id>
```

Creating a LUN

Only capacity assigned to LUNs is visible to the operating system. When selecting the size for your LUNs, consider the following factors:

- Any size limitations imposed by the operating system.
- Your backup strategy. If you do unattended backup to a device such as a tape, you may want to avoid creating a LUN that is larger than the capacity of the tape media. This allows you to back up an entire LUN without changing tapes.
- Configuring the LUN for maximum performance as described in Table 15.

NOTE! Before creating a LUN, check your operating system documentation for any additional information or steps that may be required to create a LUN.

To create a LUN, type:

```
arraycfg -L LUN -a capacity <array-id>
```

`LUN` must be an unused value between 0 and 7
`Capacity` must be less than or equal to the currently available unallocated capacity

NOTE! The following commands require LUN exclusive access. This means nothing can access the LUN while the command is running.

```
Delete LUN
Renumber LUN
```

Renumbering a LUN

NOTE! Before renumbering a LUN, check your operating system documentation for any additional information or steps that may be required to renumber a LUN.

To renumber a LUN, type:

```
arraycfg -L LUN -r newLUN <array-id>
```

LUN is the LUN to be renumbered
newLUN is a new available LUN number

Deleting a LUN

When a LUN is deleted, its capacity is returned to the pool of unallocated capacity space. Deleting a LUN is a good way of freeing up capacity for the Active Hot Spare or for simply adding more unallocated capacity to improve disk array performance.

CAUTION! All data on a LUN is lost when it is deleted. Make sure you backup any important data on the LUN before deleting it.

NOTE! Before deleting a LUN, check your operating system documentation for any additional information or steps that may be required to delete a LUN.

To delete a LUN, type:

```
arraycfg -L LUN -d <array-id>
```

LUN is the LUN to be deleted

Adding a Disk

At some time, you may want to add another disk to your array. Features such as hot-pluggable disks and Auto Include simplify the process of adding a disk to the array even while it is operating. A disk can be added to the array without disrupting current I/O operations.

After you have added a new disk, you have three options on how to use it:

- **Increase capacity** - use the disk to increase the capacity available to the operating system by creating a new LUN.
- **Improve performance** - use the disk to improve the disk array performance by simply leaving it as unallocated capacity.
- **Enable Active Spare** - use the additional capacity to enable Active Hot Spare if the disk array does not currently have the capacity to support this feature. This also improves performance as the spare space is used as RAID 0/1 space until it is needed.

To add a disk to the array:

4. Make sure the new disk has been physically inserted into the array.
5. If Auto Include is on, the disk is automatically added to the array and you can skip to the next step. If Auto Include is off, manually include the disk as described in the next section, "Including a Disk."

NOTE! In some situations, the array will not include a disk automatically, even if Auto Include is enabled. This will occur if the new disk's status is something other than Normal. See "Auto Include" in the *HP SureStore E Disk Array 12H User's and Service Manual* for more information about when this might occur.

6. Depending on how you intend to use the new disk, perform the appropriate next step:
    - To use the disk to increase capacity, create a LUN using all or a portion of the disk capacity. For more information, see "Creating a LUN" in this chapter.
    - To use the disk to increase performance, leave the disk capacity unallocated.
    - To use the disk capacity for an Active Hot Spare, enable the Active Hot Spare feature if not currently enabled. For more information, see "Changing Disk Array Configuration Settings" in this chapter.

Including a Disk

A disk must be included in the disk array configuration before it can be used by the disk array. There are two ways to include a disk:

- You can enable Auto Include, which will automatically include a disk when it is inserted into the disk array enclosure.
- You can manually include each new disk.

For convenience, Auto Include is enabled by default on a new disk array. For information on disabling Auto Include, see "Changing Disk Array Configuration Settings" in this chapter.

After including a disk, you must decide how you want to use it. For more information, see the preceding section, "Adding a Disk."

To manually include a disk, type:

```
arraycfg -D slot -a <array-id>
```

`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Rebuilding the Disk Array

To maintain data redundancy in the event of a disk failure, it is important to rebuild the disk array as quickly as possible. Auto Rebuild does this automatically, and it is enabled by default. For optimum data protection it recommended that Auto Rebuild remain enabled.

If you want more control over the Rebuild process, you can disable Auto Rebuild. This will allow you to manually start a Rebuild at the time you choose. A Rebuild impacts disk array performance while it is in progress, so before starting a Rebuild make sure the appropriate Rebuild Priority is set. See "Setting Rebuild Priority" in this chapter.

For convenience and maximum protection in the event of a disk failure, Auto Rebuild is enabled by default on a new disk array. For information on disabling Auto Rebuild, see "Changing Disk Array Configuration Settings" in this chapter.

Rebuilding the Disk Array Manually

If you have chosen to disable Auto Rebuild, you will have to start the Rebuild manually. The Rebuild will begin immediately and continue to completion. If no Rebuild is necessary, the command will be ignored.

To start a Rebuild manually, type:

```
arrayrbld -r <array-id>
```

Setting Rebuild Priority

The rebuild priority determines how quickly a Rebuild completes. It allows you to balance the servicing of host I/Os with the rebuilding of the disk array. The same rebuild priority is used for both Auto Rebuilds and manual Rebuilds.

To set the rebuild priority, type:

```
arrayrbld -P { high|low } <array-id>
```

Checking the Progress of a Rebuild

You can easily check the progress of a Rebuild. This allows you to determine approximately when a Rebuild will complete.

To check the progress of a Rebuild, type:

```
arrayrbld -p <array-id>
```

Canceling a Rebuild

A Rebuild can be canceled only if it was started manually. A Rebuild that was started by Auto Rebuild cannot be canceled. If a Rebuild is canceled, it must be started over again and any progress made during the first Rebuild will be lost.

When canceling a Rebuild, the Rebuild may not stop immediately. This occurs if the disk array is busy servicing higher priority I/O requests from the host. The Rebuild will be canceled when the disk array has serviced all higher priority commands.

To cancel a manual Rebuild, type:

```
arrayrbld -c <array-id>
```

Analyzing Disk Array Performance

The disk array monitors and stores a number of metrics that reflect how the disk array is performing. The disk array management software periodically retrieves these performance metrics and stores them for your viewing. The ARM software can also analyze the performance metrics to identify any potential performance problems. Based on this analysis, recommendations are made on how to improve disk array performance.

Checking the metrics regularly is a quick and easy way for you to monitor the performance of the disk array and identify any problems that may be developing. You may choose to display only the recommendations, or you may want to view the metrics for further analysis.

For a complete description of each performance metric, refer to the *HP SureStore E Disk Array 12H User's and Service Manual*. You can also view the `arraydsp` man page for a complete explanation of all the performance command options.

To analyze disk array performance, type:

```
arraydsp { -r stime etime} | { -m stime etime [int] } <array-id>
```

Command Examples

The following command displays performance recommendations for disk array serial number 00786B5C0000. Performance is analyzed for the time period starting at 8:00 AM and ending at 5:00 PM (1700) on March 15. The format of the `stime` and `etime` arguments is `mmddhhmm[yy]`.

```
arraydsp -r 03150800 03151700 00786B5C0000
```

The following command displays the performance metrics for disk array serial number 00786B5C0000. Metrics are displayed for the time period starting at 11:00 AM and ending at 6:00 PM on April 6. A display interval of 30 minutes is specified.

```
arraydsp -m 04061100 04061800 2 00786B5C0000
```

Selecting a Time Period for Analysis

When analyzing performance, you must define the time period over which the analysis will be performed. A starting time (`stime`) and ending time (`etime`) establish the analysis period. For the best results, select a time period when performance may be a concern. This will produce the most meaningful analysis and recommendations.

For example, if the heaviest load on the disk array occurs between the hours of 8:00 AM and 5:00 PM, restrict the analysis to this time period. If you include periods of less activity, the analysis may yield different results and consequently different recommendations. This occurs because activity is averaged over the entire analysis period, and periods of less activity will offset the effects of busier periods.

Typically, you should select a period of time that represents normal system operation. Avoid any unusual events such as a Rebuild or changes made to array capacity. If you select a time period that includes an event that may distort the analysis, the utility will alert you and will not provide any recommendations.

You can also control the display interval using the `int` option. This allows you to control how much detail you get when displaying the metrics. The display interval is the number of 15-minute increments.

Checking the Working Set Metric

A key factor in monitoring and maintaining optimal performance of the disk array is the Working Set metric. To ensure that disk array performance is maintained, you should access the performance metrics regularly and check the Working Set value.

The Working Set performance metric is derived from the Write Working Set parameter. It indicates the ratio of the Write Working Set size to the amount of RAID 0/1 space available. For a detailed explanation of the Write Working Set and its impact on performance, refer to the *HP SureStore E Disk Array 12H User's and Service Manual.*

To maintain performance, the amount of RAID 0/1 space should equal or exceed the Write Working Set, resulting in a Working Set value less than or equal to 1. A Working Set value greater than 1 indicates that the Write Working Set is larger than the available RAID 0/1 space and the disk array is servicing writes from RAID 5 space.

If the Working Set consistently exceeds 1, the amount of RAID 0 /1 space available should be increased to improve performance. This can be accomplished in several ways as described in the following section.

If the Working Set is consistently much less than 1, some of the RAID 0/1 capacity can be allocated to a new LUN without impacting performance. The remaining RAID 0/1 space should be adequate to accommodate the Write Working Set.

Performing Disk Array Maintenance Tasks

There are several tasks that you may have to perform in the on-going management of the disk array. These maintenance tasks are typically performed infrequently and may involve taking the disk array off line.

Shutting Down the Disk Array

CAUTION! When an array shutdown is performed, the disk array becomes unavailable to the host system. An array that is shutdown appears to the operating system as if its power has been turned off. As with any disk subsystem, it is essential that file system access to the disk array be correctly removed before shutting down or powering off the disk array.

Before an array Shutdown is performed, all mounted file systems mapped to the disk array must be unmounted. The `umount` operation synchronizes data in the MPE internal buffers with the data stored on the disk array.

The disk array must be Shutdown prior to performing any maintenance. The Shutdown process copies vital data mapping information from the controller NVRAM to the disks. This protects the data mapping information should the contents of the NVRAM be lost or corrupted due to battery failure. Shutdown then takes the disk array off line, making all data unavailable to the host. The disk array can still be managed and tested, but all data is inaccessible while the disk array is Shutdown.

Shutdown is initiated automatically each time the disk array is turned off using the power switch, so it is usually not necessary to initiate a Shutdown using the ARM utility.

To Shutdown the disk array, type:

```
arraymgr -s shut <array-id>
```

Restarting the Disk Array

Following Shutdown, the disk array can be brought back on line by performing a restart. This makes the data on the disk array available to the host once again.

To restart the disk array, type:

```
arraymgr -s start <array-id>
```

After the array completes initialization, file systems mapped to the disk array must be mounted for MPE to access the disk array.

Resetting the Disk Array

The disk array can be reset if there is a problem with SCSI channel communication. A reset will interrupt access to the disk array temporarily, so it should be done only when attempting to solve a problem with the disk array.

To reset the disk array, type:

```
arraymgr -R <array-id>
```

Downing (Excluding) a Disk

Downing (or excluding) a disk is typically done in preparation for testing the disk. After the disk is downed, testing can be done without impacting disk array operation. If testing reveals that the disk is good, the disk can be included back in the array configuration.

Downing a disk has the same effect as if the disk failed or was physically removed from the cabinet. If Auto Rebuild is enabled, the disk array will immediately begin a Rebuild when a disk is downed.

The `-v` option identifies the down operation as either destructive or nondestructive. This determines whether the disk array will assume there is any valid data on the disk if it is returned to the array configuration. If a destructive down is performed (`-v` not specified), the disk array will assume no data on the disk is valid. If the down is nondestructive (`-v` specified), the array will assume any data on the disk that was not updated in the disk's absence is valid.

To down a disk, type:

```
arraycfg -D slot -d [-v] [-R|-Z] <array-id>
```

To protect data availability, the disk array will not let you down a disk if doing so would result in loss of data redundancy or data unavailability. However, you can override this protection by specifying the appropriate ARM options. The `-R` option allows the disk to be downed even if a loss of redundancy would result, but not data unavailability. The `-Z` option allows the disk to be downed even if data unavailability would occur. A complete description of the options is included in the `arraycfg` man page.

NOTE.	Two of the disks in the disk array are used to store recovery map information. The disk array will not allow you to down either of these drives unless you use the -R or -Z option.

After testing, a downed disk can be returned to the disk array configuration by manually including it. For more information, see "Including a Disk" in this chapter.

Testing a Disk

Diagnostics allow you test the operation and integrity of a disk. Three different types of testing can be performed:

- **Write/Read/Verify** - a destructive test that will destroy data on the disk being tested. The disk must be downed before beginning the test.
- **Read/Verify** - a nondestructive test that will not alter any data on the disk being tested. It is not necessary to down the disk before performing a read/ verify test.
- **Self-test** - a nondestructive internal test that checks the operation of the disk.

To perform a write/read/verify test of a disk, type:

```
drivetest -D slot -w percent <array-id>
```

To perform a read/verify test of a disk, type:

```
drivetest -D slot -r percent <array-id>
```

To perform a self-test of a disk, type:

```
drivetest -D slot -s <array-id>
```

`percent` is the percent (0 to 100) of the disk to be tested
`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Displaying Test Results

After the disk testing is complete, the test results can be displayed for analysis by using the `dteststat` utility.

To display the results of a disk test, type:

```
dteststat [-D slot] <array-id>
```

If the `-D` option is not specified, results will be displayed for all disks in the array that have been tested.

Canceling a Disk Test

If you do not want to wait for a disk test to complete, you can cancel it using the `dteststat` command and testing will stop immediately.

To cancel a disk test in progress, type:

```
dteststat -D slot -c <array-id>
```

Printing ARMServer Log Contents

The contents of the various log files maintained by ARMServer can be printed using the `logprint` command. The contents of the logs may be useful in identifying any possible problems that may be occurring with the disk array.

For a detailed explanation of the log contents output, see the `logprint` man page

To print the contents of the ARMServer logs, type:

```
logprint[-d log_directory_name] [-s start_time] [-e stop_time]
[-t record_type...] [-a array_serial_number]
```

`log_directory_name` identifies the location of the log files
`start_time` and `stop_time` limit the output to events between the specified times
`record_type` identifies the type of record(s) to print. Records include system usage log (`usage`), disk error log (`disk`), controller error log (`ctrlr`), system change log (`change`), and performance log (`perf`)
`array_serial_number` limits the output to only those entries associated with the specified disk array.

Displaying Hardware Logs

In addition to the logs maintained by ARMServer, hardware logs are also stored on the disk array. The `arraylog` command provides access to the controller and disk logs maintained by the disk array. These logs contain information useful for diagnosing and troubleshooting the disk array. The logs can also be cleared using `arraylog`. The arraylog options for accessing the disk array hardware logs are listed in Table 18.

Table 18. arraylog Options for Displaying Log Contents

Option	Description
-u	Display the contents of the disk array controller usage log.
-e	Display the contents of the disk array controller event log.
-d slot	Display the contents of the log for the disk installed in the cabinet slot identified by slot. Slot numbers must be of the form "An" or "Bn", where A or B correspond to a cabinet column, and n corresponds to a shelf position (1-6).
-C {-c | -d slot}	Clear the specified logs. If -c is specified, clear the disk array controller usage and event logs. Both logs will be cleared when using this option. It is not possible to clear just one of the logs. If -d is specified, clear the log for the disk installed in the cabinet slot identified by slot.

To display the contents of a hardware log, type:

```
arraylog [-u] [-e] [ -d slot ] <array-id>
```

To clear the hardware logs, type:

```
arraylog [-C{-c|-d slot}] <array-id>
```

Formatting the Disk Array

Should it become necessary to do so, you can format the entire disk array, or a single LUN. Formatting destroys all data on the array or LUN involved. Formatting an array first requires that all LUNs be deleted.

To format the entire disk array, type:

```
arrayfmt -F [-h] <array-id>
```

To format a LUN, type:

```
arrayfmt -L LUN <array-id>
```

Changing SCSI Settings

The SCSI settings control the transfer of information over the SCSI channel connecting the host and the disk array. The default SCSI settings listed in Table 21 have been chosen to work with all supported SCSI adapters, and in most cases should not be changed.

NOTE! Before changing any SCSI setting, you should understand what the SCSI setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect SCSI setting may make it impossible for the host and disk array to communicate properly. In this case, it will be necessary to use the disk array control panel to return the SCSI setting to its original value to reestablish communication.

To change SCSI settings, type:

```
arraymgr { -W | -T | -P | -m | -r } {on|off} <array-id>
```

Changing the Controller SCSI ID

Changing the SCSI ID directly impacts the operating system's ability to access the disk array. Before performing this task, check your operating system documentation for information on how to change the SCSI ID of a disk subsystem.

To change the controller SCSI ID, type:

```
arraymgr -C {X|Y} addr <array-id>
```

`addr` is the new address (0 – 15) for the indicated controller

Switching Primary Controllers

In dual-controller disk array configurations, the array automatically switches to the secondary controller if the primary controller fails. However, you can switch controllers manually if necessary. This will cause the secondary controller to assume the role of primary controller.

To switch primary controllers, type:

```
arraymgr -c { X | Y } <array-id>
```

Setting Data Resiliency

The data map contents stored in the disk array controller NVRAM is copied to two disks on the array at regular intervals to protect against map loss. The interval at which the disks are updated with recovery map information is controlled using the data resiliency setting. Selecting a data resiliency setting involves making a tradeoff between data protection and performance. The more frequently the recovery maps are updated, the more impact it may have on performance.

To set the data resiliency mode, type:

```
arraymgr -J {SingleController | Secure | Normal | HighPerformance} <array-id>
```

The data resiliency settings are described in Table 19.

Table 19. Data Resiliency Settings

Setting	Description
SingleController	This setting should only be used if the disk array is operating with one controller. This suppresses the single controller warning messages that are normally generated when the disk array is operating with one controller. This setting will affect I/O performance. This is the default setting for single controller mode.
Secure	Continually updates the disks with any changes in the controller maps. This is the highest level of data protection, but it may result in decreased I/O performance.
Normal	Updates the maps on the disks at regular intervals (typically 4 seconds). This option offers both data protection and good performance. This is the default setting for dual controller mode.
HighPerformance	Updates the disk maps only during shutdown of the disk array. This is the lowest level of data protection, but it offers the highest level of performance.

Creating a Disk Array Alias

An alias can be created to identify the disk array. The alias provides an alternative to the disk array serial number and raw device file name that can also be used to identify the array.

Aliasing can be used in a variety of ways to help identify disk arrays in large systems. For example, by assigning numbers to racks and to the shelf positions within the racks, each disk array can be uniquely identified using an appropriate alias. If a rack is assigned number 12, the disk array installed on shelf 3 of the rack could be identified using an alias of R12_S03. This technique simplifies locating the disk array should it need service.

To create a disk array alias, type:

```
arraymgr -D alias_name <array-id>
```

`alias_name` can be up to 12 characters in length and can include upper case letters, numbers, spaces, number sign (#), underscore (_), and period (.).

Recover

If the disk array is not shutdown properly, it is possible that the data maps in NVRAM memory will be lost. For this reason, the disk array allows the data maps to be periodically written to the disk drives. If the maps are lost, an error code such as “No Address Table” will appear on the display. If your disk array is a boot device, you may have to recover the maps by using the front panel command called “Recover” under the “Cntrl Changes” menu. The Recover command is only supported in controller firmware versions later than HP40, and any patch delivered after IPR9808 release.

Downloading Firmware

The `download` command copies new firmware code to the controller(s) or individual disk mechanisms in the disk array. Firmware also can be copied from a primary array controller to a secondary controller.

The `ARMServer` process continues to run while the download is in progress. However, this process may not be able to access the array during the download because the download operation shuts down the disk array. This may cause warning messages such as the following to be displayed:

```
access error:  Unable to get status from disk array on <raw disk
file name> at <machine name>
```

These warning messages can be ignored.

CAUTION! The firmware code is copied from the primary controller to the secondary controller, so before performing this task make sure the controller that has the desirable code is designated the primary controller. See "Switching Primary Controllers" for instructions on changing the state of the controller.

To download firmware to a disk, type:

```
download -D slot codefilename <array-id>
```

`slot` identifies the cabinet shelf containing the disk drive
`codefilename` identifies the file containing the firmware code

To download firmware to the disk array controllers, type:

```
download -C codefilename <array-id>
```

`codefilename` identifies the file containing the firmware code

To download firmware from the primary controller to the secondary controller, type:

```
download -M <array-id>
```

Firmware Download Procedure

The procedure described below should be followed to perform the download. This procedure works for single or multi-host configurations.

CAUTION! In multi-host configurations, other hosts must not access the disk array while the download is in progress. Data can be lost if write requests are made to the disk array while a download is in progress.

If the system volume set is contained on the array, the offline diagnostic (ARDIAG) must be used to download the firmware.

NOTE! The download process automatically shuts down the array. The array Shutdown will not succeed unless all file systems have been unmounted access to the array has been deactivated.

To download firmware to the array controllers or to the disk mechanism:

1. Quiet (quiesce) or stop all I/O traffic to the array.
2. Download the controller or disk mechanism firmware.
3. Load the controller firmware.

```
download -C firmware.file 000000123456
```

If the disk array has LUNs that are being used as raw devices, for example a database system doing “raw” I/O, the array should be disconnected from all systems except the one doing the download.

Recovering Data Maps

If the data maps stored in the disk array controller NVRAM are lost, the `arrayrecover` command can be used to reconstruct the maps. The data maps are reconstructed using the latest recovery maps stored on two of the disk drives.

The recovery operation involves performing a parity scan on the contents of the entire disk array to validate the accuracy of the maps and to correct any drive parity inconsistencies. This process can take up to several hours depending on the amount of data on the disk array.

To start the map recovery process, type:

```
arrayrecover [[-s] | [-l[c]] | [-p] | [-v volume_set_ID]] [-c] <array-id>
```

The command options for `arrayrecover` are listed in Table 20.

Table 20. arrayrecover Command Options

Option	Description
-c	Used with other options, this will cause continuous polling during the recovery. The recovery is monitored and the current progress is displayed at regular intervals.
-l	Displays the array controller logs on standard output.
-lc	Displays the array controller logs on standard output, and then clears the logs.
-p	Begin the recovery in non-interactive mode. If there are multiple volume sets on the disk array, a list of the volume set numbers will be displayed. If there is only one volume set on the disk array, the recovery will be done on it. This option provides a mechanism to pass volume set information to a script designed to perform a recovery.
-s	Returns the recoverability status of the disk array, as well as the status of a recovery in progress. The status indicates if recovery is needed, and what percentage of the entire recovery has been completed. When used with the -c option, status will be returned at regular intervals allowing continuous monitoring of the recovery progress.
-v volume_set_ID	Starts a recovery on the volume set indicated by volume-set-id. This option is intended for use only in environments where there are multiple volume sets on the disk array.

Viewing the Disk Array General Configuration Settings

Checking the general configuration settings allows you to view the current settings for all the disk array operating parameters. The settings include the current status of the array, the array configuration, and the SCSI configuration settings.

A description of each setting is included in Table 9. The default settings have been selected to optimize disk array operation on MPE.

NOTE!	Before changing any setting, you should understand what the setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect setting may make it impossible for the host and the disk array to communicate properly.

To view the general configuration settings, type:

```
arraydsp -s <array-id>
```

A complete list of the settings will be displayed.

Table 21. General Configuration Settings

Parameter	Default Setting	Description
Overall State of Array	READY	Specifies the current state of the array
Active Hot Spare Desired	ENABLED	Indicates whether the array should reserve space within which to perform a rebuild process.
Auto Include	ENABLED	Indicates the action to be taken when a drive is physically inserted into the array.
Auto Rebuild	ENABLED	Indicates the action to be taken when a drive becomes unusable.
Rebuild Priority	HIGH	Indicates the priority the rebuild process is given with respect to host I/O.

Parameter	Default Setting	Description
Capacity Depletion Threshold	0%	Indicates the amount of space below which the disk array should signal a Capacity Depletion warning. For example, if this field is set to 99% then when the disk array reaches 99% capacity, a Capacity Depletion warning will be indicated. 0% means that Capacity Depletion warnings will not be issued.
Write Working Set Interval	8640 seconds	Indicates the period (in ten second intervals) over which write performance measurements should be gathered. For example, 8640 X 10 = 86400 seconds = 24 hours.
Language	ENGLISH	Indicates the language used when displaying information on the front panel.
Log Full Warning	DISABLED	Indicates whether the disk array should assert a warning when some portion of the controller log is full. When enabled, the disk array will assert a Log Full Warning when one of the disk array log pages fills, or a log parameter reaches its maximum value. When disabled, no Log Full Warning will be indicated.
Volume Set Partitioning	DISABLED	Indicates whether the disk array should boot when half or more of the previously available drives are unavailable (i.e., there is no drive quorum). Enabled indicates that volume set partitioning should be allowed. Disabled, the system will remain in the No Quorum state when the required quorum is not available.
Format Pattern Fill	DISABLED	Indicates whether the disk array will fill in incomplete RAID blocks with a format pattern when performing new writes. Some operating systems (not HP-UX, MPE, or NT) expect that SCSI format commands completely reinitialize data to a non-random pattern. When using the array with one of those operating systems, pattern filling should be enabled.
Disk array Type ID	12	Uniquely identifies the disk array hardware configuration. This field can be used to find the number of drives and SCSI channels supported within the disk array.
LUN Creation Limit	8	Controls the range of LUNs that may be created.
Maximum LUN Creation Limit	8	Specifies the maximum supported value for the LUN Creation Limit.

Parameter	Default Setting	Description
Array SCSI configuration:	N/A	N/A
Controller X SCSI Address		Indicates the SCSI bus address to be used by controller X. Changes in this field will take affect only after controller X is reset.
Controller Y SCSI Address		Indicates the SCSI bus address to be used by controller Y. Changes in this field will take affect only after controller Y is reset.
Write Cache	ENABLED	Indicates whether the disk array should cache write data. This field may be ignored depending on the map resiliency mode. Series 800 systems normally disable this field. Generally, write cache is used even though a host system automatically disables this field.
Read Cache	DISABLED	Indicates whether the disk array should cache read data. Note. This field does not represent what is actually happening. The disk array uses read cache algorithms. This field is put in place to facilitate some third party operating systems.
SCSI Parity Checking	ENABLED	Indicates whether the disk array should check SCSI bus parity. Disabled means that bus parity checking is disabled. Enabled indicates that bus parity checking is enabled.
SDTR	ENABLED	Indicates whether the disk array should initiate SDTR (Synchronous Data Transfer Request). Disabled, indicates the disk array will not initiate SDTR. Enabled indicates the disk array will initiate SDTR.
WDTR	ENABLED	Indicates whether the disk array should initiate WDTR (Wide Data Transfer Request). Disabled, indicates the disk array will not initiate WDTR. Enabled indicates the disk array will initiate WDTR.
Terminator Power	ENABLED	Indicates whether the disk array should provide power for the SCSI bus terminators. Disabled, indicates the disk array will not provide termination power. Enabled indicates the disk array will provide termination power.

Parameter	Default Setting	Description
Unit Attention	ENABLED	Indicates whether the disk array should signal a Unit Attention condition immediately following power-on or reset. Disabled, indicates the disk array will not signal unit attention. Enabled indicates the disk array will signal unit attention.
Disable Remote Reset	ENABLED	Controls the bus reset behavior of the second controller when a SCSI reset (reset signal, BDR or Reset Disk array command) is received in the first controller. When this bit is disabled, the second controller will assert the bus reset signal to indicate that all outstanding requests were cleared in response to the reset. When this bit is enabled, the second controller will not assert the SCSI reset signal to indicate the commands were cleared. Hosts that cannot tolerate target bus resets should enable this setting.
Secondary Controller Offline	DISABLED	Controls the behavior of the secondary controller with respect to bus selection. When disabled, any secondary controller present will respond to host selection. When enabled, the secondary controller will remain off-line until a failure of the primary controller is detected (at which point it becomes primary). Only the primary controller will go on-line.
Very Early Busy	DISABLED	Controls the behavior of the disk array with respect to SCSI bus selection during the early stages of the initialization sequence (i.e., from about three seconds after reset until about fifteen seconds prior to initialization completion). When disabled, the disk array will ignore SCSI bus selection until the late stages of initialization. When enabled, the disk array will accept selection during early initialization and will return BUSY status until the late stages of initialization.
Queue Full Threshold	1952	Specifies the target queue depth beyond which the disk array will return QUEUE FULL status to subsequent host requests.

Parameter	Default Setting	Description
Maximum Queue Full Threshold	1952	Specifies the maximum supported value for the Queue Full Threshold parameter. Attempts to set the QFT parameter to values higher than the MQFT will fail with CHECK CONDITION status and ILLEGAL REQUEST, INVALID FIELD IN PARAMETER LIST sense indications.
Simplified Resiliency Setting	Normal	Determines the values of the following eight parameters. This field regulates the mode of data resiliency that the disk array will operate in. The “Normal” mode is set at the factory when dual controllers are ordered with the array.
Single Controller Warning	ENABLED	Indicates whether the disk array should assert a warning when only one controller is present. When enabled, the disk array will assert a Single Controller Warning when there are not two controllers present in the array disk array. When disabled, no Single Controller Warning will be indicated.
Lock Write Cache On	TRUE	Controls the modification of the Write Cache setting. When LCWO is set to true, then the host cannot change the Write Cache setting. When LWCO is false, the host will be able to change Write Cache setting.
Disable NVRAM on WCE False	FALSE	Enables the disk array response to the Write Cache setting. If false, NVRAM use does not depend on the Write Cache setting, and will be enabled if no other condition inhibits it. If true, then NVRAM is disabled when Write Cache is disabled
Disable NVRAM with One Ctrlr	TRUE	Couples the use of NVRAM to the presence of an operational dual controller. If true and no operational dual controller is present, then NVRAM use is disabled. Otherwise NVRAM use does not depend on the presence of the second controller, and will be enabled if no other condition inhibits it.
Disable NVRAM on UPS absent	FALSE	Couples use of NVRAM to the presence of an operational UPS or BBU. At the time of printing, this field is reserved for future functionality with UPS and is disabled in all resiliency modes.

Parameter	Default Setting	Description
Force Unit Access Response	2	Controls the array's response to the FUA bit. The FUA bit is a command from the host when Write Cache is enabled. It gives the host an opportunity to flush write cache on command: If this field is 0, then the FUA bit is ignored. If this field is 1, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed. If this field is 2, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed along with the map journal before completing the write request. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored.
Disable Read Hits	FALSE	Controls the array's ability to satisfy read commands from write cache contents during FUA processing. If NVRAM use is disabled due to the chosen map resiliency mode, then read data is never satisfied out of write cache.
Resiliency Threshold	4	Specifies the maximum time between delivery of the response to a write command to the host, and initiation of associated writes out of write cache and map journal to disks. This time is specified in seconds. This maximum time is submitted to the scheduler for implementation. Depending on the priority of other events in the scheduler, the desired time may not be implemented. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored. The 0 value of this field is not the same as disabling NVRAM use. A value of 0h indicates that no maximum time will be enforced and that no recovery image will be available.

Simplified Resiliency Setting

The simplified resiliency setting is derived from several other fields. Collectively these settings control how data resiliency is managed. Table 22 identifies the field settings for each of the resiliency modes.

There are four modes of data resiliency: Normal, SingleController, Secure, and HighPerformance. The default setting is Normal for dual controller disk arrays. If the disk array has been ordered with a single controller, the default for this settings is SingleController.

For information on changing the data resiliency mode, see "Setting Data Resiliency" in this chapter.

Table 22. Simplified Data Resiliency Settings

Normal Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On	TRUE	Not Supported	Data map and write cache information will be flushed to the disk every four seconds.
Disable NVRAM on WCE False	FALSE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	2		
Disable Read Hits	FALSE		
Resiliency Threshold	4		
SingleController Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	DISABLED	Single Controller	Dual Controller
Lock Write Cache On	FALSE	Data map and write cache information will be flushed to the disk once every second.	Not Supported
Disable NVRAM on WCE False	TRUE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	2		
Disable Read Hits	FALSE		
Resiliency Threshold	1		

Secure Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On	FALSE	Not Supported	Data map and write cache information will be flushed to the disk once every second.
Disable NVRAM on WCE False	TRUE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	2		
Disable Read Hits	FALSE		
Resiliency Threshold	1		
HighPerformance Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On	TRUE	Not Supported	Data Resiliency disabled
Disable NVRAM on WCE False	FALSE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	0		
Disable Read Hits	FALSE		
Resiliency Threshold	0		

Chapter 7. Using the ARDIAG Offline Diagnostic on MPE

This chapter defines the AutoRAID supported offline diagnostic commands for Series 800 MPE systems. This functionality will be a combination of the support media offline diagnostic environment (***ODE***) commands and commands issued from the AutoRAID front panel.

Operating environment

ARDIAG will only operate under ODE and thus it only operates in an offline environment. When ARDIAG is executed, ODE handles all the I/O with the user and it handles several higher level commands like LOG, HELP, etc.

NOTE. There should be no I/O activity on the SCSI bus when using ARDIAG. When operating in a multi-initiator environment, make sure none of the host systems are trying to access the disk array. Bus activity make cause ARDIAG to not see the disk array.

Support Software

ARDIAG requires all the software needed for ODE to run as ARDIAG relies on ODE to load and run. Additionally, ARDIAG needs the MAPPER SL and the DIODE SL from the protocol level down.

Minimum hardware

For ARDIAG to run properly, a working I/O subsystem and at least one SureStore E Disk Array is needed. ARDIAG must also meet ODE's hardware requirements (for example a working console). ARDIAG and ODE will use no more than 4 MB of main memory.

Minimum software

ODE, MAPPER SL and DIODE SL are needed to execute ARDIAG correctly.

Definition of Terms

The following terms are used in this chapter.

MPE Hewlett-Packard's version of the MPE® Operating System.

SIO "Server I/O". The driver environment for the current Series 800 MPE system. Proprietary, non-reentrant, port-server drivers. Communication is via message passing.

SERIES 800 MPE PA-RISC multi-user systems. These systems utilize the ***SIO*** subsystem.

ISL "Initial System Loader" This is the first piece of software loaded from outside the SPU and executed during the boot process.

ODE "Offline Diagnostic Environment" The software architecture consisting of several modules to provide diagnostic functionality via ***ISL*** support media for Series 800 MPE 10.0+ systems.

LIF "Logical Interchange Format" A standard disk format that may be used for interchange of files among various HP computer systems. A LIF volume contains a header (identifying it as a LIF volume) and a directory that defines the contents of the volume. A boot device with a valid LIF is assumed to have bootable media.

SOM "Spectrum Object Module" A SOM is the smallest unit that may be generated by a compiler, and it may exist as a single entity or as part of a collection.

ARDIAG Operational Commands

Table 23 lists the ARDIAG operational commands and their descriptions.

Table 23. ARDIAG Operational Commands

Command	Description
CLRLOG	Allows the user to clear the specified target's internal logs.
CREATELUN	Allows the user to create a LUN via the specified controller path to the disk array.
DELETELUN	Allows the user to delete a LUN via the specified controller path to the disk array.
DESCRIBE	Displays LUN configurations and warning states.
DOWNLOAD	Allows the user to download firmware to the specified controller or internal disk.
FORMAT	Allows the user to format the specified target.
INQUIRY	Issues an Inquiry to an array controller or an internal disk.
READLOG	Allows the user to read the specified target's internal logs.
RECOVER	Allows the user to restore controller map information in the specified SureStore E (AutoRAID) Disk Array.
REQSENSE	Issues a Request Sense on the specified target.
RESTART	Allows the user to bring the array out of the Shutdown state via the specified controller path.
REVISION	Displays controller, drives and software revisions.
ROMT	Read/Verify test to the specified internal mechanism..
SETOPTIONS	Allows the user to view and set specific options for the array controller.
SHUTDOWN	Allows the user to put the array into a Shutdown state via the specified controller path .
WRTMT	Destructive write/read and verify test to the specified internal mechanism.

ARDIAG Interface Commands

Table 12 lists the ARDIAG test module interface commands and their descriptions.

Table 24. ARDIAG Interface Commands

Command	Description
DISPMAP	Displays a list of AutoRAID controllers.
DISPMECH	Displays the disk mechanisms within the selected disk array.
RANGE	Environment variable that represents a range of blocks to test.
SHOWENV	Displays all environment variables.
TESTDISK	Points to the disk array on which to execute commands.
TESTLEVEL	Points to a physical mechanism within the disk array on which to execute commands.

Operational Command Descriptions

CLRLOG

The CLRLOG command allows the user to clear the internal logs of the specified target.

Synopsis

```
CLRLOG
```

Output

```
ARDIAG> CLRLOG
Clearing the contents of array controller log at Indx <0>.
*********************************************************
Successful Completion
```

DELETELUN

The DELETELUN command allows the user to delete a LUN from the specified disk array.

Synopsis

```
DELETELUN
```

Output

```
ARDIAG> DELETELUN
Enter the number of the LUN to delete: [default = 0]
*********************************************************
*                   DATA LOSS WARNING!                  *
*********************************************************
Continuing with DELETELUN WILL DEFINITELY RESULT IN DATA LOSS.
 All information stored on the LUN to be deleted will be lost
and the physical storage previously used will be freed...
*********************************************************
Lun 2 selected
Delete selected lun [default = [n]?]y
Lun 2 was successfully deleted.
```


Additional notes:

- Any problems detected by the DELETLUN command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

DESCRIBE

The DESCRIBE command allows the user to display the configuration and warning states of the currently selected array. Information displayed includes replaceable FRUs and their states, subsystem and physical drive data and LUN configurations.

Synopsis

```
DESCRIBE
```

Output

```
ARDIAG> DESCRIBE
Configuration information for the controller in slot X:

Component              Instance      State
--------------------   -----------   ---------------
Fan                    F1            Good
Fan                    F2            Good
Fan                    F3            Good
Power Supply           P1            Good
Power Supply           P2            Good
Power Supply           P3            Good
Controller             X             Good
Controller             Y             Good
Controller X Battery   1             Good
Controller X Battery   2             Good
Controller Y Battery   1             Good
Controller Y Battery   2             Good

Memory                 Instance   Size          State
--------------------   --------   ---------     ---------------
Controller X DRAM      1          32MB          Good
Controller X NVRAM     1          32MB          Good
Controller X NVRAM     2          32MB          Good
Controller Y DRAM      1          32MB          Good
Controller Y NVAM      1          32MB          Good
Controller Y NVRAM     2          32MB          Good

Total Memory:                     192MB

Test
Level  FRU    Slot   State       Warning Indications
-----  -----  ----   --------    ----------------------
  0    CNTRL   Y     Warning     Redundancy Loss
  1    MECH    A1    Included
  2    MECH    B1    Downed
  3    MECH    A2    Failed
  4    MECH    B2    Included
  5    MECH    A3    Included
```

```
  6    MECH    B3    Included
  7    MECH    A4    Included
  8    MECH    B4    Included

Lun   Capacity
---   --------
0     2.0 GB
1     1.5 GB
2     1.5 GB
3     1.5 GB
4     3.5 GB
7     100 MB
```

DOWNLOAD

The DOWNLOAD command allows the user to download firmware to the specified target(s).

Synopsis

```
DOWNLOAD
```

Additional information

DOWNLOAD to the array controller:

- The DOWNLOAD process must be performed using the primary controller. The primary controller is identified using the INQUIRY command. If the secondary controller is identified, you must change the controller selection using the TESTDISK command. The TESTLEVEL command must be set to zero to indicate a controller selection.
- A *presently installed* secondary controller is *automatically* updated with the new firmware image *after* a successful DOWNLOAD to the primary controller. Thus there is no interaction needed to update the *presently installed* secondary controller.
- A *newly installed* secondary controller can be *interactively* updated to the firmware image that is presently in the primary controller using the DOWNLOAD command.
- After successful DOWNLOAD, the REVISION command can be used to verify firmware revision. Reset ARDIAG to update DISPMAP revision information.

DOWNLOAD to an internal disk:

- The DOWNLOAD process to an internal disk can be performed through either the primary or secondary controller. The internal disks are identified using the REVISION command, which will display the disks within the array along with their corresponding TESTLEVEL identifier. The TESTLEVEL command must be set to a value from one to twelve to indicate the appropriate disk selection.

Output

Example 1: Controller

```
ARDIAG> testlevel 0
TESTLEVEL = 0
ARDIAG> download
************************************************************
*                  Array Controller DOWNLOAD               *
************************************************************
The following options are available for DOWNLOAD to the array controller:
   1 - Download a firmware image file to the primary controller with an
automatic update of same firmware to the secondary controller.
   2 - Update the secondary controller with the same firmware as the
primary controller.
Choose [1]: 2
The primary controller is at XXXX
Do you want to do the update (y/[n])? y
Please be patient.  The firmware download process may take several
minutes.
WARNING!
IF YOU INTERRUPT THIS PROCESS, THE DEVICE COULD BE RENDERED INOPERATIVE!!
Shutting down the array...
Mirroring the microcode image...
Please wait while the array performs a reset...
************************************************************
*            Firmware Download Successful                  *
************************************************************
ARDIAG>
```

Example 2: Internal disk drive

```
ARDIAG> testlevel 1
TESTLEVEL = 1
ARDIAG> download
Enter the firmware file name
    ['?' displays the files. Default quits]: ?
File name        Intended Product ID           Rev.   Size
---------------- ------------------------ ------ --------
Z1CS             HPC3586A     disk array      Z1CS   1048576
SEA5400          SEAGATEST31230N disk drive   0284    261632
S2G7200          Generic Disk                 1208    261632
S4G7200          ST15150W disk drive          1207    261632
Legend:
File name           = name of the firmware file
Intended Product ID = firmware file's intended product name
Rev.                = firmware Revision of the firmware file
Size                = exact byte size of the firmware image

Enter the firmware file name
    ['?' displays the files. Default quits]: sea5400
WARNING!
Firmware file SEA5400 was made for a SEAGATEST31230N disk drive.
TESTDISK selects a Unknown Product.

STOP! CONTINUING MAY PERMANENTLY DESTROY ALL DATA ON DISK.
Do you still want to continue (y/[n])? Y
```

```
************************************************************
* About to update Unknown Product currently at
* firmware revision 0256 with new firmware revision 0284.
************************************************************
Notes for this firmware release (from SEA5400):
1G and 2G 5400 RPM Seagate
Do you want to do the update (y/[n])? y
Please be patient.  The firmware download process may take several
minutes.
WARNING!
IF YOU INTERRUPT THIS PROCESS, THE DEVICE COULD BE RENDERED INOPERATIVE!!
Shutting down the array...
Downloading the firmware image...
If this is the last firmware download you want to perform on this array,
you can reset the array, which causes firmware changes on the disks to
take effect.  If you have more downloads to do, you will save time by
waiting to do the reset after the last one.  Note that a download to the
array controller causes an automatic reset.
Do you want to perform a reset ([y]/n)? y
Please wait while the array performs a reset...
************************************************************
*             Firmware downloaded SUCCESSFULLY!
************************************************************
ARDIAG>
```

FORMAT

The FORMAT command allows the user to format the specified target.

Synopsis

```
FORMAT
```

Output

Example 1: Controller

```
ARDIAG> TESTLEVEL 0
ARDIAG> FORMAT
************************************************************
*                 Array Subsystem FORMAT                   *
************************************************************
                     N O T I C E                            Use of this
command is not recommended except where a full subsystem backup of user
data is available or when a new, uninitialized subsystem is being
prepared for use. As a precaution, this command will NOT allow a format
to an array containing any LUNs. The DELETELUN command must be used to
remove all existing LUNs.
************************************************************
Do you want to continue (y/[n])? y

Checking the array subsystem for LUNs...
There are no LUNs presently configured on the selected array.
The selected array subsystem is allowed a format.
Do you want to continue (y/[n])? y
FORMATTING...
************************************************************
*                 FORMAT Successfully Completed            *
************************************************************
ARDIAG>
```

Example 2: Internal disk drive

```
ARDIAG> TESTLEVEL 1
ARDIAG> FORMAT
************************************************************
*                Internal Disk Drive FORMAT                *
************************************************************
*                     W A R N I N G !                      *
************************************************************
* FORMAT cannot continue without a loss of redundancy on the disk array
selected!  Failure of a disk before redundancy is restored will result in
DATA LOSS.  Although continuation of this FORMAT will NOT result in
direct data loss, it may take several hours before redundancy is restored
and a disk failure can be tolerated without data loss.
************************************************************
Do you want to continue (y/[n])? y
************************************************************
*                          N O T I C E                     *
************************************************************
* The following FORMAT will require approximately ONE HOUR to complete.
During this period you will be unable to perform any other diagnostic
activities.
************************************************************
Do you want to continue (y/[n])? y
FORMATTING...
************************************************************
*              FORMAT Successfully Completed               *
************************************************************
ARDIAG>
```

Additional notes:

- Any problems detected by the FORMAT command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

INQUIRY

The INQUIRY command allows the user to view SCSI Inquiry data from the specified target.

Synopsis

```
INQUIRY
```

Output

```
ARDIAG> INQUIRY
Performing Inquiry at TestLevel Indx 0
*******************************************************
Peripheral Qualifier: Requested LUN is supported
Peripheral Device Type: Direct-access device
Medium is NOT removable
Device-type Modifier = 0(0x0)
ISO Version = 0  |  ECMA Version = 0 |  ANSI Version = 2
Device complies to present SCSI-2
Device does NOT support TERMINATE I/O PROCESS message
INQUIRY data format is as specified in SCSI-2
Other supported features:
16-bit wide data transfer, Synchronous data transfer, Tagged Command
 Queuing
This device responds to a RESET condition with a SOFT RESET alternative
Vendor Identification: HP
Product Identification: C3586A
Product Revision Level: ZPRF
Requested Lun is Supported
Product Serial Number is ffffffffffffffffffffffffffffff
Controller Pair Serial Number is
ffffffffffffffffffffffffffffffffffffffffffff
Backplane Serial Number is 007870ca0000
Requested Lun is Supported
Manufacturing Product Code is ManProdCod
Firmware Revision is 5D03159518
Number of Supported Logical Units = 32
Lun     Capacity (Logical Blocks)
===     ========================
0       2097152
1       4194304
2       6291456
```

READLOG

The READLOG command allows the user to read the internal logs of the specified target.

Synopsis

```
READLOG
```

Output

The following are examples of the READLOG command.

```
ARDIAG> READLOG
```

Example 1: Controller

```
ARDIAG> readlog
Contents of array controller log at TestLevel Indx 0
*****************************************************
Vendor ID = HP
Product ID = C3586A
Usage Log
ECC Error Count   = 0 (0x0)

  Select number to indicate display option for Event Log Information
  Number              Display Option
  ******              **************
    1                 Event Type Tables
    2                 Chronological
    3                 Both Event Type Tables & Chronological

   Note - Event Type Tables and Chronological are the same information;
they are just displayed differently.
    default[3] - Both
1
```

```
DRIVE ERROR EVENT TABLE
*********************************************************
* Time  * Module *  Event * Event * Slot * Sense * ASC * ASCQ * LBA  *
* Stamp * ID     *  Code  * Count *      * Key   *     *      *      *
*************************************************************************
  28279    0x4      0x0 0x1f   30      A2     0x5    0x24  0x0     N/A

CONTROLLER ERROR EVENT TABLE
*************************************************************************
* Time  * Module *  Event * Event * Component   * FRU *    Abterm    *
* Stamp * ID     *   Code * Count * Specific ID *     *    Code      *
*************************************************************************
  30367    0x40    0x0 0x87   1       0x7        0x81     NORMAL

SYSTEM CHANGE EVENT TABLE
*************************************************************************
* Time  * Module *  Event * Event * FRU *      Device ID Number      *
* Stamp * ID     *   Code * Count *     *                            *
*************************************************************************
  28254    0x1e   0x0 0x56     1     0x0           0       1
  30345    0xe    0x0 0xb1     1     0x0           0       1
  30348    0x30   0x0 0x8a     1     0x0           0       0
  30350    0xe    0x0 0xb1     1     0x0           0       1
  30510    0xe    0x0 0xb1     1     0x0           0       1
  30515    0x30   0x0 0x8b     1     0x0           0       0
  30515    0x30   0x0 0x89     1     0x0           0       0
  30515    0x30   0x0 0xb5     1     0x0           0       0
```

Example 2: Internal disk drive

```
ARDIAG> testlevel 4
TESTLEVEL = 4
ARDIAG> readlog
Contents of drive log at TestLevel Indx 4
************************************************************************
Vendor ID =  HP
Product ID = 1.050 GB 3rd ###

Page Code 0  Supported Log Sense Pages
================================================
Page Code 2 Error Counter Page (Write) Page [Write Errors]
Page Code 3 Error Counter Page (Read) Page [Read Errors]
Page Code 5 Error Counter Page (Verify) Page [Verify Errors]
Page Code 6 Non-Medium Error Page [Non-Medium]
Page Code 37 Vendor Unique or Non SCSI-2 Standard [Vendor Unique]
Page Code 3e Vendor Unique or Non SCSI-2 Standard [Vendor Unique]

Page Code 2  Write Errors
=====================================================
Errors Corrected With Possible Delays        =    0
Total Errors Corrected By Applying Retries   =    0
Total Errors Corrected                       =    0
Total Times Correction Algorithm Processed   =    0
Total Bytes Processed                        =   (0x00000000200d6200)
Total Uncorrected Errors                     =    0
```

```
Page Code 3  Read Errors
=======================================================
Errors Corrected Without Substantial Delay   =    4
Errors Corrected With Possible Delays        =    0
Total Errors Corrected By Applying Retries   =    0
Total Errors Corrected                       =    4
Total Times Correction Algorithm Processed   =    4
Total Bytes Processed                        =   (0x000000000de82c00)
Total Uncorrected Errors                     =    0

Page Code 5  Verify Errors
=======================================================
Errors Corrected Without Substantial Delay    =    0
Errors Corrected With Possible Delays         =    0
Total Errors Corrected By Applying Retries    =    0
Total Errors Corrected                        =    0
Total Times Correction Algorithm Processed    =    0
Total Bytes Processed                         =   (0x0000000000000000)
Total Uncorrected Errors                      =    0

Page Code 6  NonMedium Errors
=======================================================
Errors Corrected Without Substantial Delay    =   334

Page Code 37      Addr     |          Hexadecimal   |   ASCII
-------------------------------------------------------------------------
 0    (0x0   ) | 0x37 0x00 0x00 0x1e 0x00 0x00 0x80 0x02 | 7.......
 8    (0x8   ) | 0x01 0x3e 0x00 0x01 0x80 0x02 0xff 0xff | .>......
 16   (0x10  ) | 0x00 0x02 0x80 0x02 0x00 0x00 0x00 0x03 | ........
 24   (0x18  ) | 0x80 0x02 0x00 0x00 0x00 0x04 0x80 0x02 | ........
 32   (0x20  ) | 0x00 0x00                               | ..

Page Code 3e      Addr     |       Hexadecimal      |   ASCII
-----------------------------------------------------------------
 0    (0x0   ) | 0x3e 0x00 0x00 0x08 0x00 0x00 0x00 0x04 | >.......
 8    (0x8   ) | 0x00 0x00 0x97 0xf1                     | ....
```

RECOVER

The RECOVER command allows the user to restore controller map information in the specified SureStore E (AutoRAID) Disk Array.

Synopsis

```
RECOVER
```

Output


```
ARDIAG>testdisk 1
Array state is No Address Table
The following warnings are currently in effect:
   Disk Warning
   Capacity Warning

ARDIAG>testlevel 0

TESTLEVEL = 0

ARDIAG> recover

The logs should be cleared before executing this command.

Do you want to abort to clear logs ([y]/n)? no

There is only one volume set in the array.

0)    "   125B0       D")
         Disks: A1  A2  A3
Proceed with recover operation ([y]/n)? yes
Recovery Progress = 1 Percent
Recovery Progress = 2 Percent
Recovery Progress = 3 Percent
.
.
.
```

```
Recovery Progress = 97 Percent
Recovery Progress = 98 Percent
Recovery Progress = 99 Percent

Wait, This will take several minutes.

Attempting to check completion status of the recover operation.

The array state has changed!
The previous state was No Address Table. The new state is Ready.
The array warnings has changed!
The previous warnings were:
   Disk Warning
   Capacity Warning

Now there are no warnings.
```

Additional Notes

Read controller logs to assess the completion status of the command based on the number of ECC errors or event counts.

REQSENSE

The REQSENSE command allows the user to view SCSI Sense data from the specified target.

Synopsis

```
REQSENSE
```

Output

```
ARDIAG> REQSENSE
Performing Request Sense at TestLevel Indx 0
*****************************************************************
Error Code: 112 (0x70)  |  Segment Number = 0 (0x0)
File mark bit is OFF    |  End of medium bit is 1349672
The Incorrect Length Indicator is OFF
Sense Key: NO SENSE (0x0)
The information field is NOT SCSI-2 compliant
    Information field bytes: 0x0  0x0  0x0  0x0
    Information as an int = 0 (0x0)
Command Specific Information field bytes: 0x0  0x0  0x0  0x0
    Command Specific Info as an int = 0 (0x0)
Additional sense code = 0 (0x0) and qualifier = 0 (0x0)
    Translates to: No additional sense information
Field replaceable unit code = 0 (0x0)
Sense Key Specific field is NOT valid
    Sense key specific field = 0x0  0x0  0x0
Module Identifier is 0 (0x0)
Error Number is 0 (0x0)
```

RESTART

The RESTART command allows the user to bring the specified disk array out of the Shutdown state.

Synopsis

```
RESTART
```

Output

```
ARDIAG> RESTART
This command will issue a hard reset to the array controller(s)
Ready to restart the array [default = [n]]?
 The array is starting up...
Please wait while the array performs a reset...
A two minute time-out is imposed here but 90 second reset times are more
typical.
Array has been successfully restarted.
```

Additional notes:

- Any problems detected by the RESTART command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

REVISION

The REVISION command allows the user to display the internal drive's firmware revisions on the specified SureStore E (AutoRAID) Disk Array.

Synopsis

```
REVISION
```

Output

```
ARDIAG> REVISION
Test
Level  FRU    Slot   Vendor ID   Product ID          Rev
-----  -----  ----   ---------   ----------------    ----
  0    CNTRL   Y     HP          Arrays R Us         YPR1
  1    MECH    A1    HP          1.050 GB 3rd ###    0256
  2    MECH    B1    HP          2.13 GB 2nd ###     0256
  3    MECH    A2    HP          1.050 GB 3rd ###    0256
  4    MECH    B2    HP          2.13 GB 2nd ###     0256
  5    MECH    A3    HP          1.050 GB 3rd ###    0256
  6    MECH    B3    HP          2.13 GB 2nd ###     0256
  7    MECH    A4    HP          1.050 GB 3rd ###    0256
  8    MECH    B4    HP          2.13 GB 2nd ###     0256

ARDIAG>
```

ROMT

The ROMT command allows the user to perform a read only media test on the specified target.

Synopsis

```
ROMT
```

Output

```
ARDIAG> romt
**************************************************************************
*                              W A R N I N G !                           *
**************************************************************************
This test cannot continue without a loss of redundancy on the AutoRAID
Array being tested! Redundancy will be restored when the test completes.
 However, failure of another disk during the test will result in data
 unavailability until the test completes.
**************************************************************************
Do you want to continue (y/[n])? y
Testing block 0.
percent
complete
100%
Test complete.
```

```
Testing subrange 1000/1200.
percent
complete
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %
90 %
100%
Test complete.
Testing block 45000.
percent
complete
100%
Test complete.

ARDIAG>
```

SETOPTIONS

The SETOPTIONS command allows the user to view and set specific options for the array controller.

Synopsis

```
SETOPTIONS
```

Output

```
ARDIAG> SETOPTIONS
Current information for the controller in slot X:
Subsystem Parameter           Value Subsystem Parameter           Value
------------------            ----- ------------------            -----
1 Subsystem State             Ready 15 Termination Power           ON
2 Active Hot Spare            OFF   16 Unit Attention              ON
3 Volume Set Partitioning     ON    17 Controller X Address        0
4 Rebuild in Progress         OFF   18 Controller Y Address        1
5 Auto-Rebuild                ON    19 Enable Manual Override      OFF
6 Auto-Include                ON    20 Manual Override Destination OFF
7 Balance in Progress         OFF   21 Format Pattern Fill         ON
8 Optimize in Progress        ON    22 Disable Remote Reset        OFF
9 Migrating Write Destination OFF   23 Language                 English
10 Log Full Warning           ON    24 Capacity Depletion Threshold 0
11 Rebuild Priority           OFF   25 Rebuild Progress              0
12 Parity                     ON    26 Write Working Set Interval    0
13 SDTR                       ON    27 Subsystem Identifier         13
14 WDTR                       ON
Select the number of the parameter to modify.[Default quits]:  2

Allowed values for Active Hot Spare
0 - OFF
1 - ON

Select the number of new parameter value.[Default quits]:  1
```

```
Modify the parameter with the selected value?(y/[n])?  y
Subsystem Parameter           Value Subsystem Parameter           Value
------------------            ----- ------------------            -----
1 Subsystem State             Ready 15 Termination Power           ON
2 Active Hot Spare            ON    16 Unit Attention              ON
3 Volume Set Partitioning     ON    17 Controller X Address        0
4 Rebuild in Progress         OFF   18 Controller Y Address        1
5 Auto-Rebuild                ON    19 Enable Manual Override      OFF
6 Auto-Include                ON    20 Manual Override Destination OFF
7 Balance in Progress         OFF   21 Format Pattern Fill         ON
8 Optimize in Progress        ON    22 Disable Remote Reset        OFF
9 Migrating Write Destination OFF   23 Language                 English
10 Log Full Warning           ON    24 Capacity Depletion Threshold 0
11 Rebuild Priority           OFF   25 Rebuild Progress             0
12 Parity                     ON    26 Write Working Set Interval   0
13 SDTR                       ON    27 Subsystem Identifier        13
14 WDTR                       ON
```

Additional notes:

- Any problems detected by the SETOPTIONS command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.
- Table 13 contains a list of the subsystem states displayed by the SETOPTIONS command and the naming convention used in AutoRAID documents. Several of the subsystem state names displayed by the SETOPTIONS command have been abbreviated.

Table 25. Subsystem States

SCSI Specification	Front Panel Display	ARDIAG Set Options Display
Ready	Ready	Ready
Warning	Warning	Warning
Not Enough Drives	Not Enough Disks	NtEnDsk
No Quorum	No Quorum	NoQuorm
No Map	No Address Table	Nomap
Shutting Down	Shutdown Started	Shtgdwn
Shut Down	Shutdown Complete	Shutdwn
Starting Up	Initializing	Strtgup
No Code	No Code	Nocode
RESERVED	N/A	Resrved
Shutdown Warning	Shutdown Warning	Shtwrn
RESERVED	N/A	Resrved
Mismatched Code	Firmware Needed	FWneed
Controller Mismatch	Cntrl Mismatch	CTLmis

SHUTDOWN

The SHUTDOWN command allows the user to put the specified disk array into the Shutdown state.

Synopsis

```
SHUTDOWN
```

Output

```
ARDIAG> SHUTDOWN
Are you sure that you want to shutdown the array [default = [n]]?
Shutting down the array...
The array at testdisk 0 is now in the shutdown state.
```

Additional notes:

- Any problems detected by the SHUTDOWN command will be displayed with an appropriate error message and a prefix of ERROR, INVALID or FAILED.

WRTMT

The WRTMT command allows the user to perform a destructive write/read and verify test on the specified target.

Synopsis

```
WRTMT
```

Output

```
ARDIAG> wrtmt
You must set the range variable before performing this task!
SOFTWARE ERROR(S) DETECTED BY ARDIAG
ARDIAG> range 0,1000/1200,45000
The selected disk has blocks from 0 to 4165271
RANGE: 0,1000/1200,45000
ARDIAG> wrtmt
**************************************************************************
*                              W A R N I N G !                           *
**************************************************************************
* This test cannot continue without a loss of redundancy on the AutoRAID
* Array being tested!  Failure of a disk before redundancy is restored
* will result in DATA LOSS.  Although continuation of this test will NOT
* result in direct data loss, it may take several hours before redundancy
* is restored and a disk failure can be tolerated without data loss.
**************************************************************************


Do you want to continue (y/[n])? y
The following data pattern options are available:
     1 - Random pattern (0x00 to 0xFF)
     2 - User defined
     3 - Abort the test
Choose [1]: 2
Enter the pattern in hex format (0 to FF) [A5]: dd
The write data pattern will be 0xDD
Testing block 0.
percent
complete
100%
Test complete.
```

```
Testing subrange 1000/1200.
percent
complete
10 %
20 %
30 %
40 %
50 %
60 %
70 %
80 %
90 %
100%
Test complete.

Testing block 45000.
percent
complete
100%
Test complete.

ARDIAG>
```

Interface command descriptions

DISPMAP

The DISPMAP command allows the user to display all available disk arrays on the system.

Synopsis

```
ARDIAG
```

Output

```
ARDIAG> dispmap
Test
Disk Path            Product String                   Rev    Size
---- --------------- -------------------------------- -----  -----
*0   56/40.1.0       HPC3586 AUTORAID disk array      ZPRF   1.0 GB

Legend:
TestDisk - Indx of the array listed. This is flagged with a '*'
           if it is marked for testing.

NOTE:
  The size of disk may not match the Information Specified by
  the vendor due to difference in calculation methods.
```

DISPMECH

The DISPMECH command allows the user to display physical mechanisms within a selected disk array.

Synopsis

```
DISPMECH
```

Output

```
ARDIAG> DISPMECH
Path        Product String               Rev   Size
----------- --------------------------   ----  -----
* 56/40.1.0 HPC3586 AUTORAID disk array  ZPRF  1.0 GB

PHYSICAL MECHANISMS WITHIN THE SELECTED ARRAY
Test
Level  FRU    Slot   Drive State       Initialization State
----   -----  -----  ----------------  --------------------
  0    CNTRL   X
  1    MECH    A1    Ready             Ready
  2    MECH    B1    Ready             Ready
* 3    MECH    A2    Ready             Ready
  4    MECH    B2    Ready             Ready
  5    MECH    A3    Ready             Ready
  6    MECH    B3    Ready             Ready
  7    MECH    A4    Ready             Ready
  8    MECH    B4    Ready             Ready

Legend:
TestLevel -Indx of the FRU listed. This is flagged with a '*'
           if it is marked for testing.
```

RANGE

The RANGE environment variable allows the user to set the desired range of blocks for testing.

Synopsis

```
RANGE {start[/end]{, start[/end]}}
```

Output

```
ARDIAG> RANGE 300/500,1000/2000
Range: 300/500,1000/2000

ARDIAG> RANGE
Range: 300/500,1000/2000
ARDIAG> RANGE 10,20/30,50
Range: 10,20/30,50

ARDIAG>
```

SHOWENV

The SHOWENV command allows the user to view the current values of the environment variables TESTDISK, TESTLEVEL and RANGE.

Synopsis

```
SHOWENV
```

Output

```
ARDIAG> SHOWENV
TESTDISK :  0
TESTLEVEL 3
RANGE : 200/600
```

TESTDISK

The TESTDISK environment variable allows the user to reference a particular disk array for test.

Synopsis

```
TESTDISK <Indx>
```

Output

```
ARDIAG> TESTDISK 2
```

TESTLEVEL

The TESTLEVEL environment variable allows the user to reference a physical mechanism within an SureStore E (AutoRAID) Disk Array for test.

Synopsis

```
TESTLEVEL <Indx>
```

Output

```
ARDIAG> TESTLEVEL 2
```

ODE interface

The following examples illustrate ARDIAG functioning within ODE.

The user runs ODE at the ISL prompt.

```
ISL> ODE
**********************************************************************
******                                                          ******
******            OFFLINE DIAGNOSTIC ENVIRONMENT                 *****
******                                                          ******
******     (C) copyright Hewlett-Packard Co 1994                 *****
******                All Rights Reserved                       ******
******                                                          ******
******                                                          ******
******                TC Version XX.XX.XX                       ******
******                 SysLib Version XX.XX.XX                  ******
******                                                          ******
******                                                          ******
**********************************************************************
Type HELP for command information
ODE> help
BASIC COMMANDS
--------------------------
HELP - Prints detailed information when “help <command>” or “help
       <variable>” is typed.
LS - Lists modules available on the boot media.
<MODULE NAME> - Load and initialize the module.
RUN - Run module (after setting environment variables)
CONTROL-Y | CONTROL-C - Abort an ODE command; pause a module.
RESUME - Restart a paused module.
DISPLOG - After running a module, display  the contents of the log.
EXIT - Return to the next higher level prompt.
ENVIRONMENT VARIABLES
```

```
SHOWSTATE - Display the values of the following environment variables:
LOOP - Run a test this many times.
ERRPRINT [ON | OFF] - Print low level error messages.
ERRNUM [ON | OFF] - Print one-line, numbered errors.
ERRPAUSE [ON | OFF] - Pause module on error.
ERRONLY [ON | OFF] - Print only error messages.
INFOPRINT [ON | OFF] - Print informational messages.
ISOPRINT [ON | OFF] - Print fault isolation messages.
ISOPAUSE [ON | OFF] - Pause module when isolation message is generated.
LOGSIZE - Set the size of the message log.
DEFAULT - Reset environment variables to default state.


ODE> ls
Modules on this boot media are:
filename  type    size    created  description
-----------------------------------------------------------------
ARDIAG    XXXX    XXX      XXXX       XXXXXX
```

ARDIAG interface to ODE

```
ODE> ARDIAG
*****************************************************************
******                                                     ******
******                        ARDIAG                       ******
******                                                     ******
******            (C) copyright Hewlett-Packard Co 1996    ******
******               All Rights Reserved                   ******
******                                                     ******
******                                                     ******
******                                                     ******
******                     Version XX.XX.XX                ******
******                                                     ******
******                                                     ******
*****************************************************************


Please wait while I scan the device busses...
Test
Disk Path            Product String                      Rev    Size
---- --------------- ----------------------------------- -----  -----
*0    56/40.1.0       HPC3586 AUTORAID disk array        ZPRF   1.0 GB
Legend:
TestDisk - Indx of the array listed. This is flagged with a '*'
           if it is marked for testing.

NOTE:
  The size of disk may not match the Information Specified by
  the vendor due to difference in calculation methods.
ARDIAG> help
```

```
            ARDIAG Utility  Help Menu
-------------------------------------------------------------------------
  UTILINFO   - Shows commands that do the most common ARDIAG tasks.
  HELP       - This menu, or use HELP <help item> for more detailed help
  DISPMAP    - Display the disk arrays found
  DISPMECH   - Display the selected disk array and internal disks
  DISPFILES  - Display the firmware images found
  DOWNLOAD   - Download the image file to the desired disk array
               controller or internal disk.
  TESTDISK   - Select the array to be tested.
  TESTLEVEL  - Select the FRU within the disk array to be tested.
  RANGE      - Select range of blocks to be tested by ROMT and WRTMT
  SHOWENV    - Display the current settings for TESTDISK and RANGE.
  READLOG    - Read the internal logs of the desired disk array
               controller or internal disk.
  CLRLOG     - Clear the internal logs of the desired disk array
               controller or internal disk.
  REQSENSE   - View SCSI Sense data of the desired disk array
               controller or internal disk.
  INQUIRY    - View SCSI Inquiry data of the desired disk array
               controller or internal disk.
  DESCRIBE   - View Configuration data of the desired disk array.
  REVISION   - View revision information of the desired disk array.
  WRTMT      - Perform a DESTRUCTIVE write/read test on the desired disk
  ROMT       - Perform a read only test on the desired disk.
  CREATELUN  - Adds a LUN to the selected disk array.
  DELETELUN  - Removes a LUN from the selected disk array.
  SHUTDOWN   - Puts the selected disk array into the shutdown state.
  SETOPTIONS - View and modify SCSI mode parameters on the selected
               array controller.
  RECOVER    - Reconstruct data mapping and array configuration.
Continue ([y]/n)? n
```

Chapter 8. Managing the HP SureStore E Disk Array 12H on Windows NT

This chapter introduces AutoRAID Manager – the complete software package for managing your HP SureStore E Disk Array 12H on Microsoft Windows NT.

AutoRAID Manager is a management tool that allows you to monitor and manage your HP SureStore E Disk Array 12H from a network Windows® computer - either locally or remotely. Using AutoRAID Manager you can easily and quickly perform all the tasks involved in the daily management and operation of your disk arrays.

AutoRAID Manager makes it easy for you to:

- Add disk capacity to the disk array.
- Monitor array performance.
- Change disk array operating parameters.
- Identify and diagnose problems with the disk array.

Most disk array management can be done using the AutoRAID Manager for Windows. The AutoRAID Manager software also includes the HP AutoRAID Manager (ARM) command line utilities for Windows NT. These commands are typically used for performing advanced tasks such as reading logs and downloading firmware.

Using the disk array control panel

An alternative to using the AutoRAID Manager to manage your disk array is the disk array control panel. Although you can use the disk array control panel to perform many of the same management tasks, the added convenience and functionality provided by AutoRAID Manager makes it a more convenient tool for managing the disk array.

Find the Latest Information on the World Wide Web

For the latest information about operating your HP SureStore E Disk Array 12H on Windows NT visit our web site at http://www.hp.com/go/support . You'll find the latest software, firmware, and operating tips.

AutoRAID Manager Components

AutoRAID Manager software includes several components. The AutoRAID Manager Server and the AutoRAID Manager Client are required components that work together to manage the HP SureStore E Disk Array 12H. The exact combination of components you install will be determined by your system and network configuration.

- **AutoRAID Manager Clients** - these required components provide the user interface for managing the HP SureStore E Disk Array 12H. Two clients are provided: the AutoRAID Manager for Windows client and the ARM command line utilities. The Windows client can be used to manage disk arrays remotely. The command line utilities can only be used to manage disk arrays from the host server.
- **OpenView Client for AutoRAID** - this optional component runs under HP OpenView and automatically discovers and displays HP AutoRAID devices on the HP OpenView map. The HP OpenView client communicates with the SNMP agent. The OpenView Client is installed if OpenView Network Node Manager is installed on the client.
- **AutoRAID Manager Server** - this required component is the core of the AutoRAID Manager. The AutoRAID Manager Server (ARMServer) is installed as a service on the host server to which the disk array is connected. The HP AutoRAID Manager service must be running to manage disk arrays using AutoRAID Manager. Installation of the AutoRAID Manager Server must be done from the host server console by a user with Administrator access.
- **Remote Management SNMP Agent** - This optional component is installed on the server only if SNMP is installed. The AutoRAID Manager SNMP agent communicates with the HP OpenView client to provide the mechanism for broadcasting event information to network administrators and establish a communication link between the server and the client.
- **Failover Driver** - this componentenables the operating system to exploit the performance and redundancy benefits provided by dual disk array controllers. During normal operation, the failover driver manages the transfer of host data to achieve optimum performance. If one of the controllers fails, the failover driver automatically stops using the failed controller and directs all subsequent I/Os to the remaining controller. The failover driver provides the same functionality regardless of whether the two disk array controllers are on the same SCSI channel or on separate SCSI channels.

HP OpenView Integration

An OpenView client for AutoRAID is included with the AutoRAID Manager software, enabling full integration with HP OpenView. This allows you to manage the SureStore E Disk Arrays on your network from an OpenView console. If OpenView Network Node Manager (NNM) is detected on the client during installation of the AutoRAID software, the OpenView client for AutoRAID will be installed.

The OpenView client for AutoRAID communicates with the AutoRAID Manager SNMP agent running on the server. Changes to AutoRAID status are immediately communicated to the client which updates the AutoRAID icon status indicators.

SureStore E Disk Arrays are managed from OpenView in the same manner as other network resources. The following tips identify ways in which you can use OpenView to manage your disk array most efficiently.

- AutoRAID Manager can be launched by double-clicking an AutoRAID disk array icon on an OpenView submap. The AutoRAID manager will open, displaying the status window for the disk array icon that was clicked.
- The AutoRAID OpenView client requires that ARMServer and the AutoRAID SNMP agent both be running on the server
- At OpenView initialization, the client discovers all AutoRAID disk arrays connected to NT systems, then adds the associated AutoRAID icons to the server submaps.
- The disk array submap layout is updated automatically once a day to reflect the addition or deletion of devices. The submap layout is also updated manually if a server rescan is performed.
- The SNMP configuration parameters used for each SNMP session opened by the OpenView Client for AutoRAID can be set from the OpenView console.

Disk Array Events

Disk array events are logged to the NT Event Log by default. If SNMP is installed on the server, the events can be passed to network management applications such as HP OpenView using the AutoRAID Manager SNMP agent. The AutoRAID SNMP agent is installed during setup if SNMP is detected on the server.

All disk array events are listed in the online Help for AutoRAID Manager. In addition, an ASCII text file of all the events message strings is included in the `Program Files/AutoRAID/Doc` folder (default location). This file may be useful in creating filters and templates for network management applications.

System Requirements

AutoRAID Manager requires the following system environment:

- Microsoft® Windows NT® 4.0 Advanced Server or NT Server, Enterprise Edition with Service Pack 3 (host server) (or later)
- Microsoft® Windows NT® 4.0 Workstation or Windows™ 95 (client)
- TCP/IP services installed
- SNMP Services installed (required for installation of the AutoRAID SNMP agent)

Checking the System Hardware Configuration

Before installing and using the AutoRAID Manager software, the system hardware should be checked to make sure it meets the necessary requirements for proper operation on Windows NT.Check the following system components and make sure they are configured as indicated.

SCSI Hardware

CAUTION! The disk array uses a differential SCSI bus. Use only the HP A5252A SCSI HBA and C2905A differential terminator when connecting the disk array. Using single-ended SCSI hardware may damage the disk array.

Check the following SCSI bus hardware:

- The A5252A SCSI HBA is installed properly in the host.
- All SCSI cabling is installed and connected properly.
- The SCSI bus is terminated properly using differential terminator part number C2905A.

NOTE! If the disk array will be used in a stand-alone (noncluster) environment, it is recommended that the A5252A SCSI HBA setting “Reset SCSI Bus at IC Initialization” be enabled. Refer to the Installation Guide included with the HBA for instructions on changing HBA settings.

Disk Array SCSI Settings

The following disk array SCSI settings must be checked and set to the indicated value if necessary.

- `WDTR` set to enabled
- `SDTR` set to enabled

Use the disk array control panel is to view and change SCSI settings. Refer to the *HP SureStore E Disk Array 12H User's and Service Manual* for control panel information.

Logical Drive Configuration

NOTE! At least one logical drive must be created on the disk array before the array can be accessed by the host server. During the boot process, the server must recognize a logical drive on the disk array to ensure the HBA device driver is loaded properly. If there is no logical drive on the disk array, the server may hang during the boot process.

Logical drive 0 must be created on the disk array to ensure that the host recognizes the array. Your strategy for creating logical drive 0 will be influenced by the type of installation - NT cluster or standalone.

- **NT cluster** - In NT cluster installations logical drive 0 must be reserved for exclusive use by the AutoRAID Manager and should not be used for data files. This unused logical drive is essential for maintaining proper operation should one of the cluster servers fail. Because logical drive 0 is used only for management purposes, you should make it as small as possible.
- **Standalone (noncluster)** - In standalone installations logical drive 0 can be used as any other logical drive on the disk array. Its size will depend on your overall logical drive strategy for the disk array.

Use the disk array control panel to create a logical drive. Refer to the *HP SureStore E Disk Array 12H User's and Service Manual* for control panel information.

Installing AutoRAID Manager Software

Installation Tips

Remember the following tips as you install the AutoRAID Manager software.

✓ Select the appropriate system configuration to ensure the proper software components are installed.

- Select **Client Installation** to install Windows GUI and HP OpenView client softwareon remote computers used to manage network resources (no command line utilities).
- Select **Server Installation** to install the clients, server and failover driver components.

- Select **Custom Installation** only if you want to control which components are installed.

✓ Check the README file for important updates about the AutoRAID Manager software.

✓ Do not install the AutoRAID Manager software into the root directory of the local drive. Installing the software into the root directory will cause the AutoRAID Manager to be inoperative.

✓ Make sure you share the AutoRAID Manager Administrator folder (Program Files/AutoRAID/ARMadmin [the default location]) on the server if you want to manage the disk arrays from a remote client. If this folder is not shared, you will get a security access violation when you try to manage the disk array using AutoRAID Manager.

✓ Windows NT allows the static assignment of drive letters on volumes, partitions, and CD-ROM drives. This means that a drive letter can be permanently assigned to a specific hard disk, partition or volume, and CD-ROM drive. When a new hard disk is added to an existing computer system, it will not affect statically assigned drive letters. Installing the failover driver can cause remapping of your disk drives if they have not been assigned as "static". To prevent re-mapping, use the Disk Administrator (Start|Programs|Administrative Tools) and reassign the current disk drive letters to each drive. Reassigning the letters will make the assignments "static" and prevent remapping.

To install the AutoRAID Manager software:

1. Logon to the network as a user with administrator privileges
2. Load the *HP AutoRAID on Windows NT* CD into the CD-ROM drive. The AutoRun feature will automatically start the setup program (if AutoRun is not enabled, you must run setup.exe manually).
3. As you proceed through the setup, select the following options when prompted:
   - Select the appropriate system configuration option.
   - It is recommended that you use the default locations for the AutoRAID Manager files.
   - View the README file for the latest information on AutoRAID Manager
   - Share the AutoRAID Administrator folder to allow remote clients to manage the disk array. For more information see "Controlling Access to the Disk Arrays"
   - The install program will also run the Firmware Download Utility. Make sure firmware revision HP54 is installed on the disk array. If another version of firmware is installed on the disk array, download HP54 to the disk array.

CAUTION! Firmware version HP54 is required for proper operation on Windows NT. Using another version of firmware could result in improper system operation. The README file contains information regarding current firmware for the disk array.

When you have performed all the tasks required to complete setup, continue with "Setting Up AutoRAID Manager for Windows".

Controlling Access to the Disk Arrays

CAUTION! Access to AutoRAID Manager should be restricted to those involved in managing network resources. AutoRAID Manager provides capabilities that, if used improperly, could destroy data or disrupt access to the disk array. For this reason, it is recommended that you restrict user access to AutoRAID Manager.

When sharing the AutoRAID Manager Administration folder, make sure you restrict access to the folder. The default permissions when sharing a folder give everyone access, so you will need to change the permissions to restrict access to the desired users only.

The AutoRAID Administrator folder must be shared to allow remote clients to use AutoRAID Manager to manage the disk array. Disk array management is controlled by the permissions applied to the AutoRAID Administrator folder, which is located by default at Program Files/AutoRAID/ARMadmin. If you selected another location for the Administration folder during setup, the specified folder will control access to the disk array. Standard Windows NT security procedures are used to define the permissions for the Administrator folder.

Any user account with read/write access to the Administrator folder will be able to view and manage the disk array. The folder will inherit the share access rights currently defined for the system. If the default permissions are not suitable, add or remove users from the access list as necessary to impose the desired security on the folder. Also make sure the NTFS file permissions are also set properly to control access.

HP-UX Server Access

If you will be using AutoRAID Manager to manage a disk array connected to an HP-UX server, you must configure the HP-UX server as follows to allow access to the array:

1. Verify that the NT userid is valid on the HP-UX server and that the userid is a member of the adm group.
2. If you're not using the root userid, add group write access to the /var/opt/hparray/admin sub-directory.
3. Add host and userid to the /etc/hosts.equiv file.

NOTE! To administer a disk array connected to an HP-UX server from an AutoRAID Manager client, the necessary patches must be installed on the HP-UX server. Check the README file included on the HP

AutoRAID on Windows NT CD-ROM for information on which patches are required. If you will be using a Windows 95 management client, it will be necessary to restart the client before you can manage disk arrays connected to an HP-UX server.

Changing the Log File Directory Location

The default directory for the AutoRAID Manager log files is x:\ProgramFiles\AutoRAID\log. If you want to use a different directory for the log files, it will be necessary to edit the registry entry for the file location. The log file directory is defined by the following registry key:

HKEY_LOCAL_MACHINE\SOFTWARE\HEWLETT-PACKARD\AUTORAID\ARMSERVER\LOG DIRECTORY

Run the Registry Editor and edit this entry to reflect the new directory location. Make sure the proper permissions are set on the new directory.

NOTE - Use caution when modifying the registry and make a backup before making any changes!

Setting Up AutoRAID Manager for Windows NT

After installing the software, there are a few initial steps that must be performed before you can begin managing your disk arrays. This involves scanning the local network for any host that has an *HP SureStore E Disk Array 12H* connected to it. Once a host has been located, the disk arrays connected to it must be added to the Array List window before they can be managed using AutoRAID Manager.

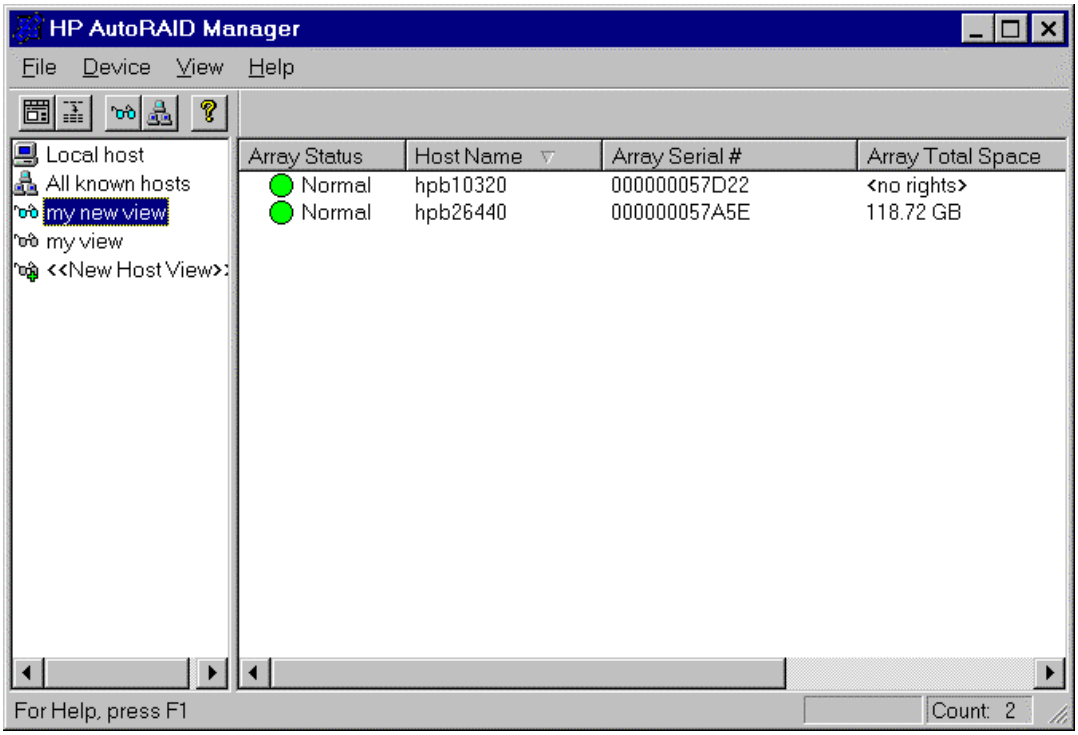
The HPAutoRAID Manager GUI

The HPAutoRAID Manager's main screen is divided into two main sections: **View** pane and **Detail** pane. The View pane (left side) contains the views that are available and the Detail pane (right side) contains the list of hosts visible to the selected view.

To run the HP AutoRAID Manager:

From the Start menu, select Programs|AutoRAID Manager|AutoRAID Manager.

AutoRAID Manager immediately begins scanning the selected hosts for the current view, searching for all operating disk arrays with AutoRAID. As disk arrays are identified, they are added to the Detail pane (right side). When the scanning is complete, each *HP SureStore E Disk Array 12H* in the view should be shown in the Detail pane.



What is a view?

To more easily manage disk arrays connected to a host, you can group sets of hosts into customized views. For example, you could group all arrays that are located in an accounting department and group them into a single view called “Accounting.”

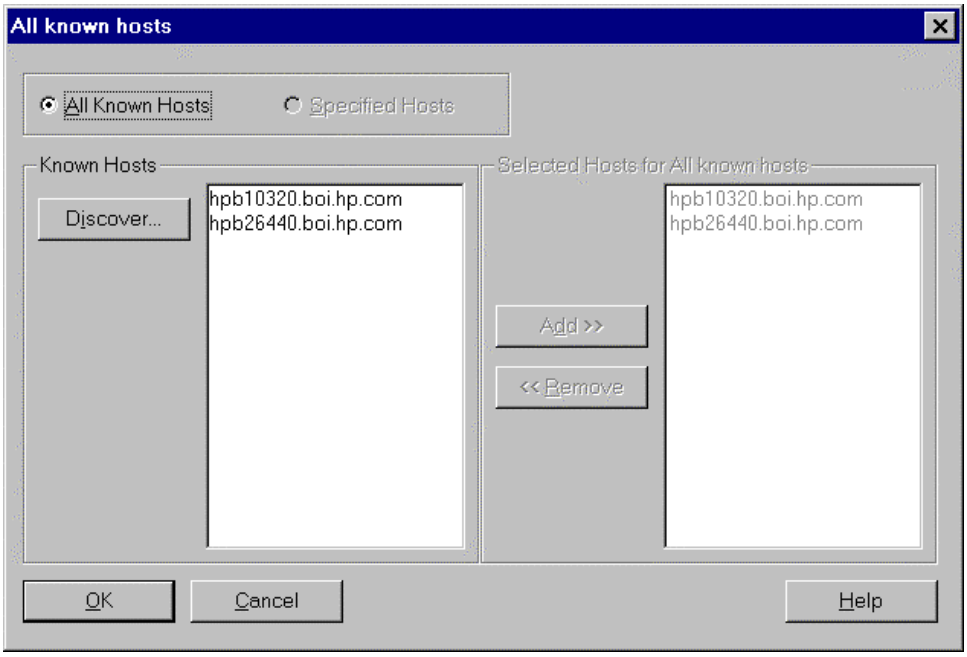
When you first start the HP AutoRAID Manager, a Local Host view and All Known Hosts view are automatically created (these views *are not* customizable).

How do I add a customized view?

To add a customized view:

1. Click  **<<Add New Host View>>** in the View pane.
2. Enter a name for the view.
3. Click **OK**.
4. Use the **Columns**, **Filter**, and **Sort** tabs to customize your view.
5. Click **OK**.
6. Select the desired Hosts
7. Click **OK**.

The view will now appear in the View pane.



To select additional arrays you want to manage:

1. On the View menu, click **Select Hosts**
2. Select a disk array you want to manage from the Known Hosts. You can select multiple arrays at once.
3. Click the **Add>>** button to move the disk array to the Selected Hosts list. Click **OK**. All the disk arrays you added are now displayed in the Detail pane.

   There may be a delay as the status of each disk array is retrieved. Until the status is retrieved, each disk array is assigned a status of UNKNOWN.

You are now ready to begin managing your disk arrays using the AutoRAID Manager.The next chapter provides step-by-step instructions for performing the tasks involved in managing the disk array.

NOTE! Disk arrays connected to an NT cluster will appear twice in the Discovered Arrays -- once for each server in the cluster.

Missing Disk Arrays? If you know there are disk arrays connected to your network but they are not displayed in the Discovered Arrays, check the following:

- Make sure the host the disk array is connected to is operational and logged on to the network.
- Make sure the disk array is turned on and operating properly.
- Make sure the disk array is properly connected to the host. This includes proper termination of the SCSI bus.
- Make sure there is at least one logical drive created on the disk array. A logical drive must be created on the disk array before the array can be accessed by the host. During the boot process, the host server must recognize a logical drive on the disk array to ensure the HBA device driver is loaded properly. If there is no logical drive on the disk array, the host may be unable to access with the array. A logical drive can be created using the disk array control panel as described in the *HP SureStore E Disk Array 12H User's and Service Manual.*

DiscoveringDisk Arrays

If the disk array configuration on your network changes, the AutoRAID Manager may be unaware of it. For example, if a disk array is added to or removed from a server, the change may not be reflected in the Array List. In this case, it will be necessary to search the network to update the information displayed by the AutoRAID Manager.

To discover disk arrays

1. From the HP AutoRAID Manager's View menu, click **Select Hosts...**.
2. Click **Discover…**.
3. Click **Automatic Discovery**.
4. The AutoRAID Manager will search the local network for disk arrays and update the Known Hosts list with the new information.
5. Check the Known Hosts list and add any new disk arrays to the Selected Hosts list, if the view is not configured for All Known Hosts.

Managing Disk Arrays on a Remote Host

The discovery feature described in the preceding procedure locates disk arrays connected to hosts on the local server (Local Hosts view) as well as remote hosts (All Known Hosts view). If a specific host is not displayed, or you do not wish to run automatic discovery, you can do the following:

To add a remote host and its disk arrays:

1. On the HP AutoRAID Manager's View menu, click **Select Hosts**.
2. Click **Discover…**.
3. Click **Specified Host** and enter the IP address or the domain name of the host server and click **OK**.
4. The AutoRAID Manager will locate the remote host and add each *HP SureStore E Disk Array 12H* connected to it to the Discovered Arrays.
5. Select the disk array(s) and click **Add>>** to add them to the Selected Hosts list, if the view is not configured for All Known Hosts.
6. Click **OK** and the disk arrays will be included in the Detail pane.

Editing the Disk Array List

Over time, the disk arrays you are responsible for managing may change. You can use the Selected Hosts list dialog box to add or remove disk arrays from the Detail pane. Only disk arrays in the Selected Hosts list window can be managed using AutoRAID Manager.

Solving Common Installation Problems

- **AutoRAID SNMP agent was not installed during Setup.**
  If the NT SNMP service is not installed on the server when running Setup, the AutoRAID SNMP agent is not installed. To load the AutoRAID SNMP agent, install the NT SNMP service and Service Pack (3 or later) then reinstall the AutoRAID Manager software.
- **Can't access remote servers from AutoRAID Manager running on a Windows 95 client.**
  A Windows 95 client must be rebooted following installation of the AutoRAID Manager software before remote severs can be accessed. Reboot the client and remote servers should be accessible from AutoRAID Manager.
- **Can't locate Help for ARM NT command line utilities.**
  The Help for the command line utilities is accessed by typing armhelp from the NT command prompt. Help can also be accessed from the NT desktop **Start** menu by selecting **Programs|AutoRAID Manager|AutoRAID Manager Command Line Help**.
- **Can't see the disk array in the NT Disk Administrator.**
  At least one logical drive must be created on the disk array before it will be visible in the NT Disk Administrator.
- **Disk array events are not being communicated to network management application.**
  This is typically caused by the AutoRAID SNMP agent not being installed. If the NT SNMP service is

not installed on the server when running Setup, the AutoRAID SNMP agent is not installed. To load the AutoRAID SNMP agent, install the NT SNMP service and reinstall the AutoRAID Manager software.

- **Security Violation error when attempting to access the disk array using AutoRAID Manager from remote client.**
  This is typically a caused by the AutoRAID Manager Administrator folder (default Program Files\AutoRAID\ARMadmin) not being shared on the server for access. For more information on security, see "Controlling Access to the Disk Arrays".
- **Server hangs during boot process after installing the HP SureStore E Disk Array 12H.**
  This may occur if there is no logical drive created on the disk array. At least one logical drive must be created on the disk array before the host server can access the array. During the boot process, the server must recognize a logical drive on the disk array to ensure the HBA device driver is loaded properly. If there is no logical drive on the disk array, the server may hang during the boot process. A logical drive can be created using the disk array control panel as described in the *HP SureStore E Disk Array 12H User's and Service Manual.*

Chapter 9. Using AutoRAID Manager for Windows NT

AutoRAID Manager for Windows can be used to perform all the tasks involved in normal management of your *HP SureStore E Disk Array 12H*. AutoRAID Manager can be used for:

- Configuring a New Disk Array
- Checking Disk Array Status
- Changing Disk Array Configuration Settings
- Managing Logical Drives
- Adding a Disk
- Rebuilding the Disk Array
- Analyzing Disk Array Performance
- Performing Disk Array Maintenance Tasks

This chapter describes the steps involved in performing each of these tasks.

Online Help

AutoRAID Manager includes detailed online Help. If you need assistance in performing any task, the Help should provide the guidance you need.

Selecting a Disk Array

Before you can manage a disk array using AutoRAID Manager, you must select the array from the Detail pane. See "Setting Up AutoRAID Manager" in the preceding chapter for information on adding disk arrays to the Array List window.

To select a disk array:

1. In the Detail pane, click the disk array you want to manage. If it is not visible in the Detail pane, you may need to select another view.

2. Right click the array and use the property pages (tabs) for the operation(s) you want to perform.

Configuring a New Disk Array

After installing a new disk array, you can perform the initial configuration using AutoRAID Manager. This establishes the desired operating environment for the disk array, and makes the capacity of the disk array available to the host server.

The following steps guide you through the typical process of configuring a new disk array.

NOTE! At least one logical drive must be created on the disk array before the host can access the array. For more information, see "Logical Drive Configuration" in the preceding chapter

To configure a new disk array:

1. **Check the available unallocated capacity on the disk array.**
   The total unallocated capacity available for creating logical drives is displayed in the Capacity screen.
2. **Plan your capacity management strategy and logical drive configuration.**
   Determine how you want to use the capacity of the disk array. Factors such as data redundancy and performance influence how you manage the capacity. For example, you can increase the amount of available capacity by disabling Active Hot Spare, but this may mean you sacrifice data redundancy in the event of a disk failure. See the "Concepts and Management" chapter in *HP SureStore E Disk Array 12H User's and Service Manual* for help in planning your strategy.
3. **Create logical drives on the disk array.**
   This required step makes disk array capacity available to your operating system. Each logical drive appears to the host as a physical disk device. Make sure you observe any limitations imposed by your system regarding disk size or number. For more information, see "Creating a Logical Drive".

Checking Disk Array Status

One of your most important management tasks is monitoring the status, operation, and configuration of your disk array. Because it is a vital piece of your system, it is important to know how well the disk array is operating and if any problems or failures have occurred. AutoRAID Manager continually monitors the operation of the disk array and updates status information regularly. This provides you with the latest information on the operation of your disk array.

To check disk array status:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Status** tab.

NOTE! Double clicking on a disk array entry in the Array List window has the same effect as right-clicking the array.

Changing Disk Array Configuration Settings

A number of configuration settings control the operation of the disk array. These settings are usually established during installation and, once set, should rarely need to be changed.

The default settings have been selected to provide the best operation for most systems. However, if you determine that any setting does not meet your needs, you can easily change it.

Table 26 lists the various settings, including factors you may want to consider before changing them.

Table 26. Disk Array Configuration Settings

Setting	Default	Comments and Considerations
Active Spare	On	Active Hot Spare provides optimum protection against disk failure. Disabling Active Hot Spare will make additional capacity available to the host, but at the expense of not maintaining data redundancy in the event of a disk failure.
Auto Rebuild	On	Auto Rebuild provides optimum protection against disk failure by rebuilding a failed disk as quickly as possible. Disabling Auto Rebuild gives you more control over the rebuild process, but it can leave the disk array vulnerable to a second disk failure until a rebuild is performed manually.
Auto Include	On	Auto Include simplifies the task of adding a new disk to your array. Disabling it will require you manually to include each disk you install in the array.
Rebuild Priority	High	Rebuild priority determines how quickly a rebuild operation will complete.

To change disk array configuration settings:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Configuration** tab.
4. Select the appropriate value for each setting.

Managing Logical Drives

Establishing and managing the logical drive structure of your disk array is an important management task. Your system requirements and file directory structure influence the logical drive strategy you choose.

Managing logical drives is a part of the overall task of managing disk array capacity. For more information on managing array capacity to meet your system needs, see the "Concepts and Management" chapter in the *HP SureStore E Disk Array 12H User's and Service Manual*

Creating a Logical Drive

Creating a logical drive makes array capacity available to the operating system. Each logical drive appears to the host as a physical disk device. Logical drives are created during initial installation of the disk array, and typically after installing a new disk module.

To create a logical drive:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click **Logical Drives**.
4. Click **Create...** to display the Create Logical Drive window. If there is no unallocated capacity on the disk array, the **Create…** option will not be available.
5. In the **Number** field, select the number of the new logical drive.
6. In the **Capacity** field, enter the desired size of the logical drive.
7. Click **OK**.

NOTE! After creating a new logical drive, you must perform the necessary steps to configure the logical drive into the operating system. This is typically done using the Windows NT Disk Administrator. Refer to Windows NT Help for information on performing this task.

Renumbering a Logical Drive

Renumbering changes the logical drive number assigned to the logical drive by the disk array. The logical drive number is the means by which the operating system identifies each logical drive. Consequently, renumbering a logical drive will impact your operating system's ability to access the data on that drive.

You should only consider renumbering a logical drive in specific situations. For example, assume you are using logical drive 0 as your boot drive, and you later decide you want to boot from a different drive. You will have to assign the current boot drive a new number, and then renumber the new boot drive to 0.

NOTE! Before renumbering a logical drive, consult your Windows NT documentation for information on what steps you will have to take to make sure the host can access the new logical drive number.

To renumber a logical drive:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Logical Drives** tab.
4. Click the drive you want to renumber.
5. Click **Renumber...** to display the Renumber Logical Drive window.
6. In the **Change to**: field, select the new number you want assigned to the logical drive.
7. Click **OK**.

Deleting a Logical Drive

CAUTION! Deleting a logical drive destroys all data on that logical drive. Before deleting a logical drive, make sure you backup any data you want to save.

When you delete a logical drive, all data on that logical drive is destroyed and its capacity is returned to the pool of unallocated capacity on the array.

To delete a logical drive:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Logical Drives** tab.
4. Click the drive you want to delete.

5. Click **Delete**.

Adding a Disk

At some time you will probably want to add another disk to your array. Features such as hot-plug disk modules and Auto Include simplify the process of adding a disk to the array, even while the disk array is operating. A disk can be added to the array without disrupting client or host operation.

After you have added a new disk, you have three options on how to use it:

- **Increase capacity** - you can use the disk to increase the capacity available to the operating system by creating a new logical drive.
- **Improve performance** - you can use the disk to improve disk array performance by simply leaving it as unallocated capacity.
- **Enable Active Hot Spare** - you can use the additional capacity to enable Active Hot Spare if your disk array does not currently have the capacity to implement this feature.

NOTE! The Auto Include feature will normally include the disk drive when it is installed. However, in some situations, the array will not include a disk automatically, even if Auto Include is enabled. In this case, you must manually include the disk. For more information on Auto Include, see the "Concepts and Management" chapter in the *HP SureStore E Disk Array 12H User's and Service Manual.*

To add a disk to increase capacity:

1. Make sure the new disk has been installed in the array cabinet.
2. Click the disk array from Detail pane.
3. If Auto Include is on, the disk is automatically added to the array and you can proceed to step 4. If Auto Include is off, manually include the disk as described in "Including a Disk Manually."
4. Create one or more logical drives using all or a portion of the disk's capacity.
5. Perform the necessary steps to configure the new logical drive into your host. This is typically done using the Windows NT Disk Administrator. Refer to Windows NT Help for information on performing this task.

To add a disk to improve array performance:

1. Make sure the new disk has been installed in the array cabinet.
2. Right-click the disk array from the Detail pane.

3. If Auto Include is on, the disk is automatically added to the array and you can proceed to step 4. If Auto Include is off, manually include the disk as described in "Including a Disk Manually".
4. Check the disk array configuration and verify that the disk has been added to the unallocated capacity.

To add a disk to enable Active Hot Spare:

1. Make sure the new disk has been installed in the array cabinet.
2. Click the disk array from the Detail pane.
3. If Auto Include is on, the disk is automatically added to the array and you can proceed to step 4. If Auto Include is off, manually include the disk as described in "Including a Disk Manually".
4. Click **Properties**.
5. Click the **Configure** tab.
6. Select the **Active Spare Enable** setting.

Including a Disk Manually

A disk must be included before it can be used by the disk array. There are two ways to include a disk:

- Enable Auto Include, which automatically includes a disk when it is installed in the array cabinet.
- Disable Auto Include and manually include each new disk.

A blue status indicator in the Status window identifies any disks that are not included.

Because of the convenience it provides, Auto Include is enabled by default. However, you can disable Auto Include and include new disks manually if you choose.

To manually include a disk:

This procedure assumes that Auto Include has been disabled.

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.
4. Click the disk you want to include from the graphic or list.
5. Click **Include**.

Rebuilding the Disk Array

To maintain data redundancy in the event of a disk failure, it is important to rebuild the disk array as soon as possible. The disk array is not data redundant until a rebuild is performed. If another disk fails before the rebuild is complete, data on the disk array may be lost.

AutoRAID Manager provides two rebuild options:

- Auto Rebuild, which allows the disk array to begin rebuilding immediately if a disk fails.
- Manual Rebuild, which requires you to initiate the rebuild. This option is provided if you want more control over the rebuild process, such as delaying the start of a rebuild until the system is less busy.

A rebuild impacts disk array performance while it is in progress, so before starting a rebuild make sure the appropriate Rebuild Priority is set.

Rebuilding the Disk Array Automatically

You can enable Auto Rebuild to allow the disk array to immediately begin rebuilding if a disk fails. To perform a Rebuild the array must have enough capacity available, either in the form of an Active Hot Spare or unallocated capacity.

Auto Rebuild with high priority is enabled by default to provide the greatest protection against disk failure; consequently, it will typically not be necessary to perform this procedure unless you want to change the rebuild priority.

To enable Auto Rebuild to rebuild the disk array automatically:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Configuration** tab.
4. Under Rebuild, click **Automatic**.
5. Select the **Priority** you want the disk array to use when it performs a rebuild.

   The disk array will now automatically rebuild the array if a disk fails.

NOTE! If there is no Active Hot Spare or not enough unallocated capacity available, Auto Rebuild will be enabled even though a rebuild cannot be performed if a disk fails. In this situation, you must increase the amount of unallocated capacity so there is enough capacity to perform a rebuild. You can increase the amount of unallocated capacity by adding another disk or deleting an existing logical drive.

Rebuilding the Disk Array Manually

You can manually start a rebuild if a disk drive has failed and Auto Rebuild is disabled. To perform a Rebuild the array must have enough capacity available, either in the form of an Active Hot Spare or unallocated capacity.

To disable Auto Rebuild:

1. Right-click the disk array from Detail pane.
2. Click **Properties**.
3. Click the **Configuration** tab.
4. Under Rebuild, select **Manual**.

With Auto Rebuild disabled, you are now prepared to perform all rebuilds manually.

To rebuild the disk array manually:

1. Right-click the disk array from Detail menu.
2. Click **Properties**.
3. Click the **Configuration** tab.
4. Under Rebuild, click **Manual**.
5. Select the **Priority** you want the disk array to use as it rebuilds the disk array.
6. Click **Start** in the Rebuild controls. The rebuild will begin and the progress of the rebuild will be displayed.

NOTE! If there is no Active Hot Spare or not enough unallocated capacity available, you must increase the amount of unallocated capacity so there is enough to perform the rebuild. You can increase the amount of unallocated capacity by adding another disk or deleting an existing logical drive.

Checking the Progress of a Rebuild

The progress of a rebuild is displayed in the Configuration window. Access this window to monitor the progress of a rebuild.

To monitor the progress of a rebuild:

1. Right-click the disk array currently undergoing a rebuild from Detail pane.

2. Click **Properties**.
3. Click the **Configuration** tab.
4. Under Rebuild, check the rebuild progress bar for the current status of the rebuild.

Canceling a Rebuild

It is possible to cancel a rebuild in progress before it completes. However, you should be aware that when you restart a stopped rebuild it starts at the beginning, not at the point where it left off. This means any portion of the rebuild completed before you canceled it will have to be repeated.

To cancel a rebuild:

1. Right-click the disk array currently undergoing a rebuild from the Detail pane.
2. Click **Properties**.
3. Click the **Configuration** tab.
4. Under Rebuild, click **Stop**. The rebuild will stop immediately.

Analyzing Disk Array Performance

The disk array controller monitors and stores a number of performance metrics that reflect how the disk array is performing. AutoRAID Manager periodically retrieves the metrics and stores them for viewing. AutoRAID Manager can also analyze the performance metrics to identify any potential performance problems. Based on this analysis, AutoRAID Manager will make recommendations on how to improve disk array performance.

Checking the metrics regularly is a quick and easy way to monitor the performance of your disk array and identify any problems that may be developing. You may choose to display only the recommendations, or you may want to view the metrics for further analysis.

For more information on performance metrics, see the "Concepts and Management" chapter in the *HP SureStore E Disk Array 12H User's and Service Manual.*

Selecting a Time Period for Analysis

When analyzing performance, you must define the time period over which the analysis will be performed. For the best results, select a time period when performance may be a concern. This will produce the most meaningful analysis and recommendations.

For example, if the highest load on your disk array occurs between the hours of 8 AM and 5 PM, restrict the analysis to this time period. If periods of lower activity are included, the analysis may yield different results

and consequently different recommendations. This occurs because activity is averaged over the entire analysis period, and periods of lower activity will offset the effects of busier periods.

For the most accurate analysis, select a period of time that represents normal system operation. Avoid any unusual events such as a rebuild or changes made to array capacity. If you select a time period that includes an event which may distort the analysis, the utility will alert you and will not provide any recommendations.

To analyze disk array performance:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Performance** tab.
4. Position the interval marker over the desired time period in the Performance Events window. If the time period you want is not displayed, use the horizontal scroll bar to display the desired time.
5. Click **Recommend** to display the Performance Recommendations window.

Displaying Performance Metric Thresholds

Several of the performance metrics maintained by the disk array can be displayed. These are the same metrics used by AutoRAID Manager to produce performance recommendations.

The performance metrics may help you understand how your disk array is performing, but you should avoid making performance-planning decisions based solely on them. AutoRAID Manager uses other metrics not displayed in this window when performing its analysis. Consequently, AutoRAID Manager can make a more accurate analysis and arrive at the best recommendations for improving performance.

To display the performance metric thresholds:

1. Right-click the disk array from the Detail menu.
2. Click **Properties**.
3. Click the **Performance** tab.
4. Click **Thresholds** to display the Performance Thresholds window.

Checking the Working Set Metric

A key factor in monitoring and maintaining optimal performance of the disk array is the Working Set metric. To ensure that disk array performance is maintained, access the performance metrics regularly and check the Working Set value.

The Working Set performance metric is derived from the Write Working Set parameter. It indicates the ratio of the Write Working Set size to the amount of RAID 0/1 space available. For a detailed explanation

of the Write Working Set and its impact on performance, refer to the *HP SureStore E Disk Array 12H User's and Service Manual.*

To maintain performance, the amount of RAID 0/1 space should equal or exceed the Write Working Set, resulting in a Working Set value less than or equal to 1. A Working Set value greater than 1 indicates that the Write Working Set is larger than the available RAID 0/1 space and the disk array is servicing writes from RAID 5 space.

If the Working Set consistently exceeds 1, the amount of RAID 0 /1 space available should be increased to improve performance. This can be accomplished in several ways as described in the following section.

If the Working Set is consistently much less than 1, some of the RAID 0/1 capacity can be allocated to a new logical drive without impacting performance. The remaining RAID 0/1 space should be adequate to accommodate the Write Working Set.

Performing Disk Array Maintenance Tasks

There are a number of tasks that may have to be performed in the ongoing management of the disk array. These maintenance tasks are typically performed infrequently and may involve taking the disk array offline.

Shutting Down the Disk Array

Shutting down the disk array makes the array unavailable to the server. When a shutdown is initiated, the disk array completes any I/Os in progress with the server, performs internal housekeeping functions, and then takes itself offline.

Shutdown is intended primarily as a maintenance operation and does not need to be done on a regular basis.

To shutdown the disk array:

1. Alert all users that the disk array is being shutdown and any data on it will not be available.
2. Right-click the disk array from the Detail pane.
3. Click **Properties**.
4. Click the **Diagnostics** tab.
5. Under Array, click **Shutdown**.
6. Click **OK** to confirm the Shutdown.

Restarting the Disk Array

The disk array must be restarted after being shutdown. Restart returns the disk array to operation, ready to once again service I/Os from the server.

To restart the disk array:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.
4. Under Array, click **Restart**.

Resetting the Disk Array

Resetting the disk array returns it to the power-on state. Access to the disk array may be interrupted during a reset.

To reset the disk array:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.
4. Under Array, click **Reset**.

Formatting the Disk Array

WARNING! A Format will destroy all the data on the disk array. Make sure you backup all the data you want to keep before formatting the disk array.

The entire disk array can be formatted, if necessary. However, the disk array can only be formatted if there are no logical drives on the array. If there are logical drives on the disk array, they must be deleted before the array can be formatted.

To format the disk array:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.

4. Under Array, click **Format**. If the **Array** control is not available, it indicates that there are logical drives on the disk array. The disk array cannot be formatted until all logical drives are deleted.
5. Click **OK** in the confirmation box to begin the format.

Formatting a Logical Drive

WARNING! A format will destroy all the data on the logical drive. Make sure all data is backed up before formatting the logical drive.

Each logical drive can be reformatted, if necessary.

To format a logical drive:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Logical Drives** tab.
4. Click the Logical Drive you want to format.
5. Click **Format** .

Testing a Disk

AutoRAID Manager includes diagnostics that test the operation and integrity of any disk in the array enclosure. Testing a disk may impact the performance of the disk array, so you may want to delay disk testing to times when the disk array is not being heavily accessed.

Two different types of testing can be performed:

- Read verify - a nondestructive test that does not alter any data on the disk being tested. The disk is not downed when performing a read/verify test.
- Write/Read - a destructive test that destroys data on the disk being tested. The disk is downed before beginning the test. If Auto Rebuild is enabled, the disk array will immediately begin rebuilding the data on the disk when it is downed.

To test a disk:

1. Right-click the disk array from Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.

4. Click on the disk you want to test.
5. Click **Test**.
6. Select **Read Verify** or **Write Read**.
7. Enter the percent of the disk media you want to test.
8. If you are performing a Write/Read test, you must first Down the disk. The diagnostic test will begin and a progress indicator will be displayed in the Test Status box. When the test concludes, the results will be displayed.

To continue using a disk following a Write/Read test, it must be manually included back in the array configuration. See "Including a Disk Manually" for more information.

Downing a Disk

If you must remove a disk from the array for testing or replacement, the disk should be downed before removing it from the array enclosure. In some situations, downing a disk may cause a loss of data redundancy or even a loss of user data. You must decide if you are willing to accept either of these conditions before downing the disk. In addition, if Auto Rebuild is enabled, the disk array will begin rebuilding the data on the downed disk immediately. If you do not want this to happen, you must disable Auto Rebuild before downing the disk. See "Rebuilding the Disk Array" for information on disabling Auto Rebuild.

To down a disk:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** tab.
4. Click on the disk you want to down.
5. Click **Down**.
6. From the Down Physical Disk Warning dialog, select the desired option restricting the conditions under which the down can occur.

To return a downed disk to the array configuration, you must manually include it. See "Including a Disk Manually " for more information.

Switching Array Controllers

In disk arrays with two controllers, the array automatically switches to the secondary controller if the primary controller fails. However, you can manually switch controllers if necessary.

To switch array controllers:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.

3. Click the **Diagnostics** tab.

4. Click **Switch to Y** (or X, as appropriate) to switch to the secondary controller.

Displaying Hardware Logs

Each controller and each disk drive in the disk array maintains its own internal hardware status log. These logs contain information that may be useful in identifying or diagnosing problems with the array. AutoRAID Manager regularly copies the contents of the controller logs to the log file on the host server.

You can read the contents of the hardware logs directly, and also clear the logs.

To restart the hardware logs:

1. Right-click the disk array from the Detail pane.
2. Click **Properties**.
3. Click the **Diagnostics** button on the toolbar.
4. Under Logs, click **Restart**.

Downloading Controller Firmware

AutoRAID Manager includes a separate utility for downloading controller firmware. This utility, `WinDownload,` simplifies the process of downloading new firmware to the controller in your disk array.

The WinDownload utility is used only for downloading firmware to the disk array controllers. Firmware can also be downloaded to the disk modules using the ARM `download` command line utility described in "Downloading Firmware to a Disk Module" in the next chapter.

The download process shuts down the disk array while the firmware is being downloaded, so the disk array will be inaccessible while the download is in progress.

CAUTION! In multi-host configurations, other hosts must not access the disk array while the download is in progress. Data can be lost if write requests are made to the disk array while a download is in progress.

Do not attempt to download controller firmware to a disk array that is serving as the NT boot device. If you attempt to do so, the operating system will crash.

To download controller firmware:

1. Alert users that data on the disk array will be inaccessible during the download.
2. From the **Start** menu, select **Programs|AutoRAID Manager|WinDownload**
3. Select the disk array you want to upgrade with new firmware.
4. Click **Select Firmware File**
5. Select the firmware file to be downloaded to the disk array. The latest version of firmware is installed in the `AutoRAID\FW` folder during setup. If the desired firmware file is in another location, locate and select it .
6. Click **Download**

   The download process will begin. The process can take up to 5 minutes to complete. When the download is complete the disk array will be brought back on line, ready to process I/Os from the host.

Chapter 10. Using the ARM Command Line Utilities for Windows NT

Included with the AutoRAID Manager (ARM) software are the ARM command line utilities for Windows NT®. These commands provide the capability of managing the disk array from the NT command prompt. The command utilities are emulated by the AutoRAID Manager Windows GUI, so the GUI should be the primary tool used to manage the disk array.

NOTE! The command line utilities can only be used on the host server to manage local disk arrays. The command line utilities cannot be used to manage disk arrays remotely.

The command line utilities do provide some additional functionality not available from the GUI. However, these are specialized tasks not typically performed in the day-to-day management of the disk array.

- The `download` command downloads new firmware to the disk array controller and disk drives.
- The `logprint` command accesses the log files maintained by AutoRAID Manager.
- The `arraymgr` command provides additional capability for managing some aspects of disk array behavior.
- The `arraydsp` command allows you to check all aspects of disk array operation and configuration.

Each of the command line utilities is described in this chapter.

LUNs and Logical Drives. To maintain consistency with ARM command line terminology, the term LUN is frequently used to refer to a disk array logical drive. The two terms are used interchangeably and refer to the same logical entity on the disk array.

Online Help

Detailed online help is available for all the command line utilities. To view the help type `armhelp` from the NT command prompt, or from the **START** menu select

Programs|AutoRAID Manager|Command-Line help

Command Syntax Conventions

The following symbols are used in the command descriptions and examples:

Symbol	Meaning
<>	Integer value, whose units are not defined.
|	"Exclusive OR." Exactly one of the parameters displayed will be used.
[ ]	Items enclosed are optional.
{ }	Items enclosed are required.

Selecting a Disk Array to Manage

When using the ARM utilities, the <array-id> field is used to identify the disk array. The <array-id> field contains the disk array serial number.

For example, assume a disk array has a serial number of 00786B5C0000. To check the available unallocated capacity on this particular disk array, you would use the following command:

```
arraydsp -V 00786B5C0000
```

The serial number of all arrays connected to the host can be obtained using the command:

```
arraydsp -i
```

For more information see "Displaying Disk Array Serial Numbers" in this chapter.

Many commands affect the operation of the entire disk array. Commands that involve only a specific logical drive on the array will include an option (-L LUN) for identifying the logical drive involved. For example, to format logical drive 3 on a disk array with serial number 00786B5C0000, use the following command:

```
arrayfmt -L 3 00786B5C0000
```

Configuring a New Disk Array

After installing a new disk array, you can perform the initial configuration using the ARM utilities. This establishes the operating environment for the disk array.

To configure a new disk array:

1. Plan your capacity management strategy and logical drive configuration.

   Decide how you want to use the disk array capacity. Factors such as data redundancy and performance influence how you manage the capacity. See "Managing the Disk Array Capacity" in the *HP SureStore E Disk Array 12H User's and Service Manual* for help in planning your strategy.

2. Display the serial number of all disk arrays by typing:

   ```
   arraydsp -i
   ```

   The serial number provides the means to identify disk arrays when using the ARM utilities. Record the serial number for future reference.

3. If the planning in step 1 requires you to disable any of the configuration settings to implement your capacity management strategy, do so now. These settings include Active Hot Spare, Auto Rebuild, and Auto Include. Change the configuration settings by typing:

   ```
   arraymgr -h { on|off } <array-id>    (Active Hot Spare)
   arraymgr -a { on|off } <array-id>    (Auto Rebuild)
   arraymgr -i { on|off } <array-id>    (Auto Include)
   ```

NOTE! Only one setting can be changed on each command line.

4. Check the available unallocated capacity on the disk array by typing:

   ```
   arraydsp $ID
   ```

   The total unallocated capacity available for creating logical drives will be displayed. Make sure there is adequate capacity to create the logical drive structure you need.

5. Create each logical drive on the disk array by typing:

   ```
   arraycfg -L LUN -a capacity <array-id>
   ```

Example: `arraycfg -L 0 -a 1000 00786B5C0000`

This command creates logical drive 0 with a capacity of 1000 Mbytes on the array identified by serial number 00786B5C0000.

This step makes disk array capacity available to your operating system, and it must be repeated for each logical drive to be created. Make sure you observe any operating system limitations on logical drive size or number. For more information, see "Creating a Logical Drive" in this chapter.

Checking Disk Array Status

One of the most important management tasks is monitoring the status, operation, and configuration of the disk array. It is important to know how well the disk array is operating and if any problems or failures have occurred. Using the ARM `arraydsp` command, you can easily check all aspects of disk array operation and configuration. The `arraydsp` command options, summarized in Table 27, allow you to display information about each disk array hardware component, as well as information about the logical configuration of the disk array.

Table 27. arraydsp Options for Displaying Disk Array Status

Option	Status Information Displayed
none	General information about the disk array
-l [LUN]	Information for the specified LUN
-a	All information displayed for options -l, -d, -c, -s, -v, and -h
-c	Array controller status
-d	Disk status
-h	Hardware status
-i	Serial numbers for all disk arrays
-m	Display performance metrics
-R	Rescan
-r	Make performance recommendations
-S	Generate raw output, used in combination with other options
-s	General configuration information. For a complete description of all the configuration settings, see "Viewing the Disk Array General Configuration Settings" at the end of this chapter.
-v	Capacity information

Displaying Disk Array Serial Numbers

The serial numbers of all disk arrays connected to the host can be displayed by typing:

```
arraydsp -i
```

Missing Disk Arrays? If you know there are disk arrays connected to the host but they are not displayed in response to this command, check the following:

- Make sure the AutoRAID Manager service is running. AutoRAID Manager must be running to execute this or any other ARM command.
- Rescan for disk arrays by typing: arraydsp -R. This will update the ARMServer information to reflect the current system configuration.
- Make sure all disk arrays are turned on and operating properly.
- Make sure all disk arrays are properly connected to the host. This includes proper termination of the SCSI bus.
- Make sure there is at least one logical drive created on the disk array. A logical drive must be created on the disk array before the host can access the array. During the boot process, the host server must recognize a logical drive on the disk array to ensure the HBA device driver is loaded properly. If there is no logical drive on the disk array, the host may be unable to access with the array. A logical drive can be created using the disk array control panel as described in the *HP SureStore E Disk Array 12H User's and Service Manual*

Changing Disk Array Configuration Settings

A number of configuration settings control the operation of the disk array. These settings are usually established during installation and, once set, should rarely need to be changed. The default settings have been selected to provide the best operation for most systems. However, if you determine that any setting does not meet your needs, you can easily change it. Table 28 lists the various settings, including factors you may want to consider before changing them.

Table 28. arraymgr Disk Array Configuration Settings

Setting	Default	Command Option	Comments and Considerations
Active Spare	On	-h	Active Hot Spare provides optimum protection against disk failure. Disabling Active Hot Spare will make additional capacity available to the host, but at the expense of not maintaining full data redundancy.
Auto Rebuild	On	-a	Auto Rebuild provides optimum protection against disk failure by rebuilding a failed disk as quickly as possible. Disabling Auto Rebuild gives you more control over the rebuild process, but it can leave the disk array vulnerable to a second disk failure until a rebuild is performed manually.
Auto Include	On	-i	Auto Include simplifies the task of adding a new disk to your array. Disabling it will require you manually to include each disk you install in the array.
Rebuild Priority	High	-p	Rebuild priority determines how quickly a rebuild operation will complete.

To change Active Spare, Auto Rebuild, or Auto Include settings, type:

```
arraymgr { -h | -a | -i } { on|off } <array-id>
```

To change Rebuild Priority setting, type:

```
arraymgr -p { high|low } <array-id>
```

Managing Logical Drives

An important part of managing the disk array involves defining and maintaining the optimal logical drive structure for your system. Your system requirements and limitations will influence the logical drive structure you choose.

Managing logical drives is a part of the overall task of managing disk array capacity. For more information on managing disk array capacity to meet your system needs, refer to the *HP SureStore E Disk Array 12H User's and Service Manual*.

Checking Logical Drive Configuration

When you are managing logical drives, you may find it convenient to check the current logical drive configuration and the available capacity.

To check the current logical drive configuration and the available capacity, type:

```
arraydsp -l [LUN] <array-id>
```

Creating a Logical Drive

Only capacity assigned to logical drives is visible to the operating system. When selecting the size for your logical drives, consider the following factors:

- Any size limitations imposed by the operating system.
- Your backup strategy. If you do unattended backup to a device such as a tape, you may want to avoid creating a logical drive that is larger than the capacity of the tape media. This allows you to back up an entire logical drive without changing tapes.

NOTE! Before creating a logical drive, check your operating system documentation for any additional information or steps that may be required to create a logical drive.

To create a logical drive, type:

```
arraycfg -L LUN -a Capacity <array-id>
```

`LUN` must be an unused value between 0 and 7
`Capacity` must be less than or equal to the currently available unallocated capacity

Renumbering a Logical Drive

NOTE! Before renumbering a logical drive, check your operating system documentation for any additional information or steps that may be required to renumber a logical drive.

To renumber a logical drive, type:

```
arraycfg -L LUN -r newLUN <array-id>
```

LUN is the logical drive to be renumbered
newLUN is a new available logical drive number

Deleting a Logical Drive

When a logical drive is deleted, its capacity is returned to the pool of unallocated capacity space. Deleting a logical drive is a good way of freeing up capacity for the Active Hot Spare or for simply adding more unallocated capacity to improve disk array performance.

CAUTION! All data on a logical drive is lost when it is deleted. Make sure you backup any important data on the logical drive before deleting it.

NOTE! Before deleting a logical drive, check your operating system documentation for any additional information or steps that may be required to delete a logical drive.

To delete a logical drive, type:

```
arraycfg -L LUN -d <array-id>
```

LUN is the logical drive to be deleted

Adding a Disk

At some time, you may want to add another disk to your array. Features such as hot-pluggable disks and Auto Include simplify the process of adding a disk to the array even while it is operating. A disk can be added to the array without disrupting current I/O operations.

After you have added a new disk, you have three options on how to use it:

- **Increase capacity** - use the disk to increase the capacity available to the operating system by creating a new logical drive.
- **Improve performance** - use the disk to improve the disk array performance by simply leaving it as unallocated capacity.
- **Enable Active Hot Spare** - use the additional capacity to enable Active Hot Spare if the disk array does not currently have the capacity to support this feature. This also improves performance as the spare space is used as RAID 0/1 space until it is needed.

To add a disk to the array:

1. Make sure the new disk has been physically inserted into the array.
2. If Auto Include is on, the disk is automatically added to the array and you can skip to the next step. If Auto Include is off, manually include the disk as described in the next section, "Including a Disk Manually."

NOTE! In some situations, the array will not include a disk automatically, even if Auto Include is enabled. This will occur if the new disk's status is something other than Normal. See "Auto Include" in the *HP SureStore E Disk Array 12H User's and Service Manual* for more information about when this might occur.

3. Depending on how you intend to use the new disk, perform the appropriate next step:
   - To use the disk to increase capacity, create a logical drive using all or a portion of the disk capacity. For more information, see "Creating a Logical Drive" in this chapter.
   - To use the disk to increase performance, leave the disk capacity unallocated.
   - To use the disk capacity for an Active Hot Spare, enable the Active Hot Spare feature if not currently enabled. For more information, see "Changing Disk Array Configuration Settings" in this chapter.

Including a Disk Manually

A disk must be included in the disk array configuration before it can be used by the disk array. There are two ways to include a disk:

- You can enable Auto Include, which will automatically include a disk when it is inserted into the disk array enclosure.
- You can manually include each new disk.

For convenience, Auto Include is enabled by default on a new disk array. For information on disabling Auto Include, see "Changing Disk Array Configuration Settings" in this chapter.

After including a disk, you must decide how you want to use it. For more information, see the preceding section, "Adding a Disk."

To manually include a disk, type:

```
arraycfg -D slot -a <array-id>
```

`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Rebuilding the Disk Array

To maintain data redundancy in the event of a disk failure, it is important to rebuild the disk array as soon as possible. Auto Rebuild does this automatically, and it is enabled by default.

If you want more control over the rebuild process, you can disable Auto Rebuild. This will allow you to manually start a rebuild at the time you choose. A Rebuild impacts disk array performance while it is in progress, so before starting a rebuild make sure the appropriate Rebuild Priority is set. See "Setting Rebuild Priority" in this chapter.

For convenience and maximum protection in the event of a disk failure, Auto Rebuild is enabled by default on a new disk array. For information on disabling Auto Rebuild, see "Changing Disk Array Configuration Settings" in this chapter.

Rebuilding the Disk Array Manually

If you have chosen to disable Auto Rebuild, you will have to start the rebuild manually. The rebuild will begin immediately and continue to completion. If no rebuild is necessary, the command will be ignored.

To start a rebuild manually, type:

```
arrayrbld -r <array-id>
```

Setting Rebuild Priority

The rebuild priority determines how quickly a rebuild completes. It allows you to balance the servicing of host I/Os with the rebuilding of the disk array. The same rebuild priority is used for both auto rebuilds and manual rebuilds.

To set the rebuild priority, type:

```
arrayrbld -P { high|low } <array-id>
```

Checking the Progress of a Rebuild

You can easily check the progress of a rebuild. This allows you to determine approximately when a rebuild will complete.

To check the progress of a rebuild, type:

```
arrayrbld -p <array-id>
```

Canceling a Rebuild

A rebuild can be canceled only if it was started manually. A rebuild that was started by Auto Rebuild cannot be canceled. If a rebuild is canceled, it must be started over again and any progress made during the first rebuild will be lost.

When canceling a rebuild, the rebuild may not stop immediately. This occurs if the disk array is busy servicing higher priority I/O requests from the host. The rebuild will be canceled when the disk array has serviced all higher priority commands.

To cancel a rebuild, type:

```
arrayrbld -c <array-id>
```

Analyzing Disk Array Performance

Disk array performance can be checked using the `arraydsp` command. However, the AutoRAID Manager for Windows provides a graphical representation of performance data that you should more useful than the information returned using the `arraydsp` command. For information about using the Auto RAID Manager for Windows and details on performance topics in general, see "Analyzing Disk Array Performance" in the preceding chapter.

To check disk array performance, type:

```
arraydsp { -r stime etime} | { -m stime etime [int] } <array-id>
```

The starting time (`stime`) and ending time (`etime`) values establish the analysis period. The format of the `stime` and `etime` arguments is `mmddhhmm[yy]`.The `int` option controls the display interval. The display interval is the number of 15-minute increments.

Command Examples

The following command displays performance recommendations for disk array serial number 00786B5C0000. Performance is analyzed for the time period starting at 8:00 AM and ending at 5:00 PM (1700) on March 15.

```
arraydsp -r 03150800 03151700 00786B5C0000
```

The following command displays the performance metrics for disk array serial number 00786B5C0000. Metrics are displayed for the time period starting at 11:00 AM and ending at 6:00 PM on April 6. A display interval of 30 minutes is specified.

```
arraydsp -m 04061100 04061800 2 00786B5C0000
```

Performing Disk Array Maintenance Tasks

There are several tasks that you may have to perform in the ongoing management of the disk array. These maintenance tasks are typically performed infrequently and may involve taking the disk array off line.

Shutting Down the Disk Array

CAUTION! When an array shutdown is performed, the disk array becomes unavailable to the host system. An array that is shutdown appears to the operating system as if its power has been turned off.

The disk array must be Shutdown prior to performing any maintenance. The Shutdown process copies vital data mapping information from the controller NVRAM to the disks. This protects the data mapping information should the contents of the NVRAM be lost or corrupted due to battery failure. Shutdown then takes the disk array off line, making all data unavailable to the host. The disk array can still be managed and tested, but all data is inaccessible while the disk array is Shutdown.

Shutdown is initiated automatically each time the disk array is turned off using the power switch, so it is usually not necessary to initiate a Shutdown using the ARM utility.

To Shutdown the disk array, type:

```
arraymgr -s shut <array-id>
```

Restarting the Disk Array

Following Shutdown, the disk array can be brought back on line by performing a restart. This makes the data on the disk array available to the host once again.

To restart the disk array, type:

```
arraymgr -s start <array-id>
```

Resetting the Disk Array

The disk array can be reset if there is a problem with SCSI channel communication. A reset will interrupt access to the disk array temporarily, so it should be done only when attempting to solve a problem with the disk array.

To reset the disk array, type:

```
arraymgr -R <array-id>
```

Downing (Excluding) a Disk

Downing (or excluding) a disk is typically done in preparation for testing the disk. After the disk is downed, testing can be done without impacting disk array operation. If testing reveals that the disk is good, the disk can be included back in the array configuration.

Downing a disk has the same effect as if the disk failed or was physically removed from the cabinet. If Auto Rebuild is enabled, the disk array will immediately begin a rebuild when a disk is downed.

The `-v` option identifies the down operation as either destructive or nondestructive. This determines whether the disk array will assume there is any valid data on the disk if it is returned to the array configuration. If a destructive down is performed (`-v` not specified), the disk array will assume no data on the disk is valid. If the down is nondestructive (`-v` specified), the array will assume any data on the disk that was not updated in the disk's absence is valid.

To down a disk, type:

```
arraycfg -D slot -d [-v] [-R|-Z] <array-id>
```

To protect data availability, the disk array will not let you down a disk if doing so would result in loss of data redundancy or data unavailability. However, you can override this protection by specifying the appropriate options. The `-R` option allows the disk to be downed even if a loss of redundancy would result, but not data unavailability. The `-Z` option allows the disk to be downed even if data unavailability would occur. A complete description of the options is included in the on-line help `arraycfg` description.

NOTE.	Two of the disks in the disk array are used to store recovery map information. The disk array will not allow you to down either of these drives unless you use the -R or -Z option.

After testing, a downed disk can be returned to the disk array configuration by manually including it. For more information, see "Including a Disk Manually" in this chapter.

Testing a Disk

Diagnostics allow you test the operation and integrity of a disk. Three different types of testing can be performed:

- **Write/read/verify** - a destructive test that will destroy data on the disk being tested. The disk must be downed before beginning the test.
- **Read/verify** - a nondestructive test that will not alter any data on the disk being tested. It is not necessary to down the disk before performing a read/ verify test.
- **Self-test** - a nondestructive internal test that checks the operation of the disk.

To perform a write/read/verify test of a disk, type:

```
drivetest -D slot -w percent <array-id>
```

To perform a read/verify test of a disk, type:

```
drivetest -D slot -r percent <array-id>
```

To perform a self-test of a disk, type:

```
drivetest -D slot -s <array-id>
```

`percent` is the percent (0 to 100) of the disk to be tested
`slot` is the cabinet shelf containing the disk drive (A1 through A6, or B1 through B6)

Displaying Test Results

After the disk testing is complete, the test results can be displayed for analysis by using the `dteststat` utility.

To display the results of a disk test, type:

```
dteststat [-D slot] <array-id>
```

If the `-D` option is not specified, results will be displayed for all disks in the array that have been tested.

Canceling a Disk Test

If you do not want to wait for a disk test to complete, you can cancel it using the `dteststat` command and testing will stop immediately.

To cancel a disk test in progress, type:

```
dteststat -D slot -c <array-id>
```

Printing ARMServer Log Contents

ARMServer maintains a number of configuration and status log files on the server. The contents of the various log files maintained by ARMServer can be printed using the `logprint` command. The contents of the logs may be useful in identifying any possible problems that may be occurring with the disk array.

For a detailed explanation of the log contents output, see the on-line help `logprint description`.

To print the contents of the ARMServer logs, type:

```
logprint[-d log_directory_name] [-s start_time] [-e stop_time]
[-t record_type...] [-a array_serial_number]
```

`log_directory_name` identifies the location of the log files
`start_time` and `stop_time` limit the output to events between the specified times
`record_type` identifies the type of record(s) to print. Records include system usage log (`usage`), disk error log (`disk`), controller error log (`ctrlr`), system change log (`change`), and performance log (`perf`)
`array_serial_number` limits the output to only those entries associated with the specified disk array.

Displaying Hardware Logs

In addition to the logs maintained by ARMServer, hardware logs are also stored on the disk array. The `arraylog` command provides access to the controller and disk logs maintained by the disk array. These logs contain information useful for diagnosing and troubleshooting the disk array. The logs can also be cleared using `arraylog`. The arraylog options for accessing the disk array hardware logs are listed in Table 29.

Table 29. arraylog Options for Displaying Log Contents

Option	Description
-u	Display the contents of the disk array controller usage log.
-e	Display the contents of the disk array controller event log.
-d slot	Display the contents of the log for the disk installed in the cabinet slot identified by slot. Slot numbers must be of the form "An" or "Bn", where A or B correspond to a cabinet column, and n corresponds to a shelf position (1-6).
-C {-c|-d slot}	Clear the specified logs. If -c is specified, clear the disk array controller usage and event logs. Both logs will be cleared when using this option. It is not possible to clear just one of the logs. If -d is specified, clear the log for the disk installed in the cabinet slot identified by slot.

To display the contents of a hardware log, type:

```
arraylog [-u] [-e] [ -d slot ] <array-id>
```

To clear the hardware logs, type:

```
arraylog [-C{-c|-d slot}] <array-id>
```


Formatting the Disk Array

Should it become necessary to do so, you can format the entire disk array, or a single logical drive. Formatting destroys all data on the array or logical drive involved. Formatting an array first requires that all logical drives be deleted.

To format the entire disk array, type:

```
arrayfmt -F [-h] <array-id>
```

To format a logical drive, type:

```
arrayfmt -L LUN <array-id>
```

Changing SCSI Settings

The SCSI settings control the transfer of information over the SCSI channel connecting the host and the disk array. The default settings listed in Table 30 have been chosen to work with all supported SCSI adapters, and in most cases should not be changed.

NOTE! Before changing any SCSI setting, you should understand what the SCSI setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect SCSI setting may make it impossible for the host and disk array to communicate properly. In this case, it will be necessary to use the disk array control panel to return the SCSI setting to its original value to reestablish communication.

To change SCSI settings, type:

```
arraymgr { -W | -T | -P | -m | -r } {on|off} <array-id>
```

Changing the Controller SCSI ID

Changing the SCSI ID directly impacts the operating system's ability to access the disk array. Before performing this task, check your operating system documentation for information on how to change the SCSI ID of a disk subsystem.

To change the controller SCSI ID, type:

```
arraymgr -C {X|Y} addr <array-id>
```

`addr` is the new address (0 – 15) for the indicated controller

Switching Primary Controllers

In dual-controller disk array configurations, the array automatically switches to the secondary controller if the primary controller fails. However, you can switch controllers manually if necessary. This will cause the secondary controller to assume the role of primary controller.

To switch primary controllers, type:

```
arraymgr -c { X | Y } <array-id>
```

Downloading Firmware

The `download` command copies new firmware code to the disk array controller(s) or individual disk drives in the disk array. Firmware can also be copied from a primary array controller to a secondary controller.

CAUTION! In multi-host configurations, other hosts must not access the disk array while the download is in progress. Data can be lost if write requests are made to the disk array while a download is in progress.

Downloading Firmware to a Disk Module

This procedure updates the firmware code on the specified disk module.

To download new firmware code to a disk module

1. Gather the following information:
   - The ID of the disk array. The disk array ID can be displayed using the `arraydsp -i` command.
   - The location and name of the file containing the new firmware code
   - The slot number of the disk module. Slot numbers are marked on the cabinet (A1 – A6, and B1 – B6).
2. From a command prompt, type in the following command:

   `download -D slot codefilename <array-id>`

   `slot` identifies the cabinet shelf containing the disk drive
   `codefilename` identifies the file containing the firmware code

Downloading Firmware to the Disk Array Controllers

This procedure updates the firmware on both controllers simultaneously.

CAUTION! Do not attempt to download controller firmware to a disk array that is serving as the NT boot device. If you attempt to do so, the operating system will crash.

NOTE! Downloading firmware to the disk array controllers is done most efficiently using the WinDownload utility described in Downloading Controller Firmware in the preceding chapter.

To download new firmware code to the disk array controllers

1. Gather the following information:
   - The ID of the disk array. The disk array ID can be displayed using the `arraydsp -i` command.
   - The location and name of the file containing the new firmware code
2. From a command prompt type in the following command:

   `download -C codefilename <array-id>`

   `codefilename` identifies the file containing the firmware code

Copying Firmware From the Primary Controller to the Secondary Controller

For proper disk array operation, the disk array controllers must have matching firmware. If the firmware revisions do not match, this procedure can be used to synchronize them. Firmware can also be copied from the primary to the secondary controller using the disk array control panel.

CAUTION! The firmware code is copied from the primary controller to the secondary controller, so before performing this task make sure the controller that has the desirable code is designated the primary controller. See "Switching Array Controllers" for instructions on changing the state of the controller.

To copy the firmware code from the primary controller to the secondary controller

1. Gather the following information:
   - The ID of the disk array. The disk array ID can be displayed using the `arraydsp -i` command.
2. From a command prompt type in the following command:

```
download -M <array-id>
```

Viewing the Disk Array General Configuration Settings

Checking the general configuration settings allows you to view the current settings for all the disk array operating parameters. The settings include the current status of the array, the array configuration, and the SCSI configuration settings.

A description of each setting is included in Table 30. The default settings have been selected to optimize disk array operation.

NOTE!	Before changing any setting, you should understand what the setting does, and what effect changing it will have on disk array operation. Be aware that using an incorrect setting may make it impossible for the host and the disk array to communicate properly.

To view the general configuration settings, type:

```
arraydsp -s <array-id>
```

A complete list of the settings will be displayed.

Table 30. General Configuration Settings

Parameter	Default Setting	Description
Overall State of Array	READY	Specifies the current state of the array
Active Hot Spare Desired	ENABLED	Indicates whether the array should reserve space within which to perform a rebuild process.
Auto Include	ENABLED	Indicates the action to be taken when a drive is physically inserted into the array.
Auto Rebuild	ENABLED	Indicates the action to be taken when a drive becomes unusable.
Rebuild Priority	HIGH	Indicates the priority the rebuild process is given with respect to host I/O.

Parameter	Default Setting	Description
Capacity Depletion Threshold	0%	Indicates the amount of space below which the disk array should signal a Capacity Depletion warning. For example, if this field is set to 99% then when the disk array reaches 99% capacity, a Capacity Depletion warning will be indicated. 0% means that Capacity Depletion warnings will not be issued.
Write Working Set Interval	8640 seconds	Indicates the period (in ten second intervals) over which write performance measurements should be gathered. For example, 8640 X 10 = 86400 seconds = 24 hours.
Language	ENGLISH	Indicates the language used when displaying information on the front panel.
Log Full Warning	DISABLED	Indicates whether the disk array should assert a warning when some portion of the controller log is full. When enabled, the disk array will assert a Log Full Warning when one of the disk array log pages fills, or a log parameter reaches its maximum value. When disabled, no Log Full Warning will be indicated.
Volume Set Partitioning	DISABLED	Indicates whether the disk array should boot when half or more of the previously available drives are unavailable (i.e., there is no drive quorum). Enabled indicates that volume set partitioning should be allowed. Disabled, the system will remain in the No Quorum state when the required quorum is not available.
Format Pattern Fill	DISABLED	Indicates whether the disk array will fill in incomplete RAID blocks with a format pattern when performing new writes. Some operating systems (not HP-UX and not NT) expect that SCSI format commands completely reinitialize data to a non-random pattern. When using the array with one of those operating systems, pattern filling should be enabled.
Disk array Type ID	12	Uniquely identifies the disk array hardware configuration. This field can be used to find the number of drives and SCSI channels supported within the disk array.
LUN Creation Limit	8	Controls the range of LUNs that may be created.
Maximum LUN Creation Limit	8	Specifies the maximum supported value for the LUN Creation Limit.

Parameter	Default Setting	Description
Array SCSI configuration:	N/A	N/A
Controller X SCSI Address		Indicates the SCSI bus address to be used by controller X. Changes in this field will take affect only after controller X is reset.
Controller Y SCSI Address		Indicates the SCSI bus address to be used by controller Y. Changes in this field will take affect only after controller Y is reset.
Write Cache	ENABLED	Indicates whether the disk array should cache write data. Generally, write cache is used even though a host system automatically disables this field.
Read Cache	DISABLED	Indicates whether the disk array should cache read data. Note: This field does not represent what is actually happening. The disk array uses read cache algorithms. This field is put in place to facilitate some third party operating systems.
SCSI Parity Checking	ENABLED	Indicates whether the disk array should check SCSI bus parity. Disabled means that bus parity checking is disabled. Enabled indicates that bus parity checking is enabled.
SDTR	ENABLED	Indicates whether the disk array should initiate SDTR (Synchronous Data Transfer Request). Disabled, indicates the disk array will not initiate SDTR. Enabled indicates the disk array will initiate SDTR.
WDTR	ENABLED	Indicates whether the disk array should initiate WDTR (Wide Data Transfer Request). Disabled, indicates the disk array will not initiate WDTR. Enabled indicates the disk array will initiate WDTR.
Terminator Power	ENABLED	Indicates whether the disk array should provide power for the SCSI bus terminators. Disabled, indicates the disk array will not provide termination power. Enabled indicates the disk array will provide termination power.
Unit Attention	ENABLED	Indicates whether the disk array should signal a Unit Attention condition immediately following power-on or reset. Disabled, indicates the disk array will not signal unit attention. Enabled indicates the disk array will signal unit attention.

Parameter	Default Setting	Description
Disable Remote Reset	ENABLED	Controls the bus reset behavior of the second controller when a SCSI reset (reset signal, BDR or Reset Disk array command) is received in the first controller. When this bit is disabled, the second controller will assert the bus reset signal to indicate that all outstanding requests were cleared in response to the reset. When this bit is enabled, the second controller will not assert the SCSI reset signal to indicate the commands were cleared. Hosts that cannot tolerate target bus resets should enable this setting.
Secondary Controller Offline	DISABLED	Controls the behavior of the secondary controller with respect to bus selection. When disabled, any secondary controller present will respond to host selection. When enabled, the secondary controller will remain off-line until a failure of the primary controller is detected (at which point it becomes primary). Only the primary controller will go on-line.
Very Early Busy	DISABLED	Controls the behavior of the disk array with respect to SCSI bus selection during the early stages of the initialization sequence (i.e., from about three seconds after reset until about fifteen seconds prior to initialization completion). When disabled, the disk array will ignore SCSI bus selection until the late stages of initialization. When enabled, the disk array will accept selection during early initialization and will return BUSY status until the late stages of initialization.
Queue Full Threshold	1952	Specifies the target queue depth beyond which the disk array will return QUEUE FULL status to subsequent host requests.
Maximum Queue Full Threshold	1952	Specifies the maximum supported value for the Queue Full Threshold parameter. Attempts to set the QFT parameter to values higher than the MQFT will fail with CHECK CONDITION status and ILLEGAL REQUEST, INVALID FIELD IN PARAMETER LIST sense indications.
Simplified Resiliency Setting	Normal	Determines the values of the following eight parameters. This field regulates the mode of data resiliency that the disk array will operate in. The “Normal” mode is set at the factory when dual controllers are ordered with the array.

Parameter	Default Setting	Description
Single Controller Warning	ENABLED	Indicates whether the disk array should assert a warning when only one controller is present. When enabled, the disk array will assert a Single Controller Warning when there are not two controllers present in the array disk array. When disabled, no Single Controller Warning will be indicated.
Lock Write Cache On	TRUE	Controls the modification of the Write Cache setting. When LCWO is set to true, then the host cannot change the Write Cache setting. When LWCO is false, the host will be able to change Write Cache setting.
Disable NVRAM on WCE False	FALSE	Enables the disk array response to the Write Cache setting. If false, NVRAM use does not depend on the Write Cache setting, and will be enabled if no other condition inhibits it. If true, then NVRAM is disabled when Write Cache is disabled
Disable NVRAM with One Ctrlr	TRUE	Couples the use of NVRAM to the presence of an operational dual controller. If true and no operational dual controller is present, then NVRAM use is disabled. Otherwise NVRAM use does not depend on the presence of the second controller, and will be enabled if no other condition inhibits it.
Disable NVRAM on UPS absent	FALSE	Couples use of NVRAM to the presence of an operational UPS or BBU. At the time of printing, this field is reserved for future functionality with UPS and is disabled in all resiliency modes.

Parameter	Default Setting	Description
Force Unit Access Response	2	Controls the array's response to the FUA bit. The FUA bit is a command from the host when Write Cache is enabled. It gives the host an opportunity to flush write cache on command: If this field is 0, then the FUA bit is ignored. If this field is 1, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed. If this field is 2, then the FUA bit in a write command disables immediate report on the write and all write cache data for the involved LUN will be flushed along with the map journal before completing the write request. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored.
Disable Read Hits	FALSE	Controls the array's ability to satisfy read commands from write cache contents during FUA processing. If NVRAM use is disabled due to the chosen map resiliency mode, then read data is never satisfied out of write cache.
Resiliency Threshold	4	Specifies the maximum time between delivery of the response to a write command to the host, and initiation of associated writes out of write cache and map journal to disks. This time is specified in seconds. This maximum time is submitted to the scheduler for implementation. Depending on the priority of other events in the scheduler, the desired time may not be implemented. If NVRAM use is disabled due to the chosen map resiliency mode, then this field is ignored. The 0 value of this field is not the same as disabling NVRAM use. A value of 0h indicates that no maximum time will be enforced and that no recovery image will be available.

Simplified Resiliency Setting

The simplified resiliency setting is derived from several other fields. Collectively these settings control how data resiliency is managed. Table 31 identifies the field settings for each of the resiliency modes.

There are four modes of data resiliency: Normal, SingleController, Secure, and HighPerformance. The default setting is Normal for dual controller disk arrays. If the disk array has been ordered with a single controller, the default for this settings is SingleController.

For information on changing the data resiliency mode, see "Setting Data Resiliency" in this chapter.

Table 31. Simplified Data Resiliency Settings

Normal Mode			
Parameter	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On Disable NVRAM on WCE False Disable NVRAM with One Ctrlr Disable NVRAM on UPS absent Force Unit Access Response Disable Read Hits Resiliency Threshold	TRUE FALSE TRUE FALSE 2 FALSE 4	Not Supported	Data map and write cache information is scheduled to flushed to the disk every four seconds.
SingleController Mode			
Parameter	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	DISABLED	Single Controller	Dual Controller
Lock Write Cache On Disable NVRAM on WCE False	FALSE TRUE	Data map and write cache information will be flushed to the disk once every second	Not Supported

Secure Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On	FALSE	Not Supported	Data map and write cache information will be flushed to the disk once every second
Disable NVRAM on WCE False	TRUE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	2		
Disable Read Hits	FALSE		
Resiliency Threshold	1		
HighPerformance Mode **Parameter**	**Default Setting**	**Simplified Resiliency Setting Results**	
Single Controller Warning	ENABLED	Single Controller	Dual Controller
Lock Write Cache On	TRUE	Not Supported	Data Resiliency disabled
Disable NVRAM on WCE False	FALSE		
Disable NVRAM with One Ctrlr	TRUE		
Disable NVRAM on UPS absent	FALSE		
Force Unit Access Response	0		
Disable Read Hits	FALSE		
Resiliency Threshold	0		

Setting Data Resiliency

The data map contents stored in the disk array controller NVRAM is copied to two disks on the array at regular intervals to protect against map loss. The interval at which the disks are updated with recovery map information is controlled using the data resiliency setting. Selecting a data resiliency setting involves making a tradeoff between data protection and performance. The more frequently the recovery maps are updated, the more impact it may have on performance.

To set the data resiliency mode, type:

```
arraymgr -J {SingleController | Secure | Normal | HighPerformance} <array-id>
```

The data resiliency settings are described in Table 32.

Table 32. Data Resiliency Settings

Setting	Description
SingleController	This setting should only be used if the disk array is operating with one controller. This suppresses the single controller warning messages that are normally generated when the disk array is operating with one controller. This setting will affect I/O performance. This is the default setting for single controller mode.
Secure	Continually updates the disks with any changes in the controller maps. This is the highest level of data protection, but it may result in decreased I/O performance.
Normal	Updates the maps on the disks at regular intervals (typically 4 seconds). This option offers both data protection and good performance. This is the default setting for dual controller mode.
HighPerformance	Updates the disk maps only during shutdown of the disk array. This is the lowest level of data protection, but it offers the highest level of performance.

Creating a Disk Array Alias

An alias can be created to identify the disk array. The alias provides an alternative to the disk array serial number and raw device file name that can also be used to identify the array.

Aliasing can be used in a variety of ways to help identify disk arrays in large systems. For example, by assigning numbers to racks and to the shelf positions within the racks, each disk array can be uniquely identified using an appropriate alias. If a rack is assigned number 12, the disk array installed on shelf 3 of the rack could be identified using an alias of R12_S03. This technique simplifies locating the disk array should it need service.

To create a disk array alias, type:

```
arraymgr -D alias_name <array-id>
```

`alias_name` can be up to 12 characters in length and can include upper case letters, numbers, spaces, number sign (#), underscore (_), and period (.).

Recover

If the disk array is not shutdown properly, it is possible that the data maps in NVRAM memory will be lost. For this reason, the disk array allows the data maps to be periodically written to the disk drives. If the maps are lost, an error code such as “No Address Table” will appear on the display. If your disk array is a boot device, you may have to recover the maps by using the front panel command called “Recover” under the “Cntrl Changes” menu. The Recover command is only supported in controller firmware versions later than HP40, and any patch delivered after IPR9808 release.

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