HP Array Configuration Utility User Guide

Sun Solaris 10 for x86/x64 Systems

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Getting Started

Features

The HP Array Configuration Utility (ACU) is a command line interface utility that can be used online (while the operating system is resident). The utility has different operating modes, enabling faster configuration or greater control over the configuration option, depending on the task. ACU also enables several array features:

- Online array capacity expansion
- Logical drive capacity extension
- Assignment of online spares
- RAID or stripe size migration

Advanced Features

Some ACU features are available only for later versions of ACU, Smart Array firmware, and Smart Array drivers.

HPQaculi 2.0.0 with firmware revision 5.10 and CPQary3 1.90 or later, the following features are available:

- Dual Domain/Port— Smart Array P800
- 108 HDD Maximum— Smart Array E500, P400, P400i, P800
- 64 LUN Support— Smart Array E500, P400, P400i, P800, P411, P212, P410
- Dual Path SATA— Smart Array P800
- Hot Replacing Expanders— Smart Array P800

HPQacucli-3.0.1 and CPQary3 2.2.0 or later adds support for a new series of firmware for Smart Array SAS controllers:

- SAP410i
- SAP410
- SAP212
- SAP712m

HPQacucli-3.1.0 and CPQary3 2.2.0 or later adds support for a new series of firmware for Smart Array SAS Controllers:

- SAP411

HPQacucli-3.1.0 and above adds support for these new features:

- ACUCLI now retains a command history of previously executed commands, which can be accessed by using the keyboard arrow keys.
- ACUCLI allows command completion by pressing 'Tab' key
- Generate diagnostic information about a specified or all controllers on the system

HPQacucli-3.2.0 and CPQary3 2.4.0 or later adds support for a new series of firmware for Smart Array SAS Controllers:

- SAP700m

SAP410i, SAP410, SAP212, SAP411, SAP700m and SAP712m controllers add support for the following features.

- Secure Erase
- Advanced Capacity Expansion
- RAID Support of RAID 50 and RAID 60
- Surface Analysis Configurability

HPQacucli-9.0.24.0 and CPQary3 2.5.0 or later adds support for a new series of firmware for Smart Array SAS Controllers:

- HP Smart Array P420i
- HP Smart Array P220i
- HP Smart Array P420
- HP Smart Array P421
- HP Smart Array P222

Features supported for the above controllers:

- New cache ratio increments: Support for 5 percent cache ratio increment. This new capability for the writemanagecontrollerparameters operation will now have the increment value as 5 percent instead of 25 percent.
- Predictive Spare Rebuild : Spareactivation keyword to support turnning predictive spare rebuilds on/off.
- Delete any logical drive : Any LD can be deleted irrespective of there order. Only on star controllers
- Move logical drive :

  - Supports to move a logical drive from an array with one drive type (say SAS) to another array with different drive type (say SATA). The logical drive can be moved to an existing array or to an new array. The drive types supported are SAS, SATA, SAS SSD and SATA SSD.

  - Allows the deletion of a failed logical drive if all the other logical drives(withinthe same array) are in OK state.

  Restircts logical drive move operation when:

  -the target array has any failed logical drives.

  -there is no enough number of unassigned drives to create a new array with the same number of physical drives as the source array.

- Support for >128 Physical drives .
- Shock-and-Awe drive carrier authentication : Carrier Autentication and Drive Authentication information are include in physical drive details.
- SSD Gas Gauge : Added support for SSD gas, where all the following details of SSD drives are shown.

  -PowerOn Hours

-PercentEnduranceUsed

-Number of days left to replace the drive

-WearOut Time.

System requirements

Hardware Requirements

An HP ProLiant server for which the HPQacucli package is supported. A list of supported ProLiant models is provided in the `RELEASE NOTES` provided in the HPQacucli package or online at **http://www.hp.com/go/solaris**.

Software Requirements

The HPQacucli package has very few software requirements, as follows:

- Oracle Solaris 10 9/10 or later
- HP Smart Array Controller Driver version 2.5.0 or later

Package Installation and Configuration

Unpacking the Distribution

The Array Configuration Utility is distributed as a gzip-compressed tar file which must be unpacked before use. The instructions below can be used on Solaris and other similar operating systems for which the *tar(1)* or *gunzip(1)* tools are available.

1. Download the HPQacucli distribution compressed tar file to a temporary local directory, such as `/var/tmp`. The name of the tar file has the form `HPQacucli-x.y.z-solaris10.i386.tar.gz`.
2. Uncompress and un-tar the compressed tar file to extract the HPQacucli package:

```
$ cd /var/tmp
$ gunzip HPQacucli-x.y.z-solaris10-i386.tar.gz
$ tar xvf HPQacucli-x.y.z-solaris10- i386.tar
$ cd HPQacucli-x.y.z-solaris10-i386
$ more LICENSE.HPQacucli
$ more RELEASENOTES.HPQacucli
```

The distribution contains the following components:

- `LICENSE.HPQacucli` — Text file containing the end-user license which governs use of the di stribution and its contents.
- `RELEASENOTES.HPQacucli` — Text file containing the release notes for the distribution.
- `INSTALLNOTES.HPQacucli` — Text file containing the installation notes for the distribution.
- `HPQacucli-x.y.z-solaris10-i386.pkg` — Solaris package for the ACUCLI utility
- `LICENSE.libstdc++` — GNU General Public License

NOTE: You must agree to the terms of the license in order to install and use the HPQacucli package and its components.

Installing the Array Configuration Utility

Use the following procedure to install the Array Configuration utility on to an existing Solaris 10 system. If necessary, unpack the distribution as described above under “Unpacking the Distribution”.

Log in as root and use *pkgadd (1M)* to install the HPQacucli package.

```
$ pwd
/var/tmp/HPQacucli-x.y.z-solaris10-i386
$ su
# pkgadd -d HPQacucli-<x.y.z>-solaris10-i386.pkg
Installation of <HPQacucli> was successful.
```

A message similar to the above is displayed following a successful installation.

Package maintenance

Package Removal

To remove the HPQacucli package, use *pkgrm(1M)*:

```
$ su
# pkgrm HPQacucli
```

pkgrm will not stop the acucli utility if it is launched/running, instead the *pkgrm* will exit with errors. To remove the package and its components from the system, first stop the acucli utility if it is running and then run *pkgrm*.

IMPORANT: pkgrm should be run on the server from which the package is being removed. It is recommended that the `–R` option to pkgrm not be used because, in addition to removing files, package removal must also unconfigure the *smf(5)* service, which cannot be done if pkgrm is operating on an alternate root.

Package Upgrade

To upgrade the HPQacucli package, first remove the existing version of the package, and then add the desired version of the package:

1. Remove the current package:

   ```
   $ su
   # pkgrm HPQacucli
   ```

2. Add the new package, following the steps outlined above in "Package Installation".

IMPORANT: Replacing the HPQacucli package without first removing the previously installed HPQacucli package is not recommended and may result in undefined behavior.

Using the Command Line Interface

Overview of the ACU CLI

The HP Array Configuration Utility is a command line utility that can be used online to create new logical volumes, delete logical volumes, enable online array capacity expansion, extend logical drive capacity, assign online spares, migrate RAID configurations or stripe size, perform a Secure Erase, or make use of advanced capacity expansion. In addition, the HP Array Configuration Utility can be used for getting information about HP Smart Array controllers and the devices connected to the controller.

Running the CLI

You can open the CLI in either Console mode or Command mode. In Console mode, you can adjust several configuration parameters on several devices without having to restart ACU each time. Command mode is more suitable for an isolated change of just one configuration parameter on one device.

The command syntax used to open the ACU CLI depends on the desired mode of operation:

Console mode

After you have entered Console mode, the screen displays the following message and console prompt:

```
# /opt/HPQacucli/sbin/hpacucli
HP Array Configuration Utility CLI 8.0-14.0
Detecting Controllers...Done.
Type "help" for a list of supported commands.
Type "exit" to close the console.
=>
```

Command mode

To use Command mode, add the specific ACU CLI command to the end of the text line used to open ACU in Console mode before you press the Enter key (see the section “The <command> variable” for a list of commands). The following example use help as the specific ACU CLI command.

```
# /opt/HPQacucli/sbin/hpacucli help
```

The remaining examples in this chapter are described as if entered in Console mode.

CLI syntax

Whether entered in Command mode or Console mode, a typical ACU CLI command line consists of three parts: a target device, a command, and a parameter with values if necessary. Using angle brackets to denote a required variable and plain brackets to denote an optional variable, the structure of a typical ACU CLI command line is as follows:

```
<target> <command> [parameter=value]
```

The <target> variable

This variable provides the path to a target device. The device can be a controller, an array, a logical drive, or a physical drive. For example:

```
controller slot=3
controller csn=E03TMLJ135
controller serialnumber=P56350D9IP903J
controller slot=3 array A
controller chassisname="A" array A logicaldrive 2
controller chassisname="A" physicaldrive 1:0
```

You can also specify that an operation be performed on several similar devices at the same time. For example:

```
controller all
controller slot=3 logicaldrive 2
```

The <command> variable

The `<command>` variable can be any of the following words or phrases:

```
add
create
delete
help
modify
remove
rescan
set
target
diag
```

Some commands require a parameter, and some parameters require a value. The descriptions of the commands in the rest of this chapter provide examples of some usable parameters and variables for those cases that need them.

Keyword abbreviations

Several commonly used keywords in the ACU CLI have acceptable abbreviations, as shown in the following table.

Table 1 Keyword abbreviations

Keyword	Abbreviation in ACU CLI	Keyword	Abbreviation in ACU CLI
arrayaccelerator	aa	expandpriority	ep
allunassigned	all	logicaldrive	ld
cacheratio	cr	parallelscsi	ps
chassisname*	ch*	physicaldrive	pd
chassisslot	chs	rebuildpriority	rp
chassisserialnumber	csn	serialnumber	sn
controller	ctrl	stripesize	ss
drivetype	dt	surfacescandelay	ssd

drivewritecache	dwc	surfaceanalysiseventnotify	saen

*The CLI also uses this keyword and abbreviation for the terms box name and RAID array ID.

Hiding warning prompts

When entering a command for an operation that can potentially destroy user data, the CLI displays a warning and prompts for input (a `y` or `n`) before continuing the operation. This situation is undesirable when running batch file scripts. To prevent warning prompts from being displayed, use the term *forced* as a parameter.

Example command:

```
ctrl ch="Lab4" ld 1 delete forced
```

Querying a device

If you do not know what values a parameter can have, you can sometimes query the device to find available parameters by entering a `?` as the value of the parameter.

Example command:

```
=> ctrl ch="Lab4" ld 1 modify raid=0 ss=?
```

A typical screen response in this case could be:

```
Available options are:
8
16 (current value)
32
64
128 (default)
256
```

For information about which parameters can be queried, refer to the CLI help ("Help").

Help

To get help with the CLI, enter help at the CLI prompt as follows:

```
=> help
```

This command does not need a target variable or a parameter.

Typical procedures

The following sections describe some common ACU CLI procedures.

The show command

The `show` command enables you to obtain information about a device.

Syntax:

```
<target> show [detail]|[status]
```

When you specify a target that consists of several devices, the information in the output is normally less comprehensive than when you specify only one device as the target. You can use the [detail] parameter in this case to retain all the information usually given for individual devices.

An extra parameter is available for controller targets: config. This parameter is used as follows:

<target controller> show config [detail]

If you use the config parameter, the output includes information about each device connected to the controller.

Example 1

```
=> ctrl slot=9 show
A typical output would be:
Smart Array P421 in Slot 9
Bus Interface: PCI
Slot: 9
Serial Number: PBKTV0XTAZZ005
RAID 6 (ADG) Status: Enabled
Controller Status: OK
Hardware Revision: A
Firmware Version: 0.02-106
Rebuild Priority: Medium
Expand Priority: Medium
Surface Scan Delay: 3 secs
Surface Scan Mode: Idle
Queue Depth: Automatic
Monitor and Performance Delay: 60 min
Elevator Sort: Enabled
Degraded Performance Optimization: Disabled
Inconsistency Repair Policy: Disabled
Wait for Cache Room: Disabled
Surface Analysis Inconsistency Notification: Disabled
Post Prompt Timeout: 15 secs
Cache Board Present: True
Cache Status: OK
```

```
Accelerator Ratio: 10% Read / 90% Write
Drive Write Cache: Disabled
Total Cache Size: 1024 MB
Total Cache Memory Available: 816 MB
No-Battery Write Cache: Disabled
Cache Backup Power Source: Capacitors
Battery/Capacitor Count: 1
Battery/Capacitor Status: OK
SATA NCQ Supported: True
Spare Activation Mode: Activate on drive failure
Controller Temperature (C): 40
Cache Module Temperature (C): 0
Capacitor Temperature (C): 0
```

Shock-and-Awe drive carrier authentication

Added Carrier Autentication and Drive Authentication support when showing the details of a physical drive.

```
=> ctrl slot=0 pd 1i:1:1 show
Smart Array P420i in Slot 0 (Embedded)
array A
physicaldrive 1I:1:1
..
…
PHY Transfer Rate: 3.0GBPS, Unknown
Drive Authentication Status: OK
Drive Carrier Authentication Status: OK
Carrier Application Version: 3
Carrier Bootloader Version: 2
```

Creating a logical drive

When you use the CLI to create a logical drive, the array that holds the logical drive is created implicitly.

Syntax:

```
<target> create type=ld [parameter=value]
```

To create a logical drive on a new array, specify both the controller and the drives that are to constitute the new array. You can specify each drive individually, or you can specify a drive range. For example:

```
ctrl slot=5 create type=ld drives=1:0,1:1,1:3 raid=adg
ctrl slot=5 create type=ld drives=1:1-1:3 raid=adg
```

To create a logical drive on an existing array, specify the array. You do not need to specify the drives in this case because they are already defined. For example:

```
ctrl slot=5 array A create type=ld size=330 raid=adg
```

Standard parameters for creating a logical drive are described in the following table. If you do not specify a particular parameter when creating a logical drive, the CLI uses the default value for that parameter.

Table 2 Create logic drive parameters

Parameter	Acceptable values	Comments
Drives	[#:]#:#,[#:]#:#,[#:]#:#– [#:]#:#,...|all |allunassigned	The default setting is all.
Raid	60, 6, adg, 5, 50, 1+0, 1, 0, 1adm, 1+0adm, ?	The default setting is the highest level that the logical drive can accept.
Ss	8, 16, 32, 64, 128, 256, 512, 1024, default, ?	Units are KB.* The default setting depends on the RAID level.
Size	#, max, ?	This parameter determines the desired size of the logical drive. Units are MB.* The default setting is max.
Sectors	32, 63, default, ?	The default setting depends on the operating system.
Aa	enable, disable	The default setting is enable.
d rivetype	sas, satalogical, sata, saslogical, parallels csi	—

*Use only these units. Do not enter any extra text in the command to specify the units.

The default stripe size gives optimum performance in a mixed read/write environment. If your system is used in a different environment, refer to the following table to determine what stripe size to set.

Table 3 Stripe size by application

Type of server application	Example	Suggested stripe size change
Mixed read/write		Accept the default value.
Mainly sequential read	Audio-video applications	Use a larger stripe size.
Mainly write	Image manipulation	Use a smaller stripe size for RAID 5 or RAID 6 (ADG). Use a larger stripe size for RAID 0 or RAID 1+0.

*Not all controllers support RAID 6 (ADG).

Sample scenario

Consider a situation in which you want to create two arrays in MSA20 storage enclosure. One of these arrays needs two logical drives, while the other needs only one.

First, determine what physical drives are available and what their properties are:

```
=> ctrl ch="Lab 4" pd all show
```

For this sample scenario, the screen response is:

```
MSA20 in Lab                                                OK)
unassigned physicaldrive                                    OK)
physicaldrive physicaldrive                                 OK)
```

Knowing this information, you can now create the first array with one logical drive:

```
=> ctrl ch="Lab 4" create type=ld drives=1:4
```

Now, verify that the array has been created:

```
=> ctrl ch="Lab 4" pd all show
```

In this case, the screen response is:

```
MSA20 in Lab 4 array A
physicaldrive      1:4   (box  1:bay4,  SATA,    250GB,          OK)
unassigned
physicaldrive      1:7   (box  1:bay7,  SATA,    250GB,          OK)
physicaldrive      1:8   (box  1:bay8,  SATA,    250GB,          OK)
```

The second array is to be created on the two remaining physical drives. Before creating this array, determine what RAID options are available for these drives:

```
=> ctrl ch="Lab 4" create type=ld drives=1:7,1:8 size=300 raid=?
```

The response in this case is:

```
Available options are: 0 1+0 (default value)
```

Now create the new array:

```
=> ctrl ch="Lab 4" create type=ld drives=1:7,1:8 size=300 raid=1+0
```

It is not strictly necessary to specify the RAID level in this example because it is the highest possible level for this scenario and will be used by default. However, it is included in the command as an example.

Now verify that the array has been formed:

```
=> ctrl ch="Lab 4" pd all show
```

The screen response is:

```
MSA20 in Lab 4 array A
physicaldrive      1:4   (box  1:bay4,  SATA,    250GB,          OK)
array B
physicaldrive      1:7   (box  1:bay7,  SATA,    250GB,          OK)
physicaldrive      1:8   (box  1:bay8,  SATA,    250GB,          OK)
```

Create the second logical drive on this array. There are two possible ways for creating subsequent logical drives. You can create logical drives by specifying the implicitly created array name shown in the first example. You can also use the physical drives in the array to distinguish which array to create the logical drives shown in the second example.

Example:

```
=> ctrl ch="Lab 4" array B create type=ld size=900
=> ctrl ch="Lab 4" create type=ld drives=1:7,1:8 size=333
```

Finally, verify that the logical drives have all been created correctly:

```
=> ctrl ch="Lab 4" ld all show
MSA20 in Lab 4 array A
logicaldrive      1     (232.9 GB,  RAID 0,                    OK)
array B
logicaldrive      2     (298 MB,    RAID 1+0,                  OK)
logicaldrive      3     (900 MB,    RAID 1+0,                  OK)
logicaldrive      4     (330 MB,    RAID 1+0,                  OK)
```

Modifying the controller chassis name

If a controller is configured with at least one logical drive, you can assign the controller a simplified name (the chassis name) to make it easier to identify and enter the correct controller in a command.

Syntax:

```
<target> modify ch="new chassis name"
```

where `<target>` is a controller. Example commands:

```
=> ctrl sn=P56350D9IP903J modify ch="Lab 6"
=> ctrl ch="Lab 4" modify ch="Lab 6"
```

Deleting target devices

Syntax:

```
<target> delete [forced]
```

where <target> can be a controller, array, or logical drive. Except in the case of controllers, you can delete several devices simultaneously if they are of similar type by using the all keyword.

Because deleting a target device can result in data loss, the screen displays a warning prompt unless you include the forced parameter.

Example commands:

```
=> ctrl ch="Lab 4" delete forced
=> ctrl slot=3 ld all delete
```

Identifying devices

You can enter a command that causes the LEDs on target devices to blink, enabling you to identify the devices. The LEDs continue to blink until you enter the command to stop them blinking.

Syntax:

```
<target> modify led=on|off
```

Example commands:

```
=> ctrl ch="Lab 4" modify led=on
=> ctrl ch="Lab 4" modify array A led=off
```

Expanding an array

You can increase the storage space on an array by adding physical drives. However, the added drives must be of the same type (for example, parallel SCSI or SATA), and they must each have a capacity no less than that of the existing drives in the array.

NOTE: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer time if the controller has battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

An array expansion, logical drive extension, or logical drive migration is not supported if the controller does not have a battery-backed cache.

Syntax:

```
<target> add drives=[#:]#:#,[#:]#:#,[#: #:#- [#:]#:#,...|allunassigned
[forced]
```

where <target> is an array (or a logical drive, if the array contains only one logical drive). The parameter forced represses warning message prompts.

If you add an odd number of drives to an array that contains at least one RAID 1+0 logical drive, the CLI displays a prompt that asks if it is acceptable to convert the RAID1+0 logical drive to RAID 5 (or RAID 6 (ADG) if the controller supports this RAID level). Adding the forced parameter to the command prevents this prompt from appearing.

Example commands:

```
=> ctrl slot=3 array A add drives=1:0,1:1
=> ctrl slot=4 ld 1 add drives=allunassigned
=> ctrl slot=5 array A add drives=1:1,1:5
```

Extending a logical drive

If the operating system supports logical drive extension, you can use any unassigned capacity on an array to enlarge one or more of the logical drives on the array.

NOTE: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer time if the controller has battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

An array expansion, logical drive extension, or logical drive migration is not supported if the controller does not have a battery-backed cache.

Syntax:

```
<target> modify size=#|max|? [forced]
```

where <target> is a logical drive.

If the operating system does not support logical drive extension, carrying out this command would make data on the logical drive unavailable. Therefore, the CLI displays a warning prompt as a safeguard in case you are using such an operating system. To prevent the prompt from appearing, use the forced parameter.

Example commands:

```
=> ctrl slot=3 ld 1 modify size=max
=> ctrl slot=4 ld 1 modify size=?
=> ctrl slot=3 ld 2 modify size=500 forced
```

Managing spare drives

Assigning online spares to an array enables you to postpone replacement of faulty drives. However, it does not increase the fault-tolerance level of any logical drives in the array. For example, a logical drive in a RAID 5 configuration suffers irretrievable data loss if two physical drives fail, regardless of the number of spare drives assigned to it.

Syntax:

```
<target> add spares=[#:]#:#,[#:]#:#,[#:]#:#- [#:] #:#,...|allunassigned
[forced]
<target> remove spares=[#:]#:#,[#:]#:#,[#:]#:#- [#:]#:#,...|all
```

where <target> is an array. If the array contains only one logical drive, the logical drive can also be the target. The parameter forced represses warning message prompts.

Example commands:

```
=> ctrl slot=3 array B add spares=1:6
=> ctrl slot=4 arrayall add spares=1:5,1:7
=> ctrl slot=5 array A add spares=1:1,1:5
=> ctrl slot=5 arrayA remove spares=1:1,1:5
```

Migrating a logical drive

This command enables you to adjust the stripe size (data block size) or RAID level of a selected logical drive. For information about selecting an appropriate stripe size or RAID level, refer to the tables in the "Creating a logical drive" and "Selecting a RAID method" sections.

Consider the following factors before performing a migration:

For some RAID-level migrations to be possible, you might need to add one or more drives to the array.

For migration to a larger stripe size to be possible, the array might need to contain unused drive space. This extra space is necessary because some of the larger data stripes in the migrated array are likely to be inefficiently filled.

NOTE: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer time if the controller has battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

An array expansion, logical drive extension, or logical drive migration is not supported if the controller does not have a battery-backed cache.

Syntax:

```
<target> modify [raid=0|1+0|1|5|6|adg|?] [ss=8 |16|32|64|128|256
|default|?]
```

where <target> is a logical drive.

The following limitations apply to this command:

- You cannot simultaneously query the RAID level and the stripe size of any given logical drive.
- If you do not specify a RAID level for a query or migration, the CLI uses the existing value by default.
- If you do not specify a stripe size, the CLI uses the default stripe size value for the RAID level that you specify.

Example commands:

```
=> ctrl slot=3 ld 1 modify raid=1 => ctrl slot=4 ld 2 modify ss=16
=> ctrl slot=2 ld 3 modify raid=5 ss=16
```

Changing the Rebuild Priority setting

The Rebuild Priority setting determines the urgency with which the controller treats an internal command to rebuild a failed logical drive.

- At the low setting, normal system operations take priority over a rebuild.
- At the medium setting, rebuilding occurs for half of the time, and normal system operations occur for the rest of the time.

- At the high setting, the rebuild takes precedence over all other system operations.

If the logical drive is part of an array that has an online spare, rebuilding begins automatically when drive failure occurs. If the array does not have an online spare, rebuilding begins when the failed physical drive is replaced.

```
<target> modify rp=high | medium | low
```

where `<target>` is a Controller.

Example command:

```
=> ctrl slot=3 modify rp=high
```

Setting the spare activation mode

The spare activation mode feature enables the controller firmware to activate a spare drive under the following conditions:

- When a data drive reports a predictive failure (SMART) status
- When a data drive fails; this mode is the default.

In normal operations, and for older controllers, the firmware starts rebuilding a spare drive only when a data

drive fails. With the predictive failure activation mode, rebuilding can begin before the drive fails, reducing

the likelihood of data loss that could occur if an additional drive fails.

Use the spareactivationmode keyword to toggle the spare activation mode for the controller between drive failure and drive predictive failure.

Syntax:

```
<target> modify spareactivationmode=[ failure | predictive ]
```

Example commands:

```
controller slot=1 modify spareactivationmode=predictive
controller slot=1 modify spareactivationmode=failure
```

Changing the Expand Priority setting

The Expand Priority setting determines the urgency with which the controller treats an internal command to expand an array.

- At the low setting level, normal system operations take priority over an array expansion.
- At the medium setting, expansion occurs for half of the time, and normal system operations occur for the rest of the time.
- At the high setting, the expansion takes precedence over all other system operations.

Syntax:

```
<target> modify ep=high | medium | low
```

where `<target>` is a controller.

Example command:

```
=> ctrl slot=3 modify ep=high
```

Changing the controller cache ratio

The controller cache ratio setting determines the amount of memory allocated to read and write operations. Different types of applications have different optimum settings. You can change the ratio only if the controller has a battery-backed cache (because only battery-backed cache can be used for write cache) and if there are logical drives configured on the controller.

Syntax:

```
<target> modify cr=#/#|?
```

where `<target>` is a controller, and `#/#` is the cache ratio in the format read percentage/write percentage.

Example command:

```
=> ctrl slot=3 modify cr=25/75
```

Changing the surface scan delay time

The setting for the surface scan delay determines the time interval for which a controller must be inactive before a surface scan analysis is started on the physical drives that are connected to it.

Surface scan analysis is an automatic background process that ensures that you can recover data if a drive failure occurs. The scanning process checks physical drives in fault-tolerant logical drives for bad sectors, and in RAID 5 or RAID 6 (ADG) configurations, it also verifies the consistency of parity data.

Syntax:

```
<target> modify ssd=#
```

where `<target>` is a controller and `#` is a number between 1 and 30. This number determines the delay time in seconds, but you do not need to include units with the command.

Example command:

```
=> ctrl sn=P56350D9IP903J modify ssd=3
```

Re-enabling a failed logical drive

If a logical drive has failed and the data on it is invalid or non-recoverable, you can re-enable the logical drive so that it can be reused. This process preserves the structure of the logical drive and merely deletes data, whereas a delete command applied to a logical drive deletes the logical drive structure as well as the data.

Syntax:

```
<target> modify reenable [forced]
```

Example command:

```
=> ctrl slot=3 ld 1 modify reenable forced
```

CacheState

This option enables you to flush the cache or disable flushing of the cache. Values are FlushEnable and FlushDisable.

You can use this option to prevent stale cache issues.

```
setcache [action=flushdisable|flushenable]
```

Enabling or disabling the drive cache

On controllers and drives that support physical drive write cache, you can use this command to enable or disable the write cache for all drives on the controller.

CAUTION: Because physical drive write cache is not battery-backed, you could lose data if a power failure occurs during a write process. To minimize this possibility, use a backup power supply.

```
<target> modify drivewritecache=enable | disable [forced]
```

where `<target>` is a controller that supports drive write cache. Example command:

```
=> ctrl slot=5 modify dwc=enable
```

Enabling or disabling the array accelerator

If the controller has an array accelerator, you can disable it or re-enable it for specified logical drives.

Note: Disabling the array accelerator for a logical drive reserves use of the accelerator cache for other logical drives on the array. This feature is useful if you want the other logical drives to have the maximum possible performance (for example, if the logical drives contain database information).

Syntax:

```
<target> modify aa=enable|disable
```

where `<target>` is a logical drive. Example command:

```
=> ctrl slot=3 ld 1 modify aa=enable
```

Setting the target

If you must perform several operations on a given target device, you can simplify the required commands by setting the device as the default <target> for the CLI operations.

After you have set the target, any command that you enter in the CLI without a specified <target> is automatically applied to the set target. If you must also perform operations on other devices, you can still do so at any time by specifying the <target> for each of those operations as usual. You can also change the set target or clear it completely. The set target is automatically cleared when you close the CLI.

IMPORTANT: You cannot use the set target command in batch file scripts.

Syntax:

```
set target <target>
```

where `<target>` is a controller, array, or logical drive. Example commands:

```
=> set target ctrl slot=3
=> clear target
```

Typical scenario

First, set a target as follows:

```
=> set target ctrl ch="Lab 4"
```

```
=> show target controller chassisname="Lab 4"
```

As an example of how the set target command works, check the status of array A on this controller:

```
=> array A show
MSA20 in Lab 4 array A
   Interface Type: SATA
   Unused Space: 0 MB
   Status: OK
```

Note that the controller does not need to be specified because it is currently the set target. Now clear the target, reset it, and enter a few commands for the new set target:

```
=> clear target
=> set target ctrl slot=3
=> array A add drives=1:7,1:8,1:9
=> array B add spares=1:10,1:11
=> ctrl slot=4 ld 3 modify ss=64
=> modify rp=high
```

This sequence includes a command for a different target (the controller in slot 4) as a demonstration. Note that the next command in the sequence (the one for modifying the rebuild priority) applies to the controller in slot 3, not the one in slot 4. This is because the command does not specify a <target> for the rebuild priority, so the default set target is used instead.

Rescanning the system

A rescan detects devices that have been added to the system since the previous rescan or since the ACU CLI was started, whichever is more recent.

Syntax:

Use the word `rescan` directly at the ACU CLI prompt, without any target device or parameters.

Example command:

```
⇨ rescan
```

Generating a diagnostic report

The diag command outputs diagnostic information about a specified controller or all controllers on the system.

Syntax:

<target> diag <file=filename> [ris=on|off] [xml=on|off] [zip=on|off]

where the following is designated:

- <target> is a controller or all controllers
- <file=filename> designates the target file in which the diagnostic information is saved
- [ris=on|off] determines whether RIS information is or is not included
- [xml=on|off] outputs diagnostic information in formatted XML
- [zip=on|off] compresses the output to a zipped file. Default behavior is uncompressed.

Example commands:

=> ctrl all diag file=/tmp/allcontrollers.zip

=> ctrl slot=4 diag file=/tmp/ctrl_slot4.zip

=> ctrl ch="mybox" diag file=myboxssd.zip ssdrpt=on

Erasing a physical or logical drive

Syntax:

<target> modify [erase

erasepattern=zero|random_zero|random_random_zero][deleteaftererase=yes|no]

where the target can be any valid physical drive or logical drive. The option to delete the target after erasing it is valid only if the target is a logical drive.

To stop an erase process at any time, enter the stoperase command.

Example commands:

=> ctrl slot=3 ld 2 modify erase erasepattern=zero

=> ctrl slot=4 ld=all modify erase erasepattern=random_zero

=> ctrl slot=3 ld 2 modify stoperase

Entering or deleting a license key

Some advanced configuration tasks (available only on certain controller models) can be performed only after software is installed on the controller and a license key is registered to activate the software.

Syntax:

<target> add [licensekey=XXXXX-XXXXX-XXXXX-XXXXX-XXXXX]

where the target is any valid controller. The hyphens are optional.

To delete a license key, use a standard delete command but use the license key (not the controller) as the target:

<target> controller slot=5 lk XXXXXXXXXXXXXXXXXXXXXXXXX delete

Example commands:

=> ctrl slot=5 lk=12345-65432-78787-43434-24680 delete

=> ctrl slot=4 add lk=9876543210222224444466666

Shrinking an array

Some controllers may not support this option or may require a license key to enable this feature.

You can shrink the size of an array by removing a drive from an existing array. Observe the following criteria:

• After the shrink, the array must have sufficient capacity to contain all of the configured logical volumes.

• You may not remove drives from the array if the resulting number of drives does not support the fault tolerance (RAID level) of any existing logical drive. For example, if you have an array with four physical drives and a RAID 5 logical drive, you can remove, at most, one drive, because RAID 5 requires at least three physical drives.

• If the array contains a RAID 1+0 logical drive, you can remove only an even number of drives.

• If the array contains a compound RAID (RAID 50 or RAID 60) logical drive, you can remove drives only in multiples of the number of parity groups. For example, an array with 10 physical drives and a RAID 50 logical drive can be shrunk by removing two or four drives only.

Syntax:

<target> remove drives=[#:]#:#-[#:]#:#

where <target> is an array, and the specified physical drives are being removed to shrink the array.

For example, in an existing array (array a), six drives (1e:1:4-1e:1:9) are in use. With all criteria met, you can shrink the array to four drives by removing the last two drives with the command: <array a> remove drives=1e:1:8-1e:1:9

Example commands:

=> array a remove drives=1e:1:12-1e:1:14

=> array b remove drives=1c:1:6-1c:1:7

Moving an array

Some controllers may not support this option or may require a license key to enable this feature.

You can move an array by designating different physical drives for the array. To move the array, each of the physical drives where the array will reside must meet the following criteria:

• It must be an unassigned drive.

• It must be of the same type as the physical drives currently in the source array (for example, SATA or SAS).

• The destination drives must have sufficient capacity to hold all the logical drives present in the source array.

Like array creation and expansion, the useable space in all drives is reduced to the size of the smallest physical drive in the destination disk set.

Moving an array automatically removes any previously assigned spare drives. If spares are assigned to the existing array, they must be designated for the array when it is moved.

Syntax:

<target> modify drives=[#:]#:#-[#:]#:# spares=[#:]#:#-[#:]#:#

where <target> is an array, and the specified physical drives are the new destination for the array.

For example, in an existing array, three 72-GB SAS drives (1e:1:4-1e:1:6) are the source. Another drive of the same size is the spare (1e:1:9). With all criteria met, you can move the array to three different 72-

GB SAS drives by specifying the new destination drives in the command (1e:1:12-1e:1:14). To maintain the same spare drive, be sure to designate the spare drive for the moved array.

Example commands:

=> array a modify drives=1e:1:12-1e:1:14 spares=1e:1:9

=> array b modify drives=1c:1:6-1c:1:7

Secure Erase

The Secure Erase process of ACUCLI erases the data of the selected physical/logical drive. Secure erase is supported on SAP410i, SAP410, SAP212, SAP712m, SAP411, P420i, P220i, P420, P421 and P222 controllers. This feature is available on purchasing/activating the license key for these controllers.

Commands supported:

- enableeraseddrive
- erase erasepattern=zero | random_zero | random_random_zero
- deleteaftererase=yes|no
- stoperase

NOTE: Firmware takes a physical drive offline whenever an erase is queued or running. Once the erase is completed the drive needs to reenabled. If no argument is specified for "erasepattern" by default "random_random_zero" will be selected.

Examples:

```
controller slot=5 physicaldrive 1E:1:1 modify enableeraseddrive
controller slot=5 logicaldrive 1 modify erase erasepattern=zero
deleteaftererase=yes
controller slot=5 physicaldrive 1E:1:1 modify erase erasepattern=zero
controller slot=5 logicaldrive 1 modify stoperase
controller slot=5 physicaldrive 1E:1:1 modify stoperase
```

Advanced Capacity Expansion

Higher capacity migration use capacity transformation to remove logical drives by shrinking and then expanding them ONLINE. Standard migration and expansion will stay standard. ACE is supported on SAP410i, SAP410, SAP212, SAP712m, SAP411, P420i, P220i, P420, P421 and P222 controllers. This feature is available by purchasing and activating the license key for these controllers.

Probability of logical drive failure

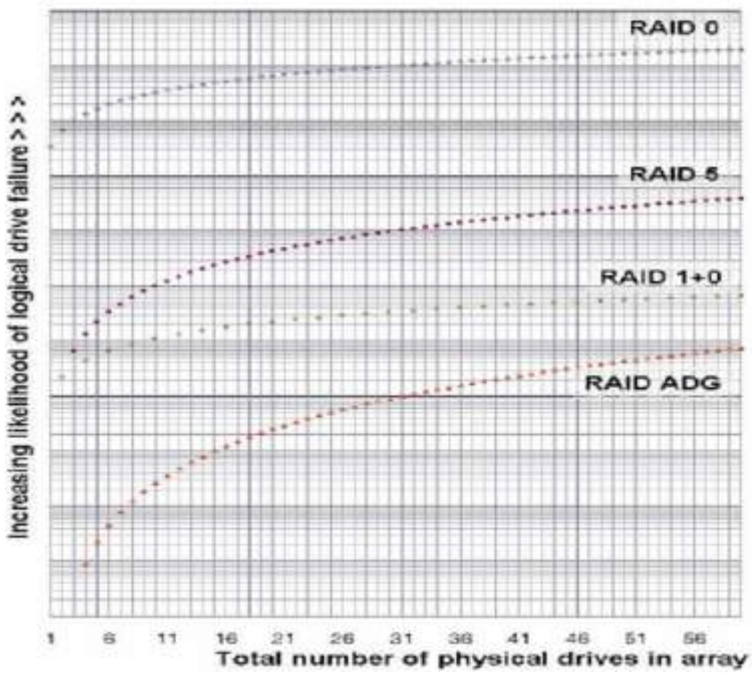
Factors involved in logical drive failure

The probability that a logical drive will fail depends on the RAID-level setting and on the number and type of physical drives in the array. If the logical drive does not have an online spare, the following results apply:

- A RAID 0 logical drive fails if only one physical drive fails.
- A RAID 1+0 logical drive fails if any two failed physical drives are mirrored to each other.
  - The maximum number of physical drives that can fail without causing failure of the logical drive is n/2, where n is the number of hard drives in the array. In practice, a logical drive usually fails before this maximum is reached. As the number of failed physical drives increases, it becomes increasingly likely that the newly failed drive is mirrored to a previously failed drive.
  - The minimum number of physical drive failures that can cause the logical drive to fail is two. This situation occurs when the two failed drives are mirrored to each other. As the total number of drives in the array increases, the probability that the only two failed drives in an array are mirrored to each other decreases.
- A RAID 5 logical drive fails if two physical drives fail.
- A RAID 6 (ADG) logical drive fails when three physical drives fail.
- RAID 50 configurations can tolerate one failed drive in each parity group.
- RAID 60 configurations can tolerate two failed drives in each parity group.
- RAID 1 (ADM) and RAID 1+0 (ADM) - Configurations can tolerate multiple drive failures if no more than two drives, mirrored to one another, fail.

At any given RAID level, the probability of logical drive failure increases as the number of physical drives in the logical drive increases. This principle is illustrated more quantitatively in the graph "Figure 1 Probability of logical drive failure vs. number of drives in array". The data for this graph is calculated from the MTBF value for a typical physical drive, assuming that no online spares are present. If an online spare is added to any of the fault-tolerant RAID configurations, the probability of logical drive failure is further decreased

Figure 1 Probability of logical drive failure vs. number of drives in array

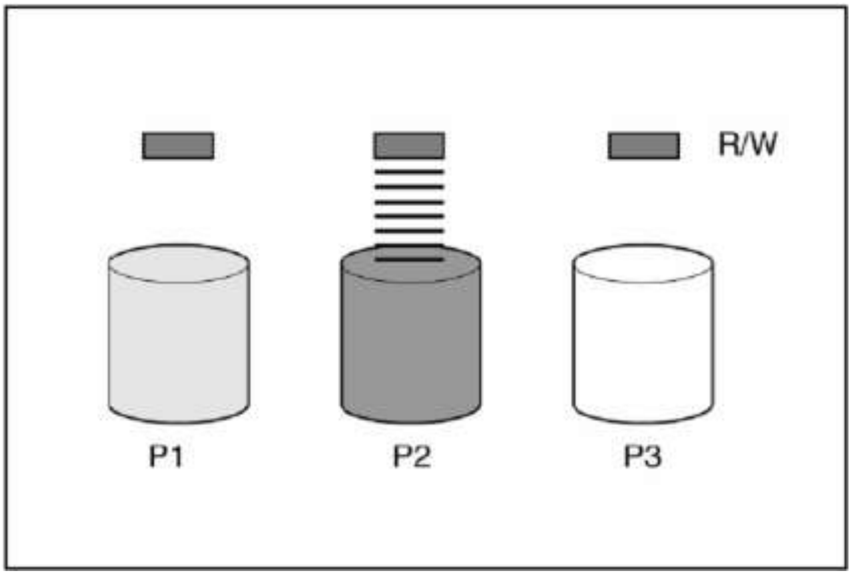


Drive arrays and fault-tolerance methods

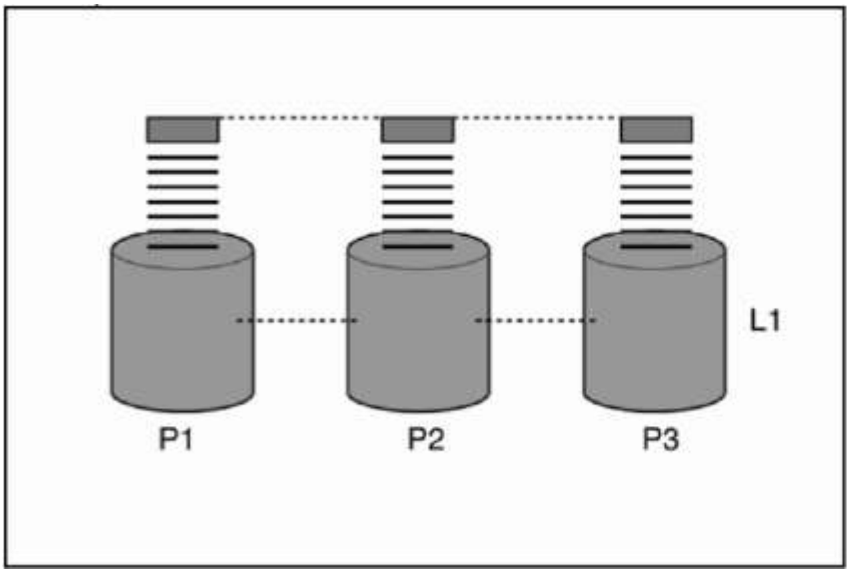
Drive arrays

The capacity and performance of a single physical (hard) drive is adequate for home users. However, business users demand higher storage capacities, higher data transfer rates, and greater protection against data loss when drives fail.

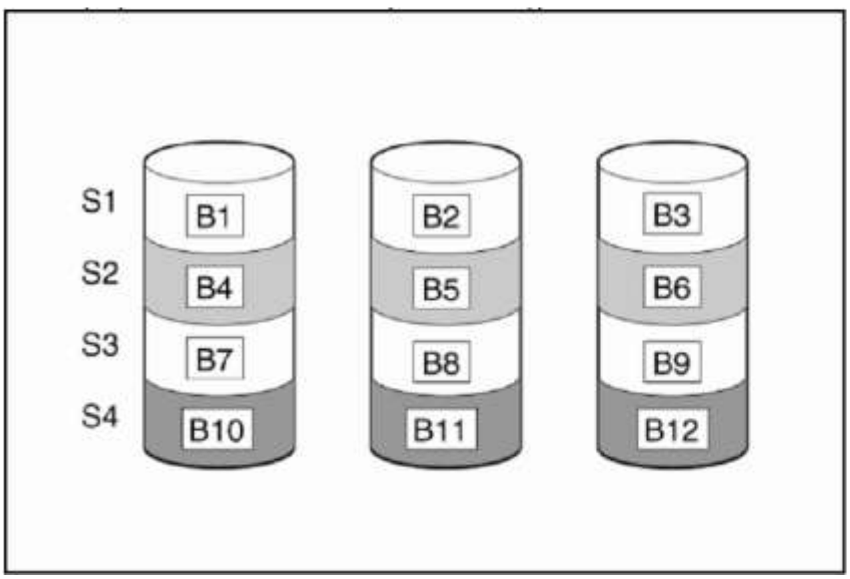
Connecting extra physical drives (P*n* in the figure) to a system increases the total storage capacity but has no effect on the efficiency of read/write (R/W) operations. Data can still be transferred to only one physical drive at a time.



With an array controller installed in the system, the capacity of several physical drives can be combined into one or more virtual units called logical drives (also called logical volumes and denoted by L*n* in the figures in this section). Then, the read/write heads of all the constituent physical drives are active simultaneously, reducing the total time required for data transfer.



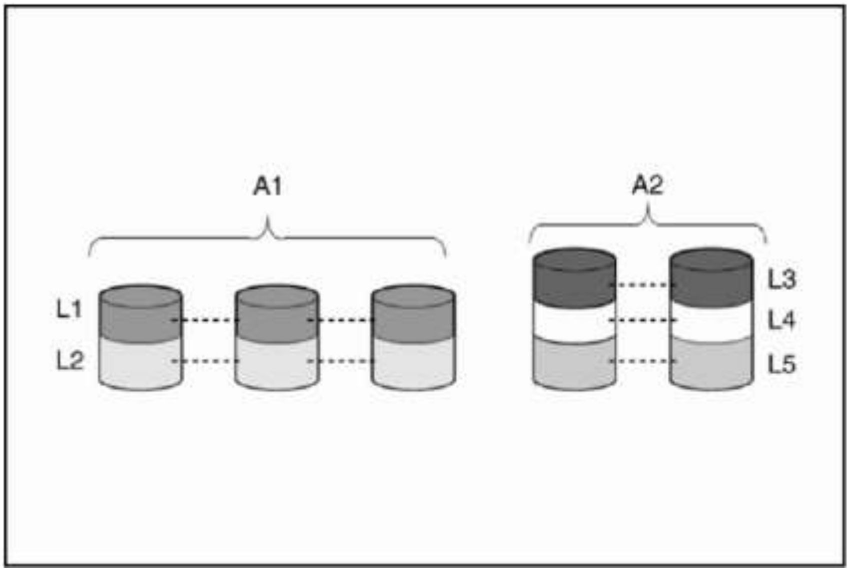
Because the read/write heads are active simultaneously, the same amount of data is written to each drive during any given time interval. Each unit of data is called a block (denoted by B*n* in the figure), and adjacent blocks form a set of data stripes (S*n*) across all the physical drives that comprise the logical drive.



For data in the logical drive to be readable, the data block sequence must be the same in every stripe. This sequencing process is performed by the array controller, which sends the data blocks to the drive write heads in the correct order.

A natural consequence of the striping process is that each physical drive in a given logical drive will contain the same amount of data. If one physical drive has a larger capacity than other physical drives in the same logical drive, the extra capacity is wasted because it cannot be used by the logical drive.

The group of physical drives containing the logical drive is called a drive array, or just array (denoted by A*n* in the figure). Because all the physical drives in an array are commonly configured into just one logical drive, the term array is often used as a synonym for logical drive. However, an array can contain several logical drives, each of a different size.



Each logical drive in an array is distributed across all of the physical drives within the array. A logical drive can also extend across more than one port on the same controller, but it cannot extend across more than one controller.

Drive failure, although rare, is potentially catastrophic. For arrays that are configured as shown in the previous figure, failure of any physical drive in the array causes every logical drive in the array to suffer irretrievable data loss. To protect against data loss due to physical drive failure, logical drives are configured with fault tolerance.

For any configuration except RAID 0, further protection against data loss can be achieved by assigning a drive as an online spare (or hot spare). This drive contains no data and is connected to the same controller as the array. When any other physical drive in the array fails, the controller automatically rebuilds information that was originally on the failed drive to the online spare. The system is thus restored to full RAID-level data protection, although it now no longer has an online spare. (However, in the unlikely event that another drive in the array fails while data is being rewritten to the spare, the logical drive will still fail.)

When you configure an online spare, it is automatically assigned to all logical drives in the same array. Additionally, you do not need to assign a separate online spare to each array. Instead, you can configure one hard drive to be the online spare for several arrays if the arrays are all on the same controller.

Fault-tolerance methods

Several fault-tolerance methods exist. Those most often used with Smart Array controllers are hardware-based RAID methods.

Two alternative fault-tolerance methods that are sometimes used are also described ("

Alternative fault-tolerance methods"). However, hardware-based RAID methods provide a much more robust and controlled fault-tolerance environment, so these alternative methods are seldom used.

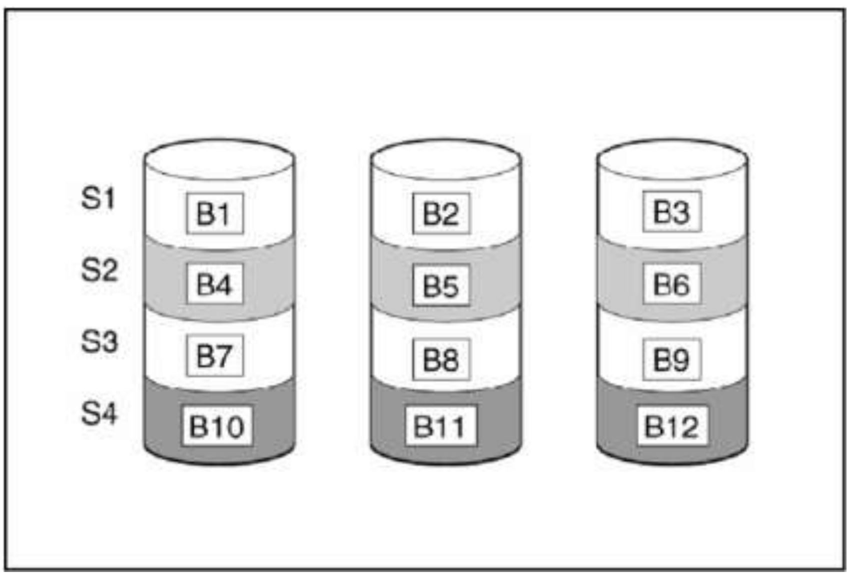
Hardware-based fault-tolerance methods

HP recommends the following hardware-based methods for use with Smart Array controllers:

- RAID 0 — Data Striping only (no fault tolerance)
- RAID 1 — Drive Mirroring
- RAID 1+0 — Drive Mirroring and Striping
- RAID 5 — Distributed Data Guarding
- RAID 6 (ADG) — Advanced Data Guarding
- RAID 50 – Striping of Distributed Parity
- RAID 60 – Striping of Double Parity
- RAID 1 (ADM) and RAID 1+0 (ADM) - Configurations can tolerate multiple drive failures if no more than two drives, mirrored to one another, fail.

RAID 0 — No fault tolerance

A RAID 0 configuration provides data striping, but there is no protection against data loss when a drive fails. However, it is useful for rapid storage of large amounts of noncritical data (for printing or image editing, for example) or when cost is the most important consideration.



Advantages:

- Has the highest write performance of all RAID methods.
- Has the lowest cost per unit of stored data of all RAID methods.
- All drive capacity is used to store data (none is needed for fault tolerance).

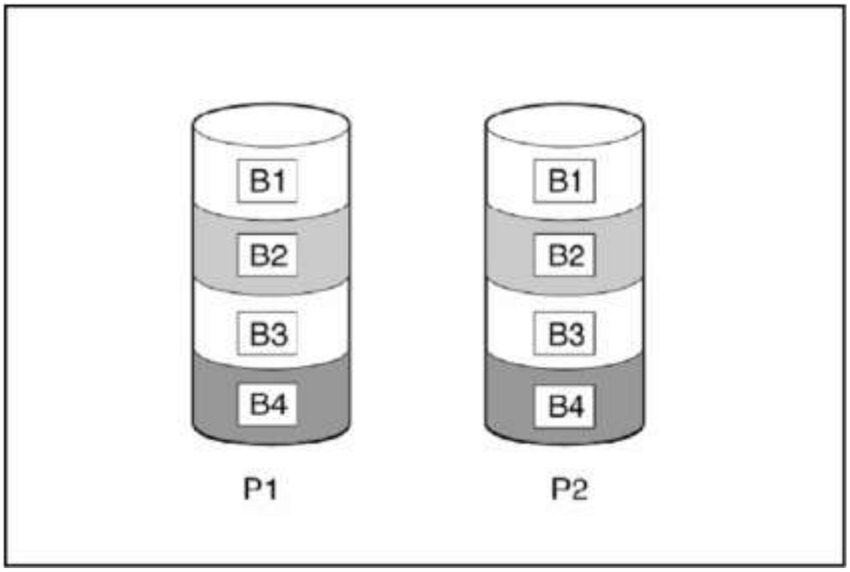
Disadvantages:

- All data on the logical drive is lost if a physical drive fails.
- Cannot use an online spare.
- Can only preserve data by backing it up to external drives.

RAID 1 — Drive mirroring

In this configuration, only two physical disks are present in the array. Data is duplicated from one disk onto the other, creating a mirrored pair of disk drives, but there is no striping of data

In a RAID 1 configuration, data is duplicated to a second drive.



Advantages:

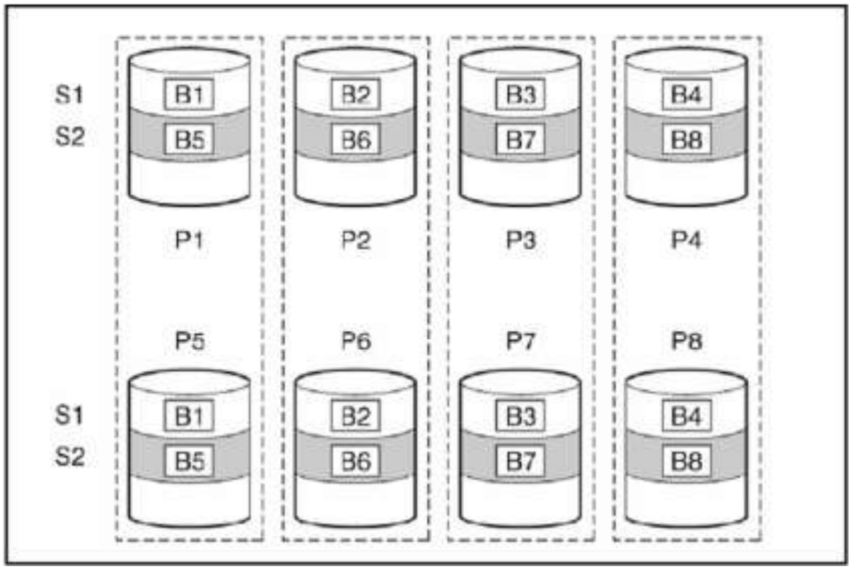
- Has the highest read performance of any fault-tolerant configuration.
- No data is lost when a drive fails, as long as no failed drive is mirrored to another failed drive (up to half of the physical drives in the array can fail).

Disadvantages:

- This method is expensive (many drives are needed for fault tolerance).
- Only half of the total drive capacity is usable for data storage.

RAID 1+0: Drive Mirroring and Striping

RAID 1+0 requires an array with four or more physical disks. The disks are mirrored in pairs and data blocks are striped across the mirrored pairs.



In each mirrored pair, the physical drive that is not busy answering other requests answers any read requests that are sent to the array. (This behavior is called load balancing.) If a physical drive fails, the remaining drive in the mirrored pair can still provide all the necessary data. Several drives in the array can fail without incurring data loss, as long as no two failed drives belong to the same mirrored pair.

This fault-tolerance method is useful when high performance and data protection are more important than the cost of physical drives.

Advantages:

- Has the highest read and write performance of any fault-tolerant configuration.
- No data is lost when a drive fails, as long as no failed drive is mirrored to another failed drive (up to half of the physical drives in the array can fail).

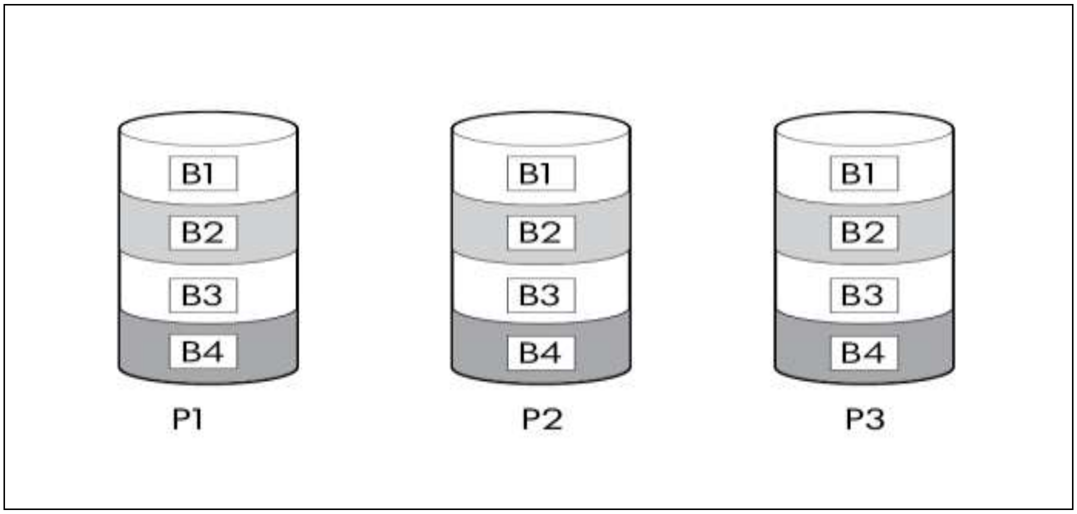
Disadvantages:

- This method is expensive (many drives are needed for fault tolerance).
- Only half of the total drive capacity is usable for data storage.

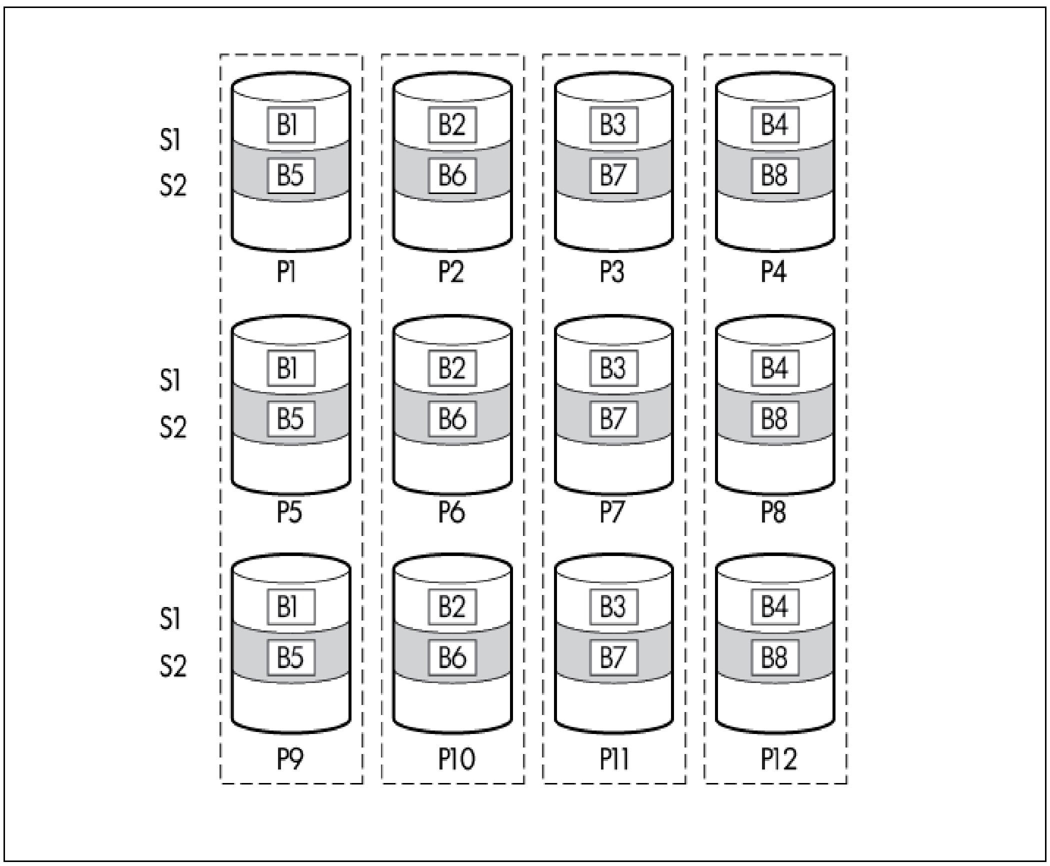
RAID 1 (ADM) and RAID 1+0 (ADM)

In RAID 1 (ADM) and RAID 1+0 (ADM) configurations, data is duplicated to two additional drives.

When the array contains only three physical drives, the fault-tolerance method is known as RAID 1 (ADM).



When the array has more than three physical drives, drives are mirrored in trios, and the fault-tolerance method is known as RAID 1+0 (ADM).



In each mirrored trio, the physical drives that are not busy answering other requests answer any read requests that are sent to the array. This behavior is called load balancing. If a physical drive fails, the remaining two drives in the mirrored trio can still provide all the necessary data. Several drives in the array can fail without incurring data loss, as long as no three failed drives belong to the same mirrored trio.

This fault-tolerance method is useful when high performance and data protection are more important than the cost of physical drives.

Advantages:

• This method has the highest read performance of any fault-tolerant configuration.

• No data is lost when two drives fail, as long as no two failed drives are mirrored to another failed drive.

• Up to two-thirds of the physical drives in the array can fail.

Disadvantages:

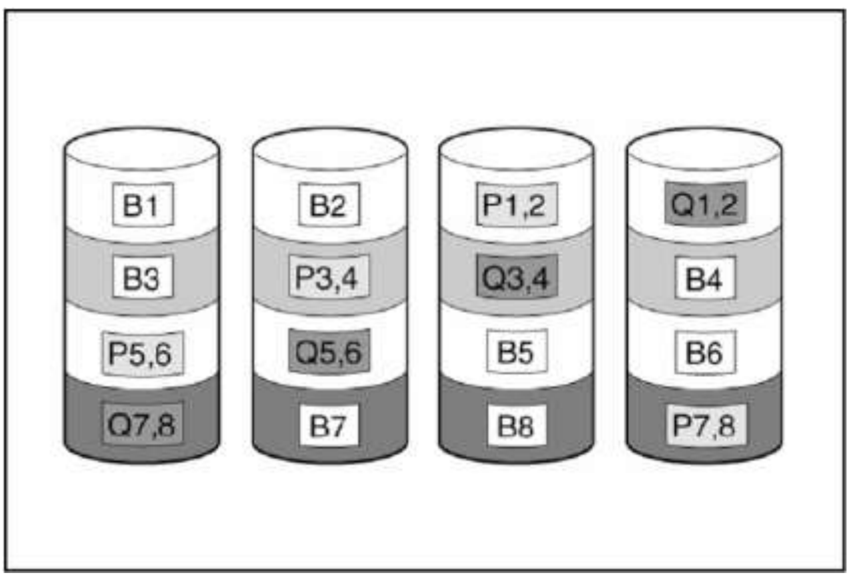
• This method is expensive, because many drives are needed for fault tolerance.

• Only one-third of the total drive capacity is usable for data storage.

RAID 6 (ADG) — Advanced Data Guarding

NOTE: Not all controllers support RAID 6 (ADG).

RAID 6 (ADG), like RAID 5, generates and stores parity information to protect against data loss caused by drive failure. With RAID 6 (ADG), however, two different sets of parity data are used (denoted by Px,y and Qx,y in the figure), allowing data to still be preserved if two drives fail. Each set of parity data uses a capacity equivalent to that of one of the constituent drives.



This method is most useful when data loss is unacceptable but cost is also an important factor. The probability that data loss will occur when an array is configured with RAID 6 (ADG) is less than it would be if it was configured with RAID 5.

Advantages:

- This method has a high read performance.
- This method allows high data availability - Any two drives can fail without loss of critical data.

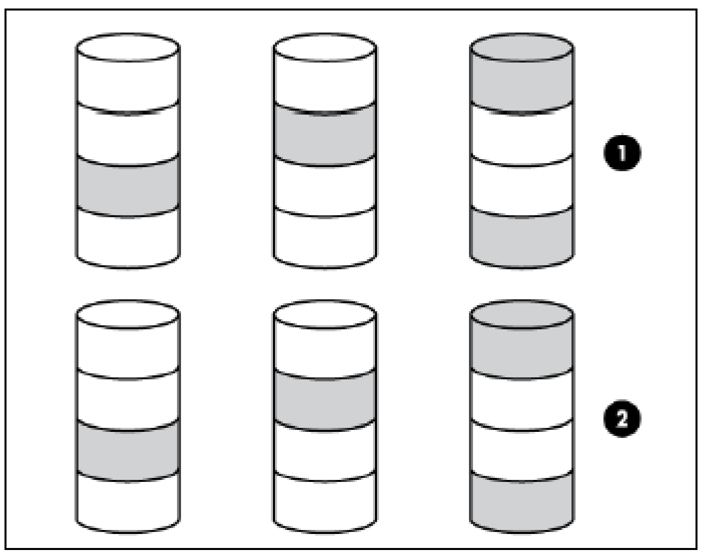
- More drive capacity is usable than with RAID 1 +0 - Parity information requires only the storage space equivalent to two physical drives.

Disadvantages:

- The main disadvantage of RAID 6 (ADG) is a relatively low write performance (lower than RAID 5) because of the need for two sets of parity data.

RAID 50 – Striping of Distributed Parity

RAID 50 is a nested RAID method in which the constituent hard drives are organized into several identical RAID 5 logical drive sets (parity groups). The smallest possible RAID 50 configuration has six drives rganized into two parity groups of three drives each.For any given number of hard drives, data loss is least likely to occur when the drives are arranged intothe configuration that has the largest possible number of parity groups. For example, four parity groups of three drives are more secure than three parity groups of four drives. However, less data can be stored on the array with the larger number of parity groups.RAID 50 is particularly useful for large databases, file servers, and application servers.



Advantages:

- Higher performance than for RAID 5, especially during writes.
- Better fault tolerance than either RAID 0 or RAID 5.
- Up to n physical drives can fail (where n is the number of parity groups) without loss of data, as long as the failed drives are in different parity groups.

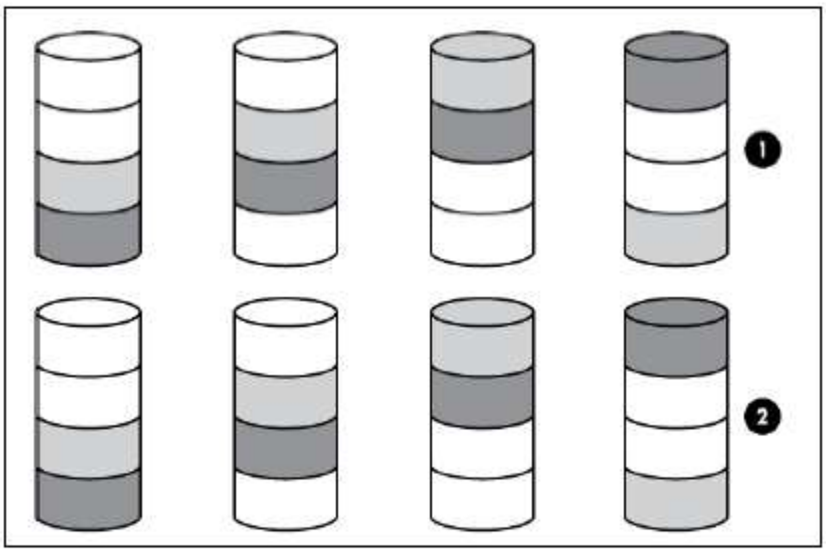
Disadvantages:

- All data is lost if a second drive fails in the same parity group before data from the first failed drive has finished rebuilding.

- A greater percentage of array capacity is used to store redundant or parity data than with nonnested RAID methods.

RAID 60 – Striping of Double Parity

RAID 60 is a nested RAID method in which the constituent hard drives are organized into several identical RAID 6 logical drive sets (parity groups). The smallest possible RAID 60 configuration has eight drives organized into two parity groups of four drives each.For any given number of hard drives, data loss is least likely to occur when the drives are arranged into the configuration that has the largest possible number of parity groups. For example, five parity groups of four drives are more secure than four parity groups of five drives. However, less data can be stored on the array with the larger number of parity groups.RAID 60 is particularly useful for data archives and high-availability solutions.



Advantages:

- Higher performance than for RAID 6, especially during writes.
- Better fault tolerance than either RAID 0 or RAID 6.
- Up to 2n physical drives can fail (where n is the number of parity groups) without loss of data, as long as no more than two failed drives are in the same parity group.

Disadvantages:

- All data is lost if a third drive in a parity group fails before one of the other failed drives in the parity group has finished rebuilding.
- A greater percentage of array capacity is used to store redundant or parity data than with nonnested RAID methods.

Comparing the hardware-based RAID methods

NOTE: Not all controllers support RAID 6 (ADG).

Table 4 Create logic drive parameters

Item	RAID 0	RAID 1+0	RAID 5	RAID 6 (ADG)	RAID 1(0) (ADM)
Alternative name	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding	Advanced Data Guarding	Advanced Data Mirroring
Formula for numberof drives usable for data (n = total number of drives in array)	n	n/2	n-1	n-2	n/3
Fraction of drive space usable*	100%	50%	67% to 93%	50% to 96%	33%
Minimum number of physical drives	1	2	3	4	3
Tolerates failure of one physical drive	No	Yes	Yes	Yes	Yes
Tolerates simultaneous failure of more than one physical drive	No	Only if no two failed drives are in the same mirrored pair	No	Yes	Only if no three drives are in the same mirror group
Read performance	High	High	High	High	High
Write performance	High	Medium	Low	Low	Medium
Relative cost	Low	High	Medium	Medium	Very high

*Values for the fraction of drive space usable are calculated with these assumptions: (1) all physical drives in the array have the same capacity; (2) online spares are not used; (3) no more than 14 physical drives are used per array for RAID 5; and (4) no more than 56 drives are used with RAID 6 (ADG).

Selecting a RAID method

NOTE: Not all controllers support RAID 6 (ADG).

Table 5 Create logic drive parameters

Most important criterion	Also important	Suggested RAID level
Fault tolerance	Cost effectiveness I/O performance	RAID 6 (ADG), RAID 1+0 (ADM), RAID 1 +0, RAID 50, RAID 60
Cost effectiveness	Fault tolerance I/O performance	RAID 6 (ADG) RAID 5 (RAID 0 if fault tolerance is not required)
I/O performance	Cost effectiveness Fault tolerance	RAID 5 (RAID 0 if fault tolerance is not required) RAID 1+0 (ADM), RAID 1+0, RAID 50, RAID 60

Alternative fault-tolerance methods

Your operating system may also support software-based RAID or controller duplexing.

Software-based RAID resembles hardware-based RAID, except that the operating system works with logical drives as if they were physical drives. To protect against data loss caused by physical drive failure, each logical drive must be in a different array from the others.

Controller duplexing uses two identical controllers with independent, identical sets of drives containing identical data. In the unlikely event of a controller failure, the remaining controller and drives will service all requests.

Neither of these alternative fault-tolerance methods supports online spares or automatic data recovery, nor do they support auto-reliability monitoring or interim data recovery.

If you decide to use one of these alternative methods, configure your arrays with RAID 0 for maximum storage capacity and refer to your operating system documentation for further implementation details.

Diagnosing array problems

Diagnostic tools

Several diagnostic tools provide feedback about problems with arrays. The most important are:

ADU

This utility is available on both the SmartStart CD and the HP website - **http://www.hp.com/support**. The meanings of the various ADU error messages are provided in the HP Servers Troubleshooting Guide.

POST messages

Smart Array controllers produce diagnostic error messages at reboot. Many of these POST messages are self-explanatory and suggest corrective actions. For more information about POST messages, refer to the HP Servers Troubleshooting Guide.

Server Diagnostics

To use Server Diagnostics:

1. Insert the SmartStart CD into the server CD-ROM drive.
2. Click Agree when the license agreement appears, and click the Maintenance tab.
3. Click Server Diagnostics, and follow the on-screen prompts and instructions.

Glossary

ADG	Advanced Data Guarding (also known as RAID 6)
ADU	Array Diagnostics Utility
ADM	Advanced Data Mirroring
MSA	Modular Smart Array
MTBF	Mean Time Between Failures
POST	Power-On Self Test