T H I R T E E N

HP Array Technologies

▲ Chapter Syllabus

After studying this chapter, you should be able to do the following:

- List and describe the advantages of HP Smart Array controllers
- List and describe the utilities used to configure, optimize, and troubleshoot HP Array controllers.
- Explain the key technological advantages of HP Array controllers
- Describe ATA RAID, and explain how HP ProLiant servers support this drive array configuration

All HP Smart Array products use a standard set of technologies and management and utility software to facilitate storage management.

The array controller utilities discussed in this chapter include the following:

- Array Diagnostics Utility (ADU)
- Array Configuration Utility (ACU)
- Array Configuration Utility XE (ACU XE)
- Option ROM Configuration for Arrays (ORCA)

The array controller technologies discussed in this chapter include the following:

- Online spare drives
- Online drive array expansion
- Logical drive capacity extension
- Online RAID-level migration
- Online stripe-size migration
- HP hard drive failure prediction technology
- Dynamic sector repair (DSR)
- Hot-plug drive support
- Automatic data recovery
- Array accelerator (read/write cache)
- Data protection
- Array performance tuning

In addition, this chapter discusses HP's implementation of ATA RAID.

13.1 Advantages of HP Smart Array Controllers

As data storage requirements increase and computing needs change, flexibility within server configurations and in storage configurations becomes more important. The HP Smart Array controller family includes a standard toolset that you can use to configure array controllers, expand an existing array configuration by adding disk drives, or reconfigure an array by extending volume sizes.

Only select Smart Array controllers offer RAID *advanced data guarding* (ADG), which offers higher fault tolerance than RAID 5 with lower implementation costs than RAID 1+0 and greater usable capacity per U than RAID 1. Using patented HP technology, you can safely deploy large-capacity disk drives and create large storage volumes.

In a RAID 1+0 configuration, all HP Smart Array controllers can

- Sustain multiple drive failures.
- Sustain an entire bus failure if the drives are equally distributed across buses.
- Service I/O requests to all operational drives in a degraded condition.
- Survive *n*/2 drive failures, where *n* is the number of drives in the array, as long as one member of each mirrored pair survives.

RAID 1+0 can support multiple drive failures when multiple drives that fail are not in the same mirrored pair.

For RAID 5, HP recommends that no more than 14 (8 is optimal) physical drives be used per logical drive. Because logical drive failure is much less likely with RAID ADG, however, HP supports the use of up to 56 physical drives per drive array when running this fault-tolerance method.

13.2 HP Array Controller Utilities

HP provides several utilities that are used to configure, optimize, and troubleshoot HP Array controllers. These utilities include the following:

- Array Diagnostics Utility (ADU)
- Array Configuration Utility (ACU)
- Array Configuration Utility XE (ACU XE)
- Option ROM Configuration for Arrays (ORCA)

13.2.1 Array Diagnostics Utility

HP provides an ADU to help you quickly identify such problems as the following:

- An incorrect version of firmware
- Drives installed in the wrong order
- Inappropriate error rates
- A failed battery on the array accelerator board

The ADU displays a detailed analysis of the system configuration. If the cause of a problem is still not apparent, the ADU can generate a full report that administrators can fax or e-mail to HP customer service for phone support.

Beginning with HP SmartStart and Support Software Release 4.10, ADU 1.10 replaced the Drive Array Advanced Diagnostics (DAAD) utility. The DAAD utility is no longer included on the SmartStart CD and has not been updated to support current Smart Array controllers.

To run ADU properly, boot the system from the SmartStart CD and select ADU from the System Utilities screen.

13.2.2 Array Configuration Utility

The HP ACU, shown in Figure 13–1, allows both online local and remote management and configuration of an array through a browser. The ACU simplifies array configuration by providing an interface to the intelligent features of HP Smart Array controllers. The ACU can be started from within the supported operating system or from the HP SmartStart CD.

ACU features include the following:

- Configuration wizards for optimized array configurations
- Express and custom initial configuration options
- Easy reconfiguration through capacity expansion, logical drive extension, RAID-level migration, and stripe-size migration tools
- Support for fault-tolerance RAID levels 0, 1, 1+0, 5, and RAID ADG
- User-selectable stripe sizes
- Variable cache read/write ratio and stripe size for tuning controller performance
- Set drive rebuild and capacity expansion priorities
- Online spare (hot spare) configuration
- Separate fault tolerance configuration on a logical drive basis
- Blinking drive tray LEDs for quick storage identification

ACU can manage all Smart Array controllers from one central location. It enables you to

- Perform online array expansions.
- Perform online logical drive capacity extensions.
- Perform online RAID-level migrations.
- Perform online stripe-size migrations.
- Perform configuration using configuration wizards.
- Perform drive and expansion priority changes.
- Perform stripe-size selection.
- Perform controller performance tuning through variable cache read/write ratios and stripe sizes.
- Perform storage identification with blinking drive tray LEDs.
- Configure online spares (hot spares).
- Configure the array accelerator.
- Configure RAID 0, 1, 1+0, 5, and ADG.
- Configure separate fault tolerance on a logical drive basis.
- Leverage express and custom initial configuration options.

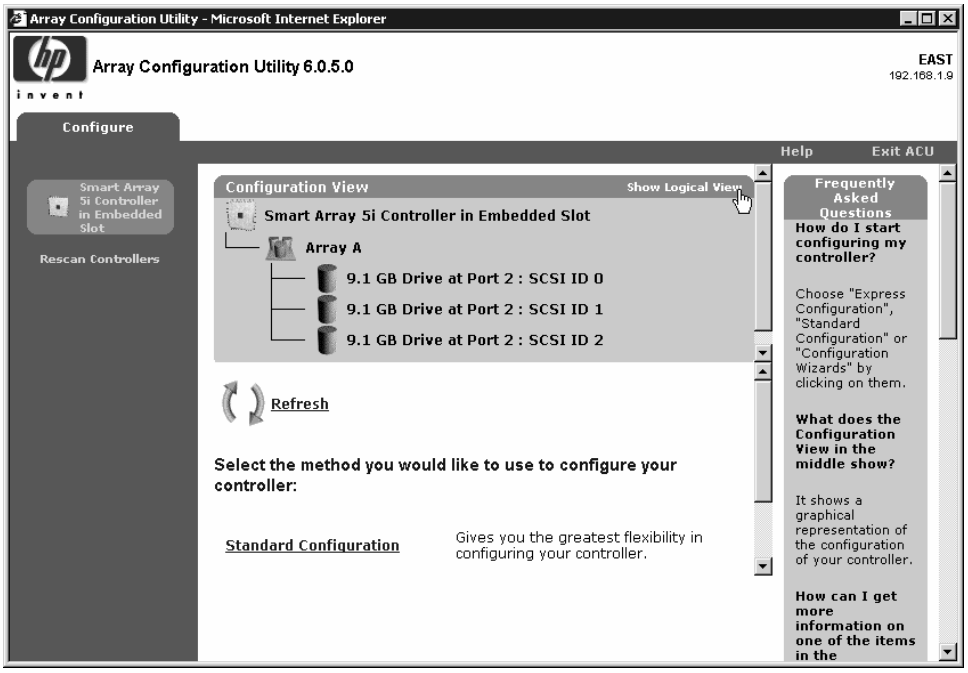


Figure 13–1 *Array Configuration Utility interface.*

ACU is compatible with Microsoft Internet Explorer 5.0 and later.

After you display the ACU, the utility will automatically begin detecting the controllers that are installed on your system. Based on your type of controllers, the following options display:

- **Express Configuration**—Allows the ACU utility to set up the optimum configuration for the controller automatically
- **Assisted Configuration**—Enables you to configure the controllers using the Configuration Wizard manually
- **Advanced Configuration**—Enables you to configure the controller manually

Download the ACU from the ACU home page at http://h18004.www1.hp.com/products/servers/proliantstorage/software-management/acumatrix/index.html.

In most cases, all disk drives attached to a controller should be grouped into a single array. This configuration provides the most efficient use of RAID fault tolerance.

Using the ACU, you can assign physical drives to an array and designate up to four drives per array controller as online spares. All physical drives within an array should be the same size. If disks of higher capacity are installed within a single array, the extra capacity will not be available.

Up to 32 logical drives can be defined with any HP Smart Array controller. Some operating systems support fewer than 32 logical drives.

13.2.2.1 LOCATION OF ARRAY CONFIGURATION DATA

When the array configuration is saved from ACU, the information is stored on the *RAID information sector* (RIS) on each hard drive. This allows replacement of computer components without losing data. A set of drives can also be moved from one machine to another without losing data.

Changes to logical volume structure and RAID level are often data-destructive.

13.2.3 Option ROM Configuration for Arrays

ORCA executes out of the option ROM that is located on an array controller, including on the RAID LC2 controller. It is designed for users who have minimal configuration requirements. During *Power-On Self-Test* (POST), any array controller that supports ORCA will provide a prompt to the computer system console as part of the initialization process.

If there are no configured logical drives on the array controller, this prompt waits 10 seconds before bypassing ORCA and continuing with POST. If any logical drives are configured, the prompt waits 5 seconds. When a HP RAID controller with ORCA support is installed in the system, the controller-based option ROM prompts during POST for 10 seconds.

Press the F8 key to start ORCA.

The main features of ORCA include the following:

- Does not require disks or CDs to run
- Can be started when the server is powering up
- Creates, configures, and deletes logical drives
- Configures controller order
- Assigns an online spare for the created logical drives
- Specifies RAID levels
- Cannot set stripe size or controller settings
- Supports only English

13.2.3.1 CONFIGURATION METHODS

Only the newest HP Smart Array controller models support ORCA. All other HP Smart Array controllers only support ACU. The HP RAID LC2 controller can be configured with ORCA only.

ORCA does not support drive expansion, RAID-level migration, or setting the stripe size.

13.3 Array Controller Technologies and Capabilities

Several key capabilities and technologies are implemented in HP array controllers, including the following:

- Online spare drives
- Array capacity expansion
- Logical volume extension
- Online RAID-level migration
- Online stripe-size migration
- Hard drive failure prediction
- Dynamic sector repair
- Hot-plug drive support
- Automatic data recovery
- Array accelerator (read/write cache)
- Data protection
- Array performance tuning

It is important for Accredited Integration Specialists to understand these technologies and features.

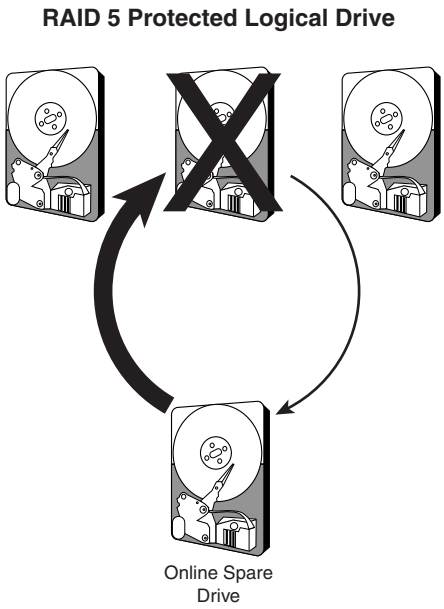
13.3.1 Online Spare Drives

The online spare drive acts as a temporary replacement for a failed drive, as illustrated in Figure 13–2. One online spare drive can be added to any fault-tolerant logical drive (RAID 0 is not supported). An online spare may be assigned to more than one array, if efficient use of drive capacity is important. The capacity of the online spare must be at least as large as that of the other drives in the array. All HP Smart Array controllers support up to four online spare drives.

When a data drive fails, the online spare drive automatically starts to rebuild the data of the failed drive. After the online spare drive has been completely rebuilt, the failure of a second drive can be handled without data loss. A second drive most likely will not fail until the online drive has been rebuilt; nevertheless, only ADG can handle two simultaneous drive failures in all cases.

As soon as the failed drive is replaced, data is automatically rebuilt on the new drive. After data has been completely rebuilt on the new drive, the online spare switches back to its role as an online spare drive. This avoids roaming online spare drives.

Figure 13–2
How an online spare drive works.



Data is rebuilt to the online spare at a rate of 10 to 20 minutes per gigabyte, depending on the priority assigned to rebuilding and the total number of drives in the array.

The online spare drive does not have to be partitioned or formatted. The online drive is always active and running, even when it is not in use.

Insight Manager 7 can monitor the online spare drive just like all the other active drives.

The online spare drive is available for RAID 1, RAID 1+0, RAID 4, RAID 5, and RAID ADG.

! IMPORTANT

Selecting a high rebuild priority results in reduced server performance while the rebuild is in progress. Setting the rebuild priority to low allows normal server performance, because rebuilding only occurs when the server is idle; rebuild time can be significantly longer depending on system activity.

13.3.2 Array Capacity Expansion

To perform an online array expansion, install a new drive in a hot-pluggable drive bay and use the ACU to add the new drive to an existing array. Figure 13–3 illustrates capacity expansion.

All data is relocated after the expansion process is started. Redistributing data across all the drives creates free space in each drive. These zones on all drives are then available to create a new logical drive or extend the capacity of an existing logical drive.

When the new logical drive is presented to the operating system after the expansion process, the operating system does not see a larger drive. It sees the old logical drive and a new logical drive. The expansion process is independent of the operating system. For example, if a 10GB logical volume is expanded from four drives to six drives, the operating system is unaware of this change.

Physical drive expansion does not create a larger logical drive, but creates a new logical drive. It is visible to the operating system after the expansion process is completed.

Drive array expansion is performed at the array controller level, not at the logical drive level. In most cases, all disk drives attached to a controller should be grouped together into a single array. This provides the most efficient use of RAID fault tolerance. Using the ACU, you can assign physical drives to an array and designate up to four drives per array controller as online spares.

Up to 32 logical drives can be defined with any HP Smart Array controller. All drives within an array should be the same size. If disks of higher capacity are installed within a single array, the extra capacity will not be available. Some operating systems support fewer than 32 logical drives.

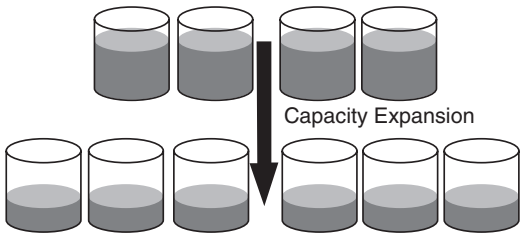


Figure 13–3
How an online spare drive works.

Under Windows 2003, Windows 2000, Windows NT, Linux, and Novell NetWare, the ACU can be started online. The server does not have to be powered down when disks are configured.

The amount of time required to perform the online capacity expansion depends on several parameters, including drive speed, server processor speed, the amount of I/O work the server is doing, and the priority level of the capacity expansion.

The priority level can be changed from low (the default in ACU) to medium or high to expand the volumes as quickly as possible. Depending on these factors, the expansion process takes between 10 to 15 minutes per gigabyte.

All current HP Smart Array controllers support online array expansion without data loss. Data reallocation runs as a background process. It can be assigned a high, medium, or low priority depending on the performance required when the data is reallocated. RAID protection is maintained throughout reallocation. The time required for data reallocation depends on the size of the logical drive.

13.3.3 Logical Volume Extension

Performing a drive extension is the process of growing the size of a logical drive. In this case, the increased size of the logical drive is reported to the operating system. Volume extension is illustrated in Figure 13–4.

Only operating systems that support volume extension can use the added capacity without losing data.

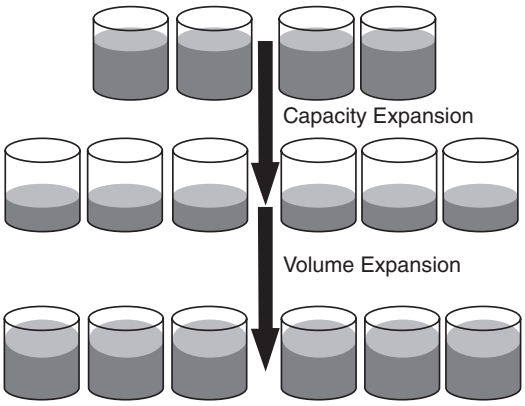


Figure 13–4
Logical volume extension.

Not all operating systems support online logical drive extension through the ACU.

Windows, NetWare, and other advanced operating systems support volume and logical drive extension, which enables you to add additional drives to an existing RAID set and extend the logical drive so that it displays as free space at the end of the same drive presented to the operating system.

Linux only supports volume and logical drive extension at the operating system level. It is not supported through the logical drive extension on the array controller.

You can use the Diskpart.exe command line utility, included with Windows Server 2003 or the Windows 2000 Resource Kit, to extend an existing partition into free space.

HP OpenView Storage Volume Growth enables dynamic expansion of volumes on Microsoft Windows 2000 or Windows Server 2003 basic disks.

Third-party software vendors have created utilities that can be used to repartition disks without data loss. Most of these utilities work offline.

Some operating systems require updates or service packs to support volume or logical drive extension. For example, Windows 2000 requires at least SP3 if you are using dynamic disks. For basic disks, Windows does require SP3.

13.3.4 Online RAID-Level Migration

All current HP array controllers support RAID-level migration. You can easily migrate a logical drive to a new RAID level. There might need to be unused drive space available on the array for the migration to be possible, depending on the initial and final settings for the stripe size and RAID level.

Online RAID-level migration is illustrated in Figure 13–5.

In a Windows or NetWare architecture, this can be performed online without disrupting system operation or causing data loss. Offline migration can be performed with any operating system.

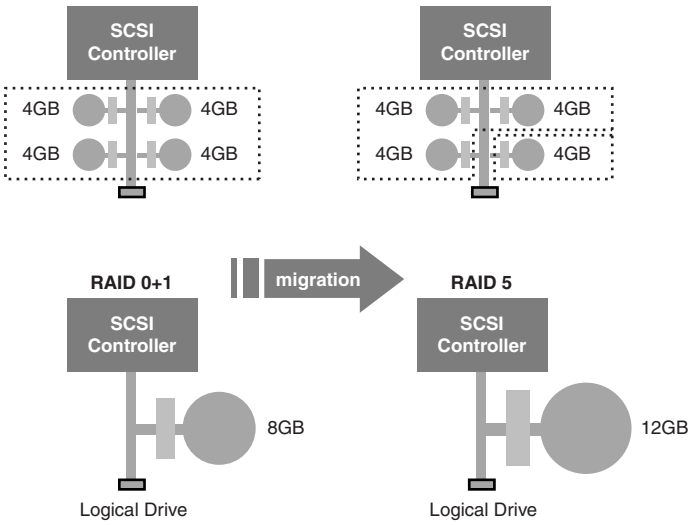


Figure 13–5 *Online RAID-level migration.*

13.3.5 Online Stripe-Size Migration

All current HP array controllers also support stripe-size migration. You can easily change the stripe size of an existing logical drive using the ACU. In a Windows and NetWare architecture, this can be performed online without disrupting system operation or causing data loss. The default data stripe size for controllers differs depending on which fault-tolerant RAID is used.

13.3.6 Hard Drive Failure Prediction Technology

HP pioneered failure prediction technology for hard disk drives in the form of monitoring tests run by Smart Array controllers. Called *Monitoring and Performance* (M&P) or Drive Parameter Tracking, these tests externally monitor hard drive attributes such as seek times, spin-up times, and media defects (more than 20 parameters) to detect changes that could indicate potential failure.

The flowchart in Figure 13–6 illustrates the process used by drive failure protection technology.

HP worked with the hard drive industry to help develop a diagnostic and failure prediction capability known as *Self-Monitoring Analysis and Reporting Technology* (S.M.A.R.T.). Over the years, as S.M.A.R.T. matured, HP used both M&P and S.M.A.R.T. to support hard drive failure prediction technology for Prefailure Warranty replacement of hard drives.

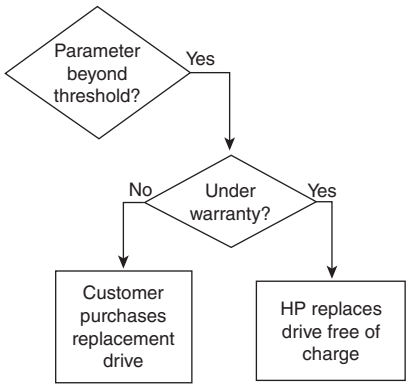


Figure 13–6
Drive failure prediction process.

S.M.A.R.T. has now matured to the point that HP relies exclusively on this technology for hard drive failure prediction technology to support Prefailure Warranty.

Starting in 2001, HP has been shipping SCSI hard drives configured to disable M&P tests on the Smart Array controllers. This eliminates false failure predictions and improves performance by eliminating the hourly M&P controller-initiated tests.

S.M.A.R.T. improves failure prediction technology by placing monitoring capabilities within the hard disk drive. These monitoring routines are more accurate than the original M&P tests because they are designed for a specific drive type and have direct access to internal performance, calibration, and error measurements. S.M.A.R.T. uses internal performance indicators and real-time monitoring and analysis to improve data protection and fault prediction capability beyond that of the original M&P tests. In addition, HP Smart Array controllers proactively scan the hard drive media during idle time and deal with any media defects detected.

S.M.A.R.T. can often predict a problem before failure occurs. HP Smart Array controllers will recognize a S.M.A.R.T. error code and notify the system of an impending hard drive failure. Insight Manager will be notified whenever a potential problem arises. HP drives that fail to meet expected criteria are eligible for replacement under the unique HP Prefailure Warranty.

13.3.7 Dynamic Sector Repair (DSR)

Under normal operation, even initially defect-free drive media can develop defects. This is a common phenomenon. The bit density and rotational speed of disks is increasing every year, and so is the likelihood of problems. Usually a drive can internally remap bad sectors without external help using *cyclic redundancy check* (CRC) checksums stored at the end of each sector.

All Smart Array controllers perform a surface analysis as a background job when there is no other disk activity. Even a completely unreadable sector can be rebuilt and remapped by using the RAID capabilities of the controller.

DSR functions automatically with hardware-handled fault tolerance. DSR is unavailable when hardware fault tolerance is not used. It uses the fault tolerance of the drive subsystem to replace a bad sector with a spare sector. The correct data is written to the spare sector on the same drive.

DSR triggers automatically. The HP Smart Array controllers trigger DSR after 30 seconds of idle time.

When DSR detects a bad or a potentially bad sector, it relocates the data to a sector on a different track (as shown in Figure 13–7), just in case two sectors within the same track are bad.

DSR does not affect disk subsystem performance because it runs as a background task. DSR discontinues when the operating system makes a request.

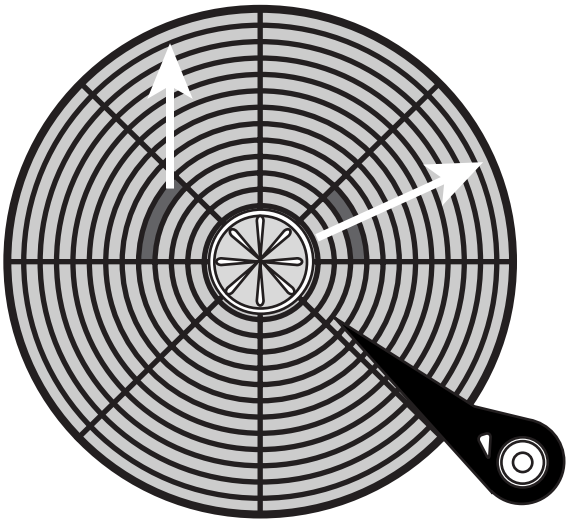


Figure 13–7
How DSR works.

The disk drive activity LEDs flash when the DSR is running.

13.3.8 Hot-Plug Drive Support

Several of the advantages provided by Smart Array controllers require hot-pluggable SCSI drives. Without hot-pluggable drives, the following operations cannot be completed with the drive online:

- Replacement of a failed drive in a fault-tolerant array
- Addition of drives and arrays
- Expansion of arrays

Although HP supports non-hot-pluggable drives on all of its array controllers, they are not recommended. One of the primary advantages of array controllers is the ability to recover fully from a drive failure without taking the server offline. This capability requires the use of hot-pluggable drives in conjunction with an array controller.

13.3.8.1 HOT-PLUGGABLE DRIVE LEDS

The HP Smart Array controller firmware has been enhanced so that when the controller detects that an attached hot-pluggable hard drive has entered a degraded status, the amber LED on the hard drive flashes. This enhancement allows easier detection and replacement of the affected physical hard drive, especially when reported by a system management utility such as Insight Manager. The affected hot-pluggable hard drive remains online and displays the LED combinations listed in the following table.

Status	Condition
Online	On
Drive Access	On, off, or blinking
Drive Failure	Blinking amber

This feature is not supported in a RAID 0 no-fault-tolerant configuration. The controller must be configured in a RAID 1, RAID 1+0, RAID 5, or RAID ADG fault-tolerant configuration.

13.3.9 Automatic Data Recovery

A Smart Array controller automatically detects whether a failed drive has been replaced. When the RAID level is set for 1, 1+0, 4, 5, or ADG, data is rebuilt automatically on the new drive. All you must do is replace the failed drive. In a system that supports hot-pluggable drives, this replacement can be done with the system up and running. The rebuild priority can be set and changed any time using the ACU.

When a drive fails, the following factors influence the data recovery time:

- Type and size of the drive
- RAID level
- Workload on the system
- Controller type
- HP Smart Array accelerator setting
- HP Smart Array drive-recovery priority level

If the system is in use during the drive rebuild, recovery time depends on the level of activity. Most systems should recover in nearly the same time with moderate activity as with no load, particularly RAID 1. RAID 5 is more sensitive to system load during the recovery period because of the considerably heavier I/O requirements of the failed system.

! IMPORTANT

Selecting a high rebuild priority results in reduced server performance when the rebuild is in progress. Setting a low rebuild priority allows normal server performance, because rebuilding occurs only when the server is idle; rebuild time can be significantly longer depending on system activity.

13.3.10 Array Accelerator (Read/Write Cache)

The array accelerator on the Smart Array controllers dramatically improves I/O performance. Depending on the controller, it can have a size of 4, 16, 32, 64, 128, or 256MB.

The array accelerator uses an intelligent read-ahead algorithm that anticipates data needs and reduces wait time. It detects sequential read activity on single or multiple I/O threads and predicts what requests will follow. The data is gathered and stored in the high-speed cache. As soon as the data is requested by the operating system, the data is delivered 100 times faster than a disk can deliver data.

Whenever random-access patterns are detected, read-ahead is disabled because reading ahead data under random I/O slows down the system instead of making it faster.

By default, the array accelerator cache capacity is equally divided between reads and writes. If your server application has significantly more reads than writes (or vice versa), you may need to change this setting to improve performance. This change can be accomplished online without rebooting the system. The optimal ratio setting is application-dependent.

If the disks are busy, new writes can be stored in the cache and written to the disk later when there is less activity (write-back). Some smaller blocks can usually be combined into larger blocks resulting in fewer but larger blocks written to the disk, thus improving performance.

The Smart Array 5300 controller is the only array controller family with upgradeable cache modules.

13.3.11 Data Protection

Data in a write cache demands special protection. Data protection provided by HP array controllers are battery backup, BBWC enabler, and recovery ROM.

13.3.11.1 BATTERY BACKUP AND BBWC ENABLER

All Smart Array controllers with a *battery-backed write cache* (BBWC) feature a removable memory module and a BBWC enabler. A short cable connects the memory module and the enabler. In the event of a server

shutdown, without using tools you can remove the memory module, the enabler, and the hard drives and install them in another ProLiant server that supports BBWC. When the new server is powered on, an initialization process writes the preserved data to the hard drives.

In the event of a general power outage, the BBWC enabler protects data in the memory module, which holds both the read cache and the write cache. You can allocate the size of each cache with the ACU.

The batteries in the BBWC enabler are recharged continuously through a trickle-charging process whenever the system power is on. The batteries protect data in a failed server for up to three or four days, depending on the size of the memory module. Under normal operating conditions, the batteries last for three years before replacement is necessary.

The BBWC enabler consists of the following components:

- A battery module, which includes a charger and status indicators
- A field-installable battery cable

Depending on the HP ProLiant server platform, there are several mechanisms for deploying a BBWC enabler. The enabler might be

- A standard feature.
- Available as an option.
- Bundled with a Smart Array 5i to 5i Plus controller upgrade.

For more information on the HP Smart Array controllers, visit http://h18004.www1.hp.com/products/servers/proliantstorage/arraycontrollers/.

13.3.11.2 RECOVERY ROM

Smart Array controllers feature recovery ROM, which provides protection against firmware corruption.

The controller maintains two copies of firmware in ROM. Previous working firmware is maintained when new firmware is flashed to the controller. The controller will roll over to standby firmware if corruption occurs.

Recovery ROM reduces the risk of flashing new firmware to the controller.

13.3.12 Array Performance Tuning

You can optimize the performance of an array in several ways, including the following:

- Choose a stripe size suitable for the type of data transfer common to the system.
- Change the fault-tolerance mode to one that requires less overhead.
- Enlarge the logical drive to span all four controller channels (depending on the controller).
- Change the read/write cache ratio in the Smart Array controller.

13.3.13 Disk Striping

To speed operations that retrieve data from disk storage, you can use disk striping to distribute volume segments across multiple disks. The most effective method is to distribute volume segments equally across the disks.

Striping improves disk response time by uniting multiple physical drives into a single logical drive. The logical drive is arranged so that blocks of data are written alternately across all physical drives in the logical array. The number of sectors per block is referred to as the *striping factor*.

Depending on the array controller in use, the striping factor can be modified, usually with the manufacturer's system configuration utility. Many of the HP Smart Array controllers can be modified online with online utilities that indicate the status of the logical drives and arrays and display the completion percentage of the rebuild process. For NetWare, this utility is cpqonlin.nlm and for Windows, it is the ACU. The ACU for Linux is installed along with the *ProLiant Support Paq* (PSP). You can enable the ACU through the Systems Management home page using the command **cpqacuexe**.

To access the System Management home page, go to https://127.0.0.1:2381.

On HP controllers released before the Smart Array 3100ES, changes to stripe size are data-destructive. In addition, any change to the logical volume geometry (such as striping factor, volume size, or RAID level) can be data-destructive.

RAID 0 striping improves volume I/O because you can read data and write data concurrently to each disk. If one of the disks fails, the entire volume becomes unavailable. To provide fault tolerance, implement some of the fault-tolerant RAID levels supported by Smart Array controllers.

13.3.14 Optimizing the Stripe Size

Selecting the appropriate stripe (chunk) size is important to achieving optimum performance within an array. The stripe size is the amount of data that is read or written to each disk in the array when data requests are processed by the array controller.

The terms *chunk*, *block*, and *segment* are used interchangeably. Chunk is used most often when discussing storage.

The following table lists the available stripe sizes and their characteristics.

Fault-Tolerance Method	Available Stripe Sizes (KB)	Default Size (KB)
RAID 0	128, 256	128
RAID 1 or 1+0	8, 16, 32, 64, 128, 256	128
RAID 5 or RAID ADG	8, 16, 32, 64	16

To choose the optimal stripe size, you should understand how the applications request data.

The default stripe size delivers good performance in most circumstances. When high performance is important, you might need to modify the stripe size.

If the stripe size is too large, there will be poor load balancing across the drives.

If the stripe size is too small, there will be many cross-stripe transfers (split I/Os) and performance will be reduced.

Split I/Os involve stripes split onto two disks, causing both disks to seek, rotate, and transfer data. The response time depends on the slowest disk. Split I/Os reduce the request rate because there are fewer drives to service incoming requests.

Type of Server Application	Suggested Stripe-Size Change
Mixed read/write	Accept the default value.
Mainly read (such as database or Internet applications)	Larger stripe sizes work best.
Mainly write (such as image-manipulation applications)	Smaller stripes for RAID 5, RAID ADG. Larger stripes for RAID 0, RAID 1, RAID 1+0.

If you stripe disks on two or more SCSI controllers (called *controller multiplexing*), the operating system must calculate where to place data in relation to the striping, in addition to other calculations that contribute to processor overhead. For best performance, stripe disks only on the same controller or use an HP Smart Array controller with multiple channels and specific circuitry for handling these calculations.

A multichannel card uses only one interrupt. The HP Smart Array 5300 and 6400 series controllers feature two or more channels for enhanced performance and capacity.

13.4 ATA RAID

ATA RAID capabilities provide an extra level of fault tolerance, performance, and convenience over software RAID, without the added cost of a SCSI-based array controller. This technology is made possible with a combination of firmware and software.

The ATA RAID 0/1 PCI card mirrors data and boots drives on an ATA system. The operating system can be installed on a preconfigured mirror (RAID 1 volume). Regardless of which drive fails, recovery of the mirror after replacing the drive does not require user or operating system intervention. This is an improvement over software RAID implementations, which often require the reconfiguring of hardware and software settings and a manually forced rebuild to recover from a similar failure.

ProLiant ATA RAID is implemented through both software BIOS and hardware. Third-party ATA RAID is available as a hardware solution.

13.4.1 Integrated ATA RAID

Some ProLiant servers feature Integrated ATA RAID capabilities for increased fault tolerance.

An integrated dual-channel ATA-100 controller with integrated ATA RAID is embedded on the system board. The firmware on the controller interfaces with the MegaIDE driver to parse data and distribute it to the disks according to the RAID setting on the configuration sector.

Because it is enabled by the BIOS, ATA RAID supports the mirroring of boot drives. However, because it uses the system processor to perform the RAID functionality, it decreases a performance of the system in comparison to hardware RAID.

Integrated ATA RAID does not support RAID 5 capability. Integrated ATA RAID functionality is monitored through the standard management utility, Insight Manager 7, so the user receives any degradation notices that might occur.

13.4.2 Setting Up ATA RAID

You can access the integrated ATA RAID configuration utility, shown in Figure 13–8, by pressing F8 during POST. Because this utility resides in ROM, you can configure an ATA hard drive array before loading the operating system. You can use the utility to create a RAID 0 or 1 array and to assign drives to the array. This information is then written to a configuration sector on the drives.

Consider these suggestions when implementing ATA RAID:

- Connect one drive per channel with both drives configured as masters for optimum performance.
- Use the same type of drives or drives with similar speeds and capacities.
- Always use 80-conductor Ultra ATA cables.
- Do not connect any ATAPI devices (for example, CD-ROM, Zip drive, or LS120 drive) to the ATA controller.
- If you do not run the integrated ATA RAID configuration utility, the option ROM will automatically configure the drives to RAID 0.

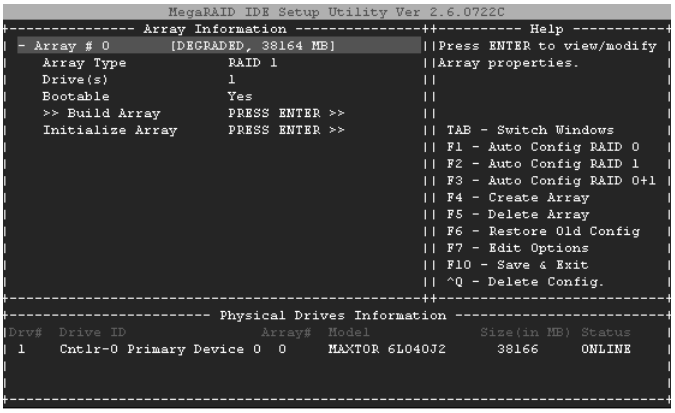


Figure 13–8 *Integrated RAID configuration utility interface.*

You cannot add drives or remove drives from an array that has already been configured. In addition, you cannot change the stripe size of an array that has already been configured.

Customers testing Windows Server 2003 need to be aware that Windows Server 2003 does not natively support the MegaIDE driver. You must install the driver from a disk or during a SmartStart assisted installation.

13.4.3 Integrated ATA RAID Management Utility

HP provides array monitoring through the integrated ATA RAID management utility. This utility runs automatically when the computer starts.

This utility provides a visual representation of array status using the Applications tray icon (Microsoft operating system only).

In addition, the ATA RAID management utility writes array status to a log file if you are running Linux or Microsoft operating systems.

The ATA RAID management utility also provides an automatic rebuild of preconfigured, online spares following a RAID 1 failure (Linux and Microsoft operating systems only).

13.4.4 Comparing RAID Implementations

Integrated ATA RAID provides an extra level of fault tolerance, performance, and convenience over software RAID, without the added cost of a SCSI-based array controller.

The requirements discussed in this section are specific to a two-drive implementation.

13.4.4.1 ATA RAID COMPARED TO SOFTWARE RAID

Software RAID, normally enabled by the operating system, enables you to mirror data files across two logical drives and uses the processor to perform the RAID functionality.

Software RAID will not allow you to set up a RAID 0 configuration on the operating system volume because it will not allow the operating system to be distributed across drives.

With integrated ATA RAID, the operating system can be installed on a preconfigured mirror (RAID 1 volume). Regardless of which drive fails, recovery of the mirror after replacing the drive does not require user or operating system intervention. This capability is an improvement over software RAID implementations, which often require reconfiguring of hardware and software settings and a manually forced rebuild to recover from a similar mirror failure.

ATA RAID provides better performance than software RAID. Software RAID normally causes system performance to decrease due to the processor being occupied by RAID-related activities. With ATA RAID, part of the RAID logic resides in the integrated dual-channel ATA-100 controller, which relieves the processor of some of the burden.

13.4.4.2 ATA RAID COMPARED TO SCSI RAID WITH SMART ARRAY TECHNOLOGY

SCSI RAID using Smart Array technology has several advantages over ATA RAID.

SCSI RAID using Smart Array technology will always be faster than ATA RAID because the Smart Array controller has a separate processor and can offload the distribution task from the system processor.

SCSI RAID using Smart Array technology supports RAID 5 capability. Integrated ATA RAID does not support RAID 5.

Both SCSI RAID and integrated ATA RAID can mirror the boot drive because they are invoked by the BIOS.

ATA RAID does have one advantage over SCSI RAID. It is generally less expensive than SCSI RAID, so some customers might be willing to sacrifice performance for price.

Customers do not have to purchase the optional SCSI daughter card to enable SCSI RAID. They need only purchase the Smart Array controller.

▲ Summary

HP array technologies are key technological differentiators in the HP server portfolio.

As an Accredited Integration Specialist, you need to know the advantages, capabilities, and features provided by HP array technologies.

You need to know how to use the utilities used to configure, optimize, and troubleshoot HP array controllers: ADU, ACU, ACU XE, and ORCA.

Finally, ATA RAID provides advantages over software RAID, without the added cost of a SCSI-based array controller. You need to understand the pros and cons of ATA RAID, and when it can appropriately be recommended as a solution.

▲ Learning Check

1. *RAID ADG offers higher fault tolerance than RAID 5.*

- ❑ True
- ❑ False

2. *What is the maximum number of drives recommended by HP for a RAID 5 implementation?*

A. 6

B. 12

C. 14

D. 56

3. *What is the recommended maximum number of drives per array for a RAID ADG implementation?*

A. 6
B. 12
C. 14
D. 56

4. *Which array utility executes out of the option ROM that is located on an array controller, and is designed for situations that have minimal configuration requirements?*

A. Array Diagnostic Utility (ADU)
B. Array Configuration Utility (ACU)
C. Array Configuration Utility XE (ACU XE)
D. Option ROM Configuration for Arrays (ORCA)

5. *What is a potential disadvantage of setting a high rebuild priority when an online spare drive is implemented?*

6. *Which of the following LED statuses indicate that a drive has failed?*

A. On
B. Blinking
C. Off
D. Blinking amber