Configuring Arrays on HP Smart Array Controllers
Reference Guide

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Audience assumptions

This document is for the person who installs, administers, and troubleshoots servers and storage systems. HP assumes you are qualified in the servicing of computer equipment and trained in recognizing hazards in products with hazardous energy levels.

Contents

Overview of array configuration tools

In this section

Utilities available for configuring an array

Three utilities are available for configuring an array on an HP Smart Array controller: ORCA, CPQONLIN, and ACU.

- ORCA is a simple utility that is used mainly to configure the first logical drive in a new server before the operating system is loaded.
- CPQONLIN is a more full-featured utility for online configuration of servers that use Novell NetWare.
- ACU is an advanced utility that enables you to perform many complex configuration tasks.

Before you use a utility, refer to the list of features and supported tasks for each utility ("Comparison of the utilities" on page 5) to confirm that the utility fulfills your requirements.

Whichever utility you use, remember the following factors when you build an array:

- All drives in an array must be of the same type (for example, all SAS or all SATA).
- For the most efficient use of drive space, all drives within an array should have approximately the same capacity. Each configuration utility treats every physical drive in an array as if it has the same capacity as the smallest drive in the array. Any excess capacity of a particular drive cannot be used in the array and so is unavailable for data storage.
- The more physical drives that there are in an array, the greater the probability that the array will experience a drive failure during any given period ("Probability of logical drive failure vs. number of drives in array" on page 68). To guard against the data loss that occurs when a drive fails, configure all logical drives in an array with a suitable fault-tolerance (RAID) method ("Drive arrays and fault-tolerance methods" on page 69).

Comparison of the utilities

Feature	ACU	CPQONLIN	ORCA
Interface	GUI, CLI, scripting	Menu-based	Menu-based or CLI
Languages	English. The GUI is also available in French, German, Italian, Japanese, and Spanish.	Only English	Only English
Source of executable file	Software CD or Web	Software CD or Web	Preinstalled in ROM of HP Smart Array controllers

Feature	ACU	CPQONLIN	ORCA
When the utility can be used	For the GUI, any time (to run the GUI before the operating system is installed, boot from the software CD). For the CLI and scripting, any time the operating system is running	Any time the operating system is running	During POST, before the operating system is installed
Where the utility can be used	On the local server; can also be used over a network if the servers are both running Linux or Microsoft® Windows®	Only on the local server	Only on the local server

ORCA supports only the most basic configuration tasks, whereas CPQONLIN and ACU support the full range of standard tasks ("Support for standard configuration tasks" on page 6). ACU also supports several advanced tasks ("Support for advanced configuration tasks" on page 6), but some of these tasks are not available in every ACU interface format (GUI, CLI, and scripting).

Support for standard configuration tasks

NOTE: A + in the appropriate column indicates that the feature or procedure is supported, while – indicates that the feature or procedure is not supported.

Procedure	ACU	CPQONLIN	ORCA
Create or delete arrays and logical drives	+	+	+
Assign a RAID level to a logical drive	+	+	+
Identify devices by causing their LEDs to illuminate	+	+	–
Configure SSP	+	+*	–
Assign a spare drive to an array	+	+	+
Share a spare drive among several arrays	+	+	–
Assign multiple spare drives to an array	+	+	–
Specify the size of the logical drive	+	+	–
Create multiple logical drives per array	+	+	–
Set the stripe size	+	+	–
Migrate the RAID level or stripe size	+	+	–
Expand an array	+	+	–
Set the expand priority, migrate priority, and accelerator ratio	+	+	–
Extend a logical drive	+	–	–
Set the boot controller	–	–	+

*Supported only in the MSA1000 and MSA1500.

Support for advanced configuration tasks

NOTE: A + in the appropriate column indicates that the feature or procedure is supported, while – indicates that the feature or procedure is not supported.

Procedure	ACU GUI	ACU CLI	ACU scripting
Configure several systems identically	+*	+*	+
Configure switches	+	–	–

Procedure	ACU GUI	ACU CLI	ACU scripting
Copy the configuration of one system to several other systems	–	–	+
Disable a redundant controller	+**	+	–
Enable or disable physical drive write cache on an MSA20	+	+	–
Identify devices by causing their LEDs to flash	+	+	–
Re-enable a failed logical drive	+	+	–
Set the surface scan delay	+	+	+
Set the preferred controller for a logical drive (in systems that support redundant controllers)	+**	+	+
Split a RAID 1 array or recombine a split array	+	–	–

*Scripting is more efficient for this task.

**Supported only in the Standard mode of the GUI.

ORCA

In this section

About ORCA

ORCA is a ROM-resident array configuration utility that automatically executes during initialization of an HP Smart Array controller. This utility is designed to enable a logical drive to be configured on a new HP server before the operating system is installed.

- If the boot drive has not been formatted and the boot controller is connected to six or fewer physical drives, ORCA runs as part of the auto-configuration process when the new server is first powered up. During this auto-configuration process, ORCA uses all of the physical drives on the controller to set up the first logical drive. The RAID level used for the logical drive depends on the number of physical drives (one drive = RAID 0; two drives = RAID 1+0; three to six drives = RAID 5). If the drives have different capacities, ORCA locates the smallest drive and uses the capacity of that drive to determine how much space to use on each of the other drives.
- If the boot drive has been formatted or if there are more than six drives connected to the controller, you are prompted to run ORCA manually.

For more information about the auto-configuration process, see the *HP ROM-Based Setup Utility User Guide* on the Documentation CD that is supplied with the server.

ORCA uses a menu-driven interface ("Using the ORCA menu-driven interface" on page 9), and new server and controller models also support a CLI format ("Using the ORCA CLI" on page 8). Either format provides a quick and easy way of configuring a basic logical drive. Both formats support relatively few configuration tasks ("Support for standard configuration tasks" on page 6), but these few tasks are adequate if your configuration needs are simple. For example, stripe size is predetermined by the RAID level that you choose, and the size of the logical drive is automatically determined by the size of the physical drives that you select.

Using the ORCA CLI

1. Power up the server.

   POST runs.

   If the BIOS interface is in Auto mode, change it to Command Line mode as follows:

   a. Press the **F9** key to open RBSU when prompted during POST.
   b. In RBSU, select **BIOS Serial Console & EMS>BIOS Interface Mode.**
   c. Change the setting to Command Line.
   d. Press the **Esc** key to exit RBSU, and then press the **F10** key to confirm that you want to exit.

      The server reboots, and POST runs again.

During POST, all controllers in the server are initialized one at a time in the current boot order sequence. If a controller is connected to one or more hard drives, a message appears during the initialization process for that controller, prompting you to start ORCA.

2. At the ORCA prompt for the controller that you want to configure, press the **F8** key.

   The ORCA command line prompt appears.

3. Enter the command for the task that you want to perform. For information about command syntax and to see a list of possible commands, enter `help`.

4. If you create a logical drive, format it when you install the operating system. If the operating system is already installed, follow the instructions for formatting logical drives that are given in the operating system documentation.

Using the ORCA menu-driven interface

1. Power up the server.

   POST runs.

   If the BIOS interface is in Command Line mode, change it to Auto mode as follows:

   a. Press the **F9** key to open RBSU when prompted during POST.

   b. Enter the following text to set the BIOS interface mode to Auto:

      ```
      set config bios interface mode 1
      ```

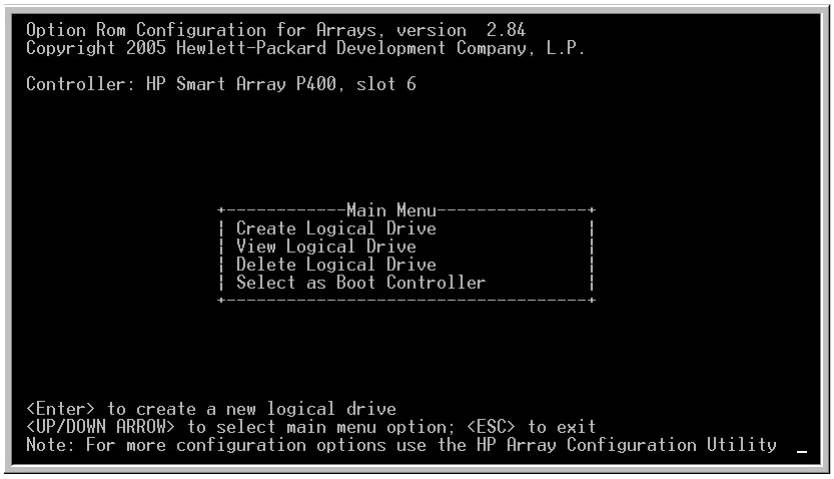
   c. Press the **Esc** key to exit RBSU, and then press the **F10** key to confirm that you want to exit.

      The server reboots, and POST runs again.

   During POST, all controllers in the server are initialized one at a time in the current boot order sequence. If a controller is connected to one or more hard drives, a message appears during the initialization process for that controller, prompting you to start ORCA.

2. At the ORCA prompt for the controller that you want to configure, press the **F8** key.

   The ORCA main menu appears, enabling you to create, view, or delete a logical drive.



To create a logical drive:

1. Select **Create Logical Drive.**

   The screen displays a list of all available (unconfigured) physical drives and the valid RAID options for the system.

2. Press the arrow keys, spacebar, and **Tab** key to navigate around the screen and set up the logical drive, including an online spare drive if one is required.

3. Press the **Enter** key to accept the settings.

4. Press the **F8** key to confirm the settings and save the new configuration.

   After several seconds, the Configuration Saved screen appears.
5. Press the **Enter** key to continue.
6. (Optional) Create additional logical drives by repeating steps 2 through 5.
7. Format the logical drive.
   - If you have not yet installed the operating system, format the logical drive when you install the operating system.
   - If the operating system is already installed, format the logical drive as described in the operating system documentation.

CPQONLIN

In this section

About CPQONLIN

The HP Online Array Configuration Utility for NetWare (CPQONLIN) enables you to configure an array on a NetWare server while the server is online. If you want to configure an array when the server is offline, use ACU ("Configuring a server using ACU located on the SmartStart CD" on page 20) instead of CPQONLIN.

To install CPQONLIN, get the appropriate Smart Component from the HP website (http://h18000.www1.hp.com/support/files/index.html) or the software CD that is provided with the controller. Installation instructions are provided with the component.

Summary of configuration procedure using CPQONLIN

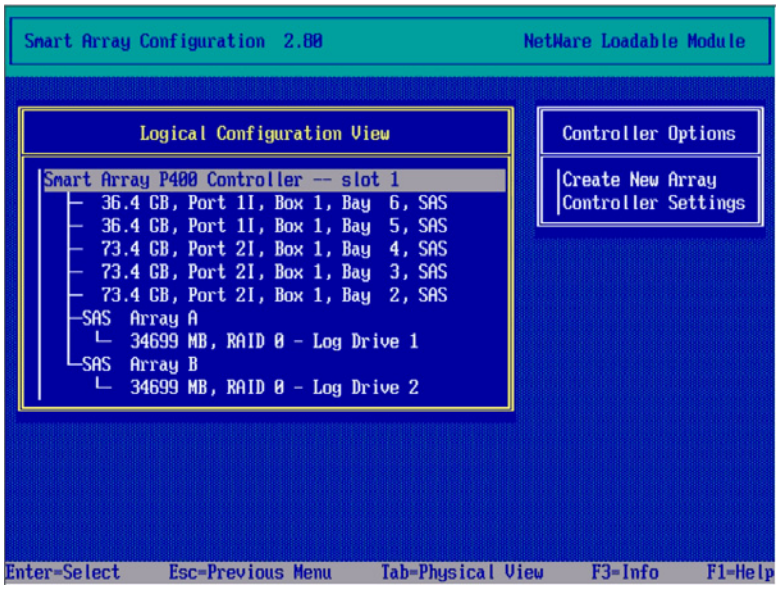
1. At the console prompt, enter `cpqonlin`.
2. Press the arrow keys to scroll the highlight to the Array Configuration Utility menu item, and then press the **Enter** key.

   The screen displays a list of the controllers in the server.
3. Scroll to the controller that you want to configure and then press the **Enter** key.
   - If there are no logical drives connected to the controller, an auto-configuration wizard opens and displays the optimum configuration for the drives on the controller. You can accept the suggested configuration, modify just the RAID level of any logical drives, or use the Custom Configuration option to completely reconfigure the drives manually ("Operating CPQONLIN in manual configuration mode" on page 11).
   - If there is at least one logical drive connected to the controller, CPQONLIN continues in manual configuration mode ("Operating CPQONLIN in manual configuration mode" on page 11). Press the arrow, **Enter,** and **Esc** keys to navigate around the screen and set up the new logical drive. To get online help at any time, press the **F1** key.
4. When you have finished configuring the array, save the changes as prompted.
5. To make new logical drives available for data storage, format them using the instructions given in the operating system documentation.

Operating CPQONLIN in manual configuration mode

When CPQONLIN opens in manual configuration mode, the screen displays two panels.

- The main panel is the Logical Configuration View panel, which shows the selected controller and a tree of all arrays, logical drives, and unassigned physical drives that are connected to the controller. (To toggle to the physical configuration view, press the **Tab** key.)
- The secondary panel displays a menu of configuration options ("Menu options in CPQONLIN" on page 12) for the item that is highlighted in the Logical Configuration View panel.



To begin the configuration process, scroll the highlight to the item listed in the main panel that you want to configure and then press the **Enter** key. The highlight jumps to the secondary panel, where you can continue the configuration process using the same method (scroll to a menu item, and then press the **Enter** key). To return the highlight to the previous panel at any time in the configuration process, press the **Esc** key.

For help, press the **F1** key.

Detailed procedures for common tasks are described in "Typical manual configuration procedures (on page 13)."

Menu options in CPQONLIN

Menu options are visible only if they are applicable. For example, if you highlight the controller in the Logical Configuration View panel and the controller does not have any unassigned physical drives, the Controller Options menu does not display the Create New Array menu option.

- Controller Options menu (appears in the secondary panel when the controller is highlighted in the Logical Configuration View panel)

Menu option	Result of selecting the option
Controller Settings	A new panel opens, displaying settings for three options: Rebuild Priority, Expand Priority, and Accelerator Ratio.
Create New Array	Three panels open: • Create Array (displays a menu with the following options: Assign Drive, Assign Spare, Remove Drive, and Accept Changes) • Physical Drives (lists the spare drives and unassigned physical drives that are connected to the controller) • New Array (shows the updated physical configuration view)

- Array Options menu (appears in the secondary panel when an array is highlighted in the Logical Configuration View panel)

Menu option	Result of selecting the option
Expand Array	Three panels open: • Expand Array (displays a menu with the following options: Assign Drive, Remove Spare, and Accept Changes) • Physical Drives (lists the spare drives and unassigned physical drives that are connected to the controller) • Expand Existing Array (shows the updated physical configuration view)
Assign Spare	A new panel opens, displaying a menu of the valid drives.
Remove Spare	A new panel opens, displaying the spares.
Delete Entire Array	The data and all the logical drive structures on the array are deleted.

- Logical Drive Options menu (appears in the secondary panel when a logical drive is highlighted in the Logical Configuration View panel)

Menu option	Result of selecting the option
Delete	The data and the logical drive structure on the array are deleted.
Drive Settings	A new panel opens, displaying settings for two options: Fault Tolerance and Stripe Size.
SSP Settings*	A new panel opens, displaying the Enable or Disable option.

*This menu option is available only with the MSA1000 and MSA1500.

Typical manual configuration procedures

This section describes the procedures for the following common tasks:

- Creating a new array and logical drive (on page 13)
- Adding spare drives (on page 14)
- Setting the rebuild priority or expand priority (on page 15)
- Setting the accelerator ratio (on page 15)
- Expanding an array (on page 15)
- Migrating RAID level or stripe size (on page 16)

Creating a new array and logical drive

1. Open CPQONLIN and select the controller that you want to configure.

   The Logical Configuration View panel appears.
2. Press the **Enter** key.

   The highlight moves to the Controller Options panel.
3. Highlight the **Create New Array** option, and then press the **Enter** key.

   The screen displays three panels (Create Array, Physical Drives, and New Array), and the highlight moves to the Create Array panel.

4. Highlight the **Assign Drive** option, and then press the **Enter** key.

   The highlight moves to the Physical Drives panel.
5. Highlight a drive that you want to be part of the array, and then press the **Enter** key.

   The New Array panel displays the added drive, and the highlight returns to the Create Array panel.
6. Repeat steps 4 and 5 until you have finished building the array.
   - For the most efficient use of drive space, select physical drives of comparable capacity.
   - For optimum system performance, select physical drives that are connected to different ports on the controller.
   - If you intend to create a RAID 5 configuration, keep the risk of logical drive failure low by assigning no more than 14 physical drives to the array.
   - Do not select any physical drives that you want to be spare drives. Spare drives are created in a separate procedure ("Adding spare drives" on page 14).
7. Highlight the **Accept Changes** menu option, and then press the **Enter** key.

   The Create New Logical Drive panel appears.
8. Select the RAID level that you want the logical drive to use, and then press the **Enter** key.
9. Select the stripe size that you want the logical drive to use, and then press the **Enter** key.
10. Enter the capacity that you want the logical drive to have, and then press the **Enter** key.
11. Press the **Esc** key to save the settings and return to the Logical Configuration View panel.
12. To make new logical drives available for data storage, format them using the instructions given in the operating system documentation.

Adding spare drives

Assigning one or more online spare drives 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 of its physical drives are simultaneously in a failed state, regardless of the number of spare drives assigned to the array.

Any drive that you want to use as a spare must meet the following criteria:

- It must be an unassigned drive or a spare for another array.
- It must be of the same type as existing drives in the array (for example, SATA or SAS).
- It must have a capacity no less than that of the smallest drive in the array.

To add a spare drive to an array:

1. In the Logical Configuration View panel, highlight the array that needs a spare, and then press the **Enter** key.
2. In the Array Options menu, highlight the **Assign Spare** option, and then press the **Enter** key.

   The screen displays the Valid Spares Selection(s) panel, which displays only the drives that qualify to be spares for the selected array. If a drive that you expect to see is not listed, it might have too small a capacity compared to the other drives in the array. Press the **Tab** key to toggle to the physical configuration view and check the drive size.
3. Highlight the drive that you want to assign as a spare, and then press the **Enter** key.
4. (Optional) Add more spares to the array by repeating step 3.
5. When you have finished assigning spares, press the **Esc** key to return the highlight to the Array Options menu.

Setting the rebuild priority or expand priority

The settings that you use for the rebuild priority and expand priority features determine how much importance you want an array rebuild or expansion to have relative to normal I/O operations.

- At the low priority setting, the rebuild or expansion takes place only when the controller is not busy handling normal I/O requests. This setting has minimal effect on normal I/O operations. However, an array that is rebuilt at this setting must operate for an extended time with possibly compromised fault tolerance during the rebuild, and if another physical drive fails during this time, you could lose data.
- At the medium priority setting, rebuild or expansion occurs for half of the time, and normal I/O requests are handled during the rest of the time.
- At the high priority setting, the rebuild or expansion occurs at the expense of normal I/O operations. Although system performance is affected, this setting provides better data protection because the array is vulnerable to drive failure for a shorter time.

To modify either of these settings:

1. In the Logical Configuration View panel, highlight the controller, and then press the **Enter** key.

   The highlight moves to the Controller Options panel.
2. Highlight the **Controller Settings** option, and then press the **Enter** key.

   The Controller Settings panel appears.
3. Highlight the rebuild priority setting that you want this controller to use, and then press the **Enter** key. (This setting applies only to logical drives that have been configured with RAID 1+0, RAID 5, or RAID 6 fault tolerance because only these logical drives can be rebuilt.)
4. Repeat step 3 for the expand priority setting.
5. Press the **Esc** key to save the settings and return to the Logical Configuration View panel.

Setting the accelerator ratio

The setting that you use for the accelerator ratio feature determines how much of the cache memory is allocated to read-ahead cache and how much to posted-write cache. Different applications have different optimum settings. This setting applies only if the controller uses a battery-backed cache.

To modify the accelerator ratio:

1. In the Logical Configuration View panel, highlight the controller, and then press the **Enter** key.

   The highlight moves to the Controller Options panel.
2. Highlight the **Controller Settings** option, and then press the **Enter** key.

   The Controller Settings panel appears.
3. Highlight the accelerator ratio setting that you want this controller to use, and then press the **Enter** key.
4. Press the **Esc** key to save the settings and return to the Logical Configuration View panel.

Expanding an array

You can increase the storage space on an array by adding physical drives. Any drive that you want to add must meet the following criteria:

- It must be an unassigned drive.
- It must be of the same type as existing drives in the array (for example, SATA or SAS).
- It must have a capacity no less than that of the smallest drive in the array.

When you want to expand an array, allow about 15 minutes per gigabyte for the expansion to be completed. During this time, the controller cannot perform any other expansion or migration. Performance might be degraded slightly during the expansion, depending on the Expand Priority setting ("Setting the rebuild priority or expand priority" on page 15). To minimize any effect on normal server operations, expand an array during periods of low server use.

To expand an array:

1. Back up all data on the array. Although array expansion is unlikely to cause data loss, observing this precaution provides extra data security.
2. Confirm that the cache battery is connected and fully charged.
3. In the Logical Configuration View panel, highlight the array, and then press the **Enter** key.
4. In the Array Options menu, highlight the **Expand Array** option, and then press the **Enter** key.

   The screen displays three panels (Expand Array, Physical Drives, and Expand Existing Array), and the highlight moves to the Expand Array panel.
5. Highlight the **Assign Drive** option, and then press the **Enter** key.

   The highlight moves to the Physical Drives panel.
6. Highlight a physical drive that you want to add to the array, and then press the **Enter** key. (For optimum use of drive capacity, select a drive that has the same capacity as other drives in the array.)

   The highlight returns to the Expand Array panel.
7. (Optional) Repeat steps 5 and 6 to add more drives.
8. Highlight the **Accept Changes** option, and then press the **Enter** key.
9. Press the **Esc** key to begin the array expansion and return to the Logical Configuration View panel.

To view the progress of the array expansion, press the **F3** key, and then scroll to the progress bar near the bottom of the screen.

Migrating RAID level or stripe size

When you want to migrate the RAID level or stripe size, allow about 15 minutes per gigabyte for the migration to be completed. During this time, the controller cannot perform any other expansion or migration. Performance might be degraded slightly during the migration, depending on the Expand Priority and Rebuild Priority settings ("Setting the rebuild priority or expand priority" on page 15). To minimize any effect on normal server operations, migrate during periods of low server use.

To perform a migration:

1. Back up all data on the array. Although migration is unlikely to cause data loss, observing this precaution provides extra data security.
2. Confirm that the cache battery is connected and fully charged.
3. In the Logical Configuration View panel, highlight the logical drive and then press the **Enter** key.

   The highlight moves to the Logical Drive Options panel.
4. Highlight the **Drive Settings** option, and then press the **Enter** key.

   The Drive Settings panel appears.
5. Modify the Fault Tolerance and Stripe Size settings on this panel to meet your needs.
6. Press the **Esc** key to begin the migration and return to the Logical Configuration View panel.

To view the progress of the migration, press the **F3** key, and then scroll to the progress bar near the bottom of the screen.

ACU

In this section

About ACU

ACU is the main tool for configuring arrays on HP Smart Array controllers. It exists in three interface formats (GUI, CLI, and scripting), each of which supports all of the standard configuration tasks ("Support for standard configuration tasks" on page 6). It also supports several advanced tasks ("Support for advanced configuration tasks" on page 6), some of which are not available in all formats.

To install ACU, locate the executable file located on the HP website (http://h18000.www1.hp.com/support/files/index.html) or on the software CD that is supplied with the controller and follow the instructions that are given with the executable. The GUI and CLI have separate executables, while scripting capability is provided as part of the GUI.

For information about the minimum monitor settings and the version numbers of supported operating systems and browsers, see the README.txt file that is provided with the executable.

Using the ACU GUI

Before you can use the ACU GUI, you must open it. The method for opening the GUI depends on how you will use it.

- Using the GUI as a local application on a server that has ACU installed ("Configuring a server that has ACU installed" on page 17)
- Using the GUI as a service on a local host in a Windows® or Linux environment to configure a remote server ("Configuring a remote server using ACU located on a local server" on page 18)
- Using the GUI as a service on a remote host in a Windows® or Linux environment to configure a local server ("Configuring a local server using ACU located on a remote server" on page 19)
- Using the GUI directly from the SmartStart CD ("Configuring a server using ACU located on the SmartStart CD" on page 20)

When the GUI is open, the procedure for configuring an array is independent of how you use the GUI. However, you must still choose an operating mode ("GUI operating modes" on page 21).

Configuring a server that has ACU installed

1. Click **Start,** and select **Setup HP Array Configuration Utility.**

   The Execution Mode screen appears.

   - If the Local Application Mode option is selected, continue with step 2.

- If the Remote Service Mode option is selected, change to Local Application mode, reboot the server, and then continue with step 2.

2. Click **Start,** and select **Programs>HP System Tools>HP Array Configuration Utility.**

   The browser opens and launches ACU, which then identifies the controllers that are connected to the system. This process could take a minute or two. When controller detection is complete, the controllers are listed on the left side of the screen.

3. Select a controller from the list.

   The main ACU configuration screen appears.

4. Select the operating mode ("GUI operating modes" on page 21) that you want to use.
5. Configure the controller. (For details, see "Using Express mode (on page 21)," "Using the Configuration Wizards mode (on page 24)," or "Using Standard Configuration mode (on page 23).")
6. Save the configuration as prompted.
7. Select another controller to configure, or exit ACU.
8. If you changed to Local Application mode in step 1, return ACU to Remote Service mode when you have finished configuring arrays on this server, and then reboot.
9. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

Configuring a remote server using ACU located on a local server

1. On the local server (host), click **Start,** and select **Setup HP Array Configuration Utility.**

   The Execution Mode screen appears.

   - If the Remote Service Mode option is selected, continue with step 2.
   - If the Local Application Mode option is selected, change to Remote Service mode, reboot the server, and then continue with step 2.

2. On the remote server, open the browser.
3. Enter the following text into the address field of the remote browser (where *servername* is the name or IP address of the host):

   `http://servername:2301`

   The login screen for the System Management Homepage opens.

4. Log in.

   - If you are using version 2.0.0 or newer of the System Management Homepage, use your operating system user name and password.
   - If you are using an older version of the System Management Homepage, use your WBEM user name and password.

For more information about System Management Homepage, see the HP System Management Homepage web page (http://h18013.www1.hp.com/products/servers/management/agents/index.html) or the *HP System Management Homepage Installation Guide* available on the HP website (http://www.hp.com).

The System Management Homepage opens.

5. Click **Array Configuration Utility** on the left side of the screen.

   ACU opens and identifies the controllers that are connected to the system. This process could take a minute or two. When controller detection is complete, the controllers are listed on the left side of the screen.

6. Select a controller from the list.

   The main ACU configuration screen appears.

7. Select the operating mode ("GUI operating modes" on page 21) that you want to use.
8. Configure the controller. (For details, see "Using Express mode (on page 21)," "Using the Configuration Wizards mode (on page 24)," or "Using Standard Configuration mode (on page 23).")
9. Save the configuration as prompted.
10. Select another controller to configure, or exit ACU.
11. If you prefer to operate ACU on this server in Local Application mode, change the mode as described in step 1, and then reboot the server.
12. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

Configuring a local server using ACU located on a remote server

1. On the server that has ACU loaded, click **Start,** and select **Setup HP Array Configuration Utility.**

   The Execution Mode screen appears.

   - If the Remote Service Mode option is selected, continue with step 2.
   - If the Local Application Mode option is selected, change to Remote Service mode, reboot the server, and then continue with step 2.

2. On the server that you want to configure, connect to the Systems Insight Manager server (port: 280), and log in.
3. Select **Device Queries.**
4. Under Device by Type, select **All Servers.**
5. Connect to the server that is running ACU.
6. Under Device Links, select **System Management Homepage.**

The login screen for the System Management Homepage opens.

7. Log in.
   - If you are using version 2.0.0 or newer of the System Management Homepage, use your operating system user name and password.
   - If you are using an older version of the System Management Homepage, use your WBEM user name and password.

   For more information about System Management Homepage, see the HP System Management Homepage web page (http://h18013.www1.hp.com/products/servers/management/agents/index.html) or the *HP System Management Homepage Installation Guide* available on the HP website (http://www.hp.com)

   The System Management Homepage opens.
8. Click **Array Configuration Utility** on the left side of the screen.

   ACU opens and identifies the controllers that are connected to the system. This process could take a minute or two. When controller detection is complete, the controllers are listed on the left side of the screen.
9. Select a controller from the list.

   The main ACU configuration screen appears.

10. Select the operating mode ("GUI operating modes" on page 21) that you want to use.
11. Configure the controller. (For details, see "Using Express mode (on page 21)," "Using the Configuration Wizards mode (on page 24)," or "Using Standard Configuration mode (on page 23).")
12. Save the configuration as prompted.
13. Select another controller to configure, or exit ACU.
14. If you prefer to operate ACU on the remote server in Local Application mode, change the mode as described in step 1 and then reboot the server.
15. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

Configuring a server using ACU located on the SmartStart CD

1. Close all applications.
2. Insert the SmartStart CD into the CD-ROM drive.
3. Restart the server.

   The server boots from the CD and loads the SmartStart executable and drivers.
4. When prompted, select the language and agree to the license restrictions.

5. Click the **Maintain Server** button.
6. Click the **Array Configuration Utility** button.

   ACU opens and identifies the controllers that are connected to the system. This process could take a minute or two. When controller detection is complete, the controllers are listed on the left side of the screen.
7. Select a controller from the list.

   The main ACU configuration screen appears.

8. Select the operating mode ("GUI operating modes" on page 21) that you want to use.
9. Configure the controller. (For details, see "Using Express mode (on page 21)," "Using the Configuration Wizards mode (on page 24)," or "Using Standard Configuration mode (on page 23).")
10. Save the configuration as prompted.
11. Select another controller to configure, or exit ACU.
12. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

GUI operating modes

The GUI format of ACU has three operating modes: Express, Configuration Wizards, and Standard.

- In Express mode ("Using Express mode" on page 21), ACU asks a few simple questions about your configuration preferences and automatically sets up the optimum configuration based on your answers. This mode is available only if an array on the selected controller contains unused drive space or if there are physical drives connected to the controller that are not assigned to an array.
- In Configuration Wizards mode ("Using the Configuration Wizards mode" on page 24), you select the item that you want to configure, and ACU guides you through the configuration procedure for that item.
- In Standard mode ("Using Standard Configuration mode" on page 23), you select the item that you want to configure, and ACU displays all the configuration options for that item, enabling you to configure the item on just one screen.

The GUI opens in Standard mode by default. To change to Express or Configuration Wizards mode, click the appropriate link in the lower right corner of the main ACU screen.

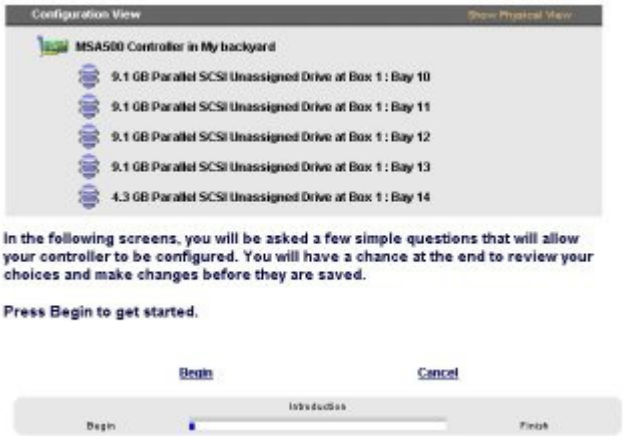
Using Express mode

Express mode is available only if an array on the selected controller contains unused drive space, or if there are physical drives connected to the controller that are not assigned to an array.

The procedure for using Express mode is slightly different when configuring a new controller ("Configuring a new controller using Express mode" on page 22) than when modifying an existing configuration ("Modifying a configuration using Express mode" on page 23).

Configuring a new controller using Express mode

1. Click **Express Configuration** in the lower right panel of the main ACU configuration screen. The Express mode start screen appears.



2. Click **Begin.**

   ACU creates the optimum number of arrays and logical drives from all of the physical drives that are attached to the controller. This process takes a few moments. When it is finished, the screen is updated. The gray Configuration View panel shows the new configuration, and under this panel is a list of possible fault-tolerance levels for the first logical drive.

3. Select a RAID level, and then click **Next.**

   If you select a fault-tolerant RAID method and an unassigned physical drive of the appropriate capacity is available, ACU asks if you want to assign spare drives to the array. Assigning spare drives enables you to postpone replacement of faulty drives, but it does not increase the fault-tolerance level of any logical drive in the array. For example, a logical drive in a RAID 5 configuration suffers irretrievable data loss if two of its physical drives are simultaneously in a failed state, regardless of the number of spare drives assigned to the array.

4. If you assigned a fault-tolerant RAID method to the logical drive, select one of the following options for the spares:

   - If you do not want this array to have a spare, click **No,** and then click **Next.**

- If you want to assign spares to the array, click **Yes,** and then click **Next.** On the next screen, select the drives that you want as the spares, and then click **Next.**

The panel displays the new configuration and asks you to confirm that it is acceptable.

5. Select the appropriate option to accept or discard the configuration.
   - If you discard the configuration, ACU returns to the main configuration screen so that you can manually configure the new array.
   - If you accept the configuration, the next screen displays confirmation that ACU has saved the new configuration. At this point, you can refine the configuration using one of the other ACU GUI operating modes, configure another controller, or exit ACU.
6. Click **Finish.**

Modifying a configuration using Express mode

1. Click **Express Configuration,** and then click **Begin.**

   If there are unassigned physical drives on the controller, you can create a new array or expand an existing array.

   If you expand an array, remember that an array expansion takes about 15 minutes per gigabyte. (If the controller does not have a battery-backed cache, the expansion takes considerably longer.) While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.
2. Make your choice, and then click **Next.**

   The screen displays the optimum configuration for the controller and asks you to confirm that it is acceptable.
3. Select the appropriate option, and then click **Finish.**

Using Standard Configuration mode

1. Click an item in the Configuration View panel. The right side of the screen displays a list of the tasks that are available for that item.

   The tasks listed for the item are a subset of the total number of tasks that are possible for the selected item. Which of the possible tasks are listed for an item and which are omitted depends on the controller model and configuration. (For example, if the selected controller has no unassigned physical drives, Create Array is not an available task.) The table ("Possible tasks in Standard Configuration mode" on page 24) lists all the possible tasks for every type of item.
2. Click a task link. A list of all possible configuration options for that task appears on the right side of the screen, replacing the task list.
3. Set the configuration options the way that you want them to be.
4. Click **OK.**

Possible tasks in Standard Configuration mode

Menu item	Possible tasks
Controller	Controller Settings Redundancy Settings (not available on all controller models) Logical Drive Array Accelerator Settings Create Array Selective Storage Presentation (for MSA1000 and Smart Array Cluster Storage controllers) Clear Configuration More Information Advanced Features (not available on all controller models)
Array	Assign Spare Create Logical Drive Delete Expand Re-Mirror Array Remove Spare Split Mirrored Array More Information
Logical drive	Migrate RAID/Stripe Size Extend Size Delete Selective Storage Presentation (for RA4x00 controllers) More Information
Unused space	Create Logical Drive More Information

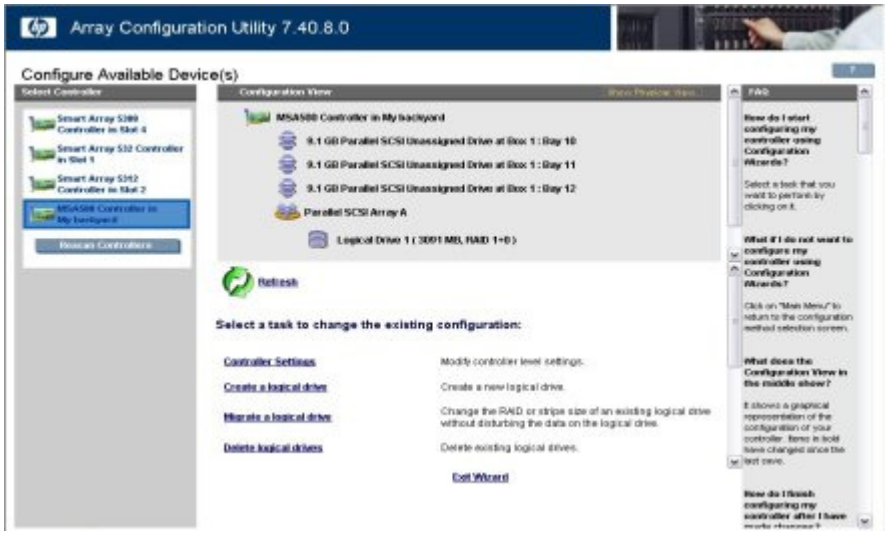
Using the Configuration Wizards mode

The procedure for using the Configuration Wizards mode is different when configuring a new controller than when reconfiguring an existing array.

- To configure a new controller, first create at least one array ("Creating an array" on page 26), and then populate the array with logical drives ("Creating a logical drive" on page 27).
- To reconfigure an array ("Modifying a configuration using the Configuration wizards" on page 28), first select the array, and then select the task that you want to perform from the menu displayed on the screen.

For more information about the screen layout, see "Typical Configuration Wizards mode screen (on page 25)."

Typical Configuration Wizards mode screen



The Configuration Wizards mode screen consists of four regions: the Devices list, the Configuration View panel, the Main Menu, and the FAQ column.

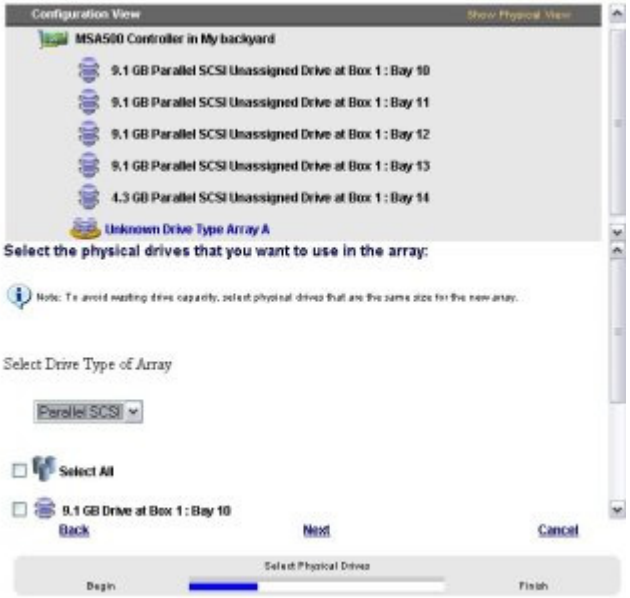
- The Devices list on the left side of the screen shows all the identifiable controllers that are connected to the system.
- The gray Configuration View panel in the upper central portion of the screen shows all arrays, logical drives, unused space, and unassigned physical drives that are connected to the selected controller. The logical configuration view is shown by default.
  - To view the physical configuration, click **Show Physical View** in the upper right corner of the panel.
  - To get further information about any item in this panel, click the icon for the item. A window appears.

- The Main Menu in the lower central portion of the screen shows the allowable options at this stage.
- The FAQ column on the right side of the screen lists information and tips that are relevant to the current screen. Look at this region before clicking **Help** in the upper right corner of the browser screen.

Creating an array

1. Click **Configuration Wizards** in the lower right panel of the main ACU configuration screen.
2. Click **Create an array,** and then click **Begin.**

   The Configuration View panel displays a placeholder for the array that you are about to create. (If there are many physical drives connected to the controller, use the scrollbars in the Configuration View panel to see all the physical drives and arrays.)



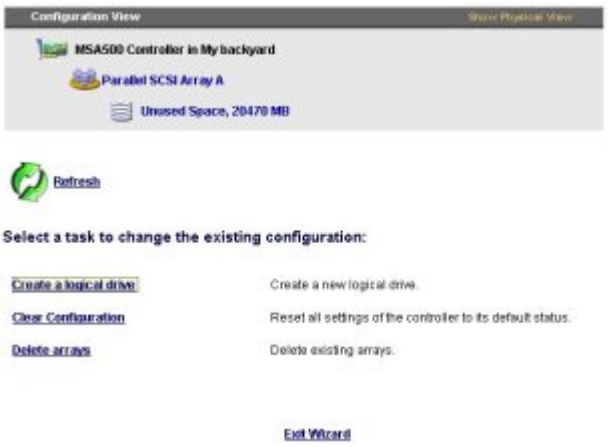
3. Select the type of drive that you will use in the array.
4. Select the physical drives that you want to use in the array.
   - Use physical drives of comparable capacity.

     ACU uses the same amount of space from each physical drive to build an array. Because this amount cannot exceed the capacity of the smallest physical drive, the extra capacity of any larger drive in the array is unusable.
   - For better system performance, use physical drives that are connected to different ports on the controller.
   - In RAID 5 configurations, keep the risk of logical drive failure low by assigning no more than 14 physical drives to the array.

   Each time that you add a physical drive to the array, the configuration view is updated to show how much free space remains on the array.
5. Click **Next** when you have finished adding physical drives to the array.
6. If an unassigned physical drive of the appropriate capacity is available, ACU asks you whether you want to assign spare drives to the array.
   - If you do not want this array to have a spare, click **No,** and then click **Next.**
   - To assign spare drives to the array, click **Yes,** and then click **Next.** On the next screen, select the drives that you want to be the spares, and then click **Next.**

IMPORTANT: Assigning one or more spare drives to an array enables you to postpone replacement of faulty drives, but 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 simultaneously, regardless of the number of spare drives assigned to it.

7. Click **Finish** to confirm the configuration. The drives are now configured as unused space on the new array.



To create more arrays on the same controller, repeat the previous steps.

Creating a logical drive

1. Click **Create a logical drive,** and then click **Begin.**
2. Select an array that has unused space, and then click **Next.** (The array must have unused space for logical drive creation to be possible.)

   The screen displays a list of the fault-tolerance levels that are possible for this configuration. For example, RAID 5 is not listed if the array has only two physical drives.
3. Select a fault-tolerance level, and then click **Next.**
4. Select a stripe size, and then click **Next.**

   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.

Type of server application	Suggested stripe size change
Mixed read/write	Accept the default value.
Mainly sequential read (such as audio/video applications)	Use a larger stripe size.
Mainly write (such as image manipulation applications)	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).

   The next screen gives you the option to enable MaxBoot. When MaxBoot is enabled, 63 sectors are used per track instead of 32. This increased number of sectors allows a larger boot partition for operating systems such as Microsoft® Windows NT® 4.0 that use cylinders, heads, and sectors of a physical drive to determine the drive size. It also enables you to create a larger logical drive or increase the logical drive size (extend it) at a later time.

   Logical drive performance is likely to decrease with MaxBoot enabled.
5. Decide whether to use MaxBoot, and then click **Next.**

   The next screen enables you to set the size of the logical drive. The default size shown is the largest possible logical drive size for the RAID level that you chose and the set of physical drives that is being used. Reducing the size of the logical drive liberates drive space, which you can use to build additional logical drives on the same array.
6. Set the size that you want the logical drive to be, and then click **Next.**

If the controller has an array accelerator, a screen appears that gives you the option of disabling it for the currently selected logical drive.

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).

7. Select the option that you want, and then click **Next.**

   The gray Configuration View panel shows the configuration that you have chosen.

8. Verify that the configuration is acceptable, and then click **Finish.**

9. Click the **Save** icon to commit the changes to the controller, and then click **OK** on the confirmation alert. (If you click **Discard Changes,** all changes since the previous save are lost.)
10. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

Modifying a configuration using the Configuration wizards

The options listed in the menu region of the screen depend on the controller model and configuration. For example, the Expand array option is listed only if there is at least one unassigned physical drive connected to the controller.

The possible menu options are:

- Clear configuration (on page 29)
- Controller settings (on page 29)
- Create an array (on page 30)
- Create a logical drive (on page 30)
- Delete arrays (on page 32)
- Delete logical drives (on page 32)
- Expand array (on page 32)
- Extend logical drive (on page 33)
- Migrate a logical drive (on page 33)
- Spare management (on page 34)
- Selective storage presentation (on page 34)

Clear Configuration

The Clear Configuration task deletes all logical drives connected to the controller, reconfigures the arrays into independent (unassigned) physical drives, and resets all controller settings to their default values.

1. Click **Clear Configuration,** and then click **Begin.**

   ACU displays a warning screen to remind you that you will lose all data on the logical drive.
2. Click **Delete** to continue.
3. Click **Finish** to accept the changes.
4. Click **Save** to apply the changes to the system, and then click **OK** on the confirmation alert.

The physical drives are now available for reconfiguration.

Controller settings

The default controller settings that ACU provides are adequate for many purposes. When necessary, however, you can use the Controller Settings task to:

- Alter the priority that the system gives to an array expansion or rebuild
- Disable the array accelerator (if one is present)
- Change the ratio of read cache to write cache (if the controller has battery-backed cache)

To change the controller settings:

1. Click **Controller Settings,** and then click **Begin.**

   The next two screens enable you to change the settings for the expand priority and the rebuild priority. These settings determine how much importance you want an array expansion or rebuild to have relative to normal I/O operations.
   - With low priority, the expansion or rebuild takes place only when the array controller is not busy handling normal I/O requests. This setting has minimal effect on normal I/O operations. However, there is an increased risk that data will be lost if another physical drive fails while the rebuild or expansion is in progress.
   - With high priority, the rebuild or expansion occurs at the expense of normal I/O operations. Although system performance is affected, this setting provides better data protection because the array is vulnerable to additional drive failures for a shorter time.
   - At the medium priority setting, expansion or rebuild occurs for half of the time, and normal I/O requests are handled during the rest of the time.
2. Set the expand priority to high, medium, or low, and then click **Next.**
3. Set the rebuild priority, and then click **Next.**

   If the controller has an array accelerator, a screen now appears that gives you the option of disabling it for particular 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).

4. Select the logical drives for which the array accelerator should be disabled, and then click **Next.**

   If the controller has a battery-backed cache, a screen now appears that enables you to change the read/write cache ratio. This ratio determines the amount of memory allocated to read and write operations. Different types of applications have different optimum ratios. You can change the ratio only if the controller has a battery-backed cache (only battery-backed cache can be used for write cache) and if there are logical drives configured on the controller.
5. Select the ratio that you want the controller to use, and then click **Next.**
6. Click **Finish** to accept the changes.

7. Click **Save** to apply the changes to the system, and then click **OK** on the confirmation alert.

Create an array

1. Click **Create an array,** and then click **Begin.**
2. Select the type of drive to be used in the array.
3. Select the physical drives that you want to use in the array.
   - Use physical drives of comparable capacity.

     ACU uses the same amount of space from each physical drive to build an array. Because this amount cannot exceed the capacity of the smallest physical drive, the extra capacity of any larger drive in the array is unusable.
   - For better system performance, use physical drives that are attached to different ports on the controller.
   - In RAID 5 configurations, keep the risk of logical drive failure low by assigning no more than 14 physical drives to the array.

   Each time that you add a physical drive to the array, the configuration view is updated to show how much free space remains on the array.
4. Click **Next** when you have finished adding physical drives to the array.
5. If a spare or unassigned physical drive of the appropriate capacity is available, ACU asks you whether you want to assign a spare drive to the array.
   - If you do not want this array to have a spare, click **No,** and then click **Next.**
   - To assign spare drives to the array, click **Yes,** and then click **Next.** On the next screen, select the drives that you want to assign as spares, and then click **Next.**

IMPORTANT: Assigning one or more spare drives to an array enables you to postpone replacement of faulty drives, but 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 simultaneously, regardless of the number of spare drives assigned to it.

NOTE: An array can have several spares, and any spare can be shared by several arrays.

6. Click through the remaining screens to confirm the configuration.

Create a logical drive

1. Click **Create a logical drive,** and then click **Begin.**
2. Select an array that has unused space, and then click **Next.** (The array must have unused space for logical drive creation to be possible.)

   The screen displays a list of the fault-tolerance levels that are possible for this configuration. For example, RAID 5 is not listed if the array has only two physical drives.
3. Select a fault-tolerance level, and then click **Next.**
4. Select a stripe size, and then click **Next.**

   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.

Type of server application	Suggested stripe size change
Mixed read/write	Accept the default value.
Mainly sequential read (such as audio/video applications)	Use a larger stripe size.

Type of server application	Suggested stripe size change
Mainly write (such as image manipulation applications)	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).

The next screen gives you the option to enable MaxBoot. When MaxBoot is enabled, 63 sectors are used per track instead of 32. This increased number of sectors allows a larger boot partition for operating systems such as Microsoft® Windows NT® 4.0 that use cylinders, heads, and sectors of a physical drive to determine the drive size. It also enables you to create a larger logical drive or increase the logical drive size (extend it) at a later time.

Logical drive performance is likely to decrease with MaxBoot enabled.

5. Decide whether to use MaxBoot, and then click **Next.**

   The next screen enables you to set the size of the logical drive. The default size shown is the largest possible logical drive size for the RAID level that you chose and the set of physical drives that is being used. Reducing the size of the logical drive liberates drive space, which you can use to build additional logical drives on the same array.

6. Set the size that you want the logical drive to be, and then click **Next.**

   If the controller has an array accelerator, a screen appears that gives you the option of disabling it for the currently selected logical drive.

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).

7. Select the option that you want, and then click **Next.**

   The gray Configuration View panel shows the configuration that you have chosen.

8. Verify that the configuration is acceptable, and then click **Finish.**

9. Click the **Save** icon to commit the changes to the controller, and then click **OK** on the confirmation alert. (If you click **Discard Changes,** all changes since the previous save are lost.)
10. To make newly created logical drives available for data storage, use the operating system disk management tools to create partitions and format the drives.

Delete arrays

This task deletes logical drives on an array and converts the array into a group of unassigned physical drives. You can then reconfigure the unassigned physical drives into one or more new arrays ("Create an array" on page 30), or you can use the liberated physical drive space for expansion of another array ("Expand Array" on page 32) on the same controller.

1. Click **Delete arrays,** and then click **Begin.**
2. Select the arrays that you want to delete, and then click **Next.** ACU displays a warning screen to remind you that you will lose all data on the array.
3. Click **Delete** to continue, and then click **Finish** to accept the changes.
4. Click **Save** to apply the changes to the system, and then click **OK** on the confirmation alert.

Delete logical drives

This task deletes the selected logical drive and converts it into unused drive space. You can then use this unused drive space to:

- Create new logical drives ("Create a logical drive" on page 30).
- Migrate the RAID level or stripe size of an existing logical drive ("Migrate a logical drive" on page 33).
- Extend existing logical drives on the same array ("Extend logical drive" on page 33), if the operating system allows logical drive extension.

To delete a logical drive:

1. Click **Delete logical drives,** and then click **Begin.**
2. Select the logical drives that you want to delete, and then click **Next.** ACU displays a warning screen to remind you that you will lose all data on the logical drive.
3. Click **Delete** to continue, and then click **Finish** to accept the changes.
4. Click **Save** to apply the changes to the system, and then click **OK** on the confirmation alert.

Expand Array

NOTE: The Expand Array task is listed only if there is an unassigned physical drive on the controller. The unassigned drive must also have a capacity no less than that of a drive in an existing array. If these conditions are not fulfilled, install at least one suitable drive on the controller, and then click Refresh.

This task increases the storage capacity of an existing array. You can use the additional storage space to:

- Create new logical drives ("Create a logical drive" on page 30).
- Migrate the RAID level or stripe size of existing logical drives ("Migrate a logical drive" on page 33).
- Extend existing logical drives on the array ("Extend logical drive" on page 33), if the operating system allows logical drive extension.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

1. Click **Controller Settings,** and verify that the Expand Priority setting is acceptable.
2. Back up all data on the array. Although array expansion is unlikely to cause data loss, observing this precaution provides additional data protection.
3. Click **Expand array,** and then click **Begin.**

4. Choose the array that you want to expand, and then click **Next.**
5. Select the physical drives that you want to add to the array, and then click **Next.**
6. Click **Finish** to accept the changes.

   At this point (before clicking **Save** in the next step), you can create logical drives on the unused space created by the expansion. You can also arrange to expand another array on the same controller by repeating the previous steps. However, the controller can expand only one array at a time. Remaining array expansions are queued.
7. Click **Save.**

   The controller now rearranges (re-stripes) the existing logical drives and their data so that they extend over all the physical drives in the enlarged array.

To check the progress of an array expansion, click the icon for that array in the Configuration View panel. A More Information pop-up window opens that describes the array status.

Extend logical drive

This option increases the storage capacity of a logical drive by adding unused space on an array to a logical drive on the same array. The unused space is obtained either by expanding an array ("Expand Array" on page 32) or by deleting another logical drive ("Delete logical drives" on page 32) on the same array.

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

Some operating systems allow you to perform logical drive extension **offline** by backing up data, reconfiguring the array, and restoring data from backup. Check the operating system documentation for current information.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

1. Back up all data on the logical drive. Although logical drive extension is unlikely to cause data loss, observing this precaution provides additional data protection.
2. Click **Extend logical drive,** and then click **Begin.**
3. Select the logical drive that you want to extend, and then click **Next.**
4. Enter the new size of the logical drive into the size field.
5. Click **Finish.**

   At this point (before clicking **Save** in the next step), you can arrange to extend another logical drive on the same controller by repeating the previous steps. However, the controller can extend only one logical drive at a time. Remaining extensions are queued.
6. Click **Save.** Logical drive extension begins.

To check the progress of a logical drive extension, click the icon for that logical drive in the Configuration View panel. A More Information pop-up window opens that describes the logical drive status.

Migrate a logical drive

This option enables you to alter the stripe size (data block size), RAID level, or both for a selected logical drive. For some combinations of initial and final settings of stripe size and RAID level, the array must contain unused drive space.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While

this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

1. Back up all data on the logical drive. Although migration is unlikely to cause data loss, observing this precaution provides additional data protection.
2. Click **Migrate a logical drive,** and then click **Begin.**
3. Select the logical drive, and then click **Next.**
4. Select the new RAID level, and then click **Next.**

   Only RAID levels that are possible for this configuration are shown. For example, RAID 5 is not listed if the array has only two physical drives.
5. Select the stripe size. Only stripe sizes that are possible for this configuration are shown.
6. Click **Finish** to accept the changes.

   At this point (before clicking Save in the next step), you can arrange to migrate another logical drive on the same controller by repeating the previous steps. However, the controller can migrate only one logical drive at a time. Remaining migrations are queued.
7. Click **Save.** Migration begins.

To check the progress of a migration, click the icon for that logical drive in the Configuration View panel. A More Information pop-up window opens that describes the logical drive status.

Spare management

NOTE: An array can have several spares, and any spare can be shared by several arrays.

1. Click **Spare Management,** and then click **Begin.**
2. Select the array that is to have additional (or fewer) spare drives.
3. Select the drives that you want to assign as spares, and deselect the appropriate checkboxes for spares that you want to remove.

IMPORTANT: Assigning one or more spare drives to an array enables you to postpone replacement of faulty drives, but 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 simultaneously, regardless of the number of spare drives assigned to it.

4. Click **Next.**
5. Click **Finish** to accept the changes.
6. Click **Save,** and then click **OK** on the confirmation alert.

Selective Storage Presentation

SSP enables you to determine which host controllers can access which particular logical drives in a storage system. This feature prevents data corruption that can occur when different servers using different operating systems access the same data.

SSP is available only for RA4x00 controllers, Smart Array Cluster Storage controllers, and some MSA controllers. To confirm that a particular MSA storage system supports SSP, refer to the user guide for that system.

RA4x00 controllers

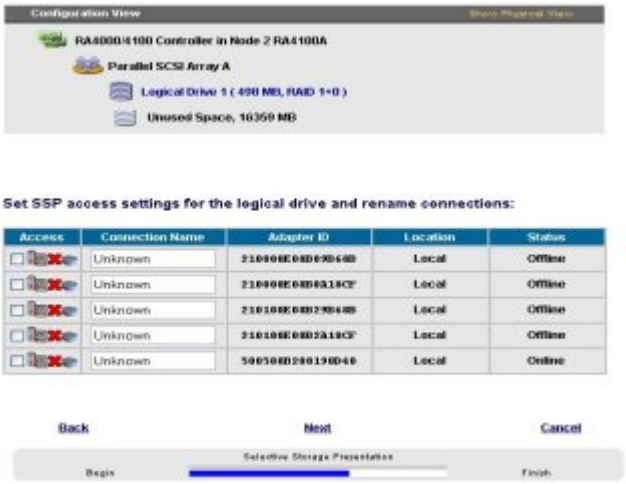
1. Click **Selective Storage Presentation,** and then click **Begin.**
2. Select the logical drive for which you want to change the access settings, and then click **Next.**
3. On the next screen that appears, select the appropriate radio button to enable or disable SSP and then click **Next.**

- If you disable SSP, all host controllers have access to the logical drive.
- If you enable SSP, you can decide which hosts are to have access to the logical drive.

If you selected **Enable,** the screen lists all identified host controllers.

4. Select the host controllers that are to have access to the logical drive, rename the connections if necessary, and then click **Next.**

NOTE: Be sure that every HBA in the system has access to the logical drives for which multi-path will be used.



5. Click **Finish.**

MSA and Smart Array Cluster storage controllers

1. Click **Selective Storage Presentation,** and then click **Begin.**

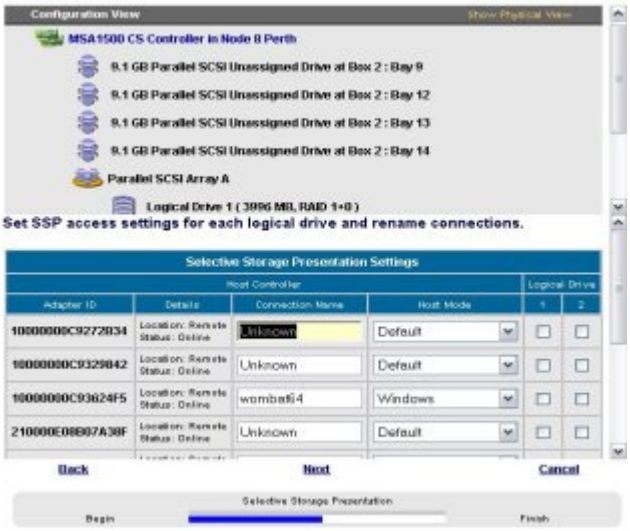
   On the next screen that appears, select the appropriate radio button to enable or disable SSP, and then click **Next.**

   - If you disable SSP, all host controllers have access to all logical drives.
   - If you enable SSP, you can decide which hosts are to have access to which logical drives.

   If you select **Enable,** the screen lists all identified host controllers.

2. Select the host controllers that are to have access to each logical drive, define the host mode for each controller, rename the connections if necessary, and then click **Next.**

NOTE: Be sure that every HBA in the system has access to the logical drives for which multi-path will be used.

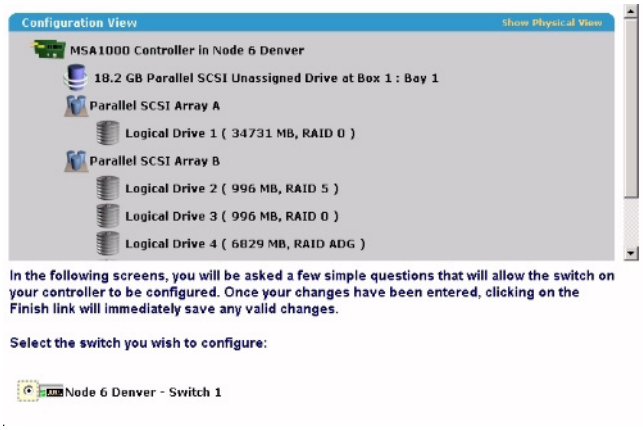


3. Click **Finish.**

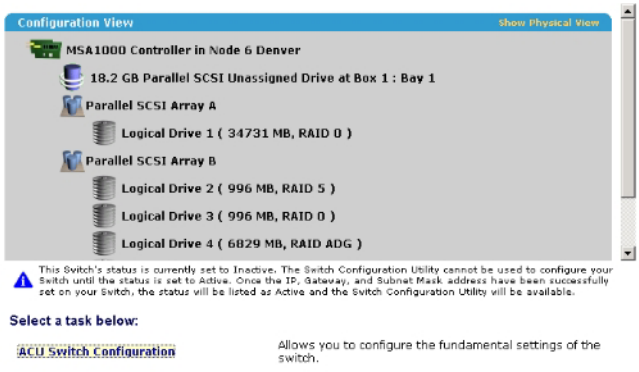
Configuring switches

If the selected controller supports switch configuration, the menu link for this feature is given in the Wizards panel in the lower right-hand corner of the main ACU configuration screen.

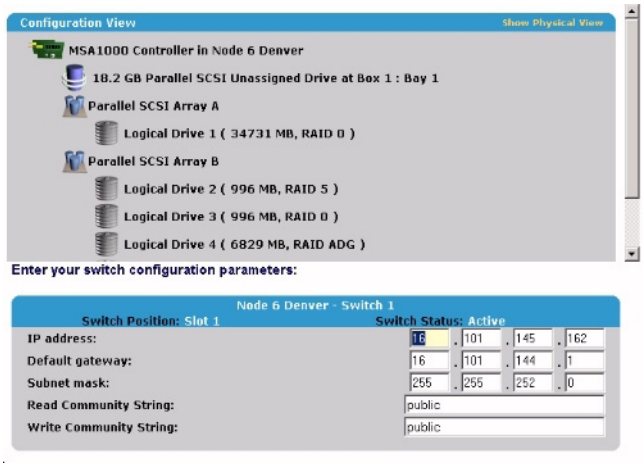
1. Use the `PING` command to confirm that the connections between the management server running ACU and the LAN management ports on the switches are reliable.
2. Click **Switch Configuration** (in the Wizards panel).
3. Select the switch that you want to configure, and then click **Next.**



4. Click **ACU Switch Configuration.**

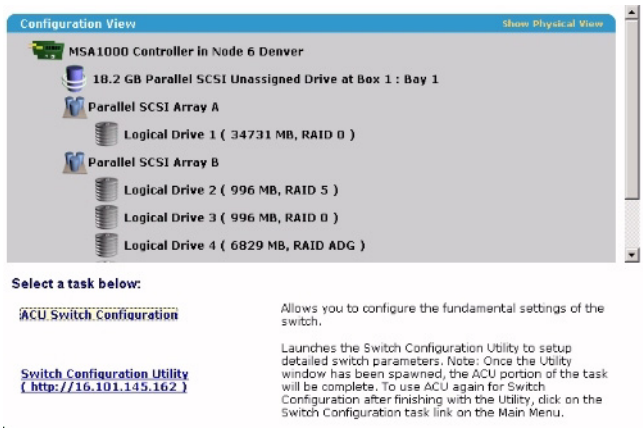


5. Set the switch parameters (IP address, default gateway, subnet mask, and community strings), and then click **Finish** to save the settings.



The screen now displays a URL for launching the Switch Configuration Utility. This utility is a Java™ applet that enables you to further configure the switch. You might need to load the most current Java™ plug-in to be able to use the applet.

6. Click the URL link.



7. Follow the on-screen prompts and instructions to use the switch configuration utility.

Splitting a mirrored array

This task splits an array that consists of one or more RAID 1+0 logical drives into two identical new arrays consisting of RAID 0 logical drives. This feature is useful when you want to replicate a configuration or when you want to build a backup before performing a risky operation.

IMPORTANT: You cannot split an array if it contains logical drives in RAID 0, RAID 5, or RAID ADG configurations.

NOTE: An array can be split or re-mirrored only when the server is offline and operating in the Standard configuration mode of the ACU GUI.

1. Take the server offline.
2. Insert the CD that contains ACU into the CD-ROM drive.
3. Open ACU, and stay in Standard configuration mode (the default).
4. Select the controller that contains the array that you want to split.
5. In the Configuration View panel, select the array.

6. In the Select a Task panel, click **Split Mirrored Array.**
7. Click **OK.**
8. When ACU has finished splitting the array, remove the physical drives that constitute one of the new arrays.

IMPORTANT: If you do not remove one of the arrays, the server will be unable to distinguish between the two new arrays after it is restarted (next step) because the arrays are identical in all respects.

9. Restart the server.

Recombining a split, mirrored array

NOTE: An array can be split or re-mirrored only when the server is offline and operating in the Standard configuration mode of the ACU GUI.

1. Take the server offline.
2. Insert the drives that contain the other half of the split array.
3. Insert the CD that contains ACU into the CD-ROM drive.
4. Open ACU, and stay in Standard configuration mode (the default).
5. Select the controller that contains the array that you want to be re-mirrored.
6. In the Configuration View panel, select the array that you want to use as the source array in the recombined mirrored array.
7. In the Select a Task panel, click Re-Mirror Array.
8. Select the array that is to be mirrored to the source array. (This is usually the array that was originally split out of the original mirrored array. However, it can be another array if it is of the correct size.)

CAUTION: All data on the second array will be destroyed.

9. Click **OK.**
10. When ACU has finished recombining the split array, restart the server.

Using ACU scripting

ACU has two scripting modes: Capture and Input.

- In Capture mode ("Capturing a configuration" on page 38), ACU inspects the configuration of all internal and external array controllers that are connected to the server and writes a script file that describes this configuration.
- In Input mode ("Applying an Input script" on page 39), ACU reads the array configuration that is described in a specified script file ("Creating an ACU script file" on page 39) and applies this configuration to a target system.

Capturing a configuration

To capture the configuration of a system, enter `cpqacuxe -c [DRIVE:][PATH]` *FILENAME*`.INI` at the system command line prompt.

FILENAME is the name that you want to give to the capture file. If you do not specify a name, ACU uses the default name ACUCAPT and places the file in the ACU working directory.

If any errors occur during capture, they are noted in the file ERROR.INI that is logged to the default working directory.

Applying an Input script

To use an Input script to configure or reconfigure a system, first locate a suitable ACU script or create one ("Creating an ACU script file" on page 39), and then enter one of the following commands at the system command line prompt:

```
cpqacuxe -i [DRIVE:][PATH] FILENAME.INI
cpqacuxe -i-with-reset [DRIVE:][PATH] FILENAME.INI
```

- To keep any data that is in the array and make only minor configuration changes, use the `-i` flag.
- To destroy any existing data and overwrite any existing configuration with the configuration specified in the script, use `-i-with-reset`.

If you do not specify the name and address of the input file, ACU searches for ACUINPUT.INI in the ACU working directory.

If any errors occur during input, they are noted in the file ERROR.INI that is logged to the default working directory.

Creating an ACU script file

You can use any of the following methods to create a valid ACU script file:

- Modify the sample script ("Sample custom input script" on page 39).
- Create a Capture file ("Capturing a configuration" on page 38) from any server that has ACU loaded, and then modify the values of options in the file as necessary for the target system. (This method is useful for applying a standard configuration to several servers that have similar storage resources.)
- Write the script from scratch. Each line of text in an ACU script file is in the format *option*=*value* and can be written in uppercase or lowercase letters. See the sample script ("Sample custom input script" on page 39) for a description of the possible option values and the minimum configuration information that a valid script must have.
- Write a script file that specifies values for only the `Controller`, `RAID`, and `OnlineSpare` options. ACU then runs in Automatic Method mode ("Method" on page 42) and uses default values for all other configuration options.

You can add blank lines and comments to any script to make it easier to read and understand. To create a comment, enter a semicolon, and then enter the comment text. ACU ignores all text on the same line after a semicolon.

Sample custom input script

The following script gives all possible values for each option.

- If an **option** is shown in bold type, you must enter a value for that option.
- If a **value** is shown in bold type, ACU uses that value as a default setting when creating new logical drives.
- An asterisk next to a line denotes that the line is not used in Automatic Method mode ("Method" on page 42).

You can use this script as a template for your own script.

```
Action = Configure|Reconfigure
Method = Custom|Auto

Controller = All | Slot [N] | WWN [N] | SerialNumber [N] | IOCabinet
[N],IOBay [N],IOChassis [N],Slot [N],Cabinet [N],Cell [N]
```

```
ClearConfigurationWithDataLoss = Yes|No
LicenseKey = XXXXX-XXXXX-XXXXX-XXXXX-XXXXX
DeleteLicenseKey = XXXXX-XXXXX-XXXXX-XXXXX-XXXXX
ChassisName = "XXXXXXXXXXXXXXXXXXXX"
ReadCache = 0|10|20|25|30|40|50|60|70|75|80|90|100
WriteCache = 0|10|20|25|30|40|50|60|70|75|80|90|100
RebuildPriority = Low|Medium|High
ExpandPriority = Low|Medium|High
SurfaceScanDelay = N
* SSPState = Enable|Disable
PreferredPathMode = Auto|Manual

* Array = A|B|C|D|E|F|G|...Z|a|b|c|d|e|f
OnlineSpare = Port:ID,Port:ID... | Box:Bay,Box:Bay... |
Port:Box:Bay,Port:Box:Bay,... | None
* Drive = Port:ID,Port:ID... |  Box:Bay,Box:Bay... |
Port:Box:Bay,Port:Box:Bay,...

* LogicalDrive = 1|2|3|...32
RAID = 0|1|5|6|adg
* Size = [N]|Max
* Sectors = 32|63
* StripeSize = 8|16|32|64|128|256
* ArrayAccelerator = Enable|Disable
* LogicalDriveSSPState = Enable|Disable
* SSPAdaptersWithAccess = [N],[N]...|None
PreferredPath = 1|2

HBA_WW_ID = WWN
ConnectionName = UserDefinedName
HostMode =
Default|Windows|Windows(degrade|openVMS|Tru64|Linux|Solaris|Netware|HP|W
indows Sp2 ; COMMENT: note that the Windows(degrade option is as written
```

Script file options

There are four categories of options in ACU script files: Control, Controller, Array, and Logical Drive. Each category has several scripting options, but you do not always need to assign values to every option. ACU can use default values in some cases, while in other cases, a given option might not be relevant for a particular controller or operating mode.

The options for each category are listed in the table ("Option categories in ACU scripting" on page 41), and described in more detail in the rest of this section.

Option categories in ACU scripting

Category	Options	Comments
Control	Action Method	These options define the overall behavior of ACU when it processes the scripts and creates configurations. Control options can occur only once in a script file and must be the first options listed.
Controller	Controller ClearConfigurationWithDataLoss LicenseKey DeleteLicenseKey ChassisName ReadCache WriteCache RebuildPriority ExpandPriority SurfaceScanDelay SSPState PreferredPathMode	Options in this category define the controller that is to be configured (or the controller that has had its configuration captured). The Controller option must be at the beginning of this section of the script, but you can script other options in this category in any order. You can use one script to configure several controllers if all controllers are to be configured identically or if you define each controller configuration separately. When you define each controller separately, specify all category options for a particular controller before starting a new controller listing.
Array	Array OnlineSpare Drive	These options define an array that is to be configured on the controller that is identified previously in the script. (If no controller is previously identified, ACU sends an error message.) The Array option must be at the beginning of this section of the script, but you can script the other options in this category in any order.
Logical Drive	LogicalDrive RAID Size Sectors StripeSize ArrayAccelerator LogicalDriveSSPState SSPAdaptersWithAccess PreferredPath	These options define a logical drive that is to be configured on an array that is defined previously in the script. (If no array is previously defined, ACU sends an error message.) The LogicalDrive option must be at the beginning of this section of the script, but you can script the other options in this category in any order.

Control category

The Control category has two options: Action (on page 41) and Method (on page 42).

Action

You must specify an Action mode.

- In Configure mode, you can create new arrays, but you cannot modify existing arrays. The controller must be connected to unassigned physical drives for this mode to be available.
- In Reconfigure mode, you can modify existing arrays. For example, you can set up an array expansion, a logical drive extension, or a migration. These procedures do not destroy data, unless you specifically want the data to be deleted. In this mode, ACU does not change an existing option setting unless you specifically script a different value for that option.

Method

The default value for this option is Automatic. If you want to use Custom mode, you must specify it.

In Automatic mode, ACU can perform an expansion, extension, or migration without user intervention if the values that you set for other options imply that such an operation is necessary.

Controller category

The following options are available under the Controller category:

- Controller (on page 42)
- ClearConfigurationWithDataLoss (on page 42)
- LicenseKey ("LicenseKey, DeleteLicenseKey" on page 42)
- DeleteLicenseKey ("LicenseKey, DeleteLicenseKey" on page 42)
- ChassisName (on page 42)
- ReadCache ("ReadCache, WriteCache" on page 43)
- WriteCache ("ReadCache, WriteCache" on page 43)
- RebuildPriority ("RebuildPriority, ExpandPriority" on page 43)
- ExpandPriority ("RebuildPriority, ExpandPriority" on page 43)
- SurfaceScanDelay (on page 43)
- SSPState (on page 43)
- PreferredPathMode (on page 44)

Controller

You must enter a value for this option because it identifies the controller that is to be configured.

- `All`—Configure all detected controllers in the system identically.
- `Slot [`*N*`]`—Configure the internal controller in slot number N.
- `WWN [`*N*`]`—Configure the external controller that has the World Wide Name *N*.
- `SerialNumber [`*N*`]`—Configure the shared storage controller that has serial number *N*.
- `IOCabinet[`*N*`],IOBay[`*N*`],IOChassis[`*N*`],Slot[`*N*`],Cabinet[`*N*`],Cell[`*N*`]`—Configure the controller in the Integrity server that has the slot path information defined by this sequence of identifiers.

ClearConfigurationWithDataLoss

The default value for this option is No. Clearing the configuration causes data loss because it deletes all logical drives on the controller. If you clear a configuration, you can write commands later in the script file to create a new configuration from the liberated drive capacity.

LicenseKey, DeleteLicenseKey

These options enable you to enter a 25-character license key to activate or uninstall some controller features. Hyphens can be entered, but are not required.

ChassisName

Enter the user-defined character string that identifies the controller. Any of the following characters can be used in the string:

a–z, A–Z, 0–9, !, @, #, *, (,), ,, -, _, +, :, ., /, [space]

You do not need to use quotation marks around the string, but doing so allows the string to begin with a space character. However, the string cannot end with a space character.

Currently, only shared-storage controllers such as the RA4x00, MSA1000, and Smart Array Cluster Storage support the ChassisName option. The RA4x00 controller uses a 24-character string, while other applicable controllers use a 20-character string.

ReadCache, WriteCache

Enter a number between 0 and 100 to specify the percentage of cache that is to be allocated to drive reads or writes. The default value for both options is 50. The allowable cache ratios depend on the controller model and whether it has battery-backed cache, as described in the table ("Allowable cache ratios" on page 43).

Allowable cache ratios

NOTE: Y indicates that the specified cache ratio is allowed for that type of controller, while -- indicates that the ratio is not allowed.

Read:write ratio	RA4x00 with 16MB cache	RA4x00 with 48MB cache	All other controllers with battery-backed cache	All other controllers without battery-backed cache
100:0	Y	Y	Y	Y
90:10	Y	Y	--	--
80:20	Y	Y	--	--
75:25	--	--	Y	--
70:30	Y	Y	--	--
60:40	Y	Y	--	--
50:50	Y	Y	Y	--
40:60	--	Y	--	--
30:70	--	Y	--	--
25:75	--	Y	Y	--
0:50*	Y	--	--	--
0:75*	--	Y	--	--
0:100	--	--	Y	--

* The cache ratio percentages do not total 100 in these cases because the additional 16-MB or 48-MB cache modules are not used. Only the battery-backed write cache is used.

RebuildPriority, ExpandPriority

This option has three possible values: Low, Medium, and High. The default value for an unconfigured controller is Low.

SurfaceScanDelay

Enter a number between 1 and 30 to specify the duration of the surface scan delay in seconds.

SSPState

There are two settings for this option: Enable and Disable. If you do not specify a value for the SSP State, the existing setting remains unchanged.

NOTE: The SSPState option is valid only for controllers that enable SSP on a controller basis, such as the MSA1000 or the Smart Array Cluster Storage controllers. RA4x00 controllers support SSP that is enabled on a logical drive basis, and use the LogicalDriveSSPState option ("LogicalDriveSSPState" on page 46) instead.

If you enable SSP, you must also specify an adapter for one or more logical drives by using the SSPAdaptersWithAccess option ("SSPAdaptersWithAccess" on page 46). Otherwise, SSP is automatically disabled.

PreferredPathMode

The setting that you select for this option determines how the preferred I/O path to a particular logical drive is set for a redundant array controller that is in an active/active configuration.

Not all controllers support this feature, and controllers in an active/standby configuration disregard this option.

- **Auto** is the default setting for new configurations. In this case, the storage system automatically selects the I/O path from the redundant controller to the logical drive and dynamically load balances all paths.
- **Manual** enables you to assign the logical drive to a specific redundant controller. If you select this setting, use the `PreferredPath` (on page 47) command to specify the path.

If you are reconfiguring a controller and do not specify a setting for this option, the existing setting remains unchanged.

Array category

These options are available under the Array category:

- Array (on page 44)
- OnlineSpare (on page 44)
- Drive (on page 45)

Array

Enter a letter in the range A–Z or a–f to identify the array that is to be created or reconfigured, bearing in mind these additional limitations:

- In Configure mode, ACU creates a new array. The letter value that you specify must be the next available letter in the sequence, considering the number of existing arrays on the controller.
- In Reconfigure mode, ACU can either create a new array or reconfigure an existing array. In this case, the letter value that you specify can identify an existing array, or it can correspond to the next available array letter in the existing configuration.

OnlineSpare

- In Automatic mode, the choices are Yes and No.
  - In Configure mode, the default setting is Yes.
  - In Reconfigure mode, ACU ignores this option and keeps any spares that the existing configuration already has.
- In Custom mode, you can specify exactly which drives are to be used as spares. If you specify None, any existing spares are removed from the array.
  - In Configure mode, the default value is None.
  - In Reconfigure mode, the default setting keeps any existing spares in the array.

Drive

You can use this option to add a drive to an existing array (that is, to expand an array) or to build a new array. If you are expanding an array, each drive that you add must have a capacity that is no less than that of the smallest drive already in the array. The added drives must also be of the same type as existing drives in the array (for example, SAS or SATA).

If you set the value of the `ClearConfigurationWithDataLoss (on page 42)` option to Yes, you can use the `Drive` option to remove drives from an array.

If you want to build or expand an array and specify Automatic mode, ACU uses all the available drives on the controller. If you use Custom mode, you can list each drive that you want in the array, or you can specify just the number of drives that you want the array to have (in which case, ACU automatically determines which drives are suitable to use).

- To list each drive, use the applicable convention (port:ID, box:bay, or port:box:bay).
- To specify only the number of drives, use that number in the option input line. For example, entering `drive=3` tells ACU to use the first three available drives to build or expand the array that you specify in the rest of the script.

Logical Drive category

The following options are available in the Logical Drive category:

LogicalDrive

Specify the ID number of the logical drive that is to be created or modified.

- In Configure mode, you can enter only the ID number of the next possible logical drive in the sequence for the existing configuration.
- In Reconfigure mode, you can also enter the ID number of an existing logical drive.

RAID

Specify the RAID level that you want for the logical drive.

- In Configure mode, the default setting is the highest RAID level that the configuration can support.
- In Reconfigure mode, the default setting is the existing RAID level for that logical drive. If you specify a different RAID setting, then ACU either ignores the new setting (in Automatic mode) or attempts to migrate the logical drive to the specified RAID level (in Custom mode).

Size

Enter the capacity that you want the logical drive to have, in megabytes. The default size setting for new logical drives is MAX. In this case, ACU creates a logical drive of the maximum possible size from the physical drives that you assigned to the array.

In Reconfigure mode, the default setting is the existing size of the logical drive. If you enter a larger value, ACU extends the logical drive to the new size if there is unused drive capacity on the same array, as long as the operating system supports logical drive extension. You cannot reduce the size of the logical drive.

△ **CAUTION:** Back up all data before extending a logical drive.

Sectors

This option specifies the number of sectors that are to comprise each track. Enter 32 to disable MaxBoot or 63 to enable it.

- For new logical drives, the default setting is 63 if the logical drive is larger than 502 GB. Otherwise, the default setting is 32.
- For an existing logical drive, the default setting is the existing setting.

Logical drive performance is likely to decrease with MaxBoot enabled.

StripeSize

This option specifies the stripe size for the logical drive in kilobytes. For RAID 0 or RAID 1 arrays, any of the stripe size values listed in the sample script can be used. For RAID 4, RAID 5, or RAID 6 (ADG) arrays, the maximum stripe size on some controllers is 64 KB. For information about the maximum supported stripe size of a particular controller, refer to the controller documentation.

If you do not specify a StripeSize value for a new logical drive, ACU uses a default value that is determined by the RAID level that you chose for the logical drive. For RAID 0 or RAID 1, the default stripe size is 128 KB, whereas for RAID 4, RAID 5, or RAID 6 (ADG) the default stripe size is 16 KB. (However, for RAID 5 on a Smart Array 6400 Series controller, the default stripe size is 64 KB.)

In Reconfigure mode, the default setting is the existing stripe size for the specified logical drive. If you specify a stripe size that is different from the existing value, then ACU attempts to migrate the logical drive to the stripe size that you specify.

△ **CAUTION:** Back up all data before extending a logical drive.

ArrayAccelerator

This option specifies whether the array accelerator is enabled or disabled for the specified logical drive. The default value is Enabled.

LogicalDriveSSPState

This option is valid only for controllers that enable SSP on a logical drive basis (at present, this applies only to the RA4x00). Other controllers that support SSP use the SSPState option ("SSPState" on page 43).

- For new logical drives, the default value is Disabled.
- For existing logical drives, the default value is the current logical drive setting.

SSPAdaptersWithAccess

Enter values here to identify the SSP adapters that you want to have access to a logical drive. The values are processed only if either SSPState or LogicalDriveSSPState is set to Enable. Otherwise, the values are ignored.

NOTE: Be sure that every HBA in the system has access to the logical drives for which multi-path will be used.

PreferredPath

If you select the Manual setting for `PreferredPathMode` (on page 44), use the `PreferredPath` command to specify the path for I/O to the logical drive on a redundant controller in active/active mode.

The default setting for this option is **1.** With this setting, the controller in chassis slot 1 is the preferred controller for I/O to the logical drive. If you select **2,** the controller in chassis slot 2 becomes the preferred controller for the logical drive.

To determine the chassis slot numbers, use the `show` command on a controller that supports redundant controllers.

HBA_WW_ID

This option specifies which HBA to apply the configuration changes to using the HBA's assigned WWN.

ConnectionName

This option is a user-defined string used as the connection name for the specified HBA.

The string can consist of:

- A maximum of 16 characters
- Embedded space characters but cannot end with a space character
- Any of the following characters: a–z, A–Z, 0–9, !, @, #, *, (,), -, _, +, :, ., /, and [space]

HostMode

This option specifies the HostMode for a selected HBA. Setting the Host Mode optimizes the storage array for the selected operating system. The available host modes for an HBA are device-specific. Not all modes are available on all devices. Not all HBAs support a HostMode.

The following operating system options might be available:

- Default
- Microsoft® Windows®
- OpenVMS
- Tru64
- Linux
- Solaris
- Netware
- HP-UX

Error reporting

Any errors that are encountered during ACU scripting are logged to ERROR.INI. This error file describes the error and if possible indicates the controller, array, and logical drive that are associated with the error.

The error reporting in ACU scripting is not as specific as the error reporting in the ACU GUI. Instead, it is designed to give an advanced user enough information to understand what went wrong so that they can correct the problem and continue. Some of the possible error messages are listed in the table ("ACU scripting error messages" on page 48).

ACU scripting error messages

Message	Comment or explanation (if not self-explanatory)
(*text*) is not a controller command.	—
(*text*) is not a logical drive command.	—
(*text*) is not a supported command.	—
(*text*) is not an array command.	—
(*text*) command expected.	The specified command is missing or in the incorrect place in the file.
Array not specified.	Some commands in the script require an array, but no array is specified in the script file.
Array requires an odd number of drives.	This error message occurs if you attempt to add an odd number of drives to an existing array that has RAID 1 logical drives, and the controller does not support RAID-level migration.
Cannot change array spare.	The current configuration does not allow the number of spares in the array to be changed.
Cannot change logical drive array accelerator setting.	The current controller configuration does not allow the array accelerator setting to be changed.
Cannot change logical drive sectors.	You cannot change the MaxBoot setting on a configured logical drive because doing so causes data loss.
Cannot change SSP settings.	—
Cannot create array.	The controller either has no unassigned physical drives, or it already has the maximum number of arrays or logical drives.
Cannot create logical drive.	There is no free space on the array, or the maximum number of logical drives has already been reached.
Cannot expand array.	The controller does not support expansion, or the current configuration of the controller does not allow expansion.
Cannot extend logical drive.	The controller does not support extension, or the current configuration does not allow extension. For example, if there is no free space on an array, extension is not supported.
Cannot migrate logical drive RAID.	The controller does not support RAID migration, or the current configuration of the controller does not allow migration.
Cannot migrate logical drive stripe size.	The controller does not support stripe size migration, or the current configuration of the controller does not allow migration.
Cannot remove physical drives from existing array.	You have inadvertently omitted one or more physical drives from the drive list when reconfiguring an existing array. ACU does not allow this because removing physical drives from a configured array causes data loss.
Controller (*text*) is invalid.	The controller specifications are not entered correctly.
Controller does not support ChassisName.	—
Controller does not support controller SSPState. Use the LogicalDriveSSPState command to set SSP states for each logical drive.	—
Controller does not support license keys.	—

Message	Comment or explanation (if not self-explanatory)
Controller does not support logical drive SSP states. Use the SSPState command to set the controller SSP state.	—
Controller does not support redundancy settings.	The controller is not redundant or does not support redundancy settings.
Controller does not support SSP.	—
Controller has maximum number of license keys.	—
Controller is locked by another machine or user.	—
Controller requires non-failed physical drives to set license keys.	—
Controller requires physical drives to set license keys.	—
Could not detect controller (*text*).	—
Error communicating with controller.	—
Error saving controller.	There is a problem saving one or more controller configurations.
Failure opening capture file (*text*).	—
Failure opening input file (*text*).	—
Internal error.	An internal ACU error has occurred, and some error is not being identified properly.
Invalid array accelerator setting.	The specified array accelerator setting is invalid or is not supported with the current configuration.
Invalid array.	The array ID is invalid.
Invalid ChassisName.	The entered ChassisName is invalid. Use characters from the set a–z, A–Z, 0–9, !, @, #, *, (,), ,, -, _, +, :, ., /, and [space]. The ID cannot end with a space character or exceed the maximum number of characters allowed by the controller.
Invalid ClearConfigurationWithDataLoss parameter.	—
Invalid Controller.	—
Invalid expand priority.	The specified expand priority is not supported, or the controller does not allow expansion and, therefore, does not support the Expand Priority feature.
Invalid license key.	—
Invalid logical drive.	The logical drive ID is not valid.
Invalid Method.	Invalid Method value.
Invalid physical drive.	The physical drive listed for the array is not a valid physical drive, or it is a physical drive that is not capable of being placed in the array.
Invalid Preferred Path.	The preferred path specified is not a valid chassis slot for an available active controller, or the controller is not available.
Invalid Preferred Path Mode.	The preferred path mode is not a valid preferred path mode, or the controller is not available.

Message	Comment or explanation (if not self-explanatory)
Invalid RAID.	The specified RAID level is invalid or is not possible with the current configuration.
Invalid read cache/write cache ratio.	The specified cache ratio is not supported by either the controller or the current controller configuration.
Invalid rebuild priority.	—
Invalid Sectors.	The specified MaxBoot setting is invalid or is not supported with the current configuration.
Invalid Size.	The specified size is invalid or is not possible with the current configuration.
Invalid Spare.	The spare drive listed for the array is not a valid spare drive, or it is a drive that cannot be placed on the array as a spare.
Invalid SSP adapter ID.	—
Invalid SSP state.	—
Invalid stripe size.	The specified stripe size is either invalid, not supported with the current RAID level, or not supported with the current configuration.
Invalid SurfaceScanDelay.	—
License key is not a controller feature license key.	The entered license key is for a feature that the controller does not support.
Logical drive not specified.	Some commands require a logical drive, but no logical drive is specified in the script file.
More than one (*text*) command cannot exist in the same section.	The specified command should be used only once per section.
New array ID already exists.	This error occurs in Configure mode when the array ID in the script file already exists in the configuration. You can only use Configure mode to create **new** arrays.
New array ID does not match the next available array ID.	The array ID that you specified in the script file does not match the ID of the newly created array. For example, the script generates this error if you have only an array A and the script file specifies creation of array C (missing array B).
New logical drive ID already exists.	This error occurs in Configure mode when the logical drive ID in the script file already exists in the configuration. You can only use Configure mode to create **new** logical drives.
New logical drive ID does not match the next available logical drive ID.	The logical drive ID that you specified in the script file does not match the ID of the newly created logical drive. For example, the script generates this error if you have only logical drive 1 and the script file specifies creation of logical drive 3 (missing logical drive 2). This error can occur when using an input file with logical drive numbers that are not sequential. In this case, change the logical drive numbers so that they are sequential in the input file.
No controllers detected.	This error applies to input mode only. If no controllers are detected in capture mode, the capture file is empty.
Slot information is not available.	You cannot run Input mode on internal controllers that do not have slot information online. For Microsoft® Windows®, you must load the System Management Driver.
Too many coinciding expansion, migration, or extension operations.	ACU does not support multiple simultaneous expansions, migrations, or extensions without saving the configuration between operations. Limit the number of such configuration changes in this script.
(*text*) is not an HBA command.	A command found in the HBA section is not a valid command for this section.

Using the ACU CLI

The ACU CLI has two operating modes: Console and Command.

- In Console mode ("Opening the CLI in Console mode" on page 51), you can adjust several configuration parameters on several devices without having to restart ACU each time.
- In Command mode ("Opening the CLI in Command mode" on page 51), you make an isolated change of just one configuration parameter on one device.

Opening the CLI in Console mode

The syntax of the command required to open the ACU CLI in Console mode depends on the operating system that you are using.

- For Microsoft® Windows®, enter the following text:
  `C:\Program Files\Compaq\Hpacucli\Bin\hpacucli.exe`

  Alternatively, click **Start,** and select **Programs>HP System Tools>HP Array Configuration Utility CLI>HP Array Configuration Utility CLI.**
- For Linux, enter the following text:
  `[root@localhost root]# hpacucli`

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

```
HP Array Configuration Utility CLI 7.15.17.0
Detecting Controllers...Done.
Type "help" for a list of supported commands.
Type "exit" to close the console.
=>
```

The remaining examples in the ACU CLI section of this guide are described as if entered in Console mode.

Opening the CLI in Command mode

To use Command mode, add the appropriate ACU CLI command ("The <command> variable" on page 52) to the end of the text line that is used to open ACU in Console mode ("Opening the CLI in Console mode" on page 51).

The following examples use `help` as the command.

- Using Microsoft® Windows®:
  `C:\Program Files\Compaq\Hpacucli\Bin\hpacucli.exe help`
- Using Linux:
  `[root@localhost root]# hpacucli help`

The remaining examples in the ACU CLI section of this guide 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 the device that you want to configure. The device can be a controller, an array, a logical drive, or a physical drive. The syntax used is as follows:

```
controller all | slot=# | wwn=# | chassisname="AAA" | serialnumber=# |
chassisserialnumber=# | [array=all|<id>] [logicaldrive all|#]
[physicaldrive all|allunassigned|[#:]#:#,[#:]#:#...|[#:]#:#-[#:]#:#]
```

For example:

```
controller slot=3
controller wwn=500805F3000BAC11
controller slot=2 array A
controller chassisname="A" array B logicaldrive 2
controller chassisname="A" physicaldrive 1:0
controller all
controller slot=2 array all
controller slot=3 physicaldrive 1:2-1:5
```

The <command> variable

The `<command>` variable can be any of the following words or phrases, corresponding to typical configuration tasks:

```
add
create
delete
modify
remove
set target
```

There are also three nonconfiguration commands: `help` ("The help command" on page 55), `rescan` ("Rescanning the system" on page 56), and `show` ("The show command" on page 53).

A command often requires a parameter, and some parameters require a value, but the specific parameters and values that are valid for a given command depend on the target to which you apply the command. To determine the valid parameters and values for a particular combination of target and command variables, query the device ("Querying a device" on page 52) or inspect the example commands in other sections of this guide.

Querying a device

If you do not know what values a parameter can have, you can sometimes query the device to find out 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
```

To determine which parameters can be queried, use the help feature of the CLI ("The help command" on page 55).

Hiding warning prompts

When you enter a command for an operation that can potentially destroy user data, the CLI displays a warning and prompts you for input (a `y` or an `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
```

Keyword abbreviations

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

Keyword	Abbreviation in ACU CLI	Keyword	Abbreviation in ACU CLI
adapterid	ai	logicaldrive	ld
arrayaccelerator	aa	parallelscsi	ps
cacheratio	cr	physicaldrive	pd
chassisname*	ch*	preferredpathmode	ppm
chassisslot	chs	rebuildpriority	rp
connectionname	cn	redundantcontroller	rc
controller	ctrl	serialnumber	sn
drivetype	dt	stripesize	ss
drivewritecache	dwc	surfacescandelay	ssd
expandpriority	ep		

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

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.

Two extra parameters are available for controller targets: `ssp` and `config`. These parameters are used as follows:

```
<target controller> show config [detail]
<target controller> show ssp
```

If you use the `config` parameter, the output includes information about each device connected to the controller. When you use the `ssp` parameter, the output displays SSP information about the target controller.

Example 1

```
=> ctrl ch="lab4" show
```

A typical output would be:

```
MSA1000 at dog
Bus Interface: Fibre
WWN: 500805F3000BAC11
```

```
Serial Number: P56350D9IP903J
Chassis Serial Number: 9J3CJN71XDCH
Chassis Name: dog
RAID 6 (ADG) Status: Enabled
SSP State: Disabled
Controller Status: OK
Chassis Slot: 1
Hardware Revision: Rev A
Firmware Version: 6.60
Rebuild Priority: Low
Expand Priority: Low
Surface Scan Delay: 20 sec
Cache Board Present: True
Cache Status: OK
Accelerator Ratio: 100/0 (read/write)
Read Cache Size: 128 MB
Write Cache Size: 0 MB
Total Cache Size: 128 MB
Battery Pack Count: 1
Battery Status: OK
```

Example 2

```
=> ctrl all show
```

Because this target consists of several devices, the output will be brief. A typical output would be:

```
MSA1000 at dog (sn: P56350D9IP903J, csn: (9J3CJN71XDCH, wwn:
500805F3000BAC11)

Smart Array 5312 in Slot 3 (sn: P4AB5X9BFMLNTJ)

Smart Array 532 in Slot 2 (sn: P44940LDAORS4F)
```

Example 3

```
=> ctrl ch="lab4" show config
```

The output in this case will have detailed information because the target consists of only one device. A typical output would be:

```
MSA1000 at dog (sn: P56350D9IP903J, csn: (9J3CJN71XDCH, wwn:
500805F3000BAC11)

array A (Parallel SCSI, Unused Space: 20091 MB)
   logicaldrive 1 (219 MB, RAID 6(ADG), OK)
      physicaldrive 1:3 (box 1:bay 3, Parallel SCSI, 4.3 GB, OK)
      physicaldrive 1:4 (box 1:bay 4, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:5 (box 1:bay 5, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:6 (box 1:bay 6, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:7 (box 1:bay 7, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:9 (box 1:bay 9, Parallel SCSI, ??? GB, failed,
      spare)

unassigned
   drive 1:1 (box 1:bay 1, Parallel SCSI, 36 GB, OK)
   physicaldrive 1:2 (box 1:bay 2, Parallel SCSI, 36 GB, OK)
   physicaldrive 1:8 (box 1:bay 8, Parallel SCSI, 9.1 GB, OK)
   physicaldrive 1:10 (box 1:bay 10, Parallel SCSI, 9.1 GB, OK)
   physical
```

```
physicaldrive 1:11 (box 1:bay 11, Parallel SCSI, 9.1 GB, OK)
```

The help command

To get help with the CLI, enter `help` at the CLI prompt, and then enter one or more help items, as follows:

```
=> help <item1> [item2] [item3]
```

A help item can be any of the following:

- A CLI command ("The <command> variable" on page 52)
- An ACU CLI keyword or keyword abbreviation ("Keyword abbreviations" on page 53)
- A CLI parameter
- A term commonly used in ACU, such as migrate, extend, or cache
- The word `shorthand` (gives a list of abbreviations for keywords in the CLI)

The help feature of the ACU CLI behaves like a browser search engine in that each item that you add to the help input string reduces the amount of help output text. For example, `help ssp` produces extensive information about SSP, while `help ssp modify` restricts the help output to information about how the `modify` command applies to SSP.

Typical procedures

The following sections describe some common ACU CLI procedures.

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
MSA1000 at Lab 4
   array A
      Interface Type: Parallel SCSI
      Unused Space: 7949 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.

Identifying devices

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

Syntax:

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

Example commands:

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

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
```

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
```

Creating a logical drive

Syntax:

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

where `<target>` is usually a controller, but it can be an array if you are creating an additional logical drive on an existing array.

If you want to create a logical drive on a group of physical drives that are not yet assigned to an array, you do not have to build the array first. In the CLI, unlike in the GUI, the array is created automatically at the same time as the logical drive.

The standard parameters used when creating a logical drive are described in the following table. If you do not specify a particular parameter, the CLI uses the appropriate default value.

Parameter	Acceptable values	Comments
drives	[#:]#:#,[#:]#:#,...|[#:]#:#-[#:]#:#|all|allunassigned	The default setting is all.
raid	6|adg|5|1+0|1|0|?	The default setting is the highest level that the logical drive can accept.
ss	8|16|32|64|128|256|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.
drivetype	sas|satalogical|sata|saslogical|parallelscsi|?	—

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

If you specify an array as the target, you can omit the drives parameter because the drives are already implicitly defined by the array ID. This feature is useful if you are entering the command directly into the CLI console because you do not need to remember which drives belong to the array. When you write a batch file, however, it is often easier to specify every drive in the array than to parse out the array ID.

When you use the drives parameter you can list each drive individually, you can specify a drive range, or you can specify both a range and some individual drives. A drive range can span ports, boxes, and bays. If you specify individual drives, they do not have to form a continuous sequence. If you specify a range, the CLI automatically excludes from the target any drive in the range that is unavailable (for example, a drive is excluded if it already belongs to an array, is a spare, has too small a capacity, or has failed).

If you want to specify an existing array by its drives rather than by array ID, then all of the drives that you specify must belong to the same array, and none of the drives in the array should be omitted.

Example commands:

```
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
ctrl slot=5 create type=ld drives=1:7,1:10-2:5,2:8-2:12 raid=adg
ctrl slot=5 array A create type=ld size=330 raid=adg
```

The following pair of commands demonstrates how the drives parameter can be used in a batch file to create two logical drives on the same array, one of 330 MB and the other of 450 MB:

```
ctrl slot=2 create type=ld drives=1:1-1:6 size=330 raid=adg
ctrl slot=2 create type=ld drives=1:1-1:6 size=450 raid=5
```

Sample scenario

Consider a situation in which you want to create two arrays. 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:

```
MSA1000 at Lab 4
   unassigned
      physicaldrive 1:12 (box 1:bay12, Parallel SCSI, 36.4 GB, OK)
      physicaldrive 1:13 (box 1:bay13, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:14 (box 1:bay14, Parallel SCSI, 9.1 GB, OK)
```

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

```
=> ctrl ch="Lab 4" create type=ld drives=1:12
```

Now, verify that the array has been created:

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

In this case, the screen response is:

```
MSA1000 at Lab 4
   array A
      physicaldrive 1:12 (box 1:bay12, Parallel SCSI, 36.4 GB, OK)
   unassigned
      physicaldrive 1:13 (box 1:bay13, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:14 (box 1:bay14, Parallel SCSI, 9.1 GB, 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=1:13,1:14 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=1:13,1:14 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:

```
MSA1000 at Lab 4
   array A
      physicaldrive 1:12 (box 1:bay12, Parallel SCSI, 36.4 GB, OK)
   array B
      physicaldrive 1:13 (box 1:bay13, Parallel SCSI, 9.1 GB, OK)
      physicaldrive 1:14 (box 1:bay14, Parallel SCSI, 9.1 GB, OK)
```

To create a second logical drive on array B, you can specify the array (method A) or you can specify every physical drive in the array (method B).

```
=> ctrl ch="Lab 4" array B create type=ld size=900 (method A)
=> ctrl ch="Lab 4" create type=ld drives=1:13,1:14 size=900 (method B)
```

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

```
=> ctrl ch="Lab 4" ld all show
MSA1000 at Lab 4
```

```
array A
   logicaldrive 1 (33.9 GB, RAID 0, OK)
array B
   logicaldrive 2 (298 MB, RAID 1+0, OK)
   logicaldrive 3 (896 MB, RAID 1+0, OK)
```

Assigning a chassis name to the controller

If a controller is configured with at least one logical drive, you can give 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. If you change the chassis name of a controller that you have set as the default target ("Setting the target" on page 55), you must reset the target.

Example commands:

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

Managing spare drives

Assigning one or more online spare drives 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 of its physical drives are simultaneously in a failed state, regardless of the number of spare drives assigned to the array.

Any drive that you want to use as a spare must meet the following criteria:

- It must be an unassigned drive or a spare for another array.
- It must be of the same type as existing drives in the array (for example, SATA or SAS).
- It must have a capacity no less than that of the smallest drive in the array.

Syntax:

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

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

where `<target>` is an array (or logical drive, if the array contains only one logical drive). The `forced` parameter represses any warning message prompts. If you specify a drive range, any drives in the range that do not meet the previous criteria are not used.

Example commands:

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

Expanding an array

You can increase the storage space on an array by adding physical drives. Any drive that you want to add must meet the following criteria:

- It must be an unassigned drive.
- It must be of the same type as existing drives in the array (for example, SATA or SAS).
- It must have a capacity no less than that of the smallest drive in the array.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

Syntax:

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

where `<target>` is an array (or a logical drive, if the array contains only one logical drive). The `forced` parameter represses any warning message prompts. If you specify a drive range, any drives in the range that do not meet the previous criteria are not used.

If you add an odd number of drives to an array that contains a RAID 1+0 logical drive, you are prompted to convert the RAID 1+0 logical drive to RAID 5 or RAID 6 (ADG). 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.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

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
```

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 (on page 27)" and "Selecting a RAID method (on page 76)" 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.

IMPORTANT: An array expansion, logical drive extension, or logical drive migration takes about 15 minutes per gigabyte, or considerably longer if the controller does not have a battery-backed cache. While this process is occurring, no other expansion, extension, or migration can occur simultaneously on the same controller.

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
```

Using Selective Storage Presentation

The SSP feature (also known as Access Control List commands) enables you to allow only specific adapter IDs or connection names to have access to particular logical drives. This functionality is useful for preventing the corruption of data that can occur when different servers using different operating systems access the same data.

Syntax:

Using SSP requires two commands:

- The first command activates the SSP feature. This action makes all logical drives on the controller inaccessible.
- The second command specifies a logical drive and the adapter IDs or connection names that are to be allowed or denied access to the logical drive.

Explicitly, these commands are as follows:

```
<target1> modify ssp=on|off [forced]
<target2> modify mask|unmask=#,#,...|all [forced]
```

where `<target1>` is a controller, `<target2>` is a logical drive, and `#` represents an adapter ID or connection name.

The CLI normally displays a warning prompt when you activate SSP because all logical drives are being made inaccessible. To prevent the prompt from appearing (for example, when using this command in a batch file script), use the `forced` parameter.

Example commands:

```
=> ctrl ch="Lab 3" modify ssp=on forced
=> ctrl ch="Lab 4" ld 1 modify mask=210000E08B07A68F
=> ctrl ch="Lab 4" ld all modify unmask="cnxn 3","cnxn 4"
```

Sample scenario

First, check the SSP status of the controller:

```
=> ctrl ch="Lab 4" show ssp
```

A typical screen response could be:

```
MSA1000 at Lab 4
```

```
   Adapter ID: 210000E08B07A68F
      connectionname: Unknown
      Location: Local
      Status: Online
      Host Mode: Default
   Adapter ID: 5034414235583942
      connectionname: Unknown
      Location: Unknown
      Status: Offline
      Host Mode: Default
```

Now activate SSP, and then show the logical drives that are present so that you can determine which drive to unmask:

```
=> ctrl ch="Lab 4" modify ssp=on forced
=> ctrl ch="Lab 4" ld all show
MSA1000 at Lab 4
   array A
      logicaldrive 1 (33.9 GB, RAID 0, OK)
   array B
      logicaldrive 2 (298 MB, RAID 1+0, OK)
      logicaldrive 3 (896 MB, RAID 1+0, OK)
```

Finally, unmask an adapter ID and then check the SSP status:

```
=> ctrl ch="Lab 4" ld 1 modify unmask 210000E08B07A68F
=> ctrl ch="Lab 4" show ssp

MSA1000 at Lab 4
   Adapter ID: 210000E08B07A68F
      connectionname: Unknown
      Location: Local
      Status: Online
      Host Mode: Default
      logicaldrive 1 is unmasked
   Adapter ID: 5034414235583942
      connectionname: Unknown
      Location: Unknown
      Status: Offline
      Host Mode: Default
      logicaldrive 1 is masked
```

Modifying connection names

You can convert a lengthy adapter ID into a brief connection name that can be used in all future commands.

Syntax:

```
<target> modify ai=# cn="connection name"
```

where `<target>` is a controller that supports SSP.

Example command:

```
ctrl ch="Lab 4" ld 1 modify ai=210000E08B07A68F cn="cnxn 3"
```

Managing host modes (connection profiles)

Syntax:

```
<target> modify ai=# hostmode="operating system type"|?
```

where `<target>` is a controller that supports host modes.

Example command:

```
=> ctrl ch="Lab 3" modify ai=5034414235583942 hostmode=?
```

NOTE: The connection name and the logical unit are required for managing host modes.

A typical response in this case could be:

```
hostmode options:
   Default
   Windows
   OpenVMS
   Tru64
   Linux
   Solaris
   NetWare
   HP
```

Setting the preferred path mode

The preferred path mode determines how I/O traffic to the logical drives is managed on controllers that are in an active/active configuration.

- In Automatic mode, the storage system automatically selects a suitable path for I/O traffic to each logical drive depending on the host I/O patterns at the time. Because the optimum path can vary with time, I/O traffic for any given logical drive can be directed through either controller.
- In Manual mode, all I/O traffic to a given logical drive is directed through a designated controller. In this case, you must also specify the preferred controller for each logical drive ("Assigning a redundant controller to a logical drive" on page 63).

Syntax:

```
<target> modify [preferredpathmode=automatic|manual|?]
```

where `<target>` is a redundant controller.

Example command:

```
controller ch="lab 3" modify ppm=manual
```

Assigning a redundant controller to a logical drive

When you have set the preferred path mode ("Setting the preferred path mode" on page 63) in a redundant system to Manual, you must use the `chassisslot` command to assign each logical drive in the system to one of the redundant controllers.

Syntax:

```
<target> modify [chassisslot=#|?]
```

where `<target>` is a valid logical drive on a controller that is in an active/active configuration and # denotes the chassis slot number of the redundant controller. (To obtain the chassis slot number, use the `show` command on the controller.)

Example command:

```
controller ch="lab 3" ld 1 modify chs=2
```

Disabling a redundant controller

This command disables a redundant controller that is in an Active-Standby configuration.

IMPORTANT: The redundant controller cannot be re-enabled after you have disabled it.

Syntax:

```
<target> modify redundantcontroller=disable
```

where `<target>` is a controller that has an enabled redundant controller.

Example command:

```
=> ctrl ch="redundant Lab4" modify rc=disable
```

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.

Syntax:

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

where `<target>` is a controller.

Example command:

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

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 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
```

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
```

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.

Syntax:

```
<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 or 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
```

Probability of logical drive failure

In this section

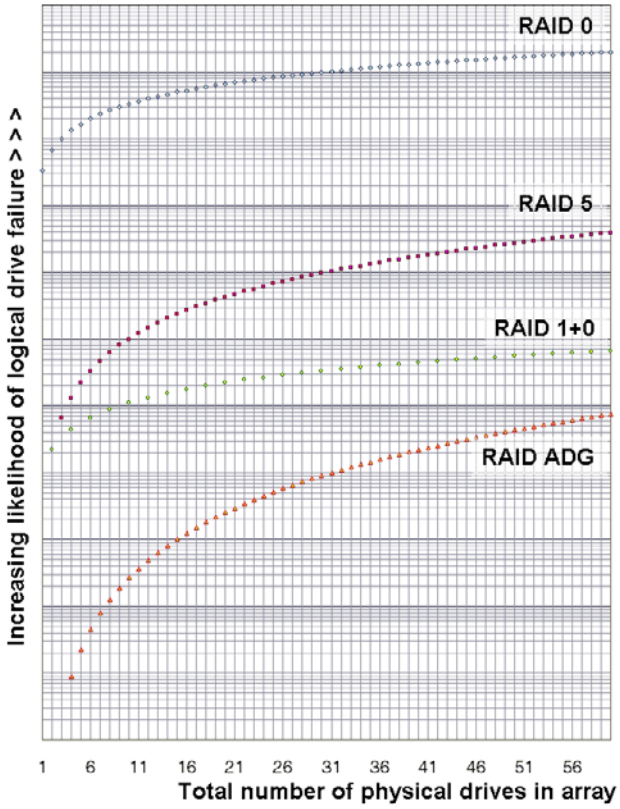
Factors involved in logical drive failure

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.

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 ("Probability of logical drive failure vs. number of drives in array" on page 68). 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.

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



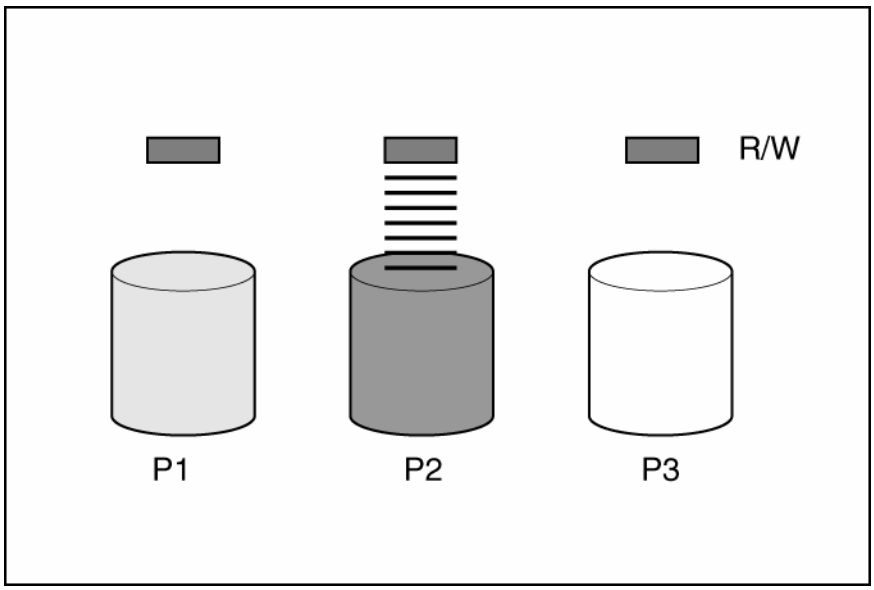
Drive arrays and fault-tolerance methods

In this section

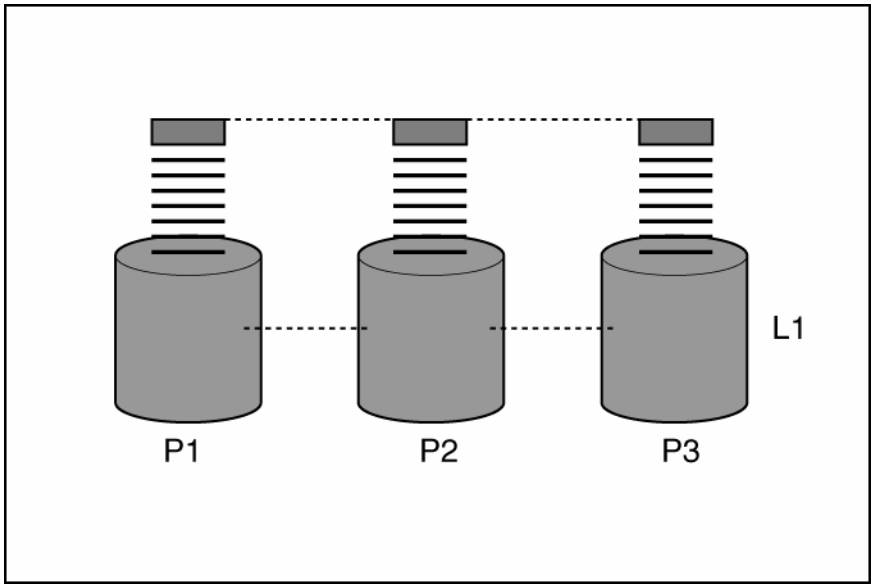
Drive arrays

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.

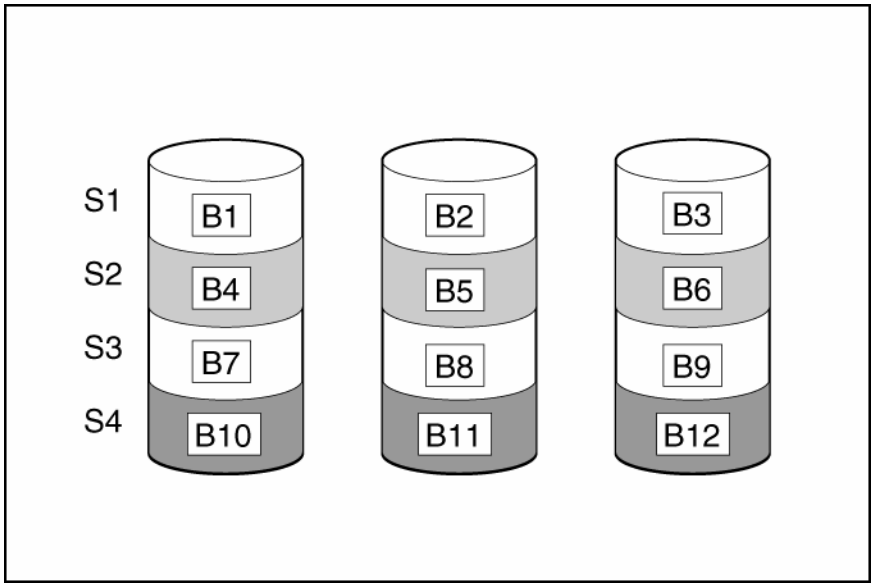
Connecting extra physical drives (P*n* in the figure) to a system increases the total storage capacity but has no effect on the efficiency of read/write (R/W) operations. Data can still be transferred to only one physical drive at a time.



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.

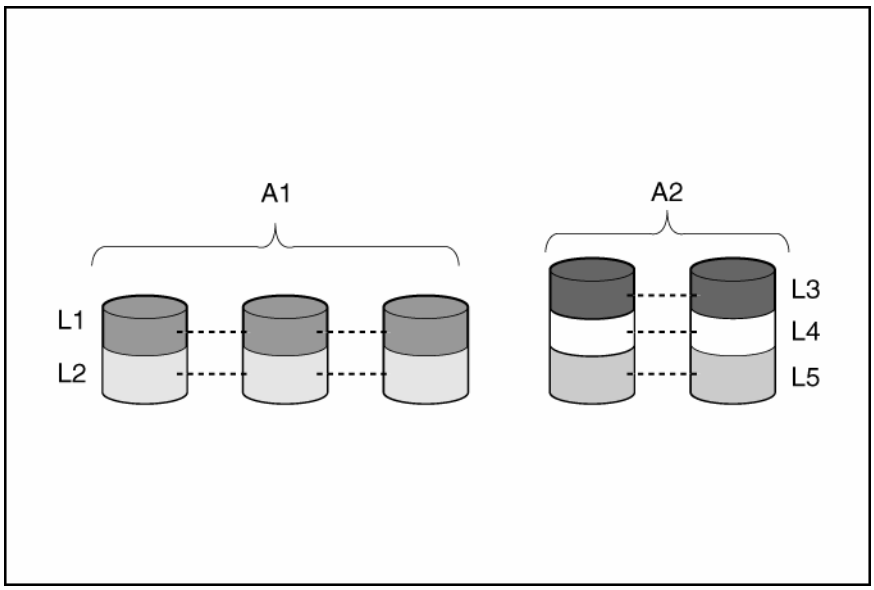


For data in the logical drive to be readable, the data block sequence must be the same in every stripe. This sequencing process is performed by the array controller, which sends the data blocks to the drive write heads in the correct order.

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** ("Fault-tolerance methods" on page 71).

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" on page 76). 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

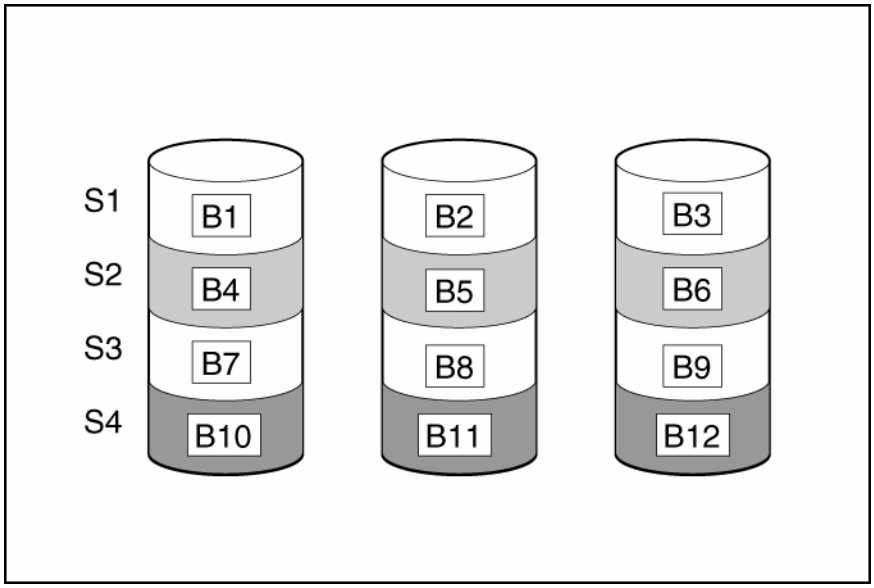
HP recommends the following hardware-based methods for use with Smart Array controllers:

- RAID 0—Data Striping only (no fault tolerance)

- RAID 1+0—Drive Mirroring
- RAID 5—Distributed Data Guarding
- RAID 6 (ADG)—Advanced Data Guarding

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:

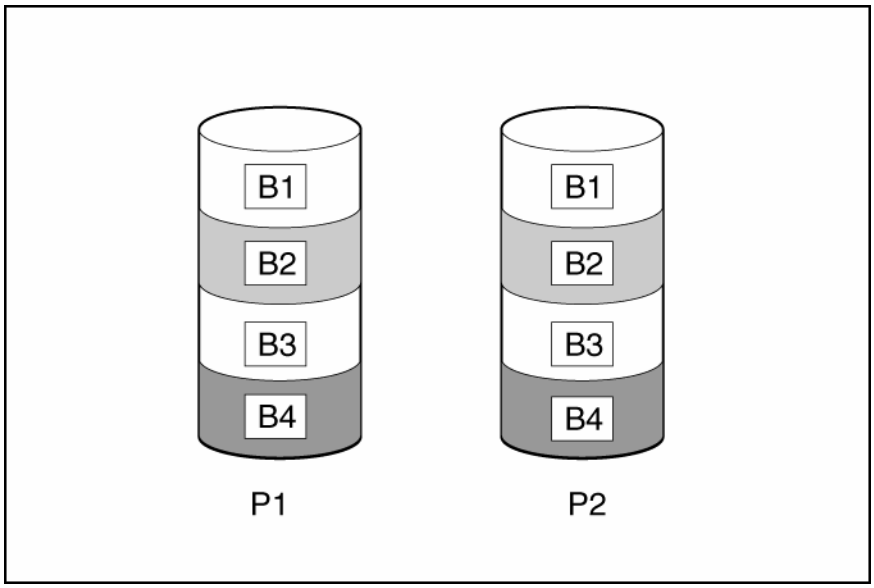
- Has the highest write performance of all RAID methods.
- Has the lowest cost per unit of stored data of all RAID methods.
- All drive capacity is used to store data (none is needed for fault tolerance).

Disadvantages:

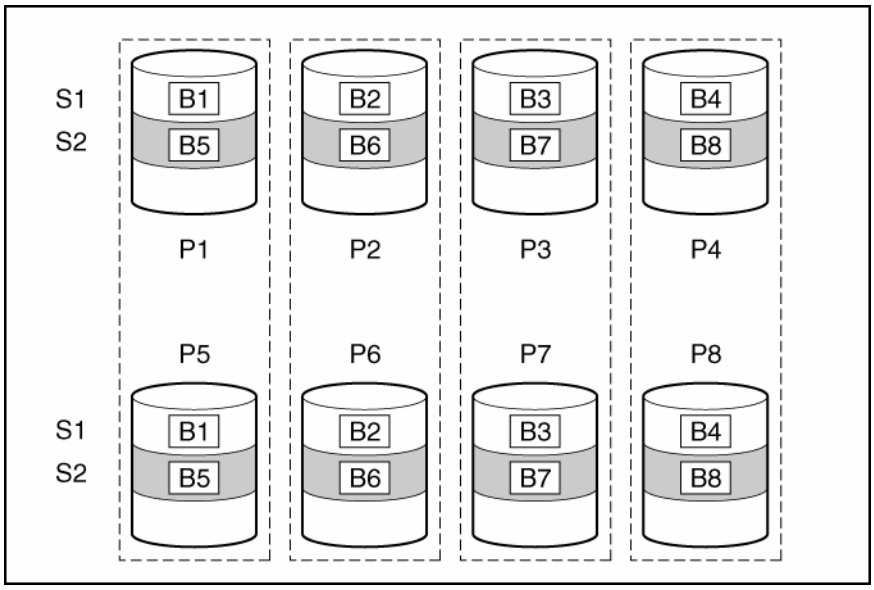
- All data on the logical drive is lost if a physical drive fails.
- Cannot use an online spare.
- Can only preserve data by backing it up to external drives.

RAID 1+0—drive mirroring

In a RAID 1+0 configuration, data is duplicated to a second drive.



When the array has more than two physical drives, drives are mirrored in 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.

NOTE: When there are only two physical drives in the array, this fault-tolerance method is often referred to as RAID 1.

Advantages:

- Has the highest read performance of any fault-tolerant configuration.

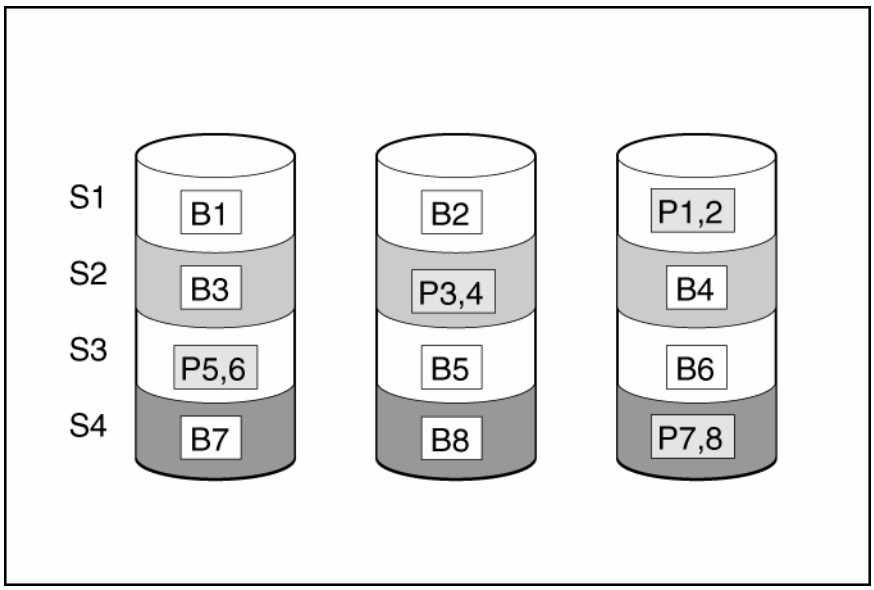
- No data is lost when a drive fails, as long as no failed drive is mirrored to another failed drive (up to half of the physical drives in the array can fail).

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 5—distributed data guarding

In a RAID 5 configuration, data protection is provided by **parity data** (denoted by P*x,y* in the figure). This parity data is calculated stripe by stripe from the user data that is written to all other blocks within that stripe. The blocks of parity data are distributed evenly over every physical drive within the logical drive.



When a physical drive fails, data that was on the failed drive can be calculated from the remaining parity data and user data on the other drives in the array. This recovered data is usually written to an online spare in a process called a **rebuild.**

This configuration is useful when cost, performance, and data availability are equally important.

Advantages:

- Has high read performance.
- Data is not lost if one physical drive fails.
- More drive capacity is usable than with RAID 1+0—parity information requires only the storage space equivalent to one physical drive.

Disadvantages:

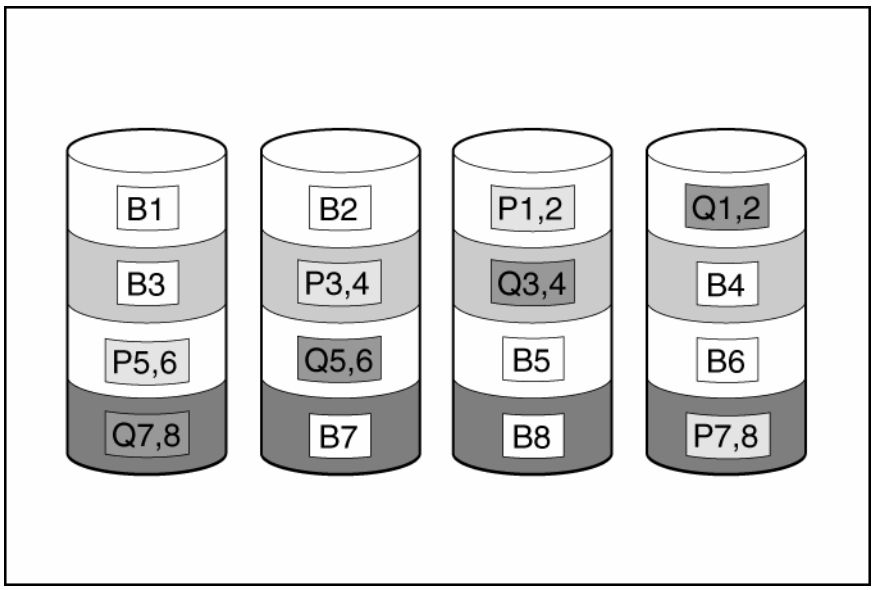
- Has relatively low write performance.
- Data is lost if a second drive fails before data from the first failed drive is rebuilt.

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 P*x,y*

and Q*x,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.

Comparing the hardware-based RAID methods

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

Item	RAID 0	RAID 1+0	RAID 5	RAID 6 (ADG)
Alternative name	Striping (no fault tolerance)	Mirroring	Distributed Data Guarding	Advanced Data Guarding
Formula for number of drives usable for data (*n* = total number of drives in array)	*n*	*n*/2	*n*-1	*n*-2
Fraction of drive space usable*	100%	50%	67% to 93%	50% to 96%
Minimum number of physical drives	1	2	3	4
Tolerates failure of one physical drive	No	Yes	Yes	Yes

Item	RAID 0	RAID 1+0	RAID 5	RAID 6 (ADG)
Tolerates simultaneous failure of more than one physical drive	No	Only if no two failed drives are in the same mirrored pair	No	Yes
Read performance	High	High	High	High
Write performance	High	Medium	Low	Low
Relative cost	Low	High	Medium	Medium

*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).

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

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

In this section

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:

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

Acronyms and abbreviations

ACU

Array Configuration Utility

ADG

Advanced Data Guarding (also known as RAID 6)

ADU

Array Diagnostics Utility

CPQONLIN

NetWare Online Array Configuration Utility

HBA

host bus adapter

MSA

Modular Smart Array

MTBF

mean time between failures

ORCA

Option ROM Configuration for Arrays

POST

Power-On Self Test

RAID

redundant array of inexpensive (or independent) disks

RBSU

ROM-Based Setup Utility

SSP

Selective Storage Presentation

WBEM

Web-Based Enterprise Management

WWN

World Wide Name

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